Journal of Psychoactive Drugs

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ujpd20

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To cite this article: Sandeep M. Nayak, Sydney H. White, Samantha N. Hilbert, Matthew X. Lowe, Heather Jackson, Roland R. Griffiths, Albert Garcia-Romeu & David B. Yaden (07 May 2024): Psychedelic Experiences Increase Mind Perception but do not Change Atheist-Believer Status: A Prospective Longitudinal Study, Journal of Psychoactive Drugs, DOI: 10.1080/02791072.2024.2346130

To link to this article: https://doi.org/10.1080/02791072.2024.2346130

JOURNAL OF PSYCHOACTIVE DRUGS
https://doi.org/10.1080/02791072.2024.2346130

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Psychedelic Experiences Increase Mind Perception but do not Change Atheist-Believer Status: A Prospective Longitudinal Study

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ABSTRACT

Recent studies suggest psychedelic use may be associated with changes in a variety of beliefs or belief-like states, including increased 1) mind perception, 2) non-naturalistic beliefs, and 3) Atheist-Believer status (e.g. believer, agnostic, or nonbeliever). We conducted a prospective longitudinal study among participants ($N = 657$) who planned to have a psilocybin experience outside a laboratory setting. We asked participants about their beliefs concerning mind perception of various entities, specific metaphysical positions, and Atheist-Believer status both before (and after their experience. Replicating previous findings, we observed increases in mind perception across a variety of living and non-living targets (e.g. plants, rocks). However, we found little to no change in metaphysical beliefs (e.g. dualism) or Atheist-Believer status. Taken together, these findings contrast with those from cross-sectional studies that psilocybin experiences result in changes to Atheist-Believer status and non-naturalistic beliefs but support the relevance of mind perception and mentalization.

ARTICLE HISTORY
Received 6 October 2023
Revised 31 January 2024
Accepted 22 March 2024

KEYWORDS
Belief change; mind perception; psilocybin; psychedelic

Introduction

Psilocybin is a psychedelic substance that has been used for centuries in settings that could be considered broadly religious or shamanic (Schultes 1976). Psychedelics have often been associated with spiritual beliefs and practices in contemporary cultures (Hartogsohn 2020). Most such beliefs fall into the category of non-naturalistic beliefs (Yaden and Anderson 2021), which refer to propositional claims about the nature of reality that posit a nonphysical mind (e.g., a soul), realm (e.g., heaven), or any other referents beyond physical reality (see Bloom 2007; Letheby 2021). In the context of contemporary medical research settings, some have discussed whether or not religious/spiritual/non-naturalist belief changes reliably occur after psychedelic experiences (Jacobs 2020; Johnson & Yaden 2020). Others have discussed the possible mechanisms of belief changes related to psychedelics (McGovern et al. 2022; Nayak et al. 2022; Timmermann et al. 2021). While preliminary data have been reported on this topic, which we review below, the magnitude and specifics of such purported belief changes are not known.

Several studies provide preliminary evidence for metaphysical belief changes in the context of psychedelic research. Cross-sectional retrospective survey studies have found decreased identification as atheist (Davis et al. 2020; Griffiths et al. 2019) and increased spirituality (Griffiths et al. 2019; Sweeney et al. 2022; Yaden et al. 2017) after psychedelic experiences. However, these studies suffer from selection bias (i.e., the surveys may have attracted those who are more likely to report religious/spiritual content), as well as potential recall bias (i.e., participants may overattribute belief change as related to psychedelic experiences post-hoc). Several controlled randomized trials with psilocybin have found that most participants attribute a great deal of spiritual significance to the acute subjective effects of psilocybin (e.g., Davis et al. 2020; Griffiths et al., 2011), although belief changes after psychedelic experiences were not directly assessed in these trials.

Evidence from a prospective survey on psychedelic use in a ceremonial context and a randomized clinical trial of psilocybin for depression both found that metaphysical beliefs shifted toward non-naturalism (referred to as non-physicalist beliefs and measured with

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/02791072.2024.2346130

a metaphysical beliefs questionnaire; Timmermann et al. 2021). In the prospective survey component of Timmermann et al. (2021; $N = 386$ respondents at follow-up) participants were recruited who planned to attend a ceremony involving a psychedelic substance. Beliefs such as materialism, panpsychism, and dualism were assessed using the metaphysical beliefs questionnaire (e.g., "There exists another separate realm or dimension beyond this physical world that can be experienced or visited"). Increases in this measure were observed from baseline to 4 weeks ($d = .33$) and 6 months ($d = .46$) after the psychedelic experience. In the randomized controlled trial comparing psilocybin to escitalopram ($N = 59$), a selective serotonin reuptake inhibitor (SSRI), the psilocybin group endorsed increased non-naturalistic beliefs on the metaphysical beliefs questionnaire after their psychedelic experiences from baseline to 6-weeks ($d = .45$). However, the SSRI group also nominally (but not significantly) increased in their non-physicalist beliefs ($d = .2$) and a direct comparison between groups on this measure was not reported, restricting what inferences can be drawn regarding this finding. Additionally, the lack of effective blinding in this clinical trial means that participants' cultural expectations and associations with psychedelics, which likely tend to lean spiritual and thus non-naturalistic in contemporary culture (Hartogsohn 2020), could help explain these findings.

A recent large retrospective survey study (Nayak et al. 2022) examined the various types of metaphysical beliefs that might change after psychedelic use in more granular detail. A factor analysis of metaphysical belief items resulted in five factors: dualism, paranormal/spirituality, non-mammal consciousness, mammal consciousness, and superstition. The mammal and non-mammal consciousness items relate to mind perception (Gray, Gray, and Wegner 2007), which involves the attribution of the capacity for agency (decision-making) and experience (e.g., feeling pleasure and pain), although in this study participants were asked to simply rate how conscious a variety of entities seem (e.g., plants, animals, humans, universe). The metaphysical belief items related to dualism, spirituality, and superstition were created by the researchers and come from measures such as: the Mind-Body Relationship Scale (Riekki, Lindeman, and Lipsanen 2013), the Metaphysical Beliefs Questionnaire (Timmermann et al. 2021), the Paranormal Belief Scale (Tobacyk 2004). The Atheist-Believer item (Griffiths et al. 2019) asked participants whether they consider themselves a "Believer (e.g., in Ultimate Reality, Higher Power, and/or God, etc.)," "Agnostic," or "Non-believer (e.g., atheist)." Participants in this study endorsed persisting increases from a psychedelic experience in dualism, paranormal/spirituality, non-mammal consciousness, mammal consciousness, but not superstition (e.g., "breaking a mirror brings bad luck"). Additionally, this survey found that 36% of the participants reported being a "non-believer (e.g., atheist)" at baseline, and only 13% reported being a nonbeliever at after their experience. However, this study was advertised as a "belief change" survey, which may introduce a substantial selection bias.

Belief changes in the context of psychedelic clinical trials raise bioethical questions for many reasons. For some patients, such changes could be construed as a kind of personal harm. Moreover, these transformations have the capacity to significantly influence an individual's social ties and relationships. Finally, such changes may be of societal concern, for example with the possibility of fostering beliefs that are nonscientific beliefs. Thus, adequate informed consent requires transparently informing participants of the possibility of such changes in worldview (Smith and Sisti 2021). Such findings also underscore the importance of careful consideration of pairing psychedelic interventions with religious/spiritual content of any kind (Johnson 2020; Yaden et al. 2022), and raise questions about how clinicians should help participants to integrate such changes, with important prohibitions against undue influence from clinicians (Yaden et al. 2021).

The magnitude and persistence of these belief changes matter. As psychedelic therapies move closer to possible approval for widespread use, the ramifications of mental health interventions with the potential to substantially change a person's belief system raises serious considerations about how and by whom they can be used appropriately. For instance, the possibility that psychedelic therapies could be used by individuals or organizations seeking to convert or otherwise coerce people into adopting particular worldviews (e.g., political or religious ideologies) clearly highlights the need for extraordinary caution in their implementation. Both Timmermann et al. (2021) and Nayak et al. (2022) found small, moderate, and large effects in the direction of non-naturalism depending on the specific measure. However, there may have been methodological problems with both of these studies that make it difficult to draw conclusions regarding the type, magnitude, and persistence of potential metaphysical belief changes associated with psychedelic experiences.

In this study, we collected data from a final sample of 657 participants who reported that they were about

to undergo a psilocybin experience outside a laboratory setting. We collected data at time of informed consent, 2 weeks before their experience, 2–4 weeks after, and 2–3 months after psilocybin use. Measures of Atheist-Believer status (i.e., nonbeliever, agnostic, believer) were collected at time of informed consent (baseline; $N = 7{,}989$) and 2–3 months after psilocybin use ($N = 657$). Measures of metaphysical belief change (e.g., dualism) were collected at time of informed consent (baseline; $N = 7{,}989$), 2–4 weeks after ($N = 1182$), and 2–3 months after psilocybin use ($N = 657$). Measures of mind perception to various targets (e.g., plants, insects, mammals) were added after the survey had already been launched and were collected 2 weeks before planned psilocybin use (baseline; $N = 1{,}159$), 2–4 weeks after ($N = 461$), and 2–3 months after psilocybin use ($N = 307$). Analyses were restricted to those participants who provided data at all timepoints, yielding sample sizes of 657 for Atheist-Believer status, 623 for metaphysical belief change, and 255 for mind perception.

We hypothesized that mind perception would increase, metaphysical beliefs would change in the direction of non-naturalism (greater dualism, greater idealism, greater determinism and less materialism), and that respondents would shift toward "believer" and away from "nonbeliever."

Methods

This prospective longitudinal study recruited participants who indicated that they were going to have a psychedelic experience in the near future with psilocybin in a naturalistic (i.e., non-laboratory) setting. Recruitment was conducted online via paid advertisements on social media and word of mouth sharing of study-related information. The study was sponsored by Unlimited Sciences, a community-based psychedelic education and research nonprofit organization dedicated to advancing evidence-based research on psychedelic medicine.

Participants were recruited using online advertisements indicating that participants were being sought to gain more information regarding the so-called "set and setting" of psychedelic use. Notably, this advertisement did *not* mention belief changes or beliefs in any way. Specifically, the main information page related to study recruitment read:

> By collecting data from more than 1,000 individuals, 18 years and older, who are already planning to use psilocybin, we aim to investigate variables such as demographics, lifestyle, mindset, and personality traits. Additionally, we want to know more about the characteristics of the experience itself such as dosage, ingestion method, intention, guidance, and setting–all of which could influence psilocybin's short- and long-term effects.

An Institutional Review Board at the Johns Hopkins University School of Medicine approved all study procedures and all participants consented to joining the study after reviewing the study information. Participants were English-speaking adults aged 18 or older who planned to use psilocybin in a real-world setting, and who were willing to complete a battery of questionnaires before and after their planned psilocybin experience. The survey included questions about demographics, specifics about psychedelic use (e.g., dosage), the setting in which the psychedelic experience occurred, and a variety of well-being related and therapeutic outcomes (Nayak et al. 2023).

Measures

Items related to three sets of questions: 1) metaphysical beliefs ($N = 623$ respondents at all three timepoints), 2) mind perception (e.g., mammals, non-mammals; $N = 255$ respondents at all three timepoints), and 3) Atheist-Believer status ($N = 657$ at both timepoints) were administered. These measures were added into the ongoing study at different times, resulting in varying sample sizes between these sets of questions. We restricted our analysis to participants who provided both baseline and follow-up data for a given set of questions.

Mind perception

This measure consists of ten items which measure beliefs about the ability of various targets to have conscious experience (Nayak and Griffiths 2022). These targets include four species of mammals, five non-mammal objects/entities, and one item about the universe as a whole. The measure uses a seven-point Likert scale ranging from −3 (strongly disagree) to + 3 (strongly agree). Some example items include "I (the person taking the survey right now) am capable of having conscious experience," "Plants (e.g., trees, flowers) are capable of having conscious experience," and "The universe is conscious." Full text of all items is available in Table 1. Cronbach's alpha for all 10 items is 0.87. This measure was collected at the following

Table 1. Mind perception agreement ratings over time, rated on a Likert-type scale ranging from − 3 (strongly disagree) to 3 (strongly agree) ($n = 255$).

	Time point Means (SD)		
Item	Baseline	2–4 week	2–3 month
Self I (the person taking the survey right now) am capable of having conscious experience.	2.62 (0.73)	2.67 (0.7)	2.71 (0.72)
Others Other human beings are capable of having conscious experience.	2.61 (0.62)	2.65 (0.71)	2.7 (0.69)
Non-human primates Some (if not all) non-human primates (e.g., chimpanzees) are capable of having conscious experience.	2.1 (1.05)	**2.33 (0.85)***	**2.33 (0.93)***
Quadrupeds Some (if not all) four-legged animals (e.g., cats, dogs) are capable of having conscious experience.	1.91 (1.22)	**2.12 (1.05)***	**2.11 (1.08)***
Insects Some insects (e.g., ants, flies) are capable of having conscious experience.	0.85 (1.6)	**1.29 (1.52)***	**1.38 (1.45)***
Fungi Some fungi (e.g., mushrooms) are capable of having conscious experience.	0.67 (1.74)	**1.02 (1.68)***	**1.11 (1.66)***
Plants Plants (e.g., trees, flowers) are capable of having conscious experience.	0.64 (1.8)	**0.9 (1.77)***	**0.95 (1.71)***
Inanimate natural Inanimate natural objects (e.g., rocks) are capable of having conscious experience.	−1.19 (1.76)	−1.04 (1.73)	**-0.9 (1.86)***
Inanimate man-made Inanimate man-made objects (e.g. chairs, buildings) are capable of having conscious experience.	−1.63 (1.58)	**-1.45 (1.71)***	−1.43 (1.69)
Universe The universe is conscious.	1.4 (1.76)	1.58 (1.58)	**1.6 (1.67)***

*Change from baseline, $p < .00333$.

timepoints: 2-weeks before the session, 2–4 weeks after, and 2–3 months after.

Metaphysical beliefs

These items are a collection of four questions pertaining to beliefs about materialism, dualism, idealism, and determinism. The language of the dualism item was a slightly modified version of an item from the Metaphysical Beliefs Questionnaire (MBQ) in Timmermann et al. (2021). The materialism and idealism items are from Nayak et al. (2022), which were originally modified from Timmermann et al. (2021) as well. The fourth item relating to determinism was used in Nayak et al. (2022) and was originally taken from Nadelhoffer et al. (2014). All items use a seven-point Likert scale from −3 (strongly disagree) to + 3 (strongly agree). Examples of the dualism and determinism items, respectively, include: "Please rate how much you agree or disagree with the following statements. - The physical and the mind (and/or consciousness) are completely distinct and separate aspects of primary reality." and "Please rate how much you agree or disagree with the following statements: Everything that has ever happened had to happen precisely as it did, given what happened before." Full text of all items is available in Table 2. Cronbach's alpha for all 4 items is 0.3. "These items were collected at the following timepoints: at baseline following informed consent, 2–4 weeks after, and 2–3 months after."

Table 2. Metaphysical belief agreement ratings over time, rated on a Likert-type scale ranging from − 3 (strongly disagree) to 3 (strongly agree) ($n = 623$).

	Time points Means (SD)		
Item	Baseline	2–4 week	2–3 month
Materialism There is just one primary reality: the physical. The mind (and/or consciousness) is just physical/functional properties of the brain which have an entirely material explanation.	−1.07 (1.83)	−1.13 (1.86)	−1.05 (1.9)
Idealism There is just one primary reality: the mind (and/or consciousness). All material things derive from the mind (and/or consciousness).	−0.39 (1.75)	−0.44 (1.79)	−0.44 (1.78)
Dualism The physical and the mind (and/or consciousness) are completely distinct and separate aspects of primary reality.	−0.56 (1.88)	−0.49 (1.92)	−0.67 (1.92)
Determinism Everything that has ever happened had to happen precisely as it did, given what happened before	−0.07 (1.79)	0.05 (1.8)	**0.15 (1.82)***

*Change from baseline, $p < .00333$.

Atheist-believer status

This item was taken from Nayak et al. (2022) and consists of a single item: "How would you characterize your overall religious or spiritual belief system?" The response options were: Non-believer (e.g., atheist); Agnostic; and Believer (e.g., in Ultimate Reality, Higher Power, and/or God, etc.). Participants were required to select only one response option. This is reported both as percentage of participants endorsing each of these categories, but also numerically with Non-believer (scored as −1), Agnostic (0), and Believer (1). This item was collected at baseline, and again 2–3 months after the session.

Descriptors of the session

Participants completed the Mystical Experience Questionnaire (MEQ) (Barrett, Johnson, and Griffiths 2015) 1–3 days after their session, and answered whether the reference psychedelic experience was their first psychedelic experience, and whether they took the psychedelic in a ceremonial setting.

Analysis

Descriptive data over time points are provided with means and standard deviations. For mind perception and metaphysical beliefs, descriptive information is also presented as the percent of participants who agree or disagree with each item, with agreement categorized as any score > 0 and disagreement categorized as any score < 0.

Separate linear mixed-effects models were computed for each item, including 10 items related to mind perception, 4 items related to metaphysics, and 1 item related to Atheist-Believer status. The outcome variables were Z-scored to facilitate interpretation of the betas as standardized mean differences (SMDs). The independent variables in each regression included time, score on the MEQ, the interaction between MEQ and time, and indicators for whether the experience was the participant's first and whether it took place in a ceremonial setting. Effect sizes are presented as standardized beta coefficients (β_{std}), which can be interpreted as covariate-adjusted Cohen's ds. Results were Bonferroni corrected for 15 tests, for an alpha level of .003333.

Means and standard deviations (SDs) for all measures across time points as well as zero-order correlations are available in Supplement Figure S1. These items are also presented as the percent of participants agreeing (to any degree) at each time point as well (Tables S2, S3, 3).

As exploratory analyses, effect sizes were also calculated for the subset of participants who were psychedelic-naive, and separately for the subset who did not have a mood disorder. These are not corrected for multiple comparisons and are simply presented with their raw p-values.

Results

Results varied across measures related to mind perception, metaphysical beliefs, and Atheist-Believer status. A total of 657 unique participants were included across all three measures (Atheist-Believer status $N = 657$ respondents at both timepoints; metaphysical beliefs $N = 623$ respondents at all three timepoints; and mind perception $N = 255$ respondents at all three timepoints). The sample was mostly male (57–60%), white (86–88%), residing in the United States (72–86%), with relatively high rates of a current mood disorder (26–31%). A minority of participants endorsed the reported experience as their first psychedelic experience (13–14%). The changes in measure responses reported below were statistically significant at $p < .00333$ unless otherwise stated.

Mind perception

In terms of mind perception, we observed increases of moderate effect size in the attribution of consciousness to a range of targets from baseline to the 2–4-week and 2–3-month follow-up timepoints (Figure 1a; Table 1). Some targets were already rated quite high at baseline, including self (the person taking the survey) and other human beings. These items did not show statistically significant changes at either follow-up time point, likely due to ceiling effects.

The following targets showed significant increases of small effect size (βstd ranging from .15 to .28) at both follow-up time points: non-human primates, quadrupeds, insects, fungi, plants, and inanimate man-made objects. Of these, the largest increases were apparent for attribution of consciousness to insects (βstd [95% CI] = 0.28 [0.18, 0.39] at 2–4 weeks, and 0.35 [0.24, 0.45] at 2–3 months). In general, these items did not show substantial change from the first (2–4 weeks) to the final (2–3 months) follow-up timepoints but tended to increase (a maximum increase of βstd = 0.08 in the case of attribution of consciousness to fungi).

A few items, including mind perception of inanimate natural targets (e.g., a rock), inanimate manmade (e.g., a robot), and the universe as a whole showed small, statistically significant effects at one time point but not the other (see Table 1).

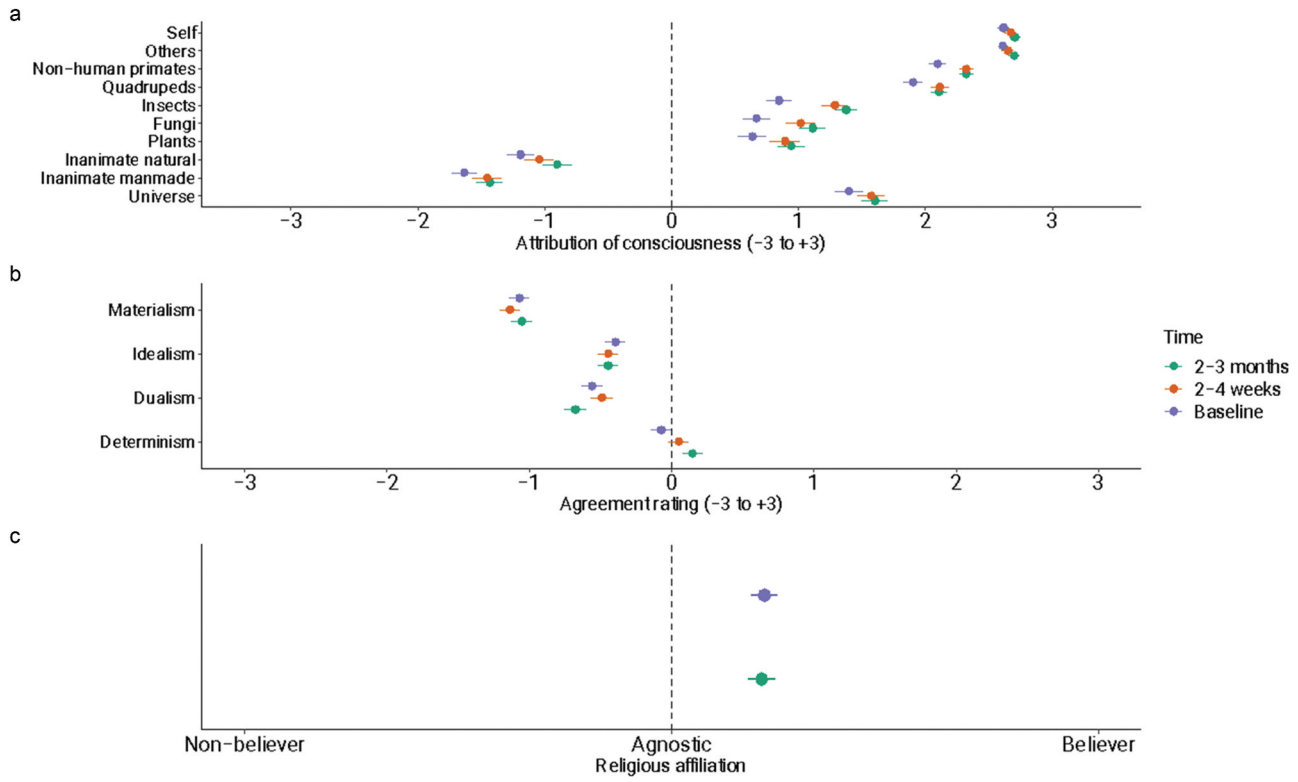

Figure 1. Changes in attribution of consciousness to various entities (mind perception), metaphysical beliefs, and atheist-believer status. (a) statistically significant increases in attribution of consciousness (i.e., mind perception) were observed at both follow-up timepoints for non-human primates, quadrupeds, insects, fungi, and plants. (b) metaphysical beliefs remained mostly unchanged though determinism was statistically significantly increased at the 2–3 month follow-up timepoint. (c) there was no change in atheist-believer status.

See table S7 for exploratory analysis of the effect sizes of mind perception in those who were psychedelic-naive and those without a mood disorder. The results of the subgroup analyses were similar to the main sample, albeit with larger effect sizes of changes in the psychedelic-naive subgroup than in the main sample, particularly insects, fungi, and plants.

Metaphysical beliefs

In terms of metaphysical beliefs, we observed little to no changes (Figure 1b; Table 2). There were no significant differences across timepoints in metaphysical beliefs regarding materialism, dualism, or idealism (with βstd ranging from −0.06 to 0.03) at both the 2–4-week and the 2–3-month follow-up timepoints. However, we observed a small statistically significant increase at the 2–3-month post session time point, but not the 2–4-week time point, in determinism (βstd [95% CI] = 0.12 [0.06, 0.19]).

See table S8 for exploratory analysis of the effect sizes of metaphysical beliefs in those who were psychedelic-naive and those without mood disorder. This demonstrated a similar pattern of results to the larger set of participants though materialism appeared to decrease more at 2–3 months (βstd [95% CI] = −0.27 [−0.44, −0.11] (p = .001)).

Atheist-believer status

Atheist-Believer status showed no change (Figure 2; Table 3). At baseline, 24% of respondents identified as atheist, compared to 25% at 2–3-month follow-up. Similarly, 46% identified as a "Believer" at baseline, compared to 47% at 2–3-month follow-up. Restricting this to the 172 respondents who had never taken a psychedelic before, there is also no change. At baseline 26% of psychedelic-naïve respondents identified as atheist, compared to 28% at 2–3-month follow-up; 33% of psychedelic-naïve respondents identified as a "Believer" at baseline, compared to 34% at 2–3 month follow-up.

See table S9 for exploratory analysis of the effect sizes of Atheist-Believer status in those who were psychedelic-naive and those without mood disorder.

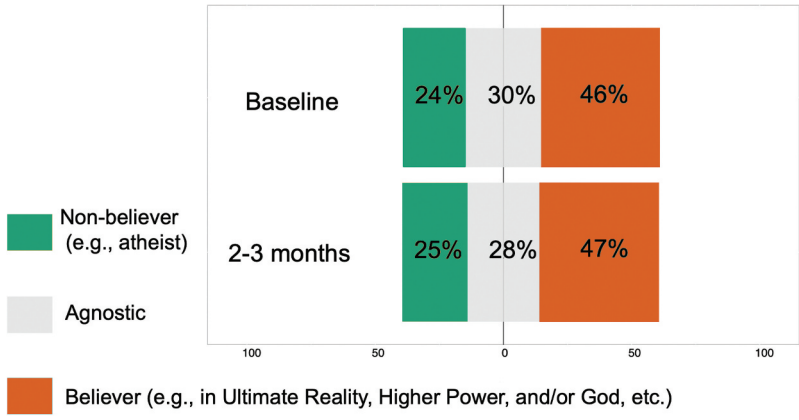

Figure 2. Percentage of respondents identifying as "non-believer (e.g., atheist)," Agnostic, and "believer (e.g., in ultimate reality, higher power, and/or god, etc.)" at baseline and 2–3 month follow-up only negligible changes were observed in Atheist-believer status.

Table 3. Percentage of participants identifying as atheist, agnostic, or believer at baseline and 2–3-month follow-up ($n = 657$).

	Time point % affiliating	
Atheist-Believer status	Baseline	2–3 month
Non-believer (e.g., atheist)	24.4%	25.4%
Agnostic	29.5%	28.0%
Believer (e.g., in Ultimate Reality, Higher Power, and/or God, etc.)	46.1%	46.6%

These subgroup analyses demonstrated decreases (toward Atheism) in the psychedelic-naive (βstd [95% CI] = 0.22 [−0.43, −0.02] ($p = .035$)). Mood disorder status did not seem to alter Atheist-Believer status.

Descriptors of the session

Mean (SD) MEQ scores were 0.5 (0.3) among respondents for all three sets of questions, and 13–14% of participants reported on their first lifetime psychedelic session, and 2–4% used it in a ceremonial setting (Table S1). The effect of MEQ scores over time was not significant for any of the 15 measures, indicating higher MEQ was not related to greater degree of belief change. There was similarly no effect of taking a psychedelic in a ceremonial setting on belief changes. The effect of taking a psychedelic for the first time was only significant for the item "The universe is conscious," with that item showing increased agreement after first-time psilocybin use with a medium effect size βstd [95% CI] = 0.68 [0.36, 1.01] ($p < .0033$).

Discussion

Our findings showed different patterns across the measures of 1) mind perception, 2) metaphysical beliefs, and 3) Atheist-Believer status. We discuss each of these in turn.

First, replicating effects from Nayak and Griffiths (2022) and Nayak et al. (2022) we found that mind perception was increased over a range of targets after psilocybin use. For example, compared to pre-drug baseline, participants indicated more perception of mind at both post-drug follow-up time points to non-human primates, quadrupeds, fungi, and plants. Individuals who were psychedelic-naive generally had greater increases in mind perception.

These targets of consciousness attribution are most relevant to mind perception research conducted by Gray, Gray, and Wegner (2007, 2011, 2010). Mind perception refers to the capacity for experience (feel pleasure and pain) and agency (make decisions and act) across a range of entities (rocks, plants, animals, humans, robots, god, etc.). Research using this measure has found systematic changes in mind perception related to certain mental disorders (Gray et al. 2011).

For example, people with autism show decreased perception of the capacity for agency in other people (but not experience). People with psychopathy show decreased perception of the capacity for experience in other people (but not agency). People with schizotypy show increased attribution of agency and experience across nearly all targets (Gray et al. 2011). The present study did not differentiate between agency and experience, but rather asked participants to rate the capacity "of having conscious experience" to a range of entities, where we found across the board increases in consciousness attribution (i.e., mind perception).

Some mind perception research has focused on issues related to mental illness (Gray et al. 2011), and there are reasons to examine a link to delusions in the context of increased attribution of agency. For example, conspiratorial thinking often rests on an attribution of (malevolent) agency to current events (Wegner and Gray 2016). Others have proposed that the perception of mind may result in increased feelings of social-like connection which could enhance well-being (e.g., "a social-spatial conflation," Yaden et al. 2017). It is likely that the increased mind perception from psychedelic increases can have positive, pathological, or mixed consequences. This is an area for future study.

Second, contrary to recent psychedelic research findings showing shifts in metaphysical beliefs (Nayak et al. 2022; Timmermann et al. 2021), we found little evidence of such shifts in this prospective study. For example, we found no significant change in endorsement of items relating to dualism, materialism, or idealism while all three of these were found to increase significantly after a psychedelic experience in one or both previously referenced papers (Nayak et al. 2022; Timmermann et al. 2021). We did find a small difference in determinism endorsement in this study at 2–3 months post session, which supports a previously reported finding in Nayak et al. (2022), and in the subsample of first-time psychedelic users, materialism appeared to decrease at 2–3 months. Psychedelics may cause such belief changes, but the present data suggest they do not occur on average in naturalistic use. To the extent that such belief changes do occur, they may 1) be more likely in a particular subset of individuals, 2) rely on particular contextual factors, and/or 3) require multiple psychedelic experiences over time.

The measurement of these non-naturalistic beliefs is difficult and the relationship between the items administered to the normal population in this study and the technical philosophical views they represent remains in question. Substantial additional validation is required for these measures (see Letheby and Mattu 2022; Yaden and Anderson 2021). However, given the concerns raised about changes in these kinds of beliefs from psychedelic experiences (e.g., Jacobs 2020; Smith and Sisti 2021), our findings provide evidence that concerns around changes to such beliefs may have been inflated given the general lack of changes observed in the present study.

Third, contrary to recent psychedelic research finding increases in endorsements of Atheist-Believer status in retrospective self-report surveys (Davis et al. 2020; Griffiths et al. 2019; Nayak et al. 2022), this prospective longitudinal self-report survey did not observe such changes. As with the lack of change in non-naturalistic beliefs, the lack of change to Atheist-Believer status should reduce the urgency of bioethical discourses regarding the potential of non-therapeutic belief changes in general. Again, however, the absence of changes in Atheist-Believer status after naturalistic psilocybin use does not preclude the possibility that these changes may happen in people with certain predispositions or under particular circumstances yet to be characterized.

The present study complements in parts and contradicts in parts the Timmermann et al. (2021) component, which found increased non-naturalistic beliefs in a population using psychedelics in a ceremonial setting ($N = 386$ who completed follow-up measures at 4 weeks post-retreat). The present study, by prospectively recruiting a population that planned to use psilocybin mushrooms in a variety of settings (mostly not in ceremonial ones), provides a more fine-grained sense of the kinds of belief changes that occur with naturalistic psilocybin use across a range of settings. Timmermann et al. (2021) demonstrated larger belief change in psychedelic-naive individuals, and we did see some indication of larger belief changes in psychedelic naive participants in exploratory analyses (see Tables S7–9). Effect sizes for mind perception were greater in the psychedelic-naive, and materialism appeared to decrease at 2–3 months in the psychedelic-naive subgroup, but not the full sample.

The present study represents a substantial increase in methodological rigor over Nayak et al. (2022). In particular, the Nayak et al. (2022) survey study format asked participants to retrospectively indicate their beliefs before and after a psychedelic experience as well as their current beliefs. The "pre-drug" ratings regarding consciousness-attribution from Nayak et al. (2022) were lower than baseline ratings of the same items in the present study. Meanwhile, findings across baseline and follow-up timepoints in the present study are relatively close to the "post-drug" and current ratings from the Nayak et al. (2022) study, raising the potential of recall bias inherent in retrospective, cross-

sectional studies. It is possible that the retrospective self-report format may artificially suppress endorsements in the "pre-drug" category. Alternatively, respondents with lower baseline belief may have greater capacity for belief change and be more likely to respond to a survey about a belief-changing psychedelic experience. In any case, we believe that appropriate caution should be taken when engaging in retrospective self-report research and interpretation of those results going forward.

Limitations

The study was limited in a number of ways. First, the measures have not been validated. Each of these measures should be examined for their psychometric properties, their convergent/divergent validity, and overall reliability. The measures should also be applied in a representative sample. A non-psychedelic control group was also absent in this study. This control data would have served as a valuable comparator for the measures. Incorporating belief change measures into the growing body of randomized controlled trial research with psychedelics would allow these questions to become the focal point of discussion rather than the limitations which carry substantial weight at this point.

Another limitation of our study is the fact that the sample is predominantly composed of experienced psychedelic users which may have decreased possible changes in belief. An exploratory analysis did show that first-time psychedelic users had larger increases in mind perception, and evidence of decreased materialism at 2–3 months. Despite psilocybin having limited to no effects on metaphysical beliefs and Atheist-Believer status in this sample, it remains quite possible that psychedelics may induce very large belief changes in contexts which facilitate that. Thus, these results should not be used to minimize ethical safeguards concerning belief changes with psychedelic use.

Conclusion

In this prospective, longitudinal survey of psychedelic experiences, we found that mind perception was increased but that metaphysical beliefs and Atheist-Believer status were almost or entirely unchanged. These results provide more evidence that constructs such as mind perception and mentalization may be notably impacted by psychedelic experiences. However, these findings suggest that concerns that psychedelics could change metaphysical beliefs or result in "conversions" across religious affiliations may be overestimated. Further research is required across each of these topics, and concerns related to providing adequate informed consent remain well-founded, but concerns related to changes in non-naturalistic beliefs or religious affiliation may be exaggerated.

Disclosure statement

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

Funding

This work was supported by Unlimited Sciences. The Center for Psychedelic and Consciousness Research is funded by philanthropic support from the Steven and Alexandra Cohen Foundation, Tim Ferriss, Matt Mullenweg, Blake Mycoskie, and Craig Nerenberg.

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