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The relationships of classic psychedelic use with criminal behavior in the United States adult population

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Abstract

Criminal behavior exacts a large toll on society and is resistant to intervention. Some evidence suggests classic psychedelics may inhibit criminal behavior, but the extent of these effects has not been comprehensively explored. In this study, we tested the relationships of classic psychedelic use and psilocybin use per se with criminal behavior among over 480,000 United States adult respondents pooled from the last 13 available years of the National Survey on Drug Use and Health (2002 through 2014) while controlling for numerous covariates. Lifetime classic psychedelic use was associated with a reduced odds of past year larceny/theft (aOR = 0.73 (0.65–0.83)), past year assault (aOR = 0.88 (0.80–0.97)), past year arrest for a property crime (aOR = 0.78 (0.65–0.95)), and past year arrest for a violent crime (aOR = 0.82 (0.70–0.97)). In contrast, lifetime illicit use of other drugs was, by and large, associated with an increased odds of these outcomes. Lifetime classic psychedelic use, like lifetime illicit use of almost all other substances, was associated with an increased odds of past year drug distribution. Results were consistent with a protective effect of psilocybin for antisocial criminal behavior. These findings contribute to a compelling rationale for the initiation of clinical research with classic psychedelics, including psilocybin, in forensic settings.

Keywords

Hallucinogen, psilocybin, lysergic acid diethylamide, psychedelic, recidivism, criminal justice, forensic psychology

Introduction

The United States places a greater proportion of its citizens under criminal justice supervision—2.8% of all adults—than any other country (Kaeble et al., 2016). Drug-related crimes (possession, use, distribution, or manufacturing of illicit drugs) and property crimes (burglary, larceny/theft, motor vehicle theft, or arson) are the most common criminal offenses, comprising approximately 14% and 13.5% of all arrests, respectively (FBI Uniform Crime Report, 2015). Though rates of violent crime (murder, manslaughter, rape/sexual assault, assault, or robbery) are at historic lows and violent crime accounts for only 5% of all arrests (FBI Uniform Crime Report, 2015; Truman and Langton, 2015), the costs of violent crime remain high. Indeed, nearly all survivors of violent crime experience mental health problems, with a majority suffering from relationship difficulties or a decline in job/school performance and about one-third evidencing severe distress (Langton and Truman, 2014). Of all crimes, murder poses the greatest financial cost to society, estimated at nearly $9,000,000 per murder (McCollister et al., 2010).

Recidivism rates are alarmingly high following release from prison, with 67.8% and 76.6% of released offenders re-arrested within three and five years for a new crime, respectively. Property offenders have the highest five-year re-arrest rates (82.1%), followed by drug offenders (76.9%), and violent offenders (71.3%). Importantly, 33.1% of violent offenders go on to be re-arrested for another violent crime (Durose et al., 2014). Several interventions have been developed to decrease recidivism and include employment programs, cognitive-behavioral approaches, Moral Reconation Therapy, and specialty programs targeting juvenile offenders. Overall, interventions that employ cognitive-behavioral approaches and Moral Reconation Therapy demonstrate small effects (Ferguson and Wormith, 2013; Pearson et al., 2002), whereas those using employment strategies or targeting juveniles demonstrate no effect (Schwalbe et al., 2012, Visher et al., 2005). Notably, individuals who have committed a violent crime are among the least likely to complete treatment and the most likely to re-offend after treatment dropout (Oliver et al., 2011).

The development of innovative and effective interventions to prevent criminal behavior is thus an obvious priority. Such interventions may involve classic psychedelics, non-selective

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5HT2AR agonists including lysergic acid diethylamide (LSD), mescaline, and psilocybin that can occasion primary mystical experiences (also known as primary religious experiences or peak experiences) and that have been used for millennia across cultures with therapeutic intention (Nichols, 2016). Indeed, during the first wave of human classic psychedelic research from the 1950s through the early 1970s, at least three studies tested the effect of classic psychedelic-assisted psychotherapy on criminal offenders. Tenenbaum (1961) provided 10 treatment-resistant sex offenders with multiple LSD-assisted group psychotherapy sessions and noted demonstrable increases in empathy, insight, communication, and treatment engagement in all but one participant. Arendsen-Hein (1963) administered multiple LSD-assisted psychotherapy sessions to 21 "criminal psychopaths" and reported similar outcomes among 14 participants. In the largest and most widely known study of classic psychedelics and recidivism, Leary (1969) provided 32 prisoners with psilocybin-assisted psychotherapy in his Concord Prison Experiment, reporting positive findings. A later review, however, concluded that these findings were overstated, inadequate support was provided outside of psilocybin sessions, and that serious methodological flaws preclude any conclusions (Doblin, 1998). Despite these mixed findings, legal proscriptions and a dearth of funding ruled out further study with classic psychedelics.

Classic psychedelic research has experienced a modest renaissance over the past two and a half decades, with recent investigations demonstrating that classic psychedelics and psilocybin in particular may confer a number of long-lasting psychological benefits. For instance, in two separate randomized clinical trials, psilocybin produced substantial and sustained decreases in anxiety and depression among patients with life-threatening cancer (Griffiths et al., 2016; Ross et al., 2016). Similarly, in a single-arm, open-label feasibility study of treatment-resistant depression, psilocybin produced large and enduring improvements in mood (Carhart-Harris et al., 2016). These findings comport with population-based studies indicating that having ever used a classic psychedelic (Hendricks et al., 2015a) and having ever used psilocybin per se (Hendricks et al., 2015b) are both associated with a decreased likelihood of psychological distress and suicidality. In addition, single-arm, open-label feasibility studies suggest psilocybin promotes abstinence from alcohol (Bogenschutz et al., 2015) and tobacco (Johnson et al., 2014; 2017), and a population-based study indicates that having ever used a classic psychedelic is associated with a decreased risk of opioid abuse and dependence (Pisano et al., 2017).

Considering that many individuals in the criminal justice system suffer from numerous comorbid psychopathologies that exacerbate criminality (Chandler et al., 2009; Perry et al., 2006), these individuals may benefit from classic psychedelic-assisted interventions. Unfortunately, there is scant contemporary data to inform this issue. To our knowledge, only two recent studies have yielded data relevant to the potential impact of classic psychedelics on criminal behavior. Hendricks et al. (2014) found that naturalistic hallucinogen use predicted a reduced likelihood of supervision failure (adjusted odds ratio (aOR) = 0.60) among over 25,000 individuals under community corrections supervision with a history of substance involvement. Walsh et al. (2016) found that naturalistic hallucinogen use predicted reduced arrest for intimate partner violence (aOR = 0.62) among 302 jail inmates. Though suggestive of protective effects, because hallucinogens are a broader class of substances that includes classic psychedelics in addition to other substances, neither Hendricks et al. (2014) nor Walsh et al. (2016) were able to test the unique relationships of classic psychedelics with criminal behavior outcomes.

Replication and extension of prior results is merited given the high rates of non-replication of research findings (Ioannidis, 2014; Open Science Collaboration, 2015), and also because the magnified political lens surrounding classic psychedelics suggests that rigorous and persuasive results will be required for application in forensic settings. Accordingly, the purpose of the current study was to examine the relationships of lifetime classic psychedelic use with past year criminal behavior using data drawn from the last 13 available years of the National Survey on Drug Use and Health (NSDUH) at the time of analysis (2002–2014). Consistent with prior research (Hendricks et al., 2015b), the specific relationships of lifetime psilocybin use with past year criminal behavior also was examined to help inform decisions by the United States Food and Drug Administration and regulatory bodies of other nations regarding future approved use. Based on findings from prior research, we hypothesized that lifetime classic psychedelic use and lifetime psilocybin use per se would be associated with a decreased likelihood of past year criminal behavior.

Data and methods

The NSDUH is an annual cross-sectional survey conducted by the Substance Abuse and Mental Health Services Administration of the United States Department of Health and Human Services. It is designed to estimate the prevalence of substance use and mental illness in the general United States civilian non-institutionalized population (United States Department of Health and Human Services, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015). Participants in the present research were adult (≥18 years old) respondents of the NSDUH pooled across years 2002 through 2014 (the maximum number of survey years providing the same variables for analysis; unweighted *N*s for all analyses > 480,000). Similar approaches have been employed by five prior investigations evaluating population-level associations of classic psychedelic use with indices of mental health (Hendricks et al., 2015a, b; Johansen and Krebs, 2015; Krebs and Johansen, 2013; Pisano et al., 2017). Detailed information on the NSDUH can be found elsewhere (https://nsduhweb.rti.org/respweb/homepage.cfm). The NSDUH survey was approved by the institutional review board of the Research Triangle Institute and the present research was approved by the institutional review board of the University of Alabama at Birmingham.

Measures

Classic psychedelic use

The measurement of classic psychedelic use followed those of two prior studies (Hendricks et al., 2015a, b). Respondents reporting that they had ever, even once, used ayahuasca, dimethyltryptamine (DMT), LSD, mescaline, peyote or San Pedro, or psilocybin mushrooms (referred to as "psilocybin" hereafter) were coded as positive for lifetime classic psychedelic use, whereas those indicating that they had never used any of these

substances were coded as negative (the NSDUH specifically queried lifetime LSD, mescaline, peyote, and psilocybin use, whereas respondents had the opportunity to volunteer lifetime use of ayahuasca, DMT, and San Pedro in open-ended questions). To better identify outcomes associated specifically with psilocybin use, four mutually exclusive groups of respondents were examined: (1) Psilocybin Only (those reporting lifetime use of psilocybin but no other classic psychedelic); (2) Psilocybin & Other Psychedelics (those reporting lifetime use of psilocybin in addition to other classic psychedelics); (3) Non-Psilocybin Psychedelics Only (those reporting lifetime use of any classic psychedelic with the exception of psilocybin); and (4) No Psychedelics (those reporting no lifetime use of any classic psychedelic substance).

Criminal behavior

We examined six outcome variables pertaining to criminal behavior, including (1) past year drug distribution ("During the past 12 months, how many times have you sold illegal drugs?"; variable SNYSELL), (2) past year larceny/theft ("During the past 12 months, how many times have you stolen or tried to steal anything worth more than $50?"; variable SNYSTOLE), and (3) past year assault ("During the past 12 months, how many times have you attacked someone with the intent to seriously hurt them?"; variable SNYATTAK). Each of these variables used the following response set: 1 = 0 times, 2 = 1 or 2 times, 3 = 3 to 5 times, 4 = 6 to 9 times, 5 = 10 or more times. Responses were collapsed into three categories (coded 0 = 0 times, 1 = 1 or 2 times, 3 = > 2 times) to maintain the ordinal nature of the measure while improving data scarcity (e.g. even in a sample size as large as ours, very few individuals have assaulted others more than five times in the past year).

The NSDUH incorporates a number of yes/no questions regarding past year arrest history ("In the past 12 months, were you arrested and booked for…"), including: "…possession, manufacture, or sale of drugs?" (variable BKDRUG); "…burglary or breaking and entering?" (variable BKBURGL); "…larceny or theft? Do not include motor vehicle theft." (variable BKLARCNY); "…motor vehicle theft?" (variable BKMVTHFT); "…arson?" (BKARSON); "…aggravated assault…forcible rape…murder, homicide, or nonnegligent manslaughter?" (variable BKSRVIOL); "…other assault, such as simple assault or battery?" (variable BKSMASLT); and "…robbery?" (variable BKROB). We condensed these questions into one of three conceptually similar categories, estimating each as a dichotomous outcome. These categories composed our final three outcome variables: (4) past year arrest for a drug-related crime (coded 0 if BKDRUG = no, 1 if response to this variable = yes), (5) past year arrest for a property crime (coded as 0 if variables BKBURGL, BKLARCNY, BKMVTHFT, or BKARSON each = no, 1 if responses to any of these variables = yes), and (6) past year arrest for a violent crime (coded as 0 if variables BKSRVIOL, BKSMASLT, or BKROB each = no, 1 if responses to any of these variables = yes).

Covariates

The relationships between classic psychedelic use and each of our dependent variables may be confounded by sociodemographic variables, illicit use of other substances, secular changes in both classic psychedelic use and our dependent variables over time, as well as other unmeasured variables. As such, we statistically adjusted for a range of measured variables. All analyses were adjusted for survey year, age in years (dummy coded as 18–25, 26–24, 35–49, and 50 or older), sex (male = 0, female = 1), ethnoracial identity (dummy coded as non-Hispanic White, non-Hispanic African American, non-Hispanic Native American/Alaska Native, non-Hispanic Native Hawaiian/Pacific Islander, non-Hispanic Asian, non-Hispanic more than one race, or Hispanic), educational attainment (dummy coded as 5th grade or less through senior college year or more across 11 categories), annual household income (dummy coded as less than $20,000, $20,000–$49,999, $50,000–$74,999, or $75,000 or more), marital status (dummy coded as married, divorced/separated, widowed, or never married), employment status (dummy coded as full time, part time, unemployed, or other (including those not in the labor force)), self-reported engagement in risky behavior (dummy coded as never, seldom, sometimes, or always), degree to which religious beliefs influence decisions ("Your religious beliefs influence how you make decisions in your life."; dummy coded as strongly disagree, disagree, agree, or strongly agree; one of three interrelated questions on the NSDUH pertaining to religiosity/spirituality and deemed most relevant to the current analyses), and lifetime illicit use of cocaine, other stimulants, sedatives, tranquilizers, heroin, pain relievers, marijuana, 3, 4-methylenedioxymethamphetamine (MDMA)/ecstasy, phencyclidine (PCP), and inhalants (each substance category coded as separate covariates; no lifetime use = 0, lifetime use = 1). These covariates mirror those of prior investigations (Hendricks et al., 2015a, b) with the exception of survey year, employment status, and degree to which religious beliefs influence decisions, which were added to further address sources of possible confounding.

Statistical analyses

We used generalized ordered logit regression to test the relationships of classic psychedelic use and group membership with past year drug distribution, past year larceny/theft, and past year assault controlling for the covariates listed above (Williams, 2006). Generalized ordered logit regression relaxes the assumption that the effects of independent variables are proportional across levels of the dependent variable, improving model fit when the proportional odds assumption is violated (Williams, 2016). For each of these three ordinal outcomes, we first estimated models in which the estimated effects of drug use variables were relaxed while holding the effects of covariates constant across levels of the dependent variable. Based on these results, we tested whether estimated coefficients differed across levels of the dependent variable using Wald tests. We then re-estimated the models, allowing any coefficient found to significantly differ across levels of the dependent variable to vary across said levels, while holding all other coefficients constant. An ordered logit model in which the proportional odds assumption is relaxed for some but not all variables is also known as a partial proportional odds model (Peterson and Harrell, 1990). Because all variables pertaining to arrest histories were dichotomously coded, we used binomial logistic regression to test the relationships of classic psychedelic use and group membership with past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime while controlling for the aforementioned covariates.

All data management was conducted in SAS 9.4 and all analyses were conducted in STATA 14. Generalized ordered logit regression was performed using the 'gologit2' user written STATA package (Williams, 2006). All analyses accounted for the complex study design variables, sampling weights, and pooling of data from multiple survey years as recommended by the NSDUH.

Results

Descriptive statistics

Supplemental Table 1 presents frequencies of classic psychedelic use and criminal behavior variables. Consistent with prior reports (Hendricks et al., 2015a, b), lifetime classic psychedelic use was reported among approximately 1/7th of respondents; most respondents fell into the No Psychedelics group, followed by the Psilocybin & Other Psychedelics group, the Non-Psilocybin Psychedelics Only group, and finally, the Psilocybin Only group. Past year drug distribution, past year larceny/theft, past year assault, past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime were each infrequent outcomes, with weighted percentages ranging from 0.2 to 1.2.

Table 1 reports weighted descriptive statistics of lifetime classic psychedelic users versus non-lifetime classic psychedelic users. Similar to prior analyses (Hendricks et al., 2015a), lifetime classic psychedelic use was concentrated among 26 to 34 year olds and 35 to 49 year olds, but less common among those 50 years of age or older. Furthermore, lifetime classic psychedelic use was more common among men, non-Hispanic Whites and Native Americans/Alaska Natives, those with greater educational attainment and income, those who were divorced/separated or who had never been married, individuals with greater self-reported engagement in risky behavior, and those who reported lifetime illicit use of each of the other substances. Lifetime classic psychedelic use was also more common among employed individuals and those who reported less influence of religious beliefs on their decisions. Though lifetime classic psychedelic use varied by survey year, findings revealed no readily interpretable pattern (results not presented in this report).

Table 2 reports weighted descriptive statistics of the Psilocybin Only, Psilocybin & Other Psychedelics, Non-Psilocybin Psychedelics Only, and No Psychedelics groups. As shown in the table, the groups differed significantly on all covariates. The Psilocybin Only group tended to be younger, more educated, higher income, and more likely to have never been married than the other three groups. The Psilocybin Only group comprised more men and non-Hispanic Whites than the No Psychedelics and Non-Psilocybin Psychedelics Only group, but fewer men and non-Hispanic Whites than the Psilocybin & Other Psychedelics group. In addition, the Psilocybin Only group was more likely to be employed than the No Psychedelics group and reported greater engagement in risky behavior and less influence of religious beliefs on their decisions than the No Psychedelics and Non-Psilocybin Psychedelics Only groups. Finally, the Psilocybin Only group was more likely to report lifetime illicit use of each of the other substances than the No Psychedelics group, but less likely to report lifetime illicit use of each of the other substances than the Psilocybin & Other Psychedelics group. The Psilocybin Only group was more likely to report lifetime illicit use of tranquilizers, pain relievers, marijuana, MDMA/Ecstasy, and inhalants but less likely to report lifetime illicit use of cocaine, other stimulants, sedatives, heroin, and PCP as compared with the Non-Psilocybin Psychedelics Only group. Group membership also varied by year, but with no obvious pattern (results not presented in this report).

Outcomes

Table 3 reports results from generalized ordered logistic regression models predicting past year drug distribution, past year larceny/theft, and past year assault. As shown in this table, lifetime classic psychedelic use was associated with an increased odds of past year drug distribution one or more times. Results of a Wald test indicated the estimated association between lifetime classic psychedelic use and past year drug distribution differed across levels of the dependent variable and that the association was stronger among individuals who distributed drugs more frequently. Lifetime illicit use of each of the other substances was associated with an increased odds of past year drug distribution, with the exception of lifetime sedative and PCP use, which were not significantly associated with this outcome (both aORs $\geq$ 1.0). Lifetime classic psychedelic use was also associated with a decreased odds of past year larceny/theft and retained the same association in both models because the effect was assumed to be proportional across levels of the dependent variable. Conversely, lifetime illicit use of each of the other substances was associated with an increased odds of past year larceny/theft, with the exception of lifetime sedative and PCP use, which were not significantly associated with this outcome (both aORs > 1.0). Finally, lifetime classic psychedelic use was associated with a decreased odds of past year assault and retained the same association in both models because the effect was assumed to be proportional across levels of the dependent variable. Lifetime illicit use of each of the other substances was associated with an increased odds of past year assault, with the exception of lifetime cocaine, other stimulant, and heroin use, which were not significantly associated with this outcome (all aORs > 1.0).

Table 4 reports results from generalized ordered logistic regression models predicting past year drug distribution, past year larceny/theft, and past year assault as a function of group membership. Relative to the Psilocybin Only group, both the No Psychedelics and Non-Psilocybin Psychedelics Only groups were less likely to report past year drug distribution. The Psilocybin Only and Psilocybin & Other Psychedelics groups did not differ on this outcome. These effects were assumed to be proportional across levels of the dependent variable. The No Psychedelics group was more likely to report past year larceny/theft as compared with the Psilocybin Only group, whereas the Psilocybin & Other Psychedelics group was less likely to report past year larceny/theft as compared with the Psilocybin Only group. However, a Wald test indicated that the association of the Psilocybin & Other Psychedelics group with past year larceny/theft differed across levels of the dependent variable and was significantly stronger among individuals who reported past year larceny/theft more than two times. Consequently, the estimated odds of past year larceny/theft more than two times did not differ between the Psilocybin Only and Psilocybin & Other Psychedelics group. The Psilocybin Only and Non-Psilocybin Psychedelics

Table 1. Characteristics of lifetime classic psychedelic users versus non-lifetime classic psychedelic users.

Variable	Lifetime classic psychedelic users	Non-lifetime classic psychedelic users	*p*
	Weighted %	Weighted %	
Age, years			<0.0001
18 to 25	15.4	14.7	
26 to 34	21.2	15.1	
35 to 49	36.1	27.0	
50 and older	27.2	43.3	
Sex			<0.0001
Male	62.4	46.0	
Female	37.6	54.1	
Ethnoracial identity			<0.0001
Non-Hispanic White	84.0	65.9	
Non-Hispanic African American	3.9	12.6	
Non-Hispanic Native American/Alaska Native	1.0	0.4	
Non-Hispanic Native Hawaiian/Pacific Islander	0.2	0.3	
Non-Hispanic Asian	1.2	5.0	
Non-Hispanic more than one race	1.9	1.1	
Hispanic	7.8	14.5	
Educational attainment			<0.0001
5th grade or less	0.3	1.7	
6th grade	0.2	1.5	
7th grade	0.2	0.6	
8th grade	0.8	1.9	
9th grade	1.9	2.5	
10th grade	3.2	3.1	
11th grade	5.1	4.7	
12th grade	28.6	31.1	
Freshman college year	10.1	8.5	
Sophomore or junior college year	20.3	16.6	
Senior college year or more	29.3	27.8	
Annual household income			<0.0001
Less than $20,000	17.0	19.0	
$20,000 to $49,999	31.4	34.3	
$50,000 to $74,999	18.2	17.4	
$75,000 or more	33.3	29.2	
Marital status			<0.0001
Married	46.7	55.6	
Widowed	1.6	6.9	
Divorced/Separated	18.3	12.8	
Never married	33.4	24.7	
Employment status			<0.0001
Full time	63.5	51.0	
Part time	14.1	13.5	
Unemployed	6.1	4.3	
Other	16.3	31.2	
Self-reported engagement in risky behavior			<0.0001
Never	26.7	55.0	
Seldom	44.9	32.8	
Sometimes	25.5	11.1	
Always	2.9	1.1	
Religious beliefs influence decisions			<0.0001
Strongly disagree	21.0	11.4	
Disagree	21.6	13.6	
Agree	37.3	38.7	
Strongly agree	20.1	36.2	
Lifetime illicit substance use			
Lifetime cocaine use	71.1	7.3	<0.0001
Lifetime other stimulant use	38.5	3.8	<0.0001
Lifetime sedative use	19.4	1.2	<0.0001
Lifetime tranquilizer use	37.6	4.9	<0.0001
Lifetime heroin use	10.6	0.4	<0.0001
Lifetime pain reliever use	45.6	9.1	<0.0001
Lifetime marijuana use	98.1	35.7	<0.0001
Lifetime MDMA/ecstasy use	31.2	1.9	<0.0001
Lifetime PCP use	18.5	0.4	<0.0001
Lifetime inhalant use	40.6	3.8	<0.0001
Weighted *N* (%)	30,711,342 (13.6)	194,394,381 (86.4)	

Note. All percentages rounded to the nearest tenth of a percent; cumulative percentages may not add to 100.0. Rao–Scott chi-square tests were used to examine the characteristics of lifetime classic psychedelic users versus non-lifetime classic psychedelic users. MDMA: 3,4-methylenedioxymethamphetamine; PCP: phencyclidine.

Only groups did not differ with regard to past year larceny/theft. Finally, the No Psychedelics group was more likely to report past year assault as compared with the Psilocybin Only group. Neither the Psilocybin & Other Psychedelics nor the Non-Psilocybin Psychedelics Only group differed from the Psilocybin Only group on this outcome. These effects were assumed to be proportional across levels of the dependent variable.

Table 5 reports results from binomial logistic regression models predicting past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime. Lifetime classic psychedelic use was not associated with past year arrest for a drug-related crime. Lifetime illicit use of each of the other substances was associated with an increased odds of past year arrest for a drug-related crime, with the exception of lifetime other stimulant and sedative use, which were not associated with this outcome (both aORs > 1.0), and lifetime inhalant use, which was associated with a decreased odds of this outcome. Lifetime classic psychedelic use was associated with a reduced odds of past year arrest for a property crime. All other lifetime illicit substance use variables were either associated with an increased odds of past year arrest for a property crime (cocaine, tranquilizers, heroin, and pain relievers) or not associated with this outcome (other stimulants, sedatives, MDMA/Ecstasy, PCP, Inhalants; all aORs > 1.0). Finally, lifetime classic psychedelic

Table 2. Characteristics of Psilocybin Only, Psilocybin & Other Psychedelics, Non-Psilocybin Psychedelics Only, and No Psychedelics groups.

Variable	Psilocybin Only	Psilocybin & Other Psychedelics	Non-Psilocybin Psychedelics Only	No Psychedelics	*p*
	Weighted %	Weighted %	Weighted %	Weighted %	
Age, years					<0.0001
18 to 25	31.8	14.6	8.7	14.7	
26 to 34	25.8	22.7	17.0	15.1	
35 to 49	29.4	36.9	38.3	26.9	
50 and older	12.9	25.8	36.0	43.3	
Sex					
Male	60.2	69.1	54.0	45.9	
Female	39.8	30.9	46.0	54.1	
Ethnoracial identity					<0.0001
Non-Hispanic White	83.3	87.7	79.2	65.9	
Non-Hispanic African American	2.8	1.8	7.3	12.6	
Non-Hispanic Native American/Alaska Native	0.5	0.7	1.7	0.4	
Non-Hispanic Native Hawaiian/Pacific Islander	0.3	0.2	0.2	0.3	
Non-Hispanic Asian	2.1	0.9	1.2	5.0	
Non-Hispanic more than one race	1.9	1.9	1.8	1.1	
Hispanic	9.1	6.7	8.6	14.5	
Educational attainment					<0.0001
5th grade or less	0.4	0.2	0.3	1.7	
6th grade	0.1	0.1	0.3	1.5	
7th grade	0.2	0.2	0.3	0.6	
8th grade	0.5	0.8	1.0	1.9	
9th grade	0.9	1.8	2.5	2.5	
10th grade	2.1	3.2	3.7	3.1	
11th grade	4.1	5.0	5.7	4.7	
12th grade	22.4	28.1	32.3	31.1	
Freshman college year	9.9	10.2	9.9	8.5	
Sophomore or junior college year	20.3	20.6	19.8	16.6	
Senior college year or more	38.9	29.8	24.0	27.8	
Annual household income					<0.0001
Less than $20,000	16.6	17.1	17.2	19.0	
$20,000 to $49,999	28.9	31.8	32.1	34.3	
$50,000 to $74,999	16.8	18.0	19.3	17.4	
$75,000 or more	37.7	33.1	31.4	29.2	
Marital status					<0.0001
Married	39.7	44.6	52.9	55.6	
Widowed	0.8	1.3	2.3	6.8	
Divorced/Separated	11.0	18.6	21.4	12.8	
Never married	48.5	35.4	23.3	24.7	
Employment status					<0.0001
Full time	63.2	64.8	61.8	51.0	
Part time	17.5	13.8	12.9	13.5	
Unemployed	6.5	6.2	5.7	4.3	
Other	12.8	15.2	19.5	31.2	
Self-reported engagement in risky behavior					<0.0001
Never	20.8	22.7	35.2	55.0	
Seldom	47.4	45.1	43.5	32.8	
Sometimes	28.3	28.7	19.8	11.1	
Always	3.5	3.5	1.6	1.1	
Religious beliefs influence decisions					<0.0001
Strongly disagree	24.8	22.9	16.5	11.4	
Disagree	23.1	22.2	20.1	13.6	
Agree	36.3	36.8	38.4	38.7	

(continued)

Table 2. (Continued)

Variable	Psilocybin Only	Psilocybin & Other Psychedelics	Non-Psilocybin Psychedelics Only	No Psychedelics	*p*
	Weighted %	Weighted %	Weighted %	Weighted %	
Strongly agree	15.7	18.1	25.0	36.2	
Lifetime illicit substance use					
Lifetime cocaine use	55.4	83.4	61.4	7.3	<0.0001
Lifetime other stimulant use	27.2	48.9	29.6	3.8	<0.0001
Lifetime sedative use	7.5	26.0	16.0	1.2	<0.0001
Lifetime tranquilizer use	30.7	47.2	27.6	4.9	<0.0001
Lifetime heroin use	3.6	15.0	7.7	0.4	<0.0001
Lifetime pain reliever use	43.7	55.1	33.3	9.1	<0.0001
Lifetime marijuana use	97.3	99.3	96.7	35.7	<0.0001
Lifetime MDMA/ecstasy use	32.3	41.5	16.3	1.9	<0.0001
Lifetime PCP use	2.7	25.9	15.9	0.4	<0.0001
Lifetime inhalant use	30.6	53.8	27.2	3.8	<0.0001
Weighted *N* (%)	5,143,062 (2.3)	14,872,415 (6.6)	10,695,865 (4.8)	194,394,381 (86.4)	

Note. Psilocybin Only: respondents reporting lifetime use of psilocybin but no other classic psychedelic; Psilocybin & Other Psychedelics: respondents reporting lifetime use of psilocybin in addition to other classic psychedelics; Non-Psilocybin Psychedelics Only: respondents reporting lifetime use of any classic psychedelic with the exception of psilocybin; No Psychedelics: respondents reporting no lifetime use of any classic psychedelic substance. All percentages rounded to the nearest tenth of a percent; cumulative percentages may not add to 100.0. Rao–Scott chi-square tests were used to examine the characteristics of the four groups. MDMA: 3,4-methylenedioxymethamphetamine; PCP: phencyclidine.

use was associated with a decreased odds of past year arrest for a violent crime. All other lifetime illicit substance use variables were either associated with an increased odds of past year arrest for a violent crime (cocaine, heroin, pain relievers, marijuana, MDMA/Ecstasy) or were not associated with this outcome (other stimulants, sedatives, PCP, inhalants; all but PCP aOR > 1.0).

Table 6 reports results from binomial logistic regression models predicting past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime as a function of group membership. No significant associations were found.

Discussion

The aim of the current research was to evaluate the associations of classic psychedelic use, and psilocybin use in particular, with criminal behavior in a large sample generalizable to the United States adult population. In support of hypotheses, lifetime classic psychedelic use was associated with a 27% decreased odds of past year larceny/theft, a 12% decreased odds of past year assault, a 22% decreased odds of past year arrest for a property crime, and an 18% decreased odds of past year arrest for a violent crime. Lifetime illicit use of other substances, in contrast, was largely associated with an increased odds of criminal behavior at or above the trend level. These findings are consistent with a growing body of research suggesting classic psychedelics confer enduring psychological and prosocial benefits (Bogenschutz et al., 2015; Carhart-Harris et al., 2016; Griffiths et al., 2016; Hendricks et al., 2015a; Johnson et al., 2014, 2017; Pisano et al., 2017; Ross et al., 2016) and an older (Arendsen-Hein, 1963; Tenenbaum, 1961) and newer (Hendricks et al., 2014; Walsh et al., 2016) literature indicating that classic psychedelics may be effective in preventing criminal behavior. The replication and extension of prior results is notable considering that scientific findings often fail to be replicated (Ioannidis, 2014; Open Science Collaboration, 2015). It is also noteworthy that whereas other recent studies have examined criminal recidivism, the present findings are based on a non-forensic sample with a majority of individuals who did not report any involvement with the criminal justice system. As such, the current results speak favorably to the generalizability of prior findings with correctional samples. Moreover, results were consistent across the complementary criteria of self-reported criminal behavior and arrest, which suggests that the apparent protective effects of classic psychedelic use are attributable to genuine reductions in antisocial behavior rather than reflecting improved evasion of arrest. Simply put, the positive effects associated with classic psychedelic use appear to be reliable. Acknowledging political hurdles, it is hoped that the current findings will contribute to a compelling rationale for the initiation of clinical research with classic psychedelics among groups at increased risk of engaging in criminal behavior, including released inmates and those engaged in problematic substance use. Given the cost to society and recalcitrance of criminal behavior, the potential represented by this treatment paradigm is significant. However, we feel it is essential to note that, given the intense, sensitive, and personal nature of primary mystical experiences, individual autonomy in the decision to engage in classic psychedelic-assisted treatment must be foregrounded, particularly with regard to vulnerable populations. The potential for coercion and undue incentivization in the administration of classic psychedelics to individuals in the criminal justice system is an issue that requires further scrutiny to ensure conformity with the highest possible ethical standards. It is our opinion that classic psychedelic-assisted treatments never be applied in a context that might be perceived as institutionally mandated.

Table 3. Results from generalized ordered logistic regression models predicting past year drug distribution, past year larceny/theft, and past year assault.

Variable	Past year drug distribution	*p*	Past year larceny/theft	*p*	Past year assault	*p*
0 vs. 1 or more	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Lifetime classic psychedelic use	1.47(1.35–1.59)	<0.0001	0.73(0.65–0.83)	<0.0001	0.88(0.80–0.97)	0.009
Lifetime cocaine use	1.52(1.40–1.65)	<0.0001	1.23(1.09–1.39)	0.001	1.10(0.98–1.22)	0.097
Lifetime other stimulant use	1.32(1.23–1.43)	<0.0001	1.20(1.07–1.34)	0.001	1.06(0.97–1.17)	0.197
Lifetime sedative use	1.05(0.94–1.18)	0.347	1.05(0.88–1.25)	0.603	1.11(0.92–1.35)	0.267
Lifetime tranquilizer use	1.46(1.34–1.59)	<0.0001	1.19(1.07–1.32)	0.002	1.17(1.05–1.30)	0.005
Lifetime heroin use	1.26(1.13–1.40)	<0.0001	1.73(1.48–2.03)	<0.0001	1.04(0.87–1.23)	0.679
Lifetime pain reliever use	1.91(1.79–2.05)	<0.0001	1.94(1.77–2.12)	<0.0001	1.66(1.53–1.80)	<0.0001
Lifetime marijuana use	1.72(1.56–1.90)	<0.0001	1.32(1.20–1.45)	<0.0001	1.37(1.26–1.50)	<0.0001
Lifetime MDMA/ecstasy use	1.70(1.56–1.85)	<0.0001	1.33(1.17–1.51)	<0.0001	1.38(1.26–1.50)	<0.0001
Lifetime PCP use	1.00(0.89–1.13)	0.915	1.13(0.95–1.34)	0.175	1.29(1.13–1.48)	<0.0001
Lifetime inhalant use	1.25(1.17–1.33)	<0.0001	1.41(1.27–1.57)	<0.0001	1.32(1.19–1.47)	<0.0001
Variable	Past year drug distribution	*p*	Past year larceny/theft	*p*	Past year assault	*P*
1 to 2 times vs. > 2	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Lifetime classic psychedelic use	1.68(1.54–1.85)	<0.0001	0.73(0.65–0.83)	<0.0001	0.88(0.80–0.97)	0.009
Lifetime cocaine use	1.52(1.40–1.65)	<0.0001	1.23(1.09–1.39)	0.001	1.10(0.98–1.22)	0.097
Lifetime other stimulant use	1.32(1.23–1.43)	<0.0001	1.20(1.07–1.34)	0.001	1.06(0.97–1.17)	0.197
Lifetime sedative use	1.05(0.94–1.18)	0.347	1.05(0.88–1.25)	0.603	1.46(1.08–1.97)	0.015
Lifetime tranquilizer use	1.46(1.34–1.59)	<0.0001	1.19(1.07–1.32)	0.002	1.17(1.05–1.30)	0.005
Lifetime heroin use	1.26(1.13–1.40)	<0.0001	2.88(2.37–3.49)	<0.0001	1.04(0.87–1.23)	0.679
Lifetime pain reliever use	1.91(1.79–2.05)	<0.0001	1.94(1.77–2.12)	<0.0001	1.66(1.53–1.80)	<0.0001
Lifetime marijuana use	5.47(4.35–6.89)	<0.0001	3.00(2.50–3.61)	<0.0001	1.86(1.56–2.22)	<0.0001
Lifetime MDMA/ecstasy use	1.70(1.56–1.85)	<0.0001	1.33(1.17–1.51)	<0.0001	1.67(1.43–1.95)	<0.0001
Lifetime PCP use	1.12(0.99–1.27)	0.066	1.13(0.95–1.34)	0.175	1.99(1.53–2.59)	<0.0001
Lifetime inhalant use	1.25(1.17–1.33)	<0.0001	1.41(1.27–1.57)	<0.0001	1.09(0.91–1.31)	0.335
N (unweighted)	484,616		485,071		485,185	
N (weighted)	221,687,999		221,791,920		221,824,983	

Note. For past year drug distribution, parallel slopes not assumed for lifetime classic psychedelic, marijuana, and PCP use. For past year larceny/theft, parallel slopes not assumed for lifetime marijuana and heroin use. For past year assault, parallel slopes not assumed for lifetime sedative, marijuana, MDMA/ecstasy, PCP, and inhalant use. Associations of demographic variables, study year, self-reported engagement in risky behavior, and degree to which religious beliefs influence decisions are not presented. MDMA: 3, 4-methylenedioxymethamphetamine; PCP: phencyclidine.

Mandated treatments are common in correctional settings, yet are generally ineffective (Parhar et al., 2008). Moreover, classic psychedelics were administered coercively and/or surreptitiously to unwitting human subjects in 1950s through the 1970s (Lee and Shlain, 1992), including to incarcerated samples without therapeutic intent (e.g. Isbell, 1959; Isbell et al., 1956, 1959; Isbell & Logan, 1957; Rosenberg et al., 1964). This unfortunate history should serve a strong cautionary tale for future investigations.

Contrary to hypotheses, lifetime classic psychedelic use was associated with a 47% to 68% increased odds of past year drug distribution. Lifetime illicit use of almost all other substances was also associated with an increased odds of this outcome. An obvious conclusion, therefore, is that one drug-related crime (use) predicts another (distribution), a contention supported by the research literature (e.g. Pedersen and Skardhamar, 2009). Considering that experienced drug users believe that classic psychedelics hold therapeutic potential (Carhart-Harris and Nutt, 2013), it may be that classic psychedelic use is associated with the distribution of classic psychedelics motivated in part by prosocial intention. There is historical precedent for this perspective, for instance, in organizations such as the Brotherhood of Eternal Love, which distributed LSD with the goal of improving the human condition (Lee and Shlain, 1992). It could not be determined which specific substances were distributed in the present analyses. However, lifetime classic psychedelic use was not associated with past year arrest for a drug-related crime, whereas lifetime illicit use of almost all other substances was associated with an increased odds of this outcome. Considering that approximately 70% of all drug-related arrests in the United States relate to heroin or cocaine and their derivatives, or marijuana, with arrests relating to classic psychedelics presumably so low that they are not specified (FBI Uniform Crime Report, 2015), it may be that classic psychedelic use is not associated with past year arrest for a drug-related crime because it largely aligns with possession, use, distribution, or manufacturing of classic psychedelics. In any event, these findings highlight that classic psychedelic use is not associated with a uniform reduction in all behavior deemed criminal. In support of this interpretation, recent survey results suggest that classic psychedelic use is associated with liberal and anti-authoritarian political views (Nour et al., 2017). Drug policy is contentious and drug-related crimes are generally not considered antisocial (Global Commission on Drug Policy, 2011; Room and Reuter, 2012). It

Table 4. Results from generalized ordered logistic regression models predicting past year drug distribution, past year larceny/theft, and past year assault as a function of group membership.

Variable	Past year drug distribution	*p*	Past year larceny/theft	*p*	Past Year assault	*p*
0 vs. 1 or more	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Psilocybin Only (reference group)	1.00	–	1.00	–	1.00	-
Psilocybin & Other Psychedelics	0.90(0.80–1.02)	0.089	0.85(0.72–0.99)	0.042	0.94(0.81–1.09)	0.416
Non-Psilocybin Psychedelics Only	0.56(0.48–0.65)	<0.0001	1.02(0.83–1.25)	0.850	1.12(0.95–1.32)	0.181
No Psychedelics	0.55(0.49–0.61)	<0.0001	1.29(1.13–1.48)	<0.0001	1.15(1.03–1.30)	0.016
Variable	Past year drug distribution	*p*	Past Year larceny/theft	*p*	Past Year assault	*p*
1 to 2 times vs. > 2	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Psilocybin Only (reference group)	1.00	–	1.00	–	1.00	-
Psilocybin & Other Psychedelics	0.90(0.80–1.02)	0.089	1.05(0.83–1.32)	0.695	0.94(0.81–1.09)	0.416
Non-Psilocybin Psychedelics Only	0.56(0.48–0.65)	<0.0001	1.02(0.83–1.25)	0.850	1.12(0.95–1.32)	0.181
No Psychedelics	0.50(0.44–0.56)	<0.0001	1.29(1.13–1.48)	<0.0001	1.15(1.03–1.30)	0.016
N (unweighted)	484,616		485,071		485,185	
N (weighted)	221,687,999		221,791,920		221,824,983	

Note. Psilocybin Only: respondents reporting lifetime use of psilocybin but no other classic psychedelic; Psilocybin & Other Psychedelics: respondents reporting lifetime use of psilocybin in addition to other classic psychedelics; Non-Psilocybin Psychedelics Only: respondents reporting lifetime use of any classic psychedelic with the exception of psilocybin; No Psychedelics: respondents reporting no lifetime use of any classic psychedelic substance. For past year larceny/theft, parallel slopes not assumed for Psilocybin & Other Psychedelics. Associations of demographic variables, study year, self-reported engagement in risky behavior, degree to which religious beliefs influence decisions, and lifetime illicit substance use are not presented.

Table 5. Results from binomial logistic regression models predicting past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime.

Variable	Past year arrest for a drug-related crime	*p*	Past year arrest for a property crime	*p*	Past year arrest for a violent crime	*p*
	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Lifetime classic psychedelic use	0.99(0.82–1.18)	0.871	0.78(0.65–0.95)	0.015	0.82(0.70–0.97)	0.023
Lifetime cocaine use	1.71(1.43–2.05)	<0.0001	1.59(1.32–1.90)	<0.0001	1.58(1.34–1.87)	<0.0001
Lifetime other stimulant use	1.19(0.99–1.43)	0.058	1.05(0.88–1.25)	0.580	1.08(0.92–1.27)	0.364
Lifetime sedative use	1.08(0.85–1.37)	0.545	1.18(0.89–1.56)	0.246	1.19(0.93–1.53)	0.166
Lifetime tranquilizer use	1.39(1.17–1.66)	<0.0001	1.42(1.21–1.67)	<0.0001	1.17(0.99–1.38)	0.058
Lifetime heroin use	1.80(1.50–2.17)	<0.0001	1.97(1.57–2.48)	<0.0001	1.42(1.12–1.81)	0.005
Lifetime pain reliever use	1.44(1.21–1.71)	<0.0001	1.51(1.28–1.77)	<0.0001	1.57(1.36–1.81)	<0.0001
Lifetime marijuana use	6.51(5.02–8.45)	<0.0001	1.92(1.62–2.27)	<0.0001	1.96(1.69–2.28)	<0.0001
Lifetime MDMA/ecstasy use	1.79(1.54–2.08)	<0.0001	1.18(1.00–1.40)	0.053	1.23(1.06–1.43)	0.006
Lifetime PCP use	1.25(1.02–1.55)	0.035	1.19(0.91–1.56)	0.192	1.19(0.95–1.49)	0.135
Lifetime inhalant use	0.80(0.70–0.92)	0.002	1.06(0.88–1.28)	0.565	0.92(0.77–1.10)	0.360
N (unweighted)	480,756		480,746		480,751	
N (weighted)	220,416,915		220,409,740		220,412,915	

Note. Associations of demographic variables, study year, self-reported engagement in risky behavior, and degree to which religious beliefs influence decisions are not presented. MDMA: 3,4-methylenedioxymethamphetamine; PCP: phencyclidine.

would not be surprising, then, if classic psychedelic use were associated with more liberal and anti-authoritarian attitudes toward drug use, as opposed to a more broadly antisocial propensity for transgressive behavior. This also leaves open the possibility that, consistent with contemporary critique of drug policy (Global Commission on Drug Policy, 2011; Room and Reuter, 2012), the prohibition of classic psychedelics causes harm insofar that it requires users to engage with the black market and risk adverse legal consequences, without in fact reducing antisocial crime.

We also hypothesized that lifetime psilocybin use, per se, would be associated with a decreased likelihood of past year criminal behavior. In partial support of hypotheses, those who reported lifetime use of psilocybin but no other classic psychedelic were less likely to report past year larceny/theft and past year assault than those reporting no lifetime use of any classic psychedelic. Contrary to hypotheses, those who reported lifetime use of psilocybin but no other classic psychedelic were more likely to report past year drug distribution than those reporting no lifetime use of any classic psychedelic and those

Table 6. Results from binomial logistic regression models predicting past year arrest for a drug-related crime, past year arrest for a property crime, and past year arrest for a violent crime as a function of group membership.

Variable	Past year arrest for a drug-related crime	*p*	Past year arrest for a property crime	*p*	Past year arrest for a violent crime	*p*
	aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
Psilocybin Only (reference group)	1.00	-	1.00	-	1.00	-
Psilocybin & Other Psychedelics	1.03(0.84–1.25)	0.806	0.80(0.61–1.05)	0.111	0.82(0.63–1.06)	0.134
Non-Psilocybin Psychedelics Only	1.07(0.88–1.29)	0.515	1.13(0.84–1.52)	0.407	1.17(0.85–1.60)	0.338
No Psychedelics	1.05(0.86–1.27)	0.638	1.23(0.95–1.60)	0.122	1.20(0.93–1.56)	0.162
N (unweighted)	480,756		480,736		480,751	
N (weighted)	220,416,915		220,409,740		220,412,915	

Note. Psilocybin Only: respondents reporting lifetime use of psilocybin but no other classic psychedelic; Psilocybin & Other Psychedelics: respondents reporting lifetime use of psilocybin in addition to other classic psychedelics; Non-Psilocybin Psychedelics Only: respondents reporting lifetime use of any classic psychedelic with the exception of psilocybin; No Psychedelics: respondents reporting no lifetime use of any classic psychedelic substance. Associations of demographic variables, study year, self-reported engagement in risky behavior, degree to which religious beliefs influence decisions, and lifetime illicit substance use are not presented.

reporting lifetime use of any classic psychedelic with the exception of psilocybin, and more likely to report larceny/theft than those reporting lifetime use of psilocybin in addition to other classic psychedelics. No other differences were found. It is noted that with the exception of past year drug distribution (the implications of which are discussed above), those who reported lifetime use of psilocybin but no other classic psychedelic were less likely to report criminal behavior at or above the trend level as compared with those reporting no lifetime use of any classic psychedelic and those reporting lifetime use of any classic psychedelic with the exception of psilocybin (i.e. all those reporting no lifetime use of psilocybin). Results are therefore consistent with a protective effect of psilocybin for antisocial criminal behavior and suggest clinical investigations making use of this particular agent may hold promise.

As described elsewhere (Hendricks et al., 2015a), there are a number of limitations of the current methodological design. Response biases inherent in self-report may have obscured the true relationships between classic psychedelic use and criminal behavior. Analyses were restricted to the available data, which preclude evaluating more precise dose-response relationships or associations between classic psychedelic use and specific types of drug distribution, among others. In addition, analyses relied on cross-sectional naturalistic data, which limit causal inferences. Though we attempted to control for multiple sources of potential confounding, a number of shared underlying or "third" variables may be responsible for the associations reported here (e.g. personality openness, spirituality, political orientation; Lerner and Lyvers, 2006; Lyvers and Meester, 2012; Móró et al., 2011; Nour et al., 2017). We also cannot rule out the possibility that classic psychedelic use may have caused harm at the individual level. Classic psychedelic use can aggravate certain mental health conditions and occasion challenging experiences characterized by anxiety, fear, panic, and paranoia. If such harms occurred, they failed to obfuscate population-level associations suggesting protective effects. This is consistent with recent survey data showing that almost 85% of those who have had challenging experiences after ingesting psilocybin mushrooms report benefiting from the experience (Carbonaro et al., 2016). Finally, we could not evaluate potential mechanisms of action underlying the associations of classic psychedelic use with criminal behavior. Though speculative, it is possible that mystical-type experiences are typified by awe, an emotion that may promote prosocial behavior via diminishment of the individual self (e.g. Piff et al., 2015).

Conclusion

The current study demonstrates that having ever used a classic psychedelic, and to some degree, having ever used psilocybin per se is associated with a decreased likelihood of larceny/theft and other property crimes as well as a decreased likelihood of assault and other violent crimes. These findings, coupled with both older and emerging bodies of evidence suggesting that classic psychedelics may provide enduring benefits for criminal justice populations, compel much-needed clinical research in forensic settings.

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