Original Paper

Cessation and reduction in alcohol consumption and misuse after psychedelic use

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Abstract

Background: Meta-analysis of randomized studies using lysergic acid diethylamide (LSD) for alcohol use disorder (AUD) showed large, significant effects for LSD efficacy compared to control conditions. Clinical studies suggest potential anti-addiction effects of LSD and mechanistically-related classic psychedelics for alcohol and other substance use disorders.

Aims: To supplement clinical studies, reports of psychedelic use in naturalistic settings can provide further data regarding potential effects of psychedelics on alcohol use.

Methods: An anonymous online survey of individuals with prior AUD reporting cessation or reduction in alcohol use following psychedelic use in non-clinical settings.

Results: 343 respondents, mostly White (89%), males (78%), in the USA (60%) completed the survey. Participants reported seven years of problematic alcohol use on average before the psychedelic experience to which they attributed reduced alcohol consumption, with 72% meeting retrospective criteria for severe AUD. Most reported taking a moderate or high dose of LSD (38%) or psilocybin (36%), followed by significant reduction in alcohol consumption. After the psychedelic experience 83% no longer met AUD criteria. Participants rated their psychedelic experience as highly meaningful and insightful, with 28% endorsing psychedelic-associated changes in life priorities or values as facilitating reduced alcohol misuse. Greater psychedelic dose, insight, mystical-type effects, and personal meaning of experiences were associated with a greater reduction in alcohol consumption, controlling for prior alcohol consumption and related distress.

Conclusions: Although results cannot demonstrate causality, they suggest that naturalistic psychedelic use may lead to cessation or reduction in problematic alcohol use, supporting further investigation of psychedelic-assisted treatment for AUD.

Keywords
Psychedelics, hallucinogens, alcohol, psilocybin, lysergic acid diethylamide (LSD)

Introduction

Alcohol use disorder (AUD) is widespread (WHO, 2018), with an estimated 68.5 million (29.1%) American adults exhibiting lifetime prevalence, and 32.6 million (13.9%) currently meeting Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013) criteria for AUD diagnosis (Grant et al., 2015). The National Institute on Alcohol Abuse and Alcoholism (NIAAA) reports that 28% of American adults currently exhibit unhealthy alcohol use patterns (Saitz, 2005), many of whom could benefit from targeted healthcare interventions (US DHHS, 2005). Only 19.8% of individuals with lifetime prevalence of AUD have, however, ever sought treatment (Grant et al., 2015).

Current FDA-approved pharmacotherapies for AUD include acamprosate (Carmen et al., 2004), naltrexone (Maisel et al., 2013), and disulfiram (Jørgensen et al., 2011; SAMHSA, 2015). Additionally, psychosocial treatments such as screening and brief intervention or motivational enhancement therapy (MET), alone or with medications, have shown some success in reducing excessive drinking, though upwards of 70% of individuals with AUD generally relapse to heavy drinking within the first year after treatment (Anton et al., 2006; Davis et al., 2018a; Dawson et al., 2005; Jonas et al., 2012; Martin and Rehm, 2012; Miller et al., 2001; Moyer, 2013; Saitz, 2010; Vaillant, 2003; Vasilaki et al., 2006; Weiss et al., 2008). Poor treatment response is typically associated with greater baseline alcohol use severity indicators (Davis et al., 2018a; Saitz, 2010), suggesting an unmet intervention need in heavy users.

Serotonin 2A (5-HT2A) agonist "classic hallucinogens" (hereafter referred to as "psychedelics") have shown promise in treating AUD (Bogenschutz et al., 2015; Krebs and Johansen, 2012). Psychedelics, primarily lysergic acid diethylamide (LSD), were studied for their potential to help reduce problematic alcohol use in the 1950s through 1970s (Abuzzahab and Anderson, 1971; Bowen et al., 1970; Chwelos et al., 1959; Dyck, 2006; Hollister et al., 1969; Krebs and Johansen, 2012; Kurland et al., 1967; Ludwig et al., 1969; Mangini, 1998; Osmond et al., 1967; Pahnke et al., 1970; Smart et al., 1966; Smith, 1958, 1959; Tomsovic and Edwards, 1970). Results from early clinical

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research with LSD for alcohol misuse were not always consistent due to considerable variation in methods between studies (Abuzzahab and Anderson, 1971; Carhart-Harris et al., 2018; Hartogsohn, 2016, 2017; Johnson et al., 2008; Rucker et al., 2018). A meta-analysis of six randomized controlled trials administering a single high-dose of LSD (ranging from 3 μg/kg to 800 μg) for treatment of alcoholism (total $N = 536$) found that individuals who received LSD exhibited significantly greater odds of improvement in alcohol misuse at the first follow-up assessment than those in control groups (OR = 1.96, $p = 0.0003$; Krebs and Johansen, 2012). Dichotomized data from five of those trials showed 59% of LSD patients improved at initial follow-up compared to 38% of control patients (Krebs and Johansen, 2012). These effects rival those of currently available AUD medications, with meta-analyses showing significant improvement in alcohol abstinence rates with acamprosate vs. placebo (OR = 1.88, $p < 0.001$; Carmen et al., 2004), non-significant improvement in abstinence rates with naltrexone vs. placebo (OR = 1.26, $p = 0.08$; Carmen et al., 2004), and significantly increased abstinence with unsupervised disulfiram vs. other or no treatment (OR = 1.59; $p = 0.02$; Jørgensen et al., 2011).

From 1971 to the 1990s, human research with psychedelics largely stalled due to Schedule I classification and associated stigma (Bonson, 2017; Nutt et al., 2013). Novel studies investigating the effects of psychedelics such as dimethyltryptamine (DMT; Strassman and Qualls, 1994; Strassman et al., 1994), mescaline (Hermle et al., 1992, 1998), and psilocybin were, however, gradually reinitiated (Gouzoulis-Mayfrank et al., 1998, 1999; Griffiths et al., 2006, 2008; Spitzer et al., 1996; Vollenweider et al., 1997), including a reemergence of clinical research examining psychedelics as potential treatments for addiction (Bogenschutz et al., 2015; Garcia-Romeu et al., 2015, 2016; Johnson et al., 2014, 2017a; Sessa and Johnson, 2015; Tupper et al., 2015).

In the first contemporary study to reassess psychedelic-assisted treatment for alcohol misuse, Bogenschutz and colleagues (2015) administered one or two doses of psilocybin (0.3 mg/kg and 0.4 mg/kg) with motivational enhancement therapy to 10 treatment-seeking volunteers meeting DSM-IV (American Psychiatric Association, 1994) criteria for alcohol dependence in an open-label trial. Participants reported significantly fewer drinking days and heavy drinking days for 32 weeks after the first dose of psilocybin compared to baseline (Bogenschutz et al., 2015). Consistent with observations from earlier studies of LSD (Kurland et al., 1967, Pahnke et al., 1970), and contemporary pilot research of psilocybin-facilitated treatment for tobacco dependence (Garcia-Romeu et al., 2015), results suggested qualitative attributes of the drug experience (e.g., mystical-type effects, ego dissolution, intensity) as potential key factors facilitating subsequent behavior changes (Bogenschutz et al., 2015; Nielson et al., 2018). Although these recent findings are limited by the small sample size and lack of randomized comparison or blinding conditions, additional controlled research on psilocybin-facilitated treatment of alcohol dependence is currently underway (ClinicalTrials.gov Identifier: NCT02061293, 2014a).

Anecdotal reports and observational data also suggest a potential link between psychedelic use in non-treatment settings, and associated reductions in problematic alcohol and drug use (Albaugh and Anderson, 1974; Barbosa et al., 2012, 2018; Fábregas et al., 2010; Halpern et al., 2008; Hill, 1990; Lattin, 2012; Prue, 2013; Thomas et al., 2013). Instances in which naturalistic psychedelic use are followed by subsequent cessation or reduction in alcohol misuse have not, however, been systematically investigated. Anonymous online surveys have previously been used to collect data regarding trends in naturalistic substance use that help inform potential risks and benefits of particular drugs and provide complementary evidence for hypothesis generation and testing in laboratory research and clinical trials (Davis et al., 2018b; Johnson et al., 2017b; Winstock et al., 2014). The aims of the present anonymous online survey study were to systematically characterize, and determine patterns within, instances in which naturalistic psychedelic use led to self-reported reductions in alcohol misuse outside a formal treatment setting. We hypothesized that some individuals would report lasting reductions in their problematic alcohol use attributed to an experience with a classic psychedelic, and that greater reductions would be associated with greater ratings of mystical-type subjective qualities for the psychedelic experience.

Materials and methods

This cross-sectional, anonymous (i.e., no name or IP address recorded) online survey study was conducted using Survey Monkey (www.surveymonkey.com) from October 2015 to August 2017. Advertisements for study recruitment were posted on social media and on websites devoted to drug discussion, education or research, such as Erowid Center (www.erowid.org), and the Multidisciplinary Association for Psychedelic Studies (www.maps.org). Advertisements sought individuals who had "overcome alcohol or drug addiction after using psychedelics," and provided a direct link to an introductory page detailing the purpose of the study, what participation entailed (e.g., filling out a survey), and study inclusion criteria. Inclusion criteria were: (1) at least 18 years of age; (2) able to speak, read, and write English fluently; (3) retrospectively met DSM-5 criteria for AUD; and (4) had used a classic psychedelic[1] outside of a university or medical setting, followed by reduction or cessation of subsequent alcohol use. Individuals who asserted that they met inclusion criteria, understood the study requirements, and were willing to voluntarily participate were able to begin the survey. Participants were not financially compensated for participation. The study was approved by an Institutional Review Board of the Johns Hopkins University School of Medicine. Participants provided informed consent by choosing to complete the survey after reviewing introductory information.

Measures

Demographic information and lifetime drug use data were collected. The survey retrospectively assessed participants' alcohol use before and after the psychedelic experience to which they attributed their alcohol use cessation or reduction (hereafter referred to as "reference psychedelic experience"). This included items rating distress related to alcohol use prior to the reference psychedelic experience, overall duration of alcohol misuse, use of medication or other AUD treatments before and after the reference psychedelic experience, age of first alcohol use, and lifetime presence of other mental health diagnoses.[2]

Participants also provided detailed information regarding their reference psychedelic experience, including the substance

used, approximate dose, setting in which the experience took place, intention for taking the substance, and any adverse effects or other behavioral changes attributed to the reference psychedelic experience. Participants were asked to endorse potential mechanisms of change attributed to their psychedelic-associated alcohol use cessation or reduction. Withdrawal symptoms after the reference psychedelic experience were rated in comparison to prior attempts to reduce or stop alcohol use. Additional measures described below were used to probe changes in alcohol use and the nature of the reference psychedelic experience hypothesized to influence alcohol-related outcomes. Participants completed two iterations of the Alcohol Use Disorders Identification Test – Consumption (AUDIT-C), the DSM-5 Alcohol Use Disorder Symptom Checklist, and the Alcohol Urge Questionnaire (AUQ). In the first, they were asked to characterize their alcohol consumption in the year prior to their reference psychedelic experience. In the second, they responded regarding their alcohol consumption since the reference psychedelic experience.

AUDIT-C. This instrument consists of the first three items of the AUDIT (Saunders et al., 1993), and provides a validated measure of alcohol use, with AUDIT-C scores ⩾3 (in women) or ⩾4 (in men) indicating potential misuse (Bush et al., 1998). The AUDIT-C has been widely used in clinical practice and research, and exhibits good reliability and construct validity (Bradley et al., 2007; Reinert and Allen, 2002).

DSM-5 alcohol use disorder symptom checklist. This instrument was adapted for DSM-5 AUD symptoms to determine past and current alcohol use behavior (American Psychiatric Association, 2013; Hudziak et al., 1993). It asked participants to endorse whether each of the 11 symptoms listed as diagnostic criteria for AUD were true or false regarding their alcohol use in the year prior to their reference psychedelic experience, and in the time since the reference psychedelic experience. According to DSM-5 criteria, the presence of two–three symptoms indicates a mild, four–five symptoms indicate a moderate, and six or more symptoms indicate a severe AUD (American Psychiatric Association, 2013).

AUQ. This instrument is an eight-item measure of alcohol craving across three domains: (1) desire to drink; (2) expectation of positive effects from drinking; and (3) inability to resist drinking when alcohol is accessible (Bohn et al., 1995; Drummond and Phillips, 2002). Scores on the AUQ range from 8 to 56, with higher scores indicating greater craving.

Mystical Experience Questionnaire (MEQ30). This is a validated 30-item measure assessing the intensity of mystical-type experiences, which has shown sensitivity to the subjective effects of psychedelics (Barrett et al., 2015; Davis et al., 2018b; Liechti et al., 2017; MacLean et al., 2012). The MEQ30 consists of four dimensions: (1) mystical, including feelings of unity, sacredness, and noetic quality (i.e., direct knowledge or insight); (2) positive mood (e.g., awe, joy); (3) transcendence of time and space; and (4) ineffability. The MEQ30 was completed with respect to the reference psychedelic experience, and individuals scoring ⩾60% of the maximum possible score on each of the four subscales of the MEQ30 were considered to have had a "complete" mystical experience (Barrett et al., 2015).

Ratings of persisting effects. Participants were asked to rate the personal meaning, psychological challenge, psychological insight, spiritual significance, and change in well-being or life satisfaction attributed to their reference psychedelic experience (Griffiths et al., 2006, 2011). Personal meaning, psychological challenge, and psychological insight were rated on a scale from 1 to 8 (1 = no more than routine, everyday experiences; 7 = among the five most meaningful/challenging/insightful experiences of my life; and 8 = the single most meaningful/challenging/insightful experience of my life). Spiritual significance was rated on a scale from 1 to 6 (1 = not at all; 5 = among the five most spiritually significant experiences of my life; 6 = the single most spiritually significant experience of my life). Change in well-being or life satisfaction was rated on a scale from −3 (decreased very much) to 0 (no change) to +3 (increased very much).

Data analyses

We calculated descriptive statistics of demographic and background characteristics, psychedelic use history and session characteristics, alcohol use and treatment history, alcohol withdrawal symptoms, and mental health history. We compared pre- to post-reference psychedelic experience scores for each of the following instruments and items using two-tailed Wilcoxon matched-pairs signed rank tests: AUDIT-C, DSM-5 symptom checklist, AUQ, and self-reported drinks per week. We calculated Pearson correlation coefficients between AUDIT-C change scores (post- minus pre-) and all primary study variables (sex, age, time since psychedelic experience, dose of psychedelic, mystical experiences, persisting effects, Pre-AUDIT-C, alcohol distress prior to experience, DSM-5 AUD checklist prior to experience, age of first drink, and number of years with a drinking problem). We conducted this first set of analyses using SPSS v.24 (IBM Corporation, 2016).

Based on correlation data regarding factors associated with change in AUDIT-C alcohol consumption score, a path analysis was conducted examining a proposed model to explain the effect of psychedelic experience on alcohol reduction (see Figure 1). The model tested included: (1) Pre-AUDIT-C as a predictor of AUDIT-C change score and alcohol distress before the reference psychedelic experience; (2) dose of the psychedelic as a predictor of insight (from persisting effects) and MEQ30 score of reference psychedelic experience; (3) insight and MEQ30 score of reference psychedelic experience as predictors of ratings of personal meaning associated with the psychedelic experience; and (4) personal meaning as a predictor of AUDIT-C change score. In this model, we also controlled for the intercorrelation of acute mystical and insightful experiences that occurred during the psychedelic experience. Analyses were conducted using maximum likelihood with robust standard errors in MPlus v.7.0 (Muthén and Muthén, 1998–2017).

Results

Respondent characteristics

During recruitment (October, 2015 through August, 2017), 4095 people clicked one of the recruitment ads and started the survey. Of these individuals, 1429 met study inclusion criteria, consented to participate, and began filling out the survey regarding alcohol. Of these respondents, a total of 512 subsequently completed the

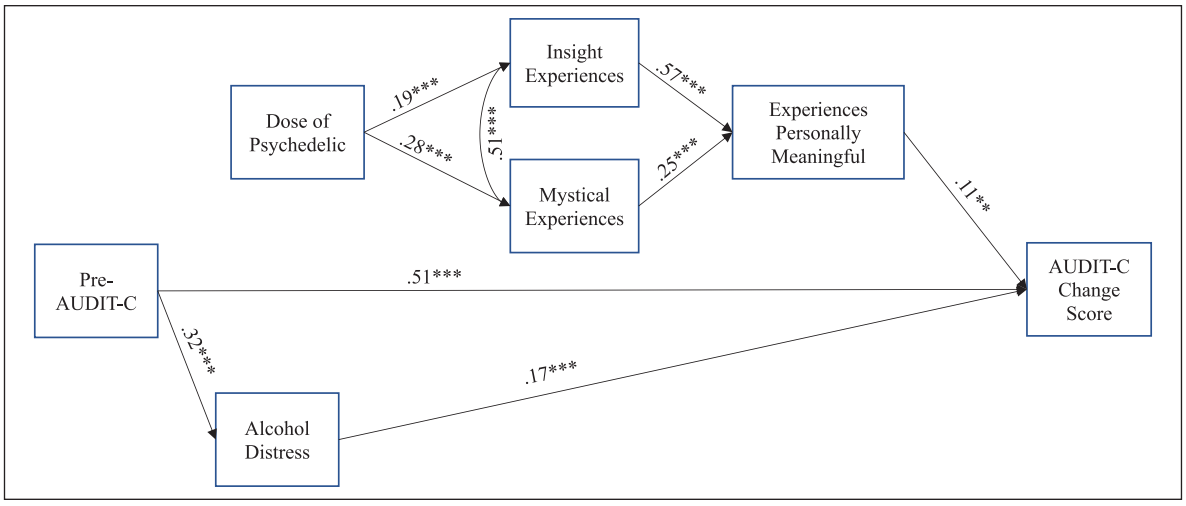

Figure 1. Path analysis examining predictors of alcohol consumption change score from pre- to post-psychedelic experience among individuals meeting criteria for an alcohol use disorder. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. AUDIT-C = Alcohol Use Disorders Identification Test – Consumption.

entire survey regarding alcohol. Of these, we excluded 120 respondents because they reported that their psychedelic experience occurred within the three months prior to the study thus limiting our ability to estimate a reliable change in alcohol use on the AUDIT-C (Canagasaby and Vinson, 2005). Of the remaining 392, we excluded an additional 33 for not meeting criteria for at least a DSM-5 mild AUD (i.e., ⩾2 AUD symptoms) prior to their reference psychedelic experience, and 16 for reporting that they had used a substance other than a classic psychedelic (e.g., 3,4-methylenedioxy-methamphetamine or MDMA) in their experience that led to a change in drinking. The final sample comprised 343 adults (Table 1), the majority of whom were White (89%), male (78%), and from the US (60%), with a mean age of 31.4 (SD = 10.8) years. According to self-reported lifetime drug use history, alcohol and cannabis were most heavily used, with only alcohol (63.0%) and cannabis (55.4%) showing ⩾500 lifetime uses. The most commonly used classic psychedelics were LSD and psilocybin, both of which had modal responses of two to five lifetime uses, with most respondents reporting <10 lifetime uses of both LSD (72.9%) and psilocybin (78.1%). Median time to complete the survey was 1 h 9 min (inter-quartile range: 0 h 47 min to 1 h 59 min), though participants could begin the survey, leave unattended, and complete later, possibly resulting in overestimated completion time.

Alcohol use, treatment, and mental health prior to psychedelic experience

Prior to their reference psychedelic experience, most respondents (72%) met the criteria for a severe AUD (Table 2), with smaller proportions meeting the criteria for a moderate (17%) or mild AUD (11%). Overall, participants endorsed a mean of 7.3 (SD = 2.7) DSM-5 AUD symptoms in the year prior to the reference psychedelic experience. Respondents self-reported consuming an average of 25.5 (SD = 21.5) drinks per week before the reference psychedelic experience. Overall, the mean alcohol consumption score on the AUDIT-C was 8.5 (SD = 2.2), suggesting these respondents were heavy drinkers experiencing several alcohol use-related consequences prior to their reference psychedelic experience. Moreover, respondents had been dealing with a drinking problem for approximately seven (SD = 7.3)

Table 1. Demographic characteristics and lifetime mental health diagnoses (N = 343).

Demographics	*n* (%)
Age in years, Mean (SD)	31.4 (10.8)
Female sex	76 (22.2%)
White	305 (88.9%)
Hispanic	20 (5.8%)
Single/not married	140 (40.8%)
US resident	207 (60.3%)
Education	
High school/GED or below	50 (14.6%)
Some college	102 (29.7%)
College graduate	94 (27.4%)
Some graduate school or graduate	97 (28.3%)
Income (US$)	
0–19.9K	93 (27.1%)
20–39.9K	76 (22.2%)
40–59.9K	56 (16.3%)
60–99.9K	59 (17.2%)
100K+	59 (17.2%)
Lifetime mental health diagnoses	
Any mental health disorder	287 (83.7%)
Anxiety disorder	202 (58.9%)
Eating disorder	24 (7.0%)
Impulse control disorder	27 (7.9%)
Mood disorder	212 (61.8%)
Personality disorder	52 (15.2%)
Psychotic disorder	17(5.0%)
Substance use disorder (including AUD)	188 (54.8%)

AUD: alcohol use disorder; GED: general educational development (high school equivalent).

Table 2. Alcohol use variables and AUD diagnosis and treatment history pre- and post-reference psychedelic experience ($N = 343$).

Alcohol use variables	Retrospective (pre-psychedelic) mean (SD)	Current (post-psychedelic) mean (SD)	Retrospective (pre-psychedelic) *n* (%)	Current (post-psychedelic) *n* (%)
Drinks/week	25.5 (21.5)	4.3 (10.2)		
AUDIT-C consumption score	8.5 (2.2)	2.7 (2.5)		
AUQ (craving)	38.8 (10.0)	13.4 (6.8)		
Years of problematic alcohol use	6.6 (7.3)	n/a		
Age in years of first alcohol use	15.1 (2.8)	n/a		
DSM5 AUD diagnostic criteria met				
No AUD			0 (0)	283 (82.5%)
Mild AUD			38 (11.1%)	32 (9.3%)
Moderate AUD			59 (17.2%)	12 (3.5%)
Severe AUD			246 (71.7%)	16 (4.7%)
AUD treatments used				
None			233 (67.9%)	241 (70.3%)
Detox			30 (8.7%)	9 (2.6%)
Counseling			70 (20.4%)	20 (5.8%)
Phone counseling			6 (1.7%)	0 (0%)
Website counseling			12 (3.5%)	4 (1.2%)
Hypnosis			6 (1.7%)	5 (1.5%)
Acupuncture			7 (2.0%)	3 (0.9%)
Support group			46 (13.4%)	24 (7.0%)
Self help			45 (13.1%)	15 (4.4%)
Spiritual practice			47 (13.7%)	56 (16.3%)
Medications				
Disulfiram			6 (1.7%)	0 (0%)
Naltrexone			9 (2.6%)	2 (0.6%)
Acamprosate			6 (1.7%)	1 (0.3%)

AUD: alcohol use disorder; AUDIT-C: Alcohol Use Disorders Identification Test – Consumption score; DSM5: Diagnostic and Statistical Manual of Mental Disorders, 5th Edition; AUQ: Alcohol Urge Questionnaire.

years on average, had been drinking since the age of 15 (SD = 2.8), and reported between "a moderate amount" and "a lot" of distress related to their alcohol use (M = 2.5/4, SD = 1.2). Furthermore, most respondents (68%) had not received treatment for their alcohol use prior to the reference psychedelic experience (Table 2), with smaller proportions having received counseling (20%), attending a support group (13%), or utilizing self-help (13%). Six percent had been treated with at least one medication (e.g., disulfiram, naltrexone, acamprosate) before the reference psychedelic experience. Furthermore, large proportions of the sample had a history of being diagnosed with a mood disorder (62%), anxiety disorder (59%), or a substance use disorder not otherwise specified (55%).

Reference psychedelic experience

Approximately three quarters of the sample reported that they used either psilocybin (36%) or LSD (38%) in the reference psychedelic experience (Table 3). Most respondents reported using a "moderate" (54%) or "high" (29%) dose, and reported that it had been at least one year since their experience (75%). Most respondents (65%) had the reference psychedelic experience in their home (Table 3), with the intention for either psychological (62%) or spiritual (39%) exploration. Only a small minority (10%) reported that they intended to reduce/quit drinking alcohol through using the psychedelic substance. Despite few respondents having the intention to change their drinking via the reference psychedelic experience, 28% of participants reported that the reference psychedelic experience contributed to a change in values or life priorities, which was the most commonly endorsed way that they believed the experience helped change their alcohol use. Participants also endorsed psychedelic-associated changes in orientation toward the future so that long-term benefits outweighed immediate desires (17%), and increased belief in their own ability to abstain (16%) as among the most important ways in which the reference psychedelic experience facilitated change in alcohol misuse (Table 3).

Table 3 shows a mean of 67% of maximum total score on the MEQ30. Additionally, approximately 39% of the sample had a "complete mystical experience" as evidenced by endorsement of ⩾60% of the total possible score on each subscale of the MEQ30 (Barrett et al., 2015). Overall, 80% of respondents rated their reference psychedelic experience among the 10 most personally meaningful; 39% rated it among the 10 most psychologically challenging; and 74% rated it among the 10 most psychologically insightful experiences of their lives. The majority of the sample (51%) rated the reference psychedelic experience among the five most spiritually significant experiences of their lives, and 79% said their sense of well-being or life satisfaction had increased

Table 3. Psychedelic experience variables, intentions, perceived mechanisms, and behavioral changes in the sample ($N = 343$).

Psychedelic experience variables	*n* (%)
Substance used	
Psilocybin mushrooms	124 (36.2%)
LSD	130 (37.9%)
Ayahuasca	27 (7.9%)
DMT (pure compound)	17 (5.0%)
Other (e.g., peyote, San Pedro)	45 (13.1%)
Estimated dose used	
Very low	3 (0.9%)
Low	31 (9.0%)
Moderate	184 (53.6%)
High	101 (29.4%)
Very high	24 (7.0%)
Time since experience	
4–6 months	41 (12.0%)
7–12 months	46 (13.4%)
1–2 years	110 (32.1%)
3–5 years	70 (20.4%)
6–10 years	38 (11.1%)
More than 10 years	38 (11.1%)
Setting of psychedelic experience†	
At home	223 (65.0%)
At a party	26 (7.6%)
In a public place (e.g., mall, movie theatre)	21 (6.1%)
At a concert/festival	33 (9.6%)
In nature	123 (35.9%)
In a religious/spiritual setting	38 (11.1%)
Other	17 (5.0%)
Intention for psychedelic experience†	
No serious intention, because others were using	7 (2.0%)
Curiosity	68 (19.8%)
Recreational	149 (43.4%)
Psychological self-exploration	213 (62.1%)
Explore spirituality or the sacred	135 (39.4%)
To reduce/quit drinking alcohol	34 (9.9%)
Other behavioral changes attributed to reference psychedelic experience	
None	17 (5.0%)
Reduced/quit using other drugs	155 (45.2%)
Started using other drugs	36 (10.5%)
Improved diet	215 (62.7%)
Worsened diet	1 (0.3%)
Increased exercise	190 (55.4%)
Decreased exercise	3 (0.9%)
Improved relationships	261 (76.1%)
Worsened relationships	13 (3.8%)
Improved career	182 (53.1%)
Worsened career	15 (4.4%)
Primary mechanism attributed to psychedelic experience for alcohol abstinence/reduction	
Changed life priorities or values	97 (28.3%)
Increased ability for delayed gratification	58 (16.9%)
Increased belief in own ability to quit/reduce	56 (16.3%)
Reframed quitting as a spiritual task	50 (14.6%)
Reduced stress involved with quitting	41 (12.0%)
Increased ability to cope with craving	30 (8.7%)
MEQ30 "complete" mystical experience	132 (38.5%)
	Mean (SD)
Age in years at time of experience	26.1 (8.6)
MEQ30 percentage of maximum total score	67.1 (20.3)
PEQ – Personal meaning‡	6.4 (1.3)
PEQ – Challenging‡	4.6 (2.2)
PEQ – Psychological insight‡	6.2 (1.6)
PEQ – Spiritual significance§	4.2 (1.5)
PEQ – Change in wellbeing/life satisfaction¶	2.7 (0.7)

LSD: lysergic acid diethylamide; DMT: dimethyltryptamine; MEQ30: Mystical Experience Questionnaire 30; PEQ: Persisting Effects Questionnaire. †These responses were not mutually exclusive (i.e., participants could choose more than one). ‡Personal meaning, psychological challenge, and psychological insight were rated on a scale from 1–8 (1 = no more than routine, everyday experiences; 7 = among the five most meaningful/challenging/insightful experiences of my life; and 8 = the single most meaningful/challenging/insightful experience of my life). §Spiritual significance was rated on a scale from 1–6 (1 = not at all; 5 = among the five most spiritually significant experiences of my life; 6 = the single most spiritually significant experience of my life). ¶Change in well-being or life satisfaction was rated on a scale from –3 (decreased very much) to 0 (no change) to +3 (increased very much).

"very much" as a result of the reference psychedelic experience and contemplation of that experience (Table 3).

Adverse effects

A large majority of participants (89%; $n = 305$) reported no persisting adverse effects beyond the period of acute drug action from their reference psychedelic experience, 6% ($n = 21$) reported they were unsure whether there were any persisting adverse effects, and 5% ($n = 17$) reported persisting adverse effects that were largely rated as not severe or slightly severe (e.g., anxiety, headache) by two-thirds of those reporting potential persisting adverse effects. Only two individuals among these 38 reported adverse effects of extreme severity, described in the participants' language as, "Panic attacks. Spiritual, existential crisis," and "loss of the ability to think clearly and a significantly altered mind that is undescribable [sic]." Neither of these individuals reported any decrease in well-being or life satisfaction related to the reference psychedelic experience. The first individual additionally described these insights from their experience, "It allowed me to feel whole again and forced me to reconnect with emotional trauma. It gave me insight into the nature of addiction and how it enslaves us—physically, mentally and spiritually. Addiction numbs us to any kind of growth as a human being." And the second stated, "I realize that I need help from a power greater than myself to overcome my alcoholism and that the psychedelics themselves were effective but cannot cure my disease."

Alcohol withdrawal symptoms

Several alcohol withdrawal symptoms were endorsed by at least half of the sample after the reference psychedelic experience (Table 4), including craving (58%), depression (58%), anxiety

Table 4. Withdrawal severity after psychedelic-associated alcohol cessation or reduction in comparison with previous quit attempts. Modal responses shown in bold type. ($N = 343$).

Withdrawal symptom	*n*	Symptom severity				
		Much less severe *n* (%)	Less severe *n* (%)	Same *n* (%)	More severe *n* (%)	Much more severe *n* (%)
Seizures	34	10 (29.4)	6 (17.6)	**16 (47.1)**	1 (2.9)	1 (2.9)
Increased heart rate	121	38 (31.4)	30 (24.8)	**39 (32.2)**	11 (9.1)	3 (2.5)
Lack of appetite	125	41 (32.8)	32 (25.6)	**44 (35.2)**	6 (4.8)	2 (1.6)
Tremors	94	31 (33.0)	22 (23.4)	**33 (35.1)**	6 (6.4)	2 (2.1)
Fever	54	19 (35.2)	7 (13.0)	**24 (44.4)**	1 (1.9)	3 (5.6)
Insomnia	172	**59 (34.3)**	39 (22.7)	48 (27.9)	15 (8.7)	11 (6.4)
Difficulty concentrating	162	**57 (35.2)**	55 (34.0)	38 (23.5)	6 (3.7)	6 (3.7)
Heart pounding	113	**42 (37.2)**	26 (23.0)	33 (29.2)	9 (8.0)	3 (2.7)
Restless	177	**66 (37.3)**	48 (27.1)	41 (23.2)	16 (9.0)	6 (3.4)
Tactile disturbance	96	**37 (38.5)**	22 (22.9)	31 (32.3)	4 (4.2)	2 (2.1)
Fatigue	153	**59 (38.6)**	36 (23.5)	40 (26.1)	13 (8.5)	5 (3.3)
Drowsiness	138	**54 (39.1)**	32 (23.2)	41 (29.7)	8 (5.8)	3 (2.2)
Headaches	140	**57 (40.7)**	28 (20.0)	44 (31.4)	6 (4.3)	5 (3.6)
Hallucinations	49	**20 (40.8)**	8 (16.3)	16 (32.7)	4 (8.2)	1 (2.0)
Nausea	98	**42 (42.9)**	20 (20.4)	27 (27.6)	7 (7.1)	2 (2.0)
Anxiety	187	**83 (44.4)**	53 (28.3)	33 (17.6)	12 (6.4)	6 (3.2)
Irritability	187	**85 (45.5)**	45 (24.1)	32 (17.1)	18 (9.6)	7 (3.7)
Confusion	129	**60 (46.5)**	28 (21.7)	32 (24.8)	5 (3.9)	4 (3.1)
Depression	198	**97 (49.0)**	42 (21.2)	35 (17.7)	15 (7.6)	9 (4.5)
Cravings	200	**137 (68.5)**	37 (18.5)	16 (8.0)	4 (2.0)	6 (3.0)

(55%), irritability (55%), and restlessness (52%). Despite experiencing these withdrawal symptoms, many respondents (range = 37–69%) reported that these symptoms were "much less severe" after their reference psychedelic experience compared to prior attempts to reduce their alcohol consumption. Although less frequent, lack of appetite (36%), increased heart rate (35%), tremors (27%), fever (16%), and seizures (10%) were reported, but almost all respondents indicated that symptom severity was the same, or less/much less severe, compared to prior quit attempts (Table 4). Craving in particular seemed to be attenuated among those who had previously experienced this withdrawal symptom, with 69% of these individuals reporting their craving as much less severe after the reference psychedelic experience compared with prior attempts to reduce or stop alcohol use.

Alcohol consumption following the psychedelic experience

Almost all respondents reported that they had greatly reduced or quit drinking alcohol since their reference psychedelic experience as evidenced by a current self-reported mean of 4.3 drinks per week (SD = 10.2), down from a mean of 25.5 (SD = 21.5) drinks per week before the reference psychedelic experience (Table 2). Similarly, on average, AUDIT-C scores reduced by 5.8 (SD = 3.0) from a mean of 8.5 (SD = 2.2) before the reference psychedelic experience to 2.7 (SD = 2.5) afterward, indicating that many respondents were no longer above the threshold considered to be a risky drinker at the time of the survey (⩾4 for males, ⩾3 for females). The majority of respondents (83%) no longer met criteria for an AUD at the time of responding to the survey, with an average of 1.0 (SD = 2.1) DSM-5 AUD symptoms endorsed since the reference psychedelic experience. Small proportions still met the criteria for mild (9%), moderate (4%), and severe (5%) AUDs. Additionally, some individuals reported only temporary reductions in alcohol consumption before returning to baseline rates. Most participants (70%) reported that they had not sought any other treatment for alcohol use problems since their reference psychedelic experience, but some endorsed that they had done so in the form of a spiritual practice (16%), support group (7%), or counseling (6%). All Wilcoxon matched-pairs signed rank tests of alcohol use variables from pre- to post-reference psychedelic experience showed significant reductions from retrospective to current AUDIT-C scores, DSM-5 symptom checklist totals, AUQ scores, and self-reported drinks per week at $p < 0.0001$.

Path analysis

First, Pearson correlation coefficients revealed that the AUDIT-C change score was significantly positively associated with dose of psychedelic substance, intensity of acute mystical experiences, ratings of the experience as personally meaningful and insightful, pre-AUDIT-C scores, intensity of alcohol distress and number of AUD symptoms prior to the experience, and number of years with a drinking problem (Table 5). Other clusters of variables with significant positive correlations included: (1) mystical and persisting effects (i.e., insight, personal meaning) associated with the reference psychedelic experience; and (2) alcohol consumption, AUD, and alcohol distress variables.

Table 5. Correlations between change in AUDIT-C scores from pre- to post-psychedelic experience and primary study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Change score†	1	−.03	.01	.07	**.13***	**.11***	**.18****	.07	.05	**.13***	**.57*****	**.34*****	**.33*****	−.06	**.13****
2. Sex		1	.03	−.04	−.07	**.12***	.01	.06	−.01	.02	**−.19****	−.03	−.06	−.05	−.04
3. Age			1	**.43*****	−.02	−.02	−.09	−.08	.03	−.05	−.07	**.13***	.03	−.01	**.57*****
4. Time since experience				1	**.13***	.05	−.01	−.05	.01	−.02	**.21*****	−.01	.08	**−.17****	**.15****
5. Dose of psychedelic					1	**.28*****	**.18****	**.23*****	**.25*****	**.19*****	**.18****	−.01	.03	−.08	.02
6. MEQ30 mean						1	**.56*****	**.60*****	**.34*****	**.54*****	.04	.07	.10	−.07	−.01
7. Experience meaningful							1	**.58*****	**.35*****	**.71*****	.09	.08	**.12***	−.01	.00
8. Experience spiritually significant								1	**.33*****	**.54*****	.00	.05	.09	−.03	.04
9. Experience challenging									1	**.41*****	−.03	.05	.04	.01	−.02
10. Experience insightful										1	.10	.04	**.13***	−.08	.03
11. Pre-AUDIT-C											1	**.32*****	**.48*****	−.08	**.27*****
12. Alcohol distress												1	**.47*****	−.02	**.29*****
13. DSM5 symptoms													1	**−.16****	**.28*****
14. Age of first drink														1	**−.16****
15. Years problematic drinking															1

AUDIT-C: Alcohol Use Disorders Identification Test – Consumption score; DSM5: Diagnostic and Statistical Manual of Mental Disorders, 5th Edition; MEQ30: Mystical Experience Questionnaire 30. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. †This variable was calculated as a difference in total score on the AUDIT-C reported in the year prior to the psychedelic experience from the AUDIT-C reported since the psychedelic experience.

As shown in the path analysis data in Figure 1, greater alcohol consumption prior to the reference psychedelic experience (pre-AUDIT-C) and greater alcohol distress were directly related to greater change in alcohol consumption (AUDIT-C change score). Greater pre-AUDIT-C scores were also indirectly related to a greater AUDIT-C change score via greater alcohol distress ($\beta = .05$, SE = .02, $p < .01$, 95% CI [.02, .09]). While controlling for the positive association between acute insight and mystical experiences, a higher dose of the psychedelic substance was directly related to greater insight and mystical effects during the psychedelic experience, both of which were also directly related to greater personal meaning associated with the experience. Additionally, higher ratings of personal meaning were directly related to a greater AUDIT-C change score. There were also two indirect effects between greater intensity of acute insight ($\beta = .07$, SE = .03, $p < .01$, 95% CI [.02, .12]) and mystical effects ($\beta = .03$, SE = .01, $p < .01$, 95% CI [.01, .05]) on higher AUDIT-C change scores via higher ratings of personal meaning. Model fit was excellent, $\chi^2(1, n = 343) = 8.28$, $p = .687$; root-mean-square error of approximation = .00 (CI [.00, .05]); standardized root-mean-square residual = .025.

Other effects

Beyond cessation or reduction in alcohol consumption, participants were also asked about other behavioral changes that may have occurred after the reference psychedelic experience (Table 3). These included changes in other drug use, diet and nutrition, physical activity and exercise, interpersonal relationships, and work/career. Many endorsed improvements in personal relationships (76%), diet (63%), exercise (55%), and work or career (53%). A minority (0.3% to 10.5%) reported deterioration in these areas overall (Table 3), and 5.0% no changes in these domains after the reference psychedelic experience.

Discussion

Findings indicate that, in some cases, naturalistic psychedelic use outside of treatment settings is followed by pronounced and enduring reductions in alcohol misuse. This survey was not designed to determine how commonly such results occur following psychedelic use, but it does provide a detailed description of such cases that suggest the potential for dramatic change. Most respondents reported meeting criteria for DSM-5 severe AUD in the year prior to the reference psychedelic experience. In the time since that experience, only a very small percentage still met the criteria for severe AUD, with the large majority no longer meeting the criteria for any AUD. Results showed congruent and statistically significant reductions in self-reported drinks per week, AUDIT-C scores, and AUQ craving. These data are consistent with reports that psychedelic use in both clinical and religious contexts has been linked to decreases in problematic alcohol consumption (Albaugh and Anderson, 1974; Barbosa et al., 2018; Bogenschutz et al., 2015; Davis et al., 2018b; Fábregas et al., 2010; Krebs and Johansen, 2012; Kurland et al., 1967; Osmond et al., 1967; Pahnke et al., 1970; Thomas et al., 2013). Although only 10% of participants reported an explicit intention to change their drinking behavior going into their reference psychedelic experience, it is possible that general intentions for psychological or spiritual exploration may have resulted in changes in drinking behavior among this sample of heavy drinkers. Furthermore, these changes appear to be long-lasting and associated with broader functional gains. Specifically, nearly three-quarters of participants reported their reference psychedelic experience to have occurred a year or more before taking the online survey, and the majority endorsed additional improvements in personal relationships, diet, exercise, and work or career (Table 3). Although such benefits cannot be wholly separated from accompanying reductions in unhealthy alcohol use, they are consistent with reports of persisting positive effects of psychedelics lasting well

beyond the period of acute drug action (Doblin, 1991; Griffiths et al., 2008; Johnson et al., 2017a; Schmid and Liechti, 2018).

A number of potential psychological mechanisms for psychedelic-associated reductions in alcohol and other substance misuse have been hypothesized, including spiritual and mystical-type effects, increased self-efficacy and motivation to change, and decreased craving, anxiety, and depressed mood (Bogenschutz and Pommy, 2012; Garcia-Romeu et al., 2015; Kurland et al., 1967; Majić et al., 2015; Osmond et al., 1967; Pahnke et al., 1970; Savage and McCabe, 1973; Ross, 2012). Consistent with these hypotheses, a large majority of respondents in the current survey rated their reference psychedelic experiences among the 10 most personally meaningful experiences of their lives, and more than half considered it among the five most spiritually significant experiences of their lives, consistent with high overall MEQ30 scores indicating strong mystical-type effects. Craving was the most commonly reported alcohol withdrawal symptom in the present sample, and more than two-thirds of respondents who experienced craving rated it as much less severe after the reference psychedelic experience in comparison with previous attempts to reduce alcohol consumption.

Similarly, a recent pilot study of psilocybin-assisted treatment for alcohol dependence found that both greater overall intensity of drug effects and greater mystical-type effects were highly correlated with subsequent decreases in percentage drinking days and percentage heavy drinking days, decreased craving, and increased alcohol abstinence self-efficacy (Bogenschutz et al., 2015). Previous studies of LSD treatment for alcoholism (Kurland et al., 1967; Pahnke et al., 1970) and opioid dependence (Savage and McCabe, 1973) also observed a relationship between mystical-type qualities of the psychedelic experience and treatment outcome. Comparable associations have been found between mystical-type effects (but not overall intensity) and long-term smoking abstinence in a pilot study of psilocybin-assisted treatment for tobacco dependence (Garcia-Romeu et al., 2015; Johnson et al., 2014, 2017a). These results highlight an important and potentially transdiagnostic therapeutic mechanism of psychedelic-assisted addiction treatment, which is also currently being studied in people who use cocaine (ClinicalTrials.gov Identifier: NCT02037126, 2014b). Based on current and previous findings including preclinical data (Cata-Preta et al., 2018; Godinho et al., 2017; Oliveira-Lima et al., 2015; Vargas-Perez et al., 2017), it seems plausible that serotonin 2A agonist psychedelics may possess some inherently anti-addictive properties, and that in humans, these may be mediated by overall intensity and/or mystical-type effects of the drug experience (Bogenschutz et al., 2015; Garcia-Romeu et al., 2015).

Spirituality has long been thought to play an important role in recovery from alcohol dependence, and has been posited as a protective factor against alcohol misuse (Bliss, 2008; Miller, 1998). Spirituality and spiritual practice have also been found to correlate with abstinence in alcohol dependence recovery (Bliss, 2008; Carroll, 1993; Kelly et al., 2011; Piderman et al., 2008). Though a major focus of research on spirituality and alcohol misuse has been on Alcoholics Anonymous (AA) and 12-step programs, psychedelics may represent an alternative path to spiritual or otherwise highly meaningful experiences that can help reframe life priorities and values, enhance self-efficacy, and increase motivation to change (Bogenschutz and Pommy, 2012; Nielson et al., 2018). Notably, Bill Wilson, the co-founder of AA, participated in medically supervised administration of LSD in the 1950s, and cited similarities between the spontaneous experience to which he attributed his sobriety, and his experience with LSD (Lattin, 2012). While such mechanisms appear largely psychological in nature, a growing body of evidence is informing the role of underlying neurological correlates of psychedelic effects in potential therapeutic efficacy, including acute and post-acute alterations in default mode network activity and functional connectivity, and changes in amygdala reactivity (Carhart-Harris et al., 2012, 2017; Kraehenmann et al., 2015; Palhano-Fontes et al., 2015; Tagliazucchi et al., 2014). Furthermore, as growing evidence continues to elucidate the role of inflammatory processes in psychiatric conditions including addiction (Crews et al., 2011; Cui et al., 2014) and depression (Hong et al., 2016; Kim et al., 2016), anti-inflammatory effects of psychedelics may represent another mechanism contributing to their therapeutic potential (Flanagan and Nichols, 2018; Nichols et al., 2017).

Although the spiritual and mystical-type effects attributed to psychedelics have garnered much of the attention surrounding behavioral and psychological changes observed following psychedelic administration in the laboratory (Bogenschutz et al., 2015; Garcia-Romeu et al., 2015; Griffiths et al., 2008; 2011; 2016; Liechti et al., 2017; MacLean et al., 2011; Roseman et al., 2017; Ross et al., 2016), evidence from the present study suggests the utility of examining other psychological mechanisms that might provide more breadth in understanding how positive outcomes such as reduced alcohol misuse may be achieved through an acute psychedelic experience. For example, it is plausible that psychedelic-occasioned experiences including both mystical-type effects and psychological insight might produce more profound behavioral changes than either type of experience alone. Miller (2004) made a similar observation regarding the construct of *quantum change*, described as a form of rapid, enduring transformation that includes both mystical experience and psychological insight subtypes (Miller and C'de Baca, 2001). Current results showed that most respondents (74%) reported their reference psychedelic experience as among the 10 most psychologically insightful experiences of their lives. Furthermore, in a path analysis predicting change in alcohol consumption, both the intensity of mystical experience and the degree to which the experience was psychologically insightful predicted alcohol consumption change via the degree to which the experience was considered personally meaningful. Additionally, these findings were significant while controlling for the influence of alcohol use severity indicators, which are themselves known to predict response to traditional interventions for problematic alcohol use (Davis et al., 2018a; Ryan et al., 1995). Although this finding is preliminary, it suggests that psychological insight is also an important mechanism of behavior change following a psychedelic experience. These data suggest a compelling need for further investigation of mechanisms and efficacy of psychedelic-assisted treatment of AUD in prospective, well-controlled laboratory and clinical studies, some of which are already underway (ClinicalTrials.gov Identifier: NCT02061293, 2014a).

In addition to substance use disorders, psychedelics have recently begun to be re-examined as treatments for depression and anxiety. Results from initial clinical trials have shown robust and rapid-acting anxiolytic and antidepressant effects in individuals with treatment-resistant depression (Carhart-Harris et al., 2016, 2017; dos Santos et al., 2016; Palhano-Fontes et al., 2019), as well

as patients with symptoms of anxiety or depression associated with life-threatening illness (Gasser et al., 2014; Griffiths et al., 2016; Grob et al., 2011; Ross et al., 2016). These results are also consistent with observational studies suggesting anxiolytic and antidepressant effects of psychedelics among psychedelic users in nonclinical settings (Davis et al., 2018b; 2019; dos Santos et al., 2007; Uthaug et al., 2018). Self-reported lifetime prevalence of depression (62%) and anxiety (59%) in the study sample was high, consistent with data showing significant comorbidity between AUD and mood and anxiety disorders (Grant et al., 2015; Hasin et al., 2018; Lai et al., 2015). A large proportion of respondents also reported affective withdrawal symptoms (e.g., depression, anxiety, irritability, restlessness) as much less severe after the reference psychedelic experience compared with previous attempts to cut down or stop drinking. Findings from a previous survey on psychedelic-associated tobacco smoking cessation also showed a similar pattern of reduced craving and affective withdrawal symptoms (Johnson et al., 2017b). Results suggest that observed anxiolytic and antidepressant effects of psychedelics likely serve as key mediators of potential efficacy in ameliorating alcohol and other substance use disorders (Bogenschutz and Pommy, 2012). Additionally, the effects of psychedelics in altering emotional processing and social cognition may represent another potential mechanism of psychedelic-associated reductions in alcohol misuse (Dolder et al., 2016; Kometer et al., 2012; Kraehenmann et al., 2016; Mueller et al., 2017; Preller et al., 2016; Stroud et al., 2018), consistent with recent findings that patients with poorer facial emotion recognition were more likely to relapse or prematurely terminate treatment for alcohol dependence (Rupp et al., 2017). Such mechanisms may also be relevant for investigation of the entactogen MDMA as a treatment for AUD and other mental health conditions (Sessa, 2018).

The current study has several notable limitations. Results are limited due to participant self-selection, volunteer bias, and the retrospective nature of the data, which are subject to recall bias. No definitive conclusions can be drawn about the role of psychedelics in alcohol use reduction as data were collected via online survey, are cross-sectional, and neither the details regarding the reference psychedelic experience nor the veracity of alcohol use information can be verified. The current study design cannot address absolute prevalence or efficacy of psychedelic-associated AUD remission, as rates of AUD remission without psychedelics were not assessed. Similarly, rates of increased alcohol consumption after psychedelic use were not assessed, as the study was conducted in a convenience sample of purposively recruited individuals who had to have experienced a reduction in their alcohol use following a psychedelic experience in order to be included in the study. In some cases, participants reported only temporary reductions in alcohol misuse that later subsided to baseline rates, as often happens following established treatments, and consistent with data from early clinical trials with LSD (Krebs and Johansen, 2012). Additionally, due to the homogeneity of the study sample (i.e., most respondents were White males), results are not necessarily generalizable to other populations. In this respect, however, current results are analogous to findings from other online surveys on psychedelic use where White males are typically over-represented (Davis et al., 2018b; Johnson et al., 2017b; Winstock et al., 2014), consistent with greater psychedelic use among this demographic in national epidemiological data (Center for Behavioral Health Statistics and Quality, 2017; Hendricks et al., 2015; Johnston et al., 2016).

Nevertheless, taken in combination with observational and anecdotal reports, results from historical clinical research, and contemporary pilot laboratory results, these findings indicate that serotonergic psychedelics such as psilocybin and LSD may hold considerable potential in the treatment of AUD. Studies of psychedelic-assisted treatment of AUD and related lines of research were relatively well-funded by the US government prior to passage of the Controlled Substances Act. A lack of federal support for therapeutic psychedelic research, prohibitive regulatory burdens, and lack of financial incentive for the clinical development of psychedelics as mostly off-patent, Schedule I substances have, however, been major limiting factors in conducting contemporary research with psychedelics (Bonson, 2017; Nutt et al., 2013; Sellers and Leiderman, 2018), despite a growing need to examine a broader range of treatment options for those with AUD. Considering the substantial mortality and morbidity associated with unhealthy alcohol use (CDC, 2013; Connor, 2017; Stahre et al., 2014), the high prevalence of AUD (WHO, 2018), and the limitations of current treatments, psychedelic-assisted treatment of AUD constitutes an innovative, timely, and compelling direction for future research for which safety and feasibility have been established (Bogenschutz et al., 2015; Johnson et al., 2008, 2018). Such work could be fostered and promoted via cooperative efforts between clinical alcohol researchers, US funding agencies such as the National Institute on Alcohol Abuse and Alcoholism, and the Substance Abuse and Mental Health Services Administration, and regulatory bodies such as the Food and Drug Administration, and the Drug Enforcement Administration. The authors advocate for a more focused and collaborative approach to accelerate research and clinical development of psychedelic-assisted treatment of AUD at this time.

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Notes

1. That is, psilocybin (magic) mushrooms, LSD, morning glory seeds, mescaline, peyote or San Pedro cactus, DMT, or Ayahuasca.
2. A copy of the survey questionnaire is available online (see the Supplementary Material).

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References

Abuzzahab FS and Anderson BJ (1971) A review of LSD treatment in alcoholism. *Int Pharmacopsychiatry* 6: 223–235.

Albaugh BJ and Anderson PO (1974) Peyote in the treatment of alcoholism among American Indians. *Am J Psychiatry* 131: 1247–1250.

American Psychiatric Association (1994) *DSM-IV: Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington DC: American Psychiatric Press.

American Psychiatric Association (2013) *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. Arlington, VA: American Psychiatric Publishing.

Anton RF, O'Malley SS, Ciraulo DA, et al. (2006) Combined pharmacotherapies and behavioral interventions for alcohol dependence: The COMBINE study: A randomized controlled trial. *JAMA* 295: 2003–2017.

Barbosa PC, Tofoli LF, Bogenschutz MP, et al. (2018) Assessment of alcohol and tobacco use disorders among religious users of Ayahuasca. *Front Psychiatry* 9: 136.

Barbosa PCR, Mizumoto S, Bogenschutz MP, et al. (2012) Health status of Ayahuasca users. *Drug Test Anal* 4: 601–609.

Barrett FS, Johnson MW and Griffiths RR (2015) Validation of the revised Mystical Experience Questionnaire in experimental sessions with psilocybin. *J Psychopharmacol* 29: 1182–1190.

Bliss DL (2008) Empirical research on spirituality and alcoholism: A review of the literature. *J Soc Work Pract Addict* 7: 5–25.

Bogenschutz MP, Forcehimes AA, Pommy JA, et al. (2015) Psilocybin-assisted treatment for alcohol dependence: A proof-of-concept study. *J Psychopharmacol* 29: 289–299.

Bogenschutz MP and Pommy JM (2012) Therapeutic mechanisms of classic hallucinogens in the treatment of addictions: From indirect evidence to testable hypotheses. *Drug Test Anal* 4: 543–555.

Bohn MJ, Krahn DD and Staehler BA (1995) Development and initial validation of a measure of drinking urges in abstinent alcoholics. *Alcohol Clin Exp Res* 19: 600–606.

Bonson KR (2017) Regulation of human research with LSD in the United States (1949–1987). *Psychopharmacology* 235(2): 591–604.

Bowen WT, Soskin RA and Chotlos JW (1970) Lysergic acid diethylamide as a variable in the hospital treatment of alcoholism: A follow-up study. *J Nerv Ment Dis* 150: 111–118.

Bradley KA, DeBenedetti AF, Volk RJ, et al. (2007) AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcohol Clin Exp Res* 31: 1208–1217.

Bush K, Kivlahan DR, McDonell MB, et al. (1998) The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. *Arch Intern Med* 158: 1789–1795.

Canagasaby A and Vinson DC (2005) Screening for hazardous or harmful drinking using one or two quantity–frequency questions. *Alcohol Alcohol* 40: 208–213.

Carhart-Harris RL, Bolstridge M, Rucker J, et al. (2016) Psilocybin with psychological support for treatment-resistant depression: An open-label feasibility study. *Lancet Psychiatry* 3: 619–627.

Carhart-Harris RL, Erritzoe D, Williams T, et al. (2012) Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *Proc Natl Acad Sci* 109: 2138–2143.

Carhart-Harris RL, Roseman L, Bolstridge M, et al. (2017) Psilocybin for treatment-resistant depression: fMRI-measured brain mechanisms. *Sci Rep* 7: 13187.

Carhart-Harris RL, Roseman L, Haijen E, et al. (2018) Psychedelics and the essential importance of context. *J Psychopharmacol* 32: 725–731.

Carmen B, Angeles M, Ana M, et al. (2004) Efficacy and safety of naltrexone and acamprosate in the treatment of alcohol dependence: A systematic review. *Addiction* 99: 811–828.

Carroll S (1993) Spirituality and purpose in life in alcoholism recovery. *J Stud Alcohol* 54: 297–301.

Cata-Preta EG, Serra YA, Moreira-Junior ED, et al. (2018) Ayahuasca and its DMT- and β-carbolines – containing ingredients block the expression of ethanol-induced conditioned place preference in mice: Role of the treatment environment. *Front Pharmacol* 9: 561.

Center for Behavioral Health Statistics and Quality (2017) *2016 National Survey on Drug Use and Health: Detailed Tables*. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Centers for Disease Control and Prevention (CDC) (2013) *Alcohol Related Disease Impact (ARDI) Application*. Available at: www.cdc.gov/ARDI.

Chwelos N, Blewett DB, Smith CM, et al. (1959) Use of d-lysergic acid diethylamide in the treatment of alcoholism. *Quart J Stud Alcohol* 20: 577–590.

ClinicalTrials.gov. National Library of Medicine (U.S.) (2014a, February 12). *A Double-Blind Trial of Psilocybin-Assisted Treatment of Alcohol Dependence*. Identifier NCT02061293. Available at: https://clinicaltrials.gov/ct2/show/NCT02061293 (accessed 12 May 2016).

ClinicalTrials.gov. National Library of Medicine (U.S.) (2014b, January 15). *Psilocybin-facilitated Treatment for Cocaine Use*. Identifier NCT02037126. Available at: https://clinicaltrials.gov/ct2/show/NCT02037126 (accessed 12 May 2018).

Connor J (2017) Alcohol consumption as a cause of cancer. *Addiction* 112: 222–228.

Crews FT, Zou J and Qin L (2011) Induction of innate immune genes in brain create the neurobiology of addiction. *Brain Behav Immun* 25: S4–S12.

Cui C, Shurtleff D and Harris RA (2014) Neuroimmune mechanisms of alcohol and drug addiction. *Int Rev Neurobiol* 118: 1–12.

Davis AK, Arterberry BJ, Bonar EE, et al. (2018a) Predictors of positive treatment response among youth receiving a brief alcohol intervention in the emergency department. *Drug Alcohol Depend* 188: 102–108. doi: 10.1016/j.drugalcdep.2018.03.044

Davis AK, Barsuglia JP, Lancelotta R, et al. (2018b) The epidemiology of 5-methoxy-***N,*** ***N***-dimethyltryptamine (5-MeO-DMT) use: Benefits, consequences, patterns of use, subjective effects, and reasons for consumption. *J Psychopharmacol* 32: 779–792.

Davis AK, So S, Lancelotta R, et al. (2019) 5-Methoxy-***N***, ***N***-dimethyltryptamine (5-MeO-DMT) used in a naturalistic setting is associated with unintended improvements in depression and anxiety. *Am J Drug Alcohol Ab*. doi: 10.1080/00952990.2018.1545024

Dawson DA, Grant BF, Stinson FS, et al. (2005) Recovery from DSM-IV alcohol dependence: United States, 2001–2002. *Addiction* 100: 281–292.

Doblin R (1991) Pahnke's "Good Friday Experiment": A long-term follow-up and methodological critique. *J Transpers Psychol* 23: 1–28.

Dolder PC, Schmid Y, Müller F, et al. (2016) LSD acutely impairs fear recognition and enhances emotional empathy and sociality. *Neuropsychopharmacology* 41: 2638.

dos Santos RG, Landeira-Fernandez J, Strassman RJ, et al. (2007) Effects of ayahuasca on psychometric measures of anxiety, panic-like, and hopelessness in Santo Daime members. *J Ethnopharmacol* 112: 507–513.

dos Santos RG, Osório FL, Crippa JAS, et al. (2016) Antidepressive and anxiolytic effects of ayahuasca: A systematic literature review of animal and human studies. *Revista Brasileira de Psiquiatria* 38: 65–72.

Drummond DC and Phillips TS (2002) Alcohol urges in alcohol-dependent drinkers: Further validation of the Alcohol Urge Questionnaire in an untreated community clinical population. *Addiction* 97: 1465–1472.

Dyck E (2006) 'Hitting highs at rock bottom': LSD treatment for alcoholism, 1950–1970. *Soc Hist Med* 19: 313–329.

Fábregas JM, González D, Fondevila S, et al. (2010) Assessment of addiction severity among ritual users of ayahuasca. *Drug Alcohol Depend* 111: 257–261.

Flanagan TW and Nichols CD (2018) Psychedelics as anti-inflammatory agents. *Int Rev Psychiatry* 30(4): 363–375.

Garcia-Romeu A, Griffiths RR and Johnson MW (2015) Psilocybin-occasioned mystical experiences in the treatment of tobacco addiction. *Curr Drug Abuse Rev* 7: 157.

Garcia-Romeu A, Kersgaard B and Addy PH (2016) Clinical applications of hallucinogens: A review. *Exper Clin Psychopharmacol* 24: 229.

Gasser P, Holstein D, Michel Y, Doblinet al. (2014) Safety and efficacy of lysergic acid diethylamide-assisted psychotherapy for anxiety associated with life-threatening diseases. *J Nerv Ment Dis* 202: 513.

Godinho AF, Silva MC, Kawashima JD, et al. (2017) Ayahuasca modifies amphetamine self-ingestion and modifies anxiety and locomotor activity in adolescent rats. *Electr J Biol* 13: 159–165.

Gouzoulis-Mayfrank E, Heekeren K, Thelen B, et al. (1998) Effects of the hallucinogen psilocybin on habituation and prepulse inhibition of the startle reflex in humans. *Behav Pharmacol* 9: 561–566.

Gouzoulis-Mayfrank E, Schreckenberger M, Sabri O, et al. (1999) Neurometabolic effects of psilocybin, 3, 4-methylenedioxyethylamphetamine (MDE) and d-methamphetamine in healthy volunteers: A double-blind, placebo-controlled PET study with [18F] FDG. *Neuropsychopharmacology* 20: 565–581.

Grant BF, Goldstein RB, Saha TD, et al. (2015) Epidemiology of DSM-5 alcohol use disorder: Results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry* 72: 757–766.

Griffiths RR, Johnson MW, Richards WA, et al. (2011) Psilocybin occasioned mystical-type experiences: Immediate and persisting dose-related effects. *Psychopharmacology* 218: 649–665.

Griffiths RR, Johnson MW, Carducci MA, et al. (2016) Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer: A randomized double-blind trial. *J Psychopharmacol* 30: 1181–1197.

Griffiths RR, Richards WA, Johnson MW, et al. (2008) Mystical-type experiences occasioned by psilocybin mediate the attribution of personal meaning and spiritual significance 14 months later. *J Psychopharmacol* 22: 621–632.

Griffiths RR, Richards WA, McCann U, et al. (2006) Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance. *Psychopharmacology* 187: 268–283.

Grob CS, Danforth AL, Chopra GS, et al. (2011) Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. *Arch Gen Psychiatry* 68: 71–78.

Halpern JH, Sherwood AR, Passie T, et al. (2008) Evidence of health and safety in American members of a religion who use a hallucinogenic sacrament. *Med Sci Monit* 14: SR15–SR22.

Hartogsohn I (2016) Set and setting, psychedelics and the placebo response: An extra-pharmacological perspective on psychopharmacology. *J Psychopharmacol* 30: 1259–1267.

Hartogsohn I (2017) Constructing drug effects: A history of set and setting. *Drug Sci Policy Law* 3: 1–17.

Hasin DS, Sarvet AL, Meyers JL, et al. (2018) Epidemiology of adult DSM-5 major depressive disorder and its specifiers in the United States. *JAMA Psychiatry* 75: 336–346.

Hendricks PS, Thorne CB, Clark CB, et al. (2015) Classic psychedelic use is associated with reduced psychological distress and suicidality in the United States adult population. *J Psychopharmacol* 29: 280–288.

Hermle L, Fünfgeld M, Oepen G, et al. (1992) Mescaline-induced psychopathological, neuropsychological, and neurometabolic effects in normal subjects: Experimental psychosis as a tool for psychiatric research. *Biol Psychiatry* 32: 976–991.

Hermle L, Gouzoulis-Mayfrank E and Spitzer M (1998) Blood flow and cerebral laterality in the mescaline model of psychosis. *Pharmacopsychiatry* 31: 85–91.

Hill TW (1990) Peyotism and the control of heavy drinking: The Nebraska Winnebago in the early 1900s. *Hum Org* 255–265.

Hollister LE, Shelton J and Krieger G (1969) A controlled comparison of lysergic acid diethylamide (LSD) and dextroamphetamine in alcoholics. *Am J Psychiatry* 125: 1352–1357.

Hong H, Kim BS and Im HI (2016) Pathophysiological role of neuroinflammation in neurodegenerative diseases and psychiatric disorders. *Int Neurourol J* 20(Suppl 1): S2–S7.

Hudziak JJ, Helzer JE, Wetzel MW, et al. (1993) The use of the DSM-III-R Checklist for initial diagnostic assessments. *Compr Psychiatry* 34: 375–383.

IBM Corporation (2016) *IBM SPSS Statistics for Windows*, Version 24.0. Armonk, NY: IBM Corp.

Johnson MW, Garcia-Romeu A, Cosimano MP, et al. (2014) Pilot study of the 5-HT2AR agonist psilocybin in the treatment of tobacco addiction. *J Psychopharmacol* 28: 983–992.

Johnson MW, Garcia-Romeu A and Griffiths RR (2017a) Long-term follow-up of psilocybin-facilitated smoking cessation. *Am J Drug Alcohol Abuse* 43: 55–60.

Johnson MW, Garcia-Romeu A, Johnson PS, et al. (2017b) An online survey of tobacco smoking cessation associated with naturalistic psychedelic use. *J Psychopharmacol* 31: 841–850.

Johnson MW, Griffiths RR, Hendricks PS, et al. (2018) The abuse potential of medical psilocybin according to the 8 factors of the Controlled Substances Act. *Neuropharmacology* 142: 143–166.

Johnson MW, Richards WA and Griffiths RR (2008) Human hallucinogen research: Guidelines for safety. *J Psychopharmacol* 22: 603–620.

Johnston LD, O'Malley PM, Bachman JG, et al. (2016) *Monitoring the Future National Survey Results on Drug Use, 1975–2015: Volume II, College Students and Adults Ages*. Ann Arbor: MI: Institute for Social Research, pp. 19–55.

Jonas DE, Garbutt JC, Amick HR, Brown JM, et al. (2012) Behavioral counseling after screening for alcohol misuse in primary care: A systematic review and meta-analysis for the US Preventive Services Task Force. *Ann Int Med* 157: 645–654.

Jørgensen CH, Pedersen B and Tønnesen H (2011) The efficacy of disulfiram for the treatment of alcohol use disorder. *Alcohol Clin Exp Res* 35: 1749–1758.

Kelly JF, Stout RL, Magill M, et al. (2011) Spirituality in recovery: A lagged mediational analysis of Alcoholics Anonymous' principal theoretical mechanism of behavior change. *Alcohol Clin Exp Res* 35: 454–463.

Kim YK, Na KS, Myint AM, et al. (2016) The role of pro-inflammatory cytokines in neuroinflammation, neurogenesis and the neuroendocrine system in major depression. *Progr Neuro Psychopharmacol Biol Psychiatry* 64: 277–284.

Kometer M, Schmidt A, Bachmann R, et al. (2012) Psilocybin biases facial recognition, goal-directed behavior, and mood state toward positive relative to negative emotions through different serotonergic subreceptors. *Biol Psychiatry* 72: 898–906.

Kraehenmann R, Preller KH, Scheidegger M, et al. (2015) Psilocybin-induced decrease in amygdala reactivity correlates with enhanced positive mood in healthy volunteers. *Biol Psychiatry* 78: 572–581.

Kraehenmann R, Schmidt A, Friston K, et al. (2016) The mixed serotonin receptor agonist psilocybin reduces threat-induced modulation of amygdala connectivity. *NeuroImage Clin* 11: 53–60.

Krebs TS and Johansen PØ (2012) Lysergic acid diethylamide (LSD) for alcoholism: Meta-analysis of randomized controlled trials. *J Psychopharmacol* 26: 994–1002.

Kurland AA, Unger S, Shaffer JW, et al. (1967) Psychedelic therapy utilizing LSD in the treatment of the alcoholic patient: A preliminary report. *Am J Psychiatry* 123: 1202–1209.

Lai HMX, Cleary M, Sitharthan T, et al. (2015) Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: A systematic review and meta-analysis. *Drug Alcohol Depend* 154: 1–13.

Lattin D (2012) *Distilled Spirits: Getting High, Then Sober, with a Famous Writer, a Forgotten Philosopher, and a Hopeless Drunk*. Berkeley, CA: University of California Press.

Liechti ME, Dolder PC and Schmid Y (2017) Alterations of consciousness and mystical-type experiences after acute LSD in humans. *Psychopharmacology* 234: 1499–1510.

Ludwig A, Levine J, Stark L, et al. (1969) A clinical study of LSD treatment in alcoholism. *Am J of Psychiatry* 126: 59–69.

MacLean KA, Johnson MW and Griffiths RR (2011) Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *J Psychopharmacol* 25: 1453–1461.

MacLean KA, Leoutsakos JMS, Johnson MW, et al. (2012) Factor analysis of the mystical experience questionnaire: A study of experiences occasioned by the hallucinogen psilocybin. *J Sci Study Relig* 51: 721–737.

Maisel NC, Blodgett JC, Wilbourne PL, et al. (2013) Meta-analysis of naltrexone and acamprosate for treating alcohol use disorders: When are these medications most helpful? *Addiction* 108: 275–293.

Majić T, Schmidt TT and Gallinat J (2015) Peak experiences and the afterglow phenomenon: When and how do therapeutic effects of hallucinogens depend on psychedelic experiences? *J Psychopharmacol* 29: 241–253.

Mangini M (1998) Treatment of alcoholism using psychedelic drugs: A review of the program of research. *J Psychoactive Drugs* 30: 381–418.

Martin GW and Rehm J (2012) The effectiveness of psychosocial modalities in the treatment of alcohol problems in adults: A review of the evidence. *Can J Psychiatry* 57: 350–358.

Miller WR (1998) Researching the spiritual dimensions of alcohol and other drug problems. *Addiction* 93: 979–990.

Miller WR (2004) The phenomenon of quantum change. *J Clin Psychol* 60: 453–460.

Miller WR and C'de Baca J (2001) *Quantum Change: When Epiphanies and Sudden Insights Transform Ordinary Lives*. New York, NY: Guilford Press.

Miller WR, Walters ST and Bennett ME (2001) How effective is alcoholism treatment in the United States? *J Stud Alcohol* 62: 211–220.

Moyer VA (2013) Screening and behavioral counseling interventions in primary care to reduce alcohol misuse: US Preventive Services Task Force recommendation statement. *Ann Int Med* 159: 210–218.

Mueller F, Lenz C, Dolder PC, et al. (2017) Acute effects of LSD on amygdala activity during processing of fearful stimuli in healthy subjects. *Transl Psychiatry* 7: e1084.

Muthén LK and Muthén B (1998–2017) *Mplus User's Guide: Statistical Analysis with Latent Variables*. Los Angeles, CA: Authors.

Nichols DE, Johnson MW and Nichols CD (2017) Psychedelics as medicines: An emerging new paradigm. *Clin Pharmacol Ther* 101: 209–219.

Nielson EM, May DG, Forcehimes AA, et al. (2018) The psychedelic debriefing in alcohol dependence treatment: Illustrating key change phenomena through qualitative content analysis of clinical sessions. *Front Pharmacol* 9: 132.

Nutt DJ, King LA and Nichols DE (2013) Effects of Schedule I drug laws on neuroscience research and treatment innovation. *Nat Rev Neurosci* 14: 577.

Oliveira-Lima AJ, Santos R, Hollais AW, et al. (2015) Effects of ayahuasca on the development of ethanol-induced behavioral sensitization and on a post-sensitization treatment in mice. *Physiol Behav* 142: 28–36.

Osmond H, Albahary R, Cheek F, et al. (1967) Some problems in the use of LSD 25 in the treatment of alcoholism. In: Abramson HA (ed) *The Use of LSD in Psychotherapy and Alcoholism*. Indianapolis, IN: Bobbs-Merrill, pp. 434–457.

Pahnke WN, Kurland AA, Unger S, et al. (1970) The experimental use of psychedelic (LSD) psychotherapy. *JAMA* 212: 1856–1863.

Palhano-Fontes F, Andrade KC, Tofoli LF, et al. (2015) The psychedelic state induced by ayahuasca modulates the activity and connectivity of the default mode network. *PLoS One* 10: e0118143.

Palhano-Fontes F, Barreto D, Onias H, et al. (2019) Rapid antidepressant effects of the psychedelic ayahuasca in treatment-resistant depression: A randomized placebo-controlled trial. *Psychol Med* 49(4): 655–663.

Piderman KM, Schneekloth TD, Pankratz VS, et al. (2008) Spirituality during alcoholism treatment and continuous abstinence for one year. *Int J Psychiatry Med* 38: 391–406.

Preller KH, Pokorny T, Hock A, et al. (2016) Effects of serotonin 2A/1A receptor stimulation on social exclusion processing. *Proc Natl Acad Sci* 113: 5119–5124.

Prue B (2013) Indigenous supports for recovery from alcoholism and drug abuse: The Native American Church. *J Ethn Cult Divers Soc Work* 22: 271–287.

Reinert DF and Allen JP (2002) The alcohol use disorders identification test (AUDIT): A review of recent research. *Alcohol Clin Exp Res* 26: 272–279.

Roseman L, Nutt DJ and Carhart-Harris RL (2017) Quality of acute psychedelic experience predicts therapeutic efficacy of psilocybin for treatment-resistant depression. *Front Pharmacol* 8: 974.

Ross S (2012) Serotonergic hallucinogens and emerging targets for addiction pharmacotherapies. *Psychiatr Clin* 35: 357–374.

Ross S, Bossis A, Guss J, et al. (2016) Rapid and sustained symptom reduction following psilocybin treatment for anxiety and depression in patients with life-threatening cancer: A randomized controlled trial. *J Psychopharmacol* 30:1165–1180.

Ryan RM, Plant RW and O'Malley S (1995) Initial motivations for alcohol treatment: Relations with patient characteristics, treatment involvement, and dropout. *Addict Behav* 20: 279–297.

Rucker JJ, Iliff J and Nutt DJ (2018) Psychiatry & the psychedelic drugs. Past, present & future. *Neuropharmacology* 142: 200–218.

Rupp CI, Derntl B, Osthaus F, et al. (2017) Impact of social cognition on alcohol dependence treatment outcome: Poorer facial emotion recognition predicts relapse/dropout. *Alcohol Clin Exper Res* 41: 2197–2206.

Saitz R (2005) Clinical practice. Unhealthy alcohol use. *N Engl J Med* 352: 596–607.

Saitz R (2010) Alcohol screening and brief intervention in primary care: Absence of evidence for efficacy in people with dependence or very heavy drinking. *Drug Alcohol Rev* 29: 631–640.

Saunders JB, Aasland OG, Babor TF, et al. (1993) Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction* 88: 791–804.

Savage C and McCabe OL (1973) Residential psychedelic (LSD) therapy for the narcotic addict: A controlled study. *Arch Gen Psychiatry* 28: 808–814.

Schmid Y and Liechti ME (2018) Long-lasting subjective effects of LSD in normal subjects. *Psychopharmacology* 235: 535–545.

Sellers EM and Leiderman DB (2018) Psychedelic drugs as therapeutics: No illusions about the challenges. *Clin Pharmacol Ther* 103: 561–564.

Sessa B (2018) Why MDMA therapy for alcohol use disorder? And why now? *Neuropharmacology* 142: 83–88.

Sessa B and Johnson MW (2015) Can psychedelic compounds play a part in drug dependence therapy? *Br J Psychiatry* 206: 1–3.

Smart RG, Storm T, Baker EF, et al. (1966) A controlled study of lysergide in the treatment of alcoholism. 1. The effects on drinking behavior. *Quart J Stud Alcohol* 27: 469–482.

Smith CM (1958) A new adjunct to the treatment of alcoholism: The hallucinogenic drugs. *Quart J Stud Alcohol* 19: 406–417.

Smith CM (1959) Some reflections on the possible therapeutic effects of the hallucinogens; with special reference to alcoholism. *Quart J Stud Alcohol* 20: 292–301.

Spitzer M, Thimm M, Hermle L, et al. (1996) Increased activation of indirect semantic associations under psilocybin. *Biol Psychiatry* 39: 1055–1057.

Stahre M, Roeber J, Kanny D, et al. (2014) Contribution of excessive alcohol consumption to deaths and years of potential life lost in the United States. *Prev Chronic Dis* 11: E109. doi: 10.5888/pcd11.130293

Strassman RJ and Qualls CR (1994) Dose-response study of N, N-dimethyltryptamine in humans: I. Neuroendocrine, autonomic, and cardiovascular effects. *Arch Gen Psychiatry* 51: 85–97.

Strassman RJ, Qualls CR, Uhlenhuth EH, et al. (1994) Dose-response study of N, N-dimethyltryptamine in humans: II. Subjective effects and preliminary results of a new rating scale. *Arch Gen Psychiatry* 51: 98–108.

Stroud JB, Freeman TP, Leech R, et al. (2018) Psilocybin with psychological support improves emotional face recognition in treatment-resistant depression. *Psychopharmacology* 235: 459–466.

Substance Abuse and Mental Health Services Administration (SAMHSA) and National Institute on Alcohol Abuse and Alcoholism (NIAAA) (2015) *Medication for the Treatment of Alcohol Use Disorder: A Brief Guide*. HHS Publication No. (SMA) 15-4907. Rockville, MD: Substance Abuse and Mental Health Services Administration.

Tagliazucchi E, Carhart-Harris R, Leech R, et al. (2014) Enhanced repertoire of brain dynamical states during the psychedelic experience. *Hum Brain Mapp* 35: 5442–5456.

Thomas G, Lucas P, Capler NR, et al. (2013) Ayahuasca-assisted therapy for addiction: Results from a preliminary observational study in Canada. *Curr Drug Abuse Rev* 6: 30–42.

Tomsovic M and Edwards RV (1970) Lysergide treatment of schizophrenic and nonschizophrenic alcoholics: A controlled evaluation. *Quart J Stud Alcohol* 31: 932–949.

Tupper KW, Wood E, Yensen R, et al. (2015) Psychedelic medicine: A re-emerging therapeutic paradigm. *CMAJ* 187: 1054–1059.

US Department of Health and Human Services (DHHS) (2005) *Helping Patients Who Drink Too Much: A Clinician's Guide*. Bethesda ,MD: National Institute on Alcohol Abuse and Alcoholism. Available at: http://pubs.niaaa.nih.gov/publications/Practitioner/CliniciansGuide2005/guide.pdf (accessed 2 May 2018).

Uthaug MV, van Oorsouw K, Kuypers KPC, et al. (2018) Sub-acute and long-term effects of ayahuasca on affect and cognitive thinking style and their association with ego dissolution. *Psychopharmacol* 235: 2979–2989.

Vaillant GE (2003) A 60-year follow-up of alcoholic men. *Addiction* 98: 1043–1051.

Vargas-Perez H, Grieder TE, Ting-A-Kee R, et al. (2017) A single administration of the hallucinogen, 4-acetoxy-dimethyltryptamine, prevents the shift to a drug-dependent state and the expression of withdrawal aversions in rodents. *Eur J Neurosci* 45: 1410–1417.

Vasilaki EI, Hosier SG and Cox WM (2006) The efficacy of motivational interviewing as a brief intervention for excessive drinking: A meta-analytic review. *Alcohol Alcohol* 41: 328–335.

Vollenweider FX, Leenders KL, Scharfetter C, et al. (1997) Positron emission tomography and fluorodeoxyglucose studies of metabolic hyperfrontality and psychopathology in the psilocybin model of psychosis. *Neuropsychopharmacology* 16:357–372.

Weiss RD, O'Malley SS, Hosking JD, et al. (2008) Do patients with alcohol dependence respond to placebo? Results from the COMBINE Study. *J Stud Alcohol Drugs* 69: 878–884.

Winstock AR, Kaar S and Borschmann R (2014) Dimethyltryptamine (DMT): Prevalence, user characteristics and abuse liability in a large global sample. *J Psychopharmacol* 28: 49–54.

World Health Organization (WHO) (2018) *Management of Substance Abuse Unit: Global Status Report on Alcohol and Health, 2018*. Geneva: World Health Organization.