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States and Traits Related to the Quality and Consequences of Psychedelic Experiences

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Many individuals experience significant positive psychological change after ingesting psychedelic agents such as psilocybin, LSD, and ayahuasca, but some do not. Such changes appear to be mediated by definable and measurable mystical experiences (MEs) during the psychedelic session, which have been shown in previous research (e.g., Griffiths, Richards, McCann, & Jesse, 2006) to be related to long-term positive personal change. Individual responses to psychedelic agents are characteristically difficult to predict, however, necessitating improved identification of predictors to (a) reduce the possibility of significant challenging experiences and sequelae and (b) increase the possibility of MEs and long-term beneficial outcomes. Our study utilized crowdsourced retrospective survey data from 143 Amazon Mechanical Turk participants who self-administered psilocybin in the past year to identify factors related to MEs and/or challenging experiences. The best performing regression model explained 66% of the variance in ME scores on the 30-item Mystical Experience Questionnaire (MacLean, Leoutsakos, Johnson, & Griffiths, 2012) and 56% of the variance in scores on the dread subscale of the Sacred Emotions Scale (Burdzy, 2014). A state of surrender at the start of the psilocybin session most strongly explained MEs, and a state of preoccupation most strongly explained challenging experiences. The trait absorption was a strong secondary predictor in both models, along with smaller predictors. Additionally, the occurrence of MEs during the psilocybin session explained long-term positive change. Based on these findings, the presented models appear to provide a powerful framework for explaining the immediate quality and long-term consequences of psychedelic experiences. Limitations as well as implications for therapeutic applications are discussed.

Keywords: psilocybin, psychedelic, state of surrender scale, mystical experience

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After a decades-long hiatus, researchers are again actively investigating psychedelic drugs such as LSD and psilocybin in humans. Studies in healthy volunteers have shown long-term increases in trait optimism (Carhart-Harris, Kaelen, et al., 2016), well-being (Carhart-Harris, Kaelen, et al., 2016; Griffiths et al., 2011), and openness (Carhart-Harris, Kaelen, et al., 2016; MacLean, Johnson, & Griffiths, 2011) in healthy individuals, and long-term improvements in patients with obsessive-compulsive disorder (Moreno, Wiegand, Taitano, & Delgado, 2006), tobacco addiction (Garcia-Romeu, Griffiths, & Johnson, 2014), alcohol addiction (Bogenschutz & Forchimes, 2017; Bogenschutz et al., 2015), anxiety related to dying (Grob et al., 2011; Johnson, Richards, & Griffiths, 2008; Ross et al., 2016), and depression (Carhart-Harris, Bolstridge, et al., 2016; Sanches et al., 2016) after treatment with psychedelics. Remarkably, these long-term effects are often evident after just one or two treatment sessions and can endure for more than a year after the compound has been metabolized and excreted from the body (e.g., Griffiths, Richards, Johnson, McCann, & Jesse, 2008).

Such outcomes challenge conventional models of pharmacological interventions for mental illness, as well as models of the nature of personality traits, which generally demonstrate coherence and continuity across the life span marked by gradual change with age (Roberts, Wood, & Caspi, 2008). Anomalous findings such as these demand further research and raise important questions about underlying mechanisms and whether and how they can be predicted a priori. Given that most of the previously cited research involved psychological support and/or psychotherapy before, during, and after the drug experience, plus attention to positive environmental stimuli during the drug-session, the relative contribution of these components to the subsequent outcomes also needs to be determined.

The occurrence of a mystical experience (ME)¹ during the psilocybin session is increasingly recognized as an important factor in producing desired responses. Roseman, Nutt, and Carhart-Harris (2018), for example, found that the occurrence of ME during a psychedelic session explained more than half of the variance in reduction in depression at 5 weeks postsession far outweighing other aspects of the psilocybin

experience. Similarly, Johnson et al. (2008) found that the occurrence of ME during psilocybin sessions mediated reductions in anxiety and depression in patients diagnosed with cancer, and Griffiths et al. (2008) found that the occurrence of ME during a psilocybin session enhanced feelings of well-being and spirituality in participants with no prior hallucinogenic experience. Thus, it is not merely the psilocybin itself but the type of experience it produces that leads to substantial personal change. Further, MEs are associated with pronounced transformational changes regardless of whether they are produced by psychedelics, endogenously, or by other means (Clark, 1968; Griffiths et al., 2008; Hunt, 2000; James, 1902; Laker, 2015; Le, 2008; Maslow, 1962; Roseman et al., 2018). Finally, MEs can be elicited by means other than psychedelics, such as hypnosis (Lynn & Evans, 2017), sweat lodges (Hibbard, 2007), childbirth (Vaughan & Maliszewski, 1982), and near-death experiences (Pennachio, 1986).

MEs are defined by specific characteristics for which self-report scales have been developed and validated. Collating reports of MEs occurring in the context of a number of different religions and religious practices, Walter Stace (1960) highlighted six key dimensions to the ME: (a) unity, or the sense that all is one (the dimension he believed to be “core”); (b) transcendence of time and space; (c) deeply felt positive mood, often accompanied by tears; (d) sense of sacredness, including awe, humility, and reverence; (e) noetic quality, or a feeling of insight with tremendous force of certainty; and (f) alleged ineffability, or an experience that is nonverbal, impossible to describe.

Based on Stace’s elements, via empirical work with psilocybin, Walter Pahnke (1963) devised a rating scale and a relatively arbitrary threshold for determining the occurrence of “complete” MEs induced by psilocybin. Other researchers have subsequently developed newer versions of this scale for measuring MEs and related phenomena (Dittrich, 1998; Hood et al., 2001). A 30-item version of the Mystical Experience Questionnaire (MEQ-30) was validated

¹ MEs are distinctive and powerful experiences defined by particular characteristics including unity, timelessness, and ineffability (e.g., Stace, 1960; more detail provided in subsequent paragraphs).

by MacLean, Leoutsakos, Johnson, and Griffiths (2012) and revalidated in psilocybin studies by Barrett, Johnson, and Griffiths (2015). Finally, the Sacred Emotions Scale (SES) was developed and validated in a study of endogenous ME to examine the accompanying positive and negative subjective emotional states (Burdzy, 2014).

Although MEs are easily measured and appear to relate strongly to the beneficial impacts of psychedelic drugs, they are not always a consistent feature of psychedelic experiences. Some researchers have argued that MEs cannot be measured on a continuous linear scale but instead involve an inflection or transition point into “complete” MEs that appears to be strongly dose-dependent (Barrett et al., 2015; Griffiths et al., 2011). Validated criteria and thresholds for determining the occurrence of such “complete” MEs have recently been tested for the MEQ-30 as involving scores greater than 60% of possible points on all four of the subscales; this criterion has predicted complete ME comparably to the 43-item version of the MEQ with only a slight bias toward false positives (Barrett et al., 2015). Barrett et al. found that just over half of participants in a recent psilocybin study experienced complete ME based on this threshold. In addition to putatively positive MEs, many individuals experience challenging emotions such as anxiety for at least part of their psychedelic experiences (Griffiths, Richards, McCann, & Jesse, 2006), and these can co-occur with MEs (Lyvers & Meester, 2012). Evidence indicated that duration rather than intensity of such challenging experiences is associated with less positive or more negative long-term psychological consequences after the experience (Bradstreet, Johnson, MacLean, & Griffiths, 2014; Doblin, 1991). If psychedelic treatment is to produce maximal benefits, it is essential that the preconditions that foster ME and minimize challenging reactions be determined.

Determining the necessary preconditions for psychedelic-induced MEs is complex. It is well known that the quality of a psychedelic experience is uniquely sensitive to the mental state (“set”) of the individual at the time, the environment (“setting”) in which the experience takes place, and the dose taken (e.g., Griffiths et al., 2011; Leary, Litwin, & Metzner, 1963; Lyvers & Meester, 2012; Metzner, Litwin, & Weil, 1965; Studerus, Gamma, Kometer, & Vollen-

weider, 2012). Much has been written about the optimal conditions for positive psychedelic experiences (e.g., Fadiman, 2011), and guidelines for ensuring safe use of psychedelics are available in the academic literature (Johnson et al., 2008). In contrast, however, the individual and combined impact of other variables assumed to be related to the quality of psychedelic experiences and their potential long-term effects have rarely or never been systematically studied. To date, most of the emphasis has been placed on components such as careful screening, psychological preparation (Johnson et al., 2008), meditative music (Bonny & Pahnke, 1972; Kaelen et al., 2016), and aftercare as they relate to avoidance of challenging experiences rather than generating MEs.

Studerus et al. (2012) carried out one of the few attempts to address this issue of predicting the quality of psychedelic experiences and evaluated both mystical and challenging experiences in a meta-analysis of 23 human studies involving 261 subjects. Using the Oceanic Boundlessness (OB) dimension of the Five-Dimensional Altered States of Consciousness Rating Scale (5D-ASC; Dittrich, 1998), which closely relates to MEs, the researchers used regression analyses to determine that the only psychological states that varied positively with OB, besides dosage, were absorption ($B = .41$), performance-related activity (a measure related to drive and optimism; $B = .31$), emotional-excitability (a measure of aversive emotional states; $B = .24$), and symptoms of psychological distress (reflected in scores on the Global Severity Index; $B = -.22$; Studerus, 2012a, 2012b). These predictors explained less than 30% of the variance in OB. Likewise, exploring the predictors of challenging experience, Studerus (2012a, 2012b) found that the only state measure predicting the Five-Dimensional Altered States of Consciousness Rating Scale dimension Dread of Ego Dissolution (DED, a factor relating to anxiety, fear, panic, and or distress) was emotional excitability ($B = .3$), and this variable added only slight explanatory power to the stronger predictors of positron emission tomography scan during the experience, time of measurement, and hallucinogen-naïveté that in total explained 18.2% of the variance in DED.

Besides this recent effort, the only other analysis of predictive states appears to have been

conducted decades earlier by Metzner et al. (1965) and Leary et al. (1963). Metzner and colleagues (1965) gathered scaled survey data from 82 individuals before and after administration of a psychedelic drug, finding small-to-moderate correlations between mood and the type of psychedelic experience. Most relevant to our study were the findings that (a) anxious mental states before the experience corresponded with unpleasant somatic sensations and greater anxiety during the session ($r = .21-.39$), (b) a state of preoccupation with one's own concerns before the session corresponded with increased feelings of paranoia and anxiety during the session ($r = .22-.35$), and (c) a positive mood before the experience corresponded with higher self-reporting of ME and pleasure during the session ($r = .26-.32$). Correlations did not surpass .42, predicting <17% of the variance in the nature of the psychedelic experience. Interestingly, even these small -to-moderate correlation ranges are higher than those found by Leary et al. (1963) in a retrospective survey of 98 individuals who had experienced a psychedelic session earlier. Thus, much remains to be learned about predictors of ME and challenging psychedelic experiences.

Although naturally occurring or endogenous MEs occur only rarely, they produce transformative impacts similar to those experienced through psychedelic drugs. According to William James (1902), natural MEs appear to occur more readily under two conditions: (a) when one's life has reached a strong turning point or existential crisis and (b) when one has released one's grasping and one's will and fully commits to an unknown future. The first condition, a state of identity distress or crisis, is described extensively by James (1902) in *The Varieties of Religious Experience* and captured in Miller and C'De Baca's (2001) description of sudden "quantum" change that occurs when a person has reached a "hairs, a turning point in the life journey where major change simply must occur because the person is unable or unwilling to continue in his present course" (p. 157). Carhart-Harris and Nutt (2017) recently discussed the pharmacology of such crises or turning points, highlighting the role of 5HT_{2A}R in both psychedelic and crisis experiences.

The second condition leading to natural MEs, a state of total acceptance or surrender, is articulated by William James' (1902) description of

religious conversion characterized by "passivity, not activity; relaxation, not intentness," a readiness to "give up the feeling of responsibility, let go your hold, resign the care of your destiny to higher powers, be genuinely indifferent as to what becomes of it all" (p. 67). This is supported in the extensive analysis of qualitative records of transformative ME conducted by Miller and C'De Baca (2001).

Finally, Maslow (1979) added to the preconditions for transformative "peak experiences" (similar to MEs) by suggesting that specific mental barriers, such as a tendency to reject information that is not easily explained through rational, logical, and scientific processes, can inhibit one's capacity for ME—perhaps, one might surmise, because such mental barriers negate the state of surrender that seems to foster ME. Each of these factors related to endogenous MEs are examined in the current study.

The current work serves three purposes. The first purpose was to explore the relationships among factors described in previous paragraphs and mystical or challenging experiences with psilocybin. These factors include (a) traits like absorption (Tellegen & Atkinson, 1974; found by Studerus (2012a, 2012b, to predict ME), (b) rational and cognitive barriers hypothesized to be significant by Maslow (1979) measured through the Rational-Emotive Inventory (Epstein, Pacini, Denes-Raj, & Heier, 1996) and a newly developed Barriers scale, and (c) newly developed measures of crisis and surrender states described by James (1902) and Miller and C'De Baca (2001). The second purpose was to determine whether mental state at the time of ingestion is a plausible mediator of the relationship between traits and response to psilocybin, and the third purpose was determine whether ME appears important for explaining long-term outcomes following psilocybin ingestion.

Method

Participants

Participants were selected from a U.S. population that reported they had ingested psilocybin within the past 12 months. Participants were recruited through Amazon Mechanical Turk (MTurk), an online source in which individuals participate in survey studies for small cash compensation of \$1.00 (see details that follow). The

final screened sample (see screening procedures that follow) consisted of 143 valid responses with 81 males (56.6%) and 62 females (43.4%) ranging in age from 18 to 62 years, with an average age of 31.3 ($SD = 9.66$). Fourteen percent ($n = 14$) of participants had a graduate degree or some graduate education, 29% ($n = 41$) had completed a bachelor degree, 40% ($n = 57$) reported that they had some college, 11% ($n = 16$) had completed an associate degree, and 11% ($n = 15$) had not yet continued their education beyond a high school diploma. Thirty-one participants (21.7%) reported no previous experience with psychedelic drugs. Of those who had previous psychedelic experience, 24 (21.4%) had taken psychedelics one to two times, 44 (39.3%) three to five times, 27 (24.1%) six to 10 times, nine (8.0%) 11 to 20 times, and eight (7.1%) more than 20 times.

Materials

The survey consisted of nearly 300 items presented in an online tool Survey Monkey. Participants were directed to the relevant web page after reading informed consent text, completing screening, and agreeing to participate in accordance with the stipulations of the institutional review board. Scaled items in all but the long-term outcomes used 4-point Likert scales ranging from 1 (*strongly disagree*) to 4 (*strongly agree*) an opt-out button “I prefer not to respond,” with answers required for all items. Open-ended questions designed to activate participants’ relevant recollections of prior state, proximal state, and psychedelic experience were completed before relevant scale items were presented.

Background items. Background items requested information about participants’ sex, education, age, and religion. See [Supplement A](#) in the online supplemental materials.

Trait measures. Items from a variety of trait scales were intermixed randomly and presented in blocks of five statements each, along with “attention” items checking on participants’ care in responding to items, written to be semantically similar to the surrounding items (e.g., “I will mark 4 for this item”). These scales included the following.

Tellegen Absorption Scale (TAS). The TAS is a 34-item scale that measures a trait or disposition “for having episodes of “total” attention that fully engage one’s representational (i.e., perceptual, enactive, imaginative, and ide-

ational) resources” (Tellegen & Atkinson, 1974). The TAS predicted mystical phenomena in psychedelic sessions (Studerus et al., 2012). Internal consistency of the full scale in the norming sample (Cronbach’s alpha) was $\alpha = .88$ (Green & Lynn, 1980) and $\alpha = .95$ in our sample.

Rational Emotive Inventory (REI). Two subscales (10 items) of the REI were included in this study: (a) Faith in Intuition (FI), or “having imconfidence in one’s feelings and immediate impressions as a basis for decisions and actions” (Epstein et al., 1996, p. 394), with Cronbach’s $\alpha = .77$ on a 5-point scale in the norming sample and $\alpha = .80$ in our sample on a 4-point scale, and (b) Need for Cognition (NFC), or the “the extent to which individuals report that they enjoy and engage in, or dislike and avoid, cognitive activities” (p. 394), with Cronbach’s $\alpha = .87$ on a 5-point scale in the norming sample and $\alpha = .80$ in our sample on a 4-point scale.

Barriers (newly developed scale). Five items measured the tendency to reject phenomena that have no rational explanation. The items are based on descriptions provided by William James (1902) and Abraham Maslow (1979), who described the hindering capacity of overreliance on logical or rational processes on capacity for peak experiences. These items produced good internal consistency ($\alpha = .87$) and included items such as “If something doesn’t make logical sense, I won’t accept it” and “I will not consider accepting any idea not backed by credible scientific evidence.” See [Table T1](#) in the online supplemental materials for loadings based on principal axis factoring.

Psilocybin history. Participants were asked whether they had ingested any sort of psychedelic drug before the current psilocybin ingestion, and if so how many times they had done so across their lifetime and in the past 10 years.

Prior state. Items in this section assessed participants’ mental state prior to psilocybin ingestion.

Memory activation. Participants were asked to describe what was happening in their lives in the days and weeks immediately preceding their experience.

Crisis (newly developed scale). Six hypothesized constructs measuring the presence or absence of a state of crisis were measured: disruption, emotionality, fear, confusion, vulnerability,

and contentment (reversed). Items were generated as directly as possible from descriptions in James' (1902) *The Varieties of Religions Experience*. Each of these factors consisted of three to six items that loaded well onto their respective constructs and produced internal consistency (Cronbach's alpha) from $\alpha = .84$ to $.92$. Significant correlations exceeding $.84$ among disruption, emotionality, fear, confusion, and vulnerability suggested that they were not distinct constructs; thus, only the factor Confusion was retained as the predictor with the strongest theoretical basis (See loadings in Table T2 in the online supplemental materials). Contentment was retained as an independent predictor with internal consistency of $\alpha = .84$.

Setting. Items measuring the setting for the psychedelic experience included (a) open-ended questions about time of day, expectations, preparations, people present, familiarity with people present, and location and (b) dropdown boxes for selecting the level of exposure to language or words (variable was words) during the experience and the extent to which eyes were open or closed (variable was eyes). Open-ended questions were coded manually and entered into the regression model as dummy variables. The dropdown boxes for eyes and words were dropped to two-level scales because the original three-level scaling did not yield sufficient numbers in all of the cells.

Mindset at time of exposure. Participants provided information about their mindset at the time of ingestion or just after ingestion. The description of the items stated,

The next items relate to your mindset as you took the psilocybin. It may be unchanged from the days before the experience, but perhaps your emotions shifted when you first put the psilocybin in your mouth. This is the time in which we are interested. Thank you.

The question prompt for the intermixed items read, "As you took the psilocybin, how much did the following items reflect your mindset?"

State of surrender (SoS). The state of surrender is defined as a readiness to accept whatever was, whether good or bad, without resisting or fighting or struggling. The final 10-item scale included "I had stopped resisting and was ready to give up control" and "I'd felt a release from the need to think so hard." Cronbach's alpha in this sample was $\alpha = .91$. See Table T3 in the online supplemental materials.

State of preoccupation (SoP). The final SoP scale included an average score for four items related to preoccupation with one's immediate life (e.g., "I felt a little bit rushed for time" and "I had a lot of things on my mind at the time"). Internal consistency within this sample was Cronbach's $\alpha = .76$. See Table T3 in the online supplemental materials.

Psilocybin experience.

Memory activation. Memory of the psilocybin experience was activated through (a) open-ended questions related to reasons, expectations, preparation for the experience (e.g., "Why did you decide to have this experience? What did you expect from this experience?") and (b) open-ended questions about the setting of the experience, including people present, familiarity, location, exposure to words, and whether their eyes were opened or closed during the experience. See survey items in Supplement B in the online supplemental materials.

Scale items. Two main scales measured their experience: (a) the Mystical Experience Questionnaire (MEQ-30; MacLean et al., 2012) and the SES (Burdzy, 2014). Items were intermixed in five-item blocks and followed the prompt, "Reflecting back on your 2015/16 psilocybin experience, please rate the degree to which at any time during that session, you experienced the following phenomena."

Mystical Experience Questionnaire (MEQ-30). This 30-item scale has been validated to measure ME following psychedelic ingestion (Barrett et al., 2015; MacLean et al., 2011). Some of the items from the MEQ-30 were adapted for this study so that they were semantically consistent with the other scale (e.g., "I felt certain that I'd encountered ultimate reality" changed to "certainty that I'd encountered ultimate reality"), and used a 4-point rather than a 7-point scale for consistency with the other items in the survey. Four subscales were validated in previous studies: Mystical ($\alpha = .93$ in the norming sample, $\alpha = .96$ in our sample), Positive Feelings ($\alpha = .83$ in the norming sample, $\alpha = .84$ in our sample), Timelessness/Spacelessness ($\alpha = .81$ in the norming sample, $\alpha = .83$ in our sample), and Ineffability ($\alpha = .80$ in the norming sample, $\alpha = .80$ in our sample). The full scale score, calculated as a mean of all 30 items, produced internal consistency (Cronbach's alpha), $\alpha = .93$, in the norming sample using a

6-point scale and $\alpha = .97$ in our sample using a 4-point scale.

Sacred Emotions Scale (SES; Burdzy, 2014). The SES is intended to measure the emotional component of sacred emotions, and consists of two subscales: 26 items measuring Sacred Exuberance ($\alpha = .93$ in the norming sample and $\alpha = .94$ in our sample), and 10 items measuring Sacred Dread ($\alpha = .90$ in the norming sample and $\alpha = .91$ in our sample). See correlations among the MEQ-30 and SES items in [Table T4](#) in the online supplemental materials.

Current state. Participants were asked about their present life to seek information about changes that might have occurred through their experience.

Memory activation. Individuals responded to an open-ended question to describe their current psychological state and life situation.

Positive and Negative Change scales. Items for the change scales included pairs of adjectives for which individuals were asked to report on a 5-point scale whether they had experienced a decrease, no change, or an increase in the characteristics. These adjectives were adapted from the scales used by (Griffiths et al., 2006). Three factors were extracted: Positive Change, including items related to interpersonal traits (e.g., social concern and compassion, empathy & sensitivity to others), intrapersonal characteristics (e.g., honesty and authenticity, patience and tolerance), and attitudes (e.g., creativity and playfulness, joy and optimism), producing $\alpha = .93$; Negative Change, including anger and guilt, anxiety and depression, and preoccupation with future or past, producing internal consistency of $\alpha = .69$; and Spiritual Change, including experiences of sacredness and reverence, time spent in meditation or prayer, and desire for closeness to a divine presence, producing $\alpha = .78$. See [Table T5](#) in the online supplemental materials for loadings based on principal axis factoring.

Material Values Scale (Richins, Mick, & Monroe, 2004). The nine-item Material Values Scale, designed to measure “importance ascribed to the ownership and acquisition of material goods in achieving major life goals or desired states” (p. 210), included three domains: use of possessions to judge others’ and one’s own success, centrality of possessions in one’s life, and the belief that possessions lead to happiness and life satisfaction. These items produced an overall $\alpha = .82$ in the norming sample

and $\alpha = .84$ in our sample. They were combined into a single variable.

Procedure

Data collection. Following institutional review board approval at Dickinson State University (Approval Number DSU201604), data were collected on MTurk, an online source in which individuals participate in survey studies for small cash compensation. MTurk is a crowdsourcing tool through which participants are accepted by Amazon as “Workers” and can choose from among a wide variety of surveys for small monetary compensation. MTurk has mounting evidence for its capacity to more broadly represent the population than the undergraduate population often used in psychological studies (Buhrmester, Kwang, & Gosling, 2011) and equivalent to lab samples (Bartneck, Duenser, Moltchanova, & Zawieska, 2015), although recent studies have found that respondents tend to be more highly educated and less representative of minority groups than the population as a whole (Berinsky, Huber, & Lenz, 2012). In this study, compensation was \$1.00, an amount affordable for this self-funded study. Although the compensation was inadequate to compensate participants for their time, the decision to participate was initiated solely and freely by the participants with full knowledge of the time demands and compensation. Recognizing this, we acknowledged at the start and conclusion of the survey that this was a donation of their time and thanked them for their generosity.

Recruitment. Subjects were recruited through MTurk postings seeking 150 subjects who had had a recent experience with psilocybin (“magic mushrooms”) to participate in study titled “Psilocybin Study.” Individuals were informed that they would be asked to participate in a lengthy survey taking approximately 40 min, in which they would answer more than 250 questions about their experience. Individuals who were registered as MTurk Workers from the United States indicated their interest by accepting the job or the “hit.” If individuals accepted the “hit,” they were directed to a screening page on Survey Monkey. If they passed those screening items, which will be described, they were given a link and password to the informed consent followed by the actual survey. Duplicate responses were prevented in MTurk, which prevents any one participant from

accepting a survey request more than one time if that setting is required by the requester.

Screening. A total of 323 individuals entered the screening page and were asked four questions to determine their eligibility: “Are you 18 years of age or older?” (one eliminated), “Have you had a recent psilocybin experience?” (21 eliminated), and “In what year was your psilocybin experience?” (19 subjects eliminated who indicated that their psilocybin experience occurred before 2015). Finally, subjects were told “This is a very long survey, taking 35–45 min to complete, and we can offer only minimal compensation for your valuable time. Do you have 35–45 min to generously donate to this survey?” Eight subjects indicated that they did not have 35–45 min to donate and were taken to an exit page. An additional 15 subjects answered all of the screening questions but failed to complete the informed consent, yielding a total of 259 individuals who completed the informed consent and were taken to the screen where the survey password was provided and 185 individuals who used the password to enter the survey. Of these, 42 individuals were eliminated because they (a) failed to answer correctly 75% of the items used to check for careless responding and (b) indicated that they had not been able to respond thoughtfully to most or all of the survey items. This left a final sample of 143 participants. Attention items were directions to mark a particular response adjusted to match the length and structure of surrounding survey items (e.g., “I will mark three for this item”).

Statistical Approach

Step 1: Exploring the relationships. The appropriateness of the data for regression analysis was examined, and all of the predictor variables were acceptable for analysis. Among the dependent measures, ME had some negative skew but was retained without transformation because the skew was minimal and visual inspection of plots appeared acceptable. Challenging experience had positive skew and was log-transformed to reduce skew, after which it fell into an acceptable distribution. Bivariate correlations were examined among all of the potential predictors before dividing them into temporally ordered blocks and entering them into a hierarchical linear regression to explain ME and dread. Block 1 included background factors, Block 2 included traits, Block 3 included prior state factors, Block 4 included set-

ting factors, and Block 5 included proximal state or “set” factors. The variables with coefficients significant at $<.1$ were retained for further exploration, while variables that had small correlations with the dependent variable and no significant coefficients in any block of the regression were dropped. See correlation matrices for all theoretical predictors in [Table 1](#).

Step 2: Generating the best-fitting model. All of the variables retained through the process described in Step 1 were entered into a backward regression model that eliminated variables stepwise if they did not meet the threshold of .05 for inclusion and .10 for exclusion. All of the assumptions for regression were examined and found to be acceptable, and the best-fitting model was reanalyzed within sex to identify any potential sex-based differences.

Step 3: Examining plausible mediation relationships. Two potential mediated relationships were examined: (a) the mediating capacity of surrender on the relationship between trait-state predictors and ME, and (b) the mediating capacity of ME on long-term positive change. To test the mediating role of surrender and preoccupation on ME and dread, two composite variables were created by retaining the standardized predicted value of the respective dependent measures based on the set of trait or prior state predictors with significance $p < .1$. The variable created was then used as the p variable to explore plausibility of ME as a mediator of positive change. The model was initially tested through hierarchical regressions in SPSS (Version 23.0), and relationships that appeared consistent with [Kenny, Kashy, and Bolger’s \(1998\)](#) criteria were then analyzed using path analysis in LISREL to test the goodness of fit.

Results

Psilocybin Experience

The psilocybin experiences on which this study was based occurred up to 12 months before data were collected. A description of the location, group, and expectations from the experience can be found in [Table O](#) in the online supplemental materials. None was included in the regression model because they were based on subjective analysis of open-ended responses and had some responses that could not be

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Table 1
Bivariate Correlations Among All Predictors and Dependent Measures

| Predictors | 1a | 1b | 1c | 1d | 1e | 2a | 2b | 2c | 2d | 3a | 3b | 4a | 4b | 4c | 5a | 5b | 6a | 6b | 8a | 8b |
|------------|--------|------|--------|-------|--------|-------|------|-------|--------|--------|-------|-------|-------|------|-------|-------|-------|--------|--------|-------|
| 1a_Age | 1 | | | | | | | | | | | | | | | | | | | |
| 1b_Edu | .098 | 1 | | | | | | | | | | | | | | | | | | |
| 1c_Pex | -.06 | -.01 | 1 | | | | | | | | | | | | | | | | | |
| 1d_IRF | -.12 | .09 | -.02 | 1 | | | | | | | | | | | | | | | | |
| 1e_Isp | .08 | .06 | -.21* | .36** | 1 | | | | | | | | | | | | | | | |
| 2a_Abs | -.08 | -.02 | -.16 | .20* | .29** | 1 | | | | | | | | | | | | | | |
| 2b_Bar | -.23** | -.02 | .08 | .07 | -.23** | -.12 | 1 | | | | | | | | | | | | | |
| 2c_REI_FI | .004 | -.15 | -.03 | .17* | .22 | .53** | -.1 | 1 | | | | | | | | | | | | |
| 2d_REI_NFC | -.08 | -.09 | .18* | -.03 | 0 | .24** | -.14 | .04 | 1 | | | | | | | | | | | |
| 3a_Conf | -.15 | .04 | -.07 | .23** | .25 | .39** | .12 | .16 | -.03 | 1 | | | | | | | | | | |
| 3b_Cont | .07 | .13 | .07 | .06 | .02 | -.03 | .13 | -.01 | -.16 | -.47** | 1 | | | | | | | | | |
| 4a_Eyes | .06 | .03 | -.10 | -.01 | -.09 | -.03 | -.16 | -.09 | .001 | -.22* | .16 | 1 | | | | | | | | |
| 4b_Group | -.21* | .09 | .09 | .04 | -.03 | .05 | -.10 | .16 | -.04 | -.11 | .12 | .03 | 1 | | | | | | | |
| 4c_Words | -.05 | .01 | -.14 | .06 | -.02 | .13 | -.01 | .14 | .02 | .01 | -.01 | -.12 | .072 | 1 | | | | | | |
| 5a_Pre | -.03 | .15 | -.1 | .30** | .21* | .23** | .12 | .20* | -.25** | .53** | -.09 | -.16 | -.015 | .123 | 1 | | | | | |
| 5b_Sur | .12 | -.02 | -.17* | .24** | .15 | .47** | .04 | .22** | .19* | .38** | -.051 | -.04 | -.092 | .06 | .14 | 1 | | | | |
| 6a_Dread | -.23** | .1 | .02 | .25** | .24** | .34** | .13 | .19* | -.17* | .58** | -.11 | -.20* | .036 | .15 | .64** | .04 | 1 | | | |
| 6b_MysExp | -.03 | -.03 | -.20* | .16 | .23** | .61** | -.14 | .30** | .25** | .38** | -.15 | .02 | -.042 | -.05 | .06 | .72** | .10 | 1 | | |
| 8a_NegChg | -.10 | .17* | .02 | .16 | .05 | -.04 | .15 | .07 | -.28** | .18* | .20* | -.11 | .125 | .13 | .36** | -.19* | .35** | -.28** | 1 | |
| 8b_PosChg | .04 | -.11 | -.31** | -.01 | .21* | .38** | -.16 | .22 | .22** | .18* | -.14 | .02 | -.09 | .04 | .03 | .39** | -.00 | .62** | -.31** | 1 |
| 8c_SpiChg | .05 | -.06 | -.19* | .047 | .34** | .26** | -.15 | .10 | .05 | .04 | .12 | -.00 | .12 | .03 | .081 | .200* | .01 | .35** | -.22** | .56** |

Note. Edu = education; Pex = previous experience with psychedelics (higher numbers = more experience); IRF = importance of religion in childhood family; Isp = importance of spiritual or religious practices today; Abs = absorption; Bar = barriers; REI-FI = Rational-Emotive Inventory-Faith in Intuition; REI-NFC = REI-Need for Cognition; Conf = prior state of confusion; Cont = prior state of contentment; Eyes = eyes open; Group = group size; Words = talking or lyrics/video words during session; Pre = state of preoccupation at the onset of the session; Sur = state of surrender at the onset of the session; Dread = dread during session; MysExp = mystical experience; NegChg = negative change long after session; PosChg = positive change long after session; SpiChg = spiritual change long after session. Numbers before each variable name refer to blocks in which they were entered into the theoretical regression model.

* $p < .05$. ** $p < .01$.

coded, which would have reduced the sample size for the regression.

Explaining Mystical Experience

Preliminary theoretical model. All predictors were entered into an initial linear regression in blocks to identify likely predictors of ME (see correlation matrix of all predictors in Table 1). Demographic factors were entered first in Block 1 (age, education, previous psychedelic use, importance of religion in childhood family, importance of spiritual practices today). They explained 8.9% of the variance in ME (adj. $R^2 = .055$, $p < .05$). Trait factors were entered next in Block 2 (absorption, barriers, REI- FI and REI-NFC). They increased the predictive power to 40.3% (adj. $R^2 = .362$, $p < .001$). Prior state factors confusion and contentment were entered in Block 3. They increased the explanatory power to 41.5% (adj. $R^2 = .389$, $p < .05$). Addition of setting factors in Block 4 (words: none/some, eyes: open/closed, group: alone/not alone) did not increase the explanatory power significantly. Proximal state or “set” factors were added in Block 5 (surrender and preoccupation). They significantly increased the predictive power to 67.8% of the variance in ME (adj. $R^2 = .636$, $p < .001$). See Table 2 for explanatory power for each block, and Table T6 in the online supplemental materials for beta weights.

Best-fitting model predicting ME. Variables were retained for testing for the best-fitting model if they produced Beta weights significant at $p < .1$ within any block; these variables were entered into backward regression to identify those with the

strongest predictive power. The best-fitting model (see Table 2) included seven predictors explaining 65.7% of the variance in ME (adj. $R^2 = .644$).

The state of surrender ($\beta = .607$, $p < .001$) was the strongest predictor, followed by the traits absorption ($\beta = .308$, $p < .001$) and barriers ($\beta = -.151$, $p < .05$), the setting factor words ($\beta = -.130$, $p < .05$), and age ($\beta = -.126$, $p < .05$). Examination of the residuals identified two outliers with residuals $>3 SD$ from the mean; one was found to have used systematic response sets and was eliminated, and the other was retained because the data showed no anomalies. The distribution of the remaining residuals through the scatterplot and P–P plot suggests that the distribution was acceptably normal and homoscedastic.

Sex differences. The best-fitting model shown in Table 3 was tested separately by sex, and explained more of the variance in ME for males (adj. $R^2 = .693$) than for females (adj. $R^2 = .527$). Surrender was the strongest predictor for both sexes, with $\beta = .545$ (female) and .578 (male), and absorption was the second strongest predictor with $\beta = .390$ (female) and .312 (male; $p < .001$). For females, no other predictor was statistically significant. For males, words ($\beta = -.191$, $p < .01$), barriers ($\beta = -.164$, $p < .05$), and age ($\beta = -.115$, $p < .1$) were also retained within the parameters for the best-fitting model.

Plausibility of surrender as a mediator of ME. To explore the plausibility of surrender as a mediator in predicting ME, it was necessary to establish relationships between a set of predictors with ME as an outcome variable, between predic-

Table 2
Blocks of Predictors Contributing to Explaining the Variance in
Mystical Experience

| Model, block | R | R^2 | Adj. R^2 | SE est. | ΔR^2 | ΔF |
|-----------------------------|------|-------|------------|-----------|--------------|------------|
| 1, –Background | .299 | .089 | .055 | .67996 | .089 | 2.622* |
| 2, +Traits | .635 | .403 | .362 | .55885 | .314 | 17.092*** |
| 3, +Prior state | .661 | .437 | .389 | .54685 | .034 | 3.885* |
| 4, +Setting | .676 | .456 | .396 | .54387 | .019 | 1.469 |
| 5, +Proximal state or “set” | .823 | .678 | .636 | .42192 | .222 | 42.353*** |

Note. Adj. = adjusted; est. = estimated; Background = age, education, previous psychedelic use, importance of religion in childhood family, importance of spiritual practices today; +Traits = absorption, barriers, and Rational-Emotive Inventory–Faith in Intuition and Need for Cognition; +Prior state = confusion, contentment; +Setting = words: none/some, eyes: open/closed, group: alone/not alone; +Proximal states = surrender, preoccupation. Dependent variable = Mystical Experience MEQ-30.

* $p < .05$. *** $p < .001$.

Table 3
Best-Fitting Model Predicting Mystical Experience Through Backwards Regression

| Model | Unst. Coeff. | | Std. Coeff. β | t | Tolerance | VIF |
|--------------|--------------|------|---------------------|-----------|-----------|-------|
| | B | SE | | | | |
| (Constant) | 1.171 | .283 | | 4.133*** | | |
| 1_Age | -.009 | .004 | -.126 | -2.369* | .723 | 1.382 |
| 2_Absorption | .356 | .068 | .308 | 5.237*** | .904 | 1.106 |
| 2_Barriers | -.135 | .047 | -.151 | -2.866** | .982 | 1.018 |
| 4_Words | -.182 | .071 | -.130 | -2.577* | .736 | 1.359 |
| 5_Surrender | .588 | .057 | .607 | 10.401*** | .891 | 1.122 |

Note. Unst. = unstandardized; Coeff. = coefficient; Std. = standardized; VIF = variance inflation factor. Numbers at the start of variable names refer to blocks in which they were originally entered.

* $p < .05$. ** $p < .01$. *** $p < .001$.

tors and surrender as a mediator, and between mediator and outcome variable. The variable Trait-State Composite (TSC) was created. It is the standardized predicted value of ME using the traits absorption, barriers, and REI-NFC and the prior state of confusion in a regression model; these were the traits and state that produced significance levels $p < .1$ in any block in the theoretical regression. As shown in Figure 1, TSC produced $\beta = .64$ ($p < .001$) in explaining ME, and $\beta = .51$ ($p < .001$) explaining surrender, which, in turn, produced $\beta = .72$ ($p < .001$) in explaining ME. Adding surrender with TSC to explain ME, the coefficient for TSC dropped to

.37 ($p < .001$), and the overall explanatory power increased from .409 to .62 (adj. R^2), demonstrating plausibility of surrender as a meaningful partial mediator of the relations of background variables with ME.

The model displayed excellent goodness of fit characteristics within all recommended thresholds (Maruyama, 1998), including a nonsignificant chi square, $\chi^2(8) = 8.18$, $p = .42$, a root mean square error of approximation of .012 (lower than the recommended threshold of .05), a normed fit index of .99 (greater than .95 threshold recommended by Schumacker & Lomax, 2004), a goodness-of-fit index of .98 and a comparative fit index

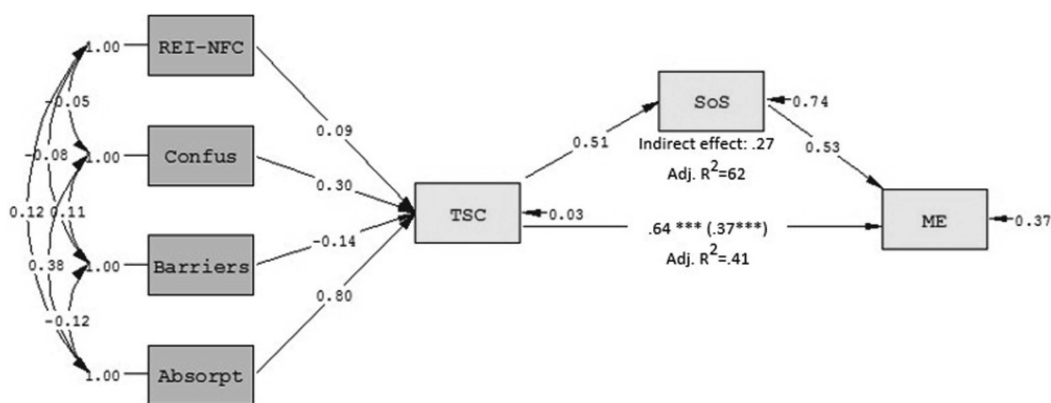


Figure 1. Path model showing surrender as plausible mediator of mystical experience (ME) as measured by the 30-item Mystical Experience Questionnaire. REI-NFC = Rational Emotive Inventory–Need for Cognition; Confus = a prior state of confusion; Absorpt = the trait variable absorption; TSC = Trait-State Composite; SoS = state of surrender (proximal); Adj. = adjusted. Chi-Square = 8.18, $df = 8$, p -value = 0.41632, RMSEA = 0.012. *** $p < .001$.

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of 1 (both greater than the thresholds of .9 and .93 recommended by Byrne, 1994).

Predicting Dread

The initial model explaining dread used the same sequence of blocks and variables used to explore ME in the previous analysis. As shown in Table 4, background factors in Block 1 explained 14.1% of the variance in dread ($\text{adj. } R^2 = .109$, $p < .01$). Trait variables in Block 2 increased the explanatory power to 27.8% ($\text{adj. } R^2 = .228$), and the addition of prior state factors in Block 3 increased the predictive power to 42.8% ($\text{adj. } R^2 = .379$). Setting variables in Block 4 did not add significantly to the model ($R^2 = .451$, $\text{adj. } R^2 = .390$), but the proximal state items entered in Block 5 added significantly, increasing the predictive power to 58.8% ($\text{adj. } R^2 = .534$).

As was done for ME, variables examined for inclusion in the best-fitting model were those with beta weights significant at $< .1$; these were reduced through stepwise backward regression. The best-fitting model (see Table 5) explained 56.2% of the variance ($\text{adj. } R^2 = .546$). The strongest factor related to dread was preoccupation ($\beta = .440$, $p < .001$), followed by confusion, ($\beta = .335$, $p < .001$), surrender ($\beta = -.234$, $p < .01$), absorption ($\beta = .208$, $p < .01$), and age ($\beta = -.124$, $p < .05$).

Explaining Long-Term Change

The ME variable was divided into “low/no ME” and “complete ME.” Those included in “complete ME” were those with $\geq 60\%$ of the

possible points in all four subcategories of the MEQ-30, in the threshold established by Barrett et al. (2015) to define “complete ME.” Mean positive change, as measured by the adapted version of the scale used by Griffiths et al. (2006; see description in Method), was then compared for each group. The mean positive change for the low-ME group ($n = 79$) was 3.34 ($SD = .61$), and the mean positive change for the high-ME group ($n = 64$) was 4.09 ($SD = .60$). An independent t test confirmed that the mean difference was statistically significant ($t = 7.424$, $p < .001$).

To determine the role of ME relative to other variables in predicting positive change, a regression model was generated in which the trait variables absorption and barriers were used as Block 1, the state of surrender was used as Block 2, and ME was used as Block 3 in a hierarchical regression predicting positive change. It can be seen in Table 6 that absorption and surrender were significant predictors of positive change in Block 2 ($\beta = .229$ and $.290$, respectively) in a model explaining 22.5% ($\text{adj. } R^2 = .208$) of the variance in positive change. When ME was added to the model in Block 3, it produced a beta weight of $.667$ in a model explaining 39.0% ($\text{adj. } R^2 = .373$) of the variance in positive change, and surrender and absorption retained no significant predictive value.

A similar model process was followed to examine the other potential outcomes. When spiritual change was entered as the dependent variable, the predictors in Block 1 explained only 6.9% ($\text{adj. } R^2$) of the change; this increased to 7.2% with

Table 4
Blocks of Predictors Contributing to Explaining the Variance in Dread

| Model, block | R | R^2 | Adj. R^2 | SE est. | ΔR^2 | ΔF |
|-----------------------------|------|-------|------------|-----------|--------------|------------|
| 1, -Background | .375 | .141 | .109 | .14507 | .141 | 4.398** |
| 2, +Traits | .527 | .278 | .228 | .13507 | .137 | 6.144*** |
| 3, +Prior state | .655 | .428 | .379 | .12107 | .151 | 16.896*** |
| 4, +Setting | .672 | .451 | .390 | .12007 | .023 | 1.718 |
| 5, +Proximal state or “set” | .767 | .588 | .534 | .10490 | .137 | 20.375*** |

Note. Adj. = adjusted; est. = estimated; Background = age, education, previous psychedelic use, importance of religion in childhood family, importance of spiritual practices today; +Traits = absorption, barriers, and Rational-Emotive Inventory–Faith in Intuition and Need for Cognition; +Prior state = confusion, contentment; +Setting = words: none/some, eyes: open/closed, group: alone/not alone; +Proximal states = surrender, preoccupation. Dependent variable = Mystical Experience MEQ-30. The numbers preceding predictors represent the block in which they were entered in the original regression model.

** $p < .01$. *** $p < .001$.

Table 5
Best-Fitting Model Predicting Dread With Backwards Regression

| Model | Unst. Coeff. | | Std. Coeff. β | t | Tolerance | VIF |
|-----------------|--------------|------|---------------------|----------|-----------|-------|
| | B | SE | | | | |
| (Constant) | .014 | .056 | | .245 | | |
| 1_Age | -.002 | .001 | -.124 | -2.113* | .924 | 1.083 |
| 2_Absorption | .054 | .017 | .208 | 3.113** | .717 | 1.394 |
| 2_Confusion | .052 | .012 | .335 | 4.525*** | .581 | 1.720 |
| 5_Preoccupation | .087 | .013 | .440 | 6.561*** | .711 | 1.406 |
| 5_Surrender | -.051 | .015 | -.234 | -3.432** | .687 | 1.457 |

Note. Unst. = unstandardized; Coeff. = coefficient; Std. = standardized; VIF = variance inflation factor. Numbers at the start of variable names refer to blocks in which they were originally entered. The numbers preceding predictors represent the block in which they were entered in the original regression model.

* $p < .05$. ** $p < .01$. *** $p < .001$.

the addition of surrender in Block 2, and to 11.6% after ME was added to the model. Only absorption had a significant Beta weight in the first two blocks, producing $\beta = .25$ ($p < .01$) in Block 1 and $\beta = .20$ ($p < .05$) in Block 2. When ME was added in Block 3, the beta weight for absorption was reduced to $\beta = .08$ (nonsignificant), surrender remained nonsignificant with $\beta = -.10$, and ME remained as the only significant predictor with $\beta = .364$, $p = .006$.

For negative change, the traits absorption and barriers explained negligible variance when en-

tered as the only predictors. When surrender and preoccupation were added to the model in Block 2, the model explained 19.6% of the variance (adj. $R^2 = .172$), with significant beta weights for surrender with $\beta = -.238$ ($p < .05$) and preoccupation with $\beta = .412$ ($p < .001$). The addition of ME in Block 3 increased the explanatory power to 23.1% (adj. $R^2 = .203$), and only ME and preoccupation produced significant beta weights with $\beta = -.309$ and $.354$, respectively. No patterns or relationships could be detected for material values.

Table 6
Hierarchical Linear Regression Predicting Long-Term Positive Change From Trait and State Predictors

| Model | Unstandardized coefficients | | Standardized coefficient β | t | Sig. |
|-----------------|-----------------------------|------|----------------------------------|--------|------|
| | B | SE | | | |
| 1 | | | | | |
| (Constant) | 2.674 | .336 | | 7.958 | .000 |
| Aa2_Absorption | .440 | .093 | .369 | 4.727 | .000 |
| Aa2_Barriers | -.106 | .072 | -.115 | -1.473 | .143 |
| 2 | | | | | |
| (Constant) | 2.380 | .335 | | 7.099 | .000 |
| Aa2_Absorption | .273 | .102 | .229 | 2.677 | .008 |
| Aa2_Barriers | -.131 | .070 | -.142 | -1.878 | .062 |
| Aa5_Surrender10 | .290 | .085 | .290 | 3.412 | .001 |
| 3 | | | | | |
| (Constant) | 1.984 | .305 | | 6.499 | .000 |
| Aa2_Absorption | .020 | .100 | .016 | .196 | .845 |
| Aa2_Barriers | -.059 | .063 | -.064 | -.930 | .354 |
| Aa5_Surrender10 | -.095 | .098 | -.095 | -.964 | .337 |
| Aa6_MEQall | .688 | .112 | .667 | 6.124 | .000 |

Note. Sig. = significance. Dependent variable = 8_ChgPositive. The numbers preceding predictors represent the block in which they were entered in the original regression model.

Discussion

This study first sought to test a predictive model for mystical and challenging experience following psilocybin ingestion, and emerged with well-fitting models explaining nearly two thirds of the variance in ME and more than half of the variance in dread using state and trait predictors. The model explained ME and dread similarly for both males and females, and thus supports the importance of the psychological state at the time of ingestion regardless of sex. Second, the study sought to determine whether a state of surrender at the time of ingestion could serve as a plausible mediator of trait predictors and ME after psilocybin ingestion. A structural equation analysis exceeding well-established criteria for goodness of fit and other key statistics supported a partial mediation model, further arguing for the essentiality of a state of surrender to underlie ME. Third, the study sought to determine whether the occurrence of complete ME under psilocybin was important to long-term positive change. Here again, mean positive change was significantly greater for those who had a ME when compared with those who had experienced weaker mystical components. Further, the other significant predictors of positive change (absorption and surrender) were muted when ME was entered into a regression model. This finding suggests that including ME produces a more robust model and that ME contributes to an optimal response to psilocybin that increases the likelihood of long-term positive change.

Despite including set and setting factors in our model, both ME and dread in this study related most strongly on mental state at the time of ingestion. Specifically, a state of surrender at the time of ingestion substantially and significantly explained ME, and a state of preoccupation with time and one's daily tasks or concerns in conjunction with low surrender explained dread. It thus appears that an ability to set aside one's preoccupying interests and goals, place oneself in a fully receptive state, and commit or surrender to the psychedelic session fully and completely increases the extent to which MEs can be experienced, and decreases the likelihood of dread.

A prototype illustrating the importance of a fully present state of surrender in facilitating ME might be observed in the traditional use of psychedelic substances among native people, in which the consciousness-altering experience

was often entered ritually in conjunction with some sort of challenging state-altering practice such as prolonged fasting or intensive dancing/drumming (Carod-Artal, 2015). These physical trials might serve to foster or induce a state of surrender through deprivation, therein maximizing the positive outcomes of the experience. The importance of surrender for transformative ME is also supported in the model of conversion described by James (1902), in which a state of deep uncertainty followed by surrender was described as a precursor to an endogenous ME that produces a life-changing "conversion" or transformation. Thus, it appears that the same mental states that have historically been shown to precede sudden mystical conversion remain applicable today, even if the transformation occurs (perhaps serendipitously) for individuals taking psychedelics volitionally in a modern world.

The trait absorption explained more than one third of the variance in ME ($\beta = .308$) and more than one fifth the variance in dread ($\beta = .208$) within their respective best-fitting regression models. The explanatory power of absorption for ME was similar to that found in the studies included in the meta-analysis by Studerus et al. (2012), in which absorption explained 20–40% of variance on dimensions of ME. This suggests that the population in our study resembled the population in other controlled studies, despite the differences in the conditions of the psychedelic administration. Further, the role of trait absorption as a significant factor explaining both dread and ME suggest that absorption may amplify psilocybin experience, regardless of whether that experience is desirable or undesirable, consistent with Tellegen's (1981) previous correlative finding that "high-absorption persons may become involved in either negative or positive experiences" (p. 223). High trait absorption may also be the factor contributing to the increase in suggestibility after ingestion of LSD (Carhart-Harris et al., 2015), consistent with findings that highly suggestive individuals absorb more deeply in imaginative experiences (e.g., Baum & Lynn, 1981), and may potentially be related to genetic factors (Ott, Reuter, Henig, & Vaitl, 2005).

The trait barriers, representing the tendency to reject experiences or information not grounded firmly in logic, was inversely related to MEs as predicted by Maslow (1979) and James (1902). This type of entrenched skepti-

cism may cause one to remain embedded in cognitive processes during a psychedelic experience and reduce the openness necessary for MEs. Clinically, this suggests the need either to screen for these types of cognitive barriers or to attempt to use empirical evidence on the neural underpinnings of psychedelic change to alter the rigid mental constructs of individuals hindered by cognitive barriers. This education might include general instruction in brain function and neuroplasticity, an explanation of the default mode network (DMN) in typical life experience and under altered consciousness states (e.g., Carhart-Harris et al., 2014), and expounding on different functions of 5HT1A and 2A receptor systems (Carhart-Harris & Nutt, 2017). For individuals with strong barriers against nonrational experiences, such education might dissolve the otherwise impassable walls.

The setting variable words, a two-level variable representing the extent to which participants were exposed to language during the psilocybin session, was retained in the model as a significant inverse factor related to ME: More exposure to language corresponds with less MEs. The inverse relationship between words and ME can be explained in several possible ways: (a) activation of the language pathways could dilute the ineffable or indescribable nature of ME, (b) activation of the language pathways could delimit the psychedelic experience by grounding one in the more material state of consciousness, or (c) excessive conversation could represent a socially demanding situation with an accompanying tension that could reduce MEs. This lends support to the importance of reducing language of all sorts during the psilocybin session to create space for the ineffable nature of the ME.

The strongest predictor of ME, a state of surrender, was also shown to be a plausible mediator of the relationship between traits and ME. Trait predictors in combination with a state of surrender explained 62% of the variance in ME; this compares with an explanatory power of only 41% with a significantly reduced Beta weight for trait predictors alone. In other words, the importance of traits in predicting ME is reduced significantly for individuals who fully surrender to the experience offered through psilocybin. Despite its importance, the state of surrender may emerge from the individual and be difficult to induce, requiring a

detachment from personal goals and strivings that does not easily resonate in western culture.

This mediating role of surrender, as well as some of the other predictors, may best be understood by considering current research about altered DMN functionality under psilocybin (Carhart-Harris & Friston, 2010; Lebedev et al., 2015; Speth et al., 2016). The DMN is an interconnected set of brain regions linked to an ongoing, background, introspective mode of thought, which includes thoughts about past and future, self-referential processing, imagined perspectives of others (Buckner, Andrews-Hanna, & Schacter, 2008), and imagination more generally (Hassabis, Kumaran, & Maguire, 2007). Studies have shown compromised integrity of the DMN under psychedelics (Carhart-Harris et al., 2012; Carhart-Harris, Muthukumaraswamy, et al., 2016; Muthukumaraswamy et al., 2013; Palhano-Fontes et al., 2015), and this DMN diminishment correlates with the experience of “ego-dissolution” (Tagliazucchi, Carhart-Harris, Leech, Nutt, & Chialvo, 2014), a state in which one’s sense of oneself and objects outside the self (other people, inanimate objects) is blurred (Nour, Evans, Nutt, & Carhart-Harris, 2016). This relation suggests that a unified brain may relate to a subjective sense of unity or boundlessness, the same sense that is arguably the essential characteristic of an ME (Carhart-Harris et al., 2013; Stace, 1960).

Similarly, DMN functionality is reduced during meditation (Berkovich-Ohana, Harel, Hahamy, Arieli, & Malach, 2016), a state in which one intentionally releases attachment to thoughts of past, future, and self. In the case of meditation, unlike the task-oriented processes that normally accompany DMN reduction, individuals release both problem-solving cogitations and self-past-future preoccupation to enter into a receptive state. The state of surrender may act similarly to a state of meditation by preemptively releasing preoccupation and cogitation therein assisting the processes of network disintegration that appear to characterize intense psychedelic states (Carhart-Harris, Muthukumaraswamy, et al., 2016) and allowing the brain to operate more freely and openly as a “unified whole.” The barriers found to be significant inverse predictors of ME in this study may in fact work against DMN disintegration by increasing preoccupation with oneself and attachment to one’s ideas. Finally, the trait absorption may represent a general individual strength or capacity for more readily reducing DMN func-

tionality—a possibility supported in the consciousness state space model proposed by Berkovich-Ohana and Glicksohn (2016).

Preoccupation and Dread

A state of preoccupation with daily concerns and tasks at the time of ingestion of psilocybin contributed to an experience of dread, a variable measured by a new tool focusing on emotions with descriptive words like powerless, afraid, and ashamed (Burdzy, 2014). Absorption and a state of identity confusion also positively and significantly explain dread, although their weight was diminished when preoccupation and surrender were entered into the equation. Finally, age contributed inversely to dread, such that older people reported less dread.

The negative consequences of a state of preoccupation with the details of one's life at the onset of the experience is consistent with Metzner et al.'s (1965) description of the linkage between preoccupation and a corresponding mood state of anxiety under a psychedelic. It seems reasonable to suppose that trait absorption may amplify this effect. Studerus et al. (2012), however, found that absorption did not significantly relate to DED. Marked differences in setting may explain these differences: Some participants in the Studerus et al. (2012) studies had a positron emission tomography scan during the psilocybin session, and this variable may have overshadowed trait and state predictors. Also, careful preparation of Studerus's participants may have reduced the likelihood that they entered the session in a preoccupied state that portended a dread experience in our model.

Although speculative, the state of preoccupation may represent a strengthening of DMN activation in resistance to the effects of the psychedelic, creating an experience of conflict or tension. We might further surmise that the trait of absorption corresponds with both a greater capacity for DMN disintegration (relating to "surrender") or DMN strengthening (relating to "preoccupation") by intensifying both experiences. As the drug acts to relax the DMN's executive hold on the mind, preoccupied individuals may experience a strong desire to resist this tendency, which may manifest as an internal mental struggle and emotional dissonance. Therein may lie the heart of the DED experienced by some individuals during the

psychedelic session, known colloquially as a "bad trip" or more formally as a challenging experience (Barrett, Bradstreet, Leoutsakos, Johnson, & Griffiths, 2016).

Consistent with other research (e.g., Studerus, 2012a), experiences of dread were relatively infrequent within our sample. The mean dread score was 1.97 of a possible 4 points, and only 10% of participants had mean scores higher than 3 on the Dread scale (compared with 55% on the MEQ). Nevertheless, as addressed by Barrett et al. (2016), challenging or challenging psychedelic experiences may be highly significant to the individual and warrant further exploration. As with ME, the psychological state at the time of ingestion impacts the experience in significant ways. The significance of the state of preoccupation identified in our study suggests that individuals who cannot release their minds from daily tasks and responsibilities are more likely to have a challenging experience. Thus, efforts to assist individuals in relinquishing such preoccupations would reduce risk. Reducing preoccupation would be most important for those participants high in absorption that our data suggest are more susceptible to extreme positive and negative reactions. Finally, additional care must be taken with younger people, for whom a state of confusion from which they cannot withdraw might contribute to a challenging reaction.

Positive Long-Term Change

The third objective of the study, examining whether an experience of a "complete ME" would contribute meaningfully to long-term positive change, also garnered considerable support from our data. Although the variables absorption, barriers, and surrender explained less than one fourth of the variance ($R^2 = .21$) in positive change, independently of ME, the addition of ME to the model nearly doubled the explanatory power to 39% ($R^2 = .37$). Further, the addition of ME muted the significance of all of the other predictors, leaving ME as the only significant predictor. Thus, to the extent that the model is adequate, absorption, barriers, and surrender do little to produce long-term positive change; rather, it is the ME itself that leads to transformations in mood, outlook, and spirituality, and the other variables merely influence ME. This finding affirms previous research re-

garding the crucial role of ME in producing transformative outcomes (Barrett et al., 2015; Griffiths et al., 2006) and is consistent with suggestions in literature about endogenous ME (Clark, 1968; Hunt, 2000; Pahnke, 1969). Thus, it appears that a psilocybin session with inexplicable, ineffable, timeless, and ecstatic characteristics—a ME—serves as essential among the variables examined for producing a sense of psychological “improvement” an indexed by gains in tolerance, patience, humor, playfulness, creativity, and similar states that bring joy and meaning to life.

Limitations

Even though the results of our study are compelling, many limitations are present. First, it is not a controlled study, thereby precluding explicit causal conclusions. Second, the retrospective nature of the research opens potential problems related to participants’ (a) intentional or unintentional distorted recollections of the experience, (b) current mood state affecting retrospective reports, and (c) halo effects (in which participants recall antecedents of a good experience more favorably) or the inverse of a halo effect.

Third, the sample itself may have been a limitation. We assessed a small sample of individuals that volitionally used psilocybin in uncontrolled settings, a potentially different population than those involved in controlled studies with psychedelics or those who might seek psychedelics as an aid to therapy. Further, the study itself may have appealed to participants whose experiences were more positive, leading to overreported positive experiences or selective memory in recalling experiences that happened in the past.

Fourth, although volitional drug users often benefit from a wealth of recommendations regarding dosage and setting (e.g., Fadiman, 2011), the sampling and retrospective survey design in this study offers no control over the setting and dosage, in contrast with controlled studies in which both factors are strongly regulated. The absence of information about dosage and purity of the psilocybin is a particularly significant limitation, as dosage is the most significant predictor in controlled studies (e.g., Studerus, 2012a).

Finally, new scales were developed for the states and traits hypothesized as predictors. Although these new scales proved to be reliable factors in this sample and in a separate sample of intensive meditators (Russ & Elliott, 2017) and produced strong reliabilities within this sample also (See [Supplementary Tables 1–5](#) in the online supplemental materials), additional validation is needed. Further, we relied on 4-point scales in most of the survey, whereas the original scales used greater ranges, which may have reduced variability in responses and artifactually reduced the magnitude of relationships. Given the reliabilities of the scales, however, this possibility seems unlikely. Although one might wonder if the relationships found in this study can be explained by acquiescent or response set tendencies, the prevalence of expected relationships in the results despite intermixing of scale items for absorption, barriers, and other scales (including attention items) make it highly unlikely that these relationships are merely an artifact.

Conclusion

Mounting evidence suggests that psychedelic substances have potential to serve as clinically important therapeutic tools of the future (e.g., Carhart-Harris, Bolstridge, et al., 2016; Griffiths et al., 2016). Because the quality of the experience is related to outcomes (e.g., Roseman et al., 2018), and because the effects of psychedelics can vary by the physical situation and psychological state in which it is ingested, it is essential to learn from every source of information about their effects—even sources that cannot apply the rigor of controlled studies. In this model, information from volitional users in a range of settings provide a plausible and powerful model of the psychological states that relate to optimal or challenging experiences. The model is consistent with findings from controlled studies, supported by related research in meditation, and aligned with theoretical perspectives on the importance of the conditions of mental “set” under which the psychedelic is consumed (Hartogsohn, 2016). Additional research is needed to validate the new predictor scales, replicate the study in a second sample, and, most importantly, gather predictive data that includes dosage prior to a psychedelic ex-

perience to reduce the potential challenges of retrospective data.

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