Original Paper

Psilocybin use is associated with lowered odds of crime arrests in US adults: A replication and extension

Grant M Jones and Matthew K Nock

Journal of Psychopharmacology
2022, Vol. 36(1) 66–73

DOI: 10.1177/02698811211058933
journals.sagepub.com/home/jop

Abstract

Background: The United States boasts the largest prison population in the world, conferring significant direct and indirect costs (e.g. lost wages for the incarcerated, increased morbidity/mortality, etc.) to society. Recidivism rates are high for the imprisoned and most interventions to reduce criminality are minimally effective. Thus, in addition to the need for criminal justice reform, there is a need to better understand factors linked to lowered criminal behavior.

Aim: The aim of this study was to assess the relationships between the use of classic psychedelic substances (psilocybin, LSD, peyote, and mescaline) and past year arrests for various crimes (i.e. property, violence, alcohol and substance use, miscellaneous crimes).

Methods: This study used nationally representative data from The National Survey on Drug Use and Health (NSDUH) (2015–2019) (N = 211,549) to test the aforementioned associations.

Results: Lifetime psilocybin use was associated with lowered odds of seven of 11 past year arrest variables (adjusted odds ratio (aOR) range = 0.30–0.73). Peyote was associated with reduced odds of motor vehicle theft (aOR = 0.30) and driving under the influence (aOR = 0.52), and mescaline was associated with reduced odds of drug possession/sale (aOR = 0.51). Virtually all other substances either shared no relationship to our outcomes or conferred higher odds of arrest.

Conclusion: This study suggests that use of classic psychedelic substances is associated with lowered odds of crime arrests. Future research should explore whether causal factors and/or third variable factors (e.g. personality, political orientation) underlie the relationship between classic psychedelic use and reduced criminal behavior.

Keywords

NSDUH, psychedelics, psilocybin, criminality, arrests

The United States currently has the largest prison population in the world as well as the highest per capita prison rate (Walmsley, 2018). Recidivism for the imprisoned is the rule, rather than the exception, as 77% of individuals are re-arrested within 5 years following their release (Alper et al., 2018; Yukhnenko et al., 2020) and many interventions meant to curb criminality have limited effectiveness (Harrison et al., 2020; Kettrey and Lipsey, 2018). Accordingly, the public health and economic costs of incarceration are immense. Incarceration costs the United States $80 billion in direct expenditures per year (Bureau of Justice Statistics (BJS), 2012) and some estimate the true cost to be as high as $1.2 trillion dollars (McLaughlin et al., 2016) once social costs such as the criminogenic nature of prison, lost wages for the incarcerated, and increased morbidity and mortality related to incarceration are accounted for (Binswanger et al., 2007; Spaulding et al., 2011; Weidner and Schultz, 2019). Alongside the need for structural changes to the criminal justice system, there is a clear and pressing need to identify factors associated with reduced criminal behavior.

Studies examining psychedelics have linked these compounds to reduced criminality. Psychedelic compounds are known to elicit perceptual shifts and mystical experiences that have profound and lasting personal and spiritual significance (Griffiths et al., 2006); additionally, recent trials indicate that psychedelic compounds like psilocybin (the active compound in "magic mushrooms") may alleviate a host of mental health conditions, including depression (Carhart-Harris et al., 2021; Davis et al., 2021) and anxiety (Grob et al., 2011). Four recent naturalistic studies have also tied the use of psychedelics to reduced odds of criminality. First, Hendricks et al. (2014) reported that hallucinogen use was associated with lowered odds of noncompliance of legal requirements (e.g. drug and alcohol abstinence) within a sample of 25,000 individuals under the supervision of community correction. Second, Walsh et al. (2016) found that hallucinogen use was associated with significantly reduced odds of intimate partner violence among 302 inmates. Third, Thiessen et al. (2018) conducted a survey of 1266 males and found LSD and psilocybin use to be associated with decreased odds of intimate partner violence as well as increased emotion regulation. Finally, Hendricks et al. (2018) analyzed data across 13 years of survey data from the National Survey on Drug Use and Health (NSDUH, 2002–2014) (N = ~480,000) and found that use of classic psychedelics (naturally occurring or derived hallucinogenic compounds) was associated with lowered odds of arrest for multiple forms of crime. Thus, there is a need to both replicate and

Department of Psychology, Harvard University, Cambridge, MA, USA

Corresponding author:
Grant M Jones, Department of Psychology, Harvard University, 33 Kirkland St, Cambridge, MA 02138, USA.
Email: gmj005@g.harvard.edu

extend findings surrounding the use of psychedelics for various crime-related outcomes.

The goal of this study was to test whether the use of classic psychedelic compounds is associated with lowered odds of crime arrests within the last 5 years of data from The National Survey on Drug Use and Health (NSDUH) (2015–2019). This article seeks to both replicate and extend findings from Hendricks et al. (2018) by testing both overlapping (larceny, motor vehicle theft, robbery, burglary, simple assault/battery, serious violent offense, drug sale/possession) and novel (public drunkenness, driving under the influence (DUI), fraud, and miscellaneous crimes) criminal arrest outcomes, allowing for greater insight into the generality of previous findings on classic psychedelics and crime. Furthermore, we hypothesized psilocybin to be the psychedelic substance that was most strongly related to reduced odds of criminal outcomes. Previous population-based research suggests that psilocybin may underlie previously observed associations between psychedelic use and lowered odds of adverse outcomes (Hendricks et al., 2015; Jones and Nock, 2021). Thus, in contrast to previous research that only has examined the association between classic psychedelics (as a group) and crime arrests, we also sought to test the associations between individual classic psychedelic compounds (psilocybin, LSD, peyote, mescaline) and crime arrest outcomes. This finer-grained analysis may provide greater insight into the nature of the previously reported associations between psychedelics and crime arrests.

Methods

Sample

Data were from the National Survey on Drug Use and Health (NSDUH), a yearly survey that seeks to collect the most up-to-date information on drug use and mental health outcomes in the United States. To ensure that the survey is representative of the US population, the NSDUH uses a weighted, complex survey design and employs a computer-assisted self-interviewing paradigm to gather survey responses from respondents aged 12 and older in all 50 states and the District of Columbia. NSDUH representatives administer the survey to participants within their homes, and participants are paid $30 for their participation. Individuals experiencing homelessness, active duty members, and currently incarcerated individuals are not included in the NSDUH survey.

Within our study, we analyzed the last 5 years of available NSDUH Data for U.S. adult participants aged 18 and older (US Department of Health and Human Services, 2015, 2016, 2017, 2018, 2019). The overall weighted response rates to the NSDUH survey for these years was between ~45% and 55%; additionally, response rates for the NSDUH are higher among females, Black participants, southerners, and individuals residing in non-metropolitan areas. The validity of NSDUH self-report measures has been tested and demonstrated in ancillary analyses (L. D. Harrison et al., 2007). All NSDUH data are publicly available: https://www.datafiles.samhsa.gov. The total sample size for the current study was 211,549.

Measures

Lifetime use (yes/no) of individual classic psychedelic substances (psilocybin, LSD, peyote, and mescaline), other illicit substances (MDMA/ecstasy, cocaine, heroin, phencyclidine (PCP), inhalants), and legal/medicinal substances of misuse (pain relievers, tranquilizers, stimulants, sedatives, and marijuana (legality varies by state)) formed the primary independent variables within our study. The primary dependent variables were past year arrest (yes/no) outcomes related to four different types of crime included within the NSDUH dataset: property crimes, violent crimes, alcohol and substance related crimes, and miscellaneous crimes.

In line with previous population-based research on this topic (Hendricks et al., 2018, 2015; Jones and Nock, 2021; Pisano et al., 2017), we report on (and statistically control for, as noted below) the following covariates within our analyses: sex (male or female), age (18–25, 26–34, 35–49, 50–64, or 65 or older), race (Non-Hispanic White, Non-Hispanic Black, 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 (5th grade or less, 6th grade, 7th grade, 8th grade, 9th grade, 10th grade, 11th grade, 11th or 12th grade, High School Diploma, Some College (No Degree), Associate's Degree, College Degree or Higher), self-reported engagement in risky behavior (never, seldom, sometimes, or always), annual household income (less than $20,000, $20,000–$49,999, $50,000–$74,999, or $75,000 or more), and marital status (married, divorced/separated, widowed, or never married). Demographic characteristics are listed in Table 1.

Data analyses

We estimated a series of 11 multivariable logistic regression models to test the unique associations between the aforementioned substances (entered simultaneously) and the 11 past year arrest variables (yes/no) as our outcomes: larceny, motor vehicle theft, robbery (theft + use of force/intimidation), burglary (illegal entry + intent to harm or steal), fraud/possession of stolen goods/vandalism, simple assault/battery, serious violent offense (e.g. aggravated assault, rape, homicide), drug sale/possession, public drunkenness, DUI, miscellaneous crimes (for any arrests that did not fall neatly within the categories provided by NSDUH). All aforementioned covariates were entered simultaneously into our models as well. Within our study, public drunkenness, DUI, fraud, and miscellaneous crimes were the four additional variables that extended the reach of the current study beyond that of Hendricks et al. (2018). We excluded any variables that consistently had fewer than 30 cases in a given year to ensure our models were well powered. In addition, ~1.6% of total responses were omitted from our analyses due to missing data. To incorporate the weighting and the survey design of the NSDUH into our models, we used the "Survey" package (Lumley, 2020) in R version 3.5.3.

Results

Prevalence

The total unweighted *N*s for past year arrest for each crime were as follows: larceny (671), motor vehicle theft (214), robbery (133), burglary (226), fraud (278), simple assault/battery (942), serious violence (467), drug possession/sale (1030), public intoxication (793), DUI (1171), and miscellaneous crimes (2278). The total unweighted *Ns* for lifetime use of each substance included in our analyses were: MDMA/ecstasy (21,195), psilocybin (22,276), LSD (22,552), peyote (3766), mescaline (4595),

Table 1. Demographics for lifetime psilocybin users versus non-users (2015–2019).

	Non-lifetime psilocybin users (weighted %)	Lifetime psilocybin users (weighted %)	*p* value
Age, years			<0.001
18–25	14	12.6	
26–34	15.3	22	
35–49	24.1	29.8	
50–64	24.9	29.2	
65 and older	21.6	6.5	
Sex			<0.001
Male	46.4	66	
Female	53.6	34	
Race			<0.001
Non-Hispanic White	61.8	83.3	
Non-Hispanic Black	12.9	2.2	
Non-Hispanic Native American/Alaska Native	0.5	0.6	
Non-Hispanic Native Hawaiian/Pacific Islander	0.4	0.2	
Non-Hispanic Asian	6	1.9	
Non-Hispanic more than one race	1.6	2.7	
Hispanic	16.8	9	
Annual household income ($)			<0.001
Less than 20,000	16.5	14.7	
20,000–49,999	29.7	27	
50,000–74,999	16	16.1	
75,000 or more	37.8	42.2	
Education			<0.001
5th grade or less	1.3	0.2	
6th grade	1.2	0.1	
7th grade	0.5	0.1	
8th grade	1.2	0.6	
9th grade	1.9	0.9	
10th grade	2.2	1.6	
11th or 12th grade	5.2	3.7	
High school diploma/GED	25.2	21.1	
Some college (no degree)	21	26.6	
Associate's degree	9.2	10.2	
College degree or higher	31.3	34.9	
Marital status			<0.001
Married	52.7	42.8	
Widowed	6.3	2.3	
Divorced or separated	13.5	17.4	
Never been married	27.6	37.5	
Self-reported engagement in risky behavior			<0.001
Never	58.1	26.5	
Seldom	30.4	44.9	
Sometimes	9.8	25.2	
Always	1.1	3.3	

cocaine (32,783), heroin (4790), PCP (3935), inhalants (21,856), prescription pain relievers (132,643), tranquilizers (48,572), stimulants (32,033), sedatives (27,218), and marijuana (110,175).

Associations between substance use and crime arrests

Tables 2–5 detail the results of the 11 logistic regression models predicting arrest for past year property crimes (larceny, motor vehicle theft, burglary, robbery, fraud), violent crimes (simple assault/battery, serious violence), alcohol and substance crimes (drug possession/sale, public drunkenness, DUI), and miscellaneous crimes. Bolded values indicate that a given substance is associated with lowered odds of a given outcome.

Psilocybin use was associated with lowered odds of three of five property crimes (larceny, robbery, and burglary), both violent crimes (simple assault/battery, serious violence), one of three alcohol and substance related crimes (DUI), and miscellaneous

Table 2. Results of multivariable logistic regressions predicting past year property crime arrests.

Lifetime use	Larceny	MV theft	Burglary	Robbery	Fraud
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Psilocybin	**0.67* (0.49, 0.93)**	1.0 (0.53, 1.93)	**0.39** (0.22, 0.67)**	**0.30** (0.15, 0.61)**	1.1 (0.62, 1.88)
LSD	0.78 (0.55, 1.10)	0.61 (0.31, 1.21)	0.88 (0.48, 1.62)	0.60 (0.34, 1.06)	0.77 (0.43, 1.38)
Peyote	0.74 (0.37, 1.50)	**0.30* (0.10, 0.90)**	1.2 (0.30, 4.92)	1.2 (0.21, 6.55)	1.3 (0.68, 2.35)
Mescaline	1.0 (0.58, 1.84)	1.2 (0.40, 3.42)	0.62 (0.22, 1.79)	1.2 (0.27, 5.75)	0.44 (0.20, 0.99)
MDMA/Ecstasy	1.2 (0.88, 1.60)	1.2 (0.59, 2.37)	2.2* (1.13, 4.18)	1.2 (0.55, 2.41)	1.4 (0.94, 2.15)
Cocaine	2.1*** (1.41, 3.09)	1.1 (0.64, 1.94)	1.0 (0.50, 2.02)	2.2 (0.88, 5.78)	3.0*** (1.72, 5.22)
Heroin	5.5*** (3.97, 7.64)	4.0*** (2.32, 7.04)	6.7*** (3.31, 13.7)	5.1** (1.92, 13.5)	2.3*** (1.47, 3.59)
PCP	1.2 (0.79, 1.83)	0.78 (0.35, 1.77)	1.4 (0.59, 3.30)	0.90 (0.35, 2.32)	1.8* (1.04, 3.27)
Inhalants	1.1 (0.83, 1.50)	1.2 (0.61, 2.55)	1.3 (0.62, 2.70)	1.3 (0.65, 2.60)	1.1 (0.67, 1.75)
Pain relievers	1.6** (1.20, 2.04)	0.88 (0.47, 1.65)	1.2 (0.85, 1.73)	1.2 (0.69, 1.93)	1.1 (0.73, 1.54)
Tranquilizers	1.3* (1.05, 1.71)	1.0 (0.66, 1.62)	1.6* (1.07, 2.48)	1.3 (0.70, 2.43)	1.2 (0.84, 1.68)
Stimulants	1.0 (0.73, 1.28)	1.5 (0.88, 2.40)	1.4 (0.78, 2.46)	1.5 (0.51, 4.35)	0.81 (0.54, 1.21)
Sedatives	1.2 (0.88, 1.58)	1.4 (0.79, 2.38)	0.60 (0.34, 1.05)	0.53 (0.22, 1.29)	1.2 (0.67, 2.03)
Marijuana	2.6*** (1.97, 3.47)	2.1 (1.02, 4.24)	1.3 (0.78, 2.21)	2.1* (1.04, 4.38)	3.5*** (2.08, 5.84)

MV = motor vehicle; aOR = adjusted odds ratio; CI = confidence interval; PCP = phencyclidine.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3. Results of multivariable logistic regressions predicting past year violent crime arrests (simple assault/battery, serious violent crimes).

Lifetime use	Assault	Serious violence
	aOR (95% CI)	aOR (95% CI)
Psilocybin	**0.71* (0.54, 0.94)**	**0.41*** (0.29, 0.60)**
LSD	1.0 (0.75, 1.32)	0.73 (0.45, 1.20)
Peyote	1.2 (0.69, 2.08)	1.4 (0.58, 3.53)
Mescaline	1.0 (0.66, 1.56)	0.73 (0.28, 1.89)
MDMA/Ecstasy	1.6** (1.17, 2.10)	1.6* (1.08, 2.37)
Cocaine	2.0*** (1.53, 2.71)	2.1** (1.34, 3.37)
Heroin	2.3*** (1.58, 3.26)	1.9* (1.14, 3.10)
PCP	1.2 (0.77, 1.75)	1.9* (1.08, 3.41)
Inhalants	0.92 (0.67, 1.26)	1.1 (0.67, 1.66)
Pain relievers	1.2 (0.98, 1.54)	1.1 (0.79, 1.50)
Tranquilizers	1.2 (0.94, 1.44)	1.4 (0.93, 1.99)
Stimulants	0.84 (0.66, 1.06)	0.85 (0.54, 1.34)
Sedatives	1.3* (1.07, 1.69)	1.1 (0.78, 1.55)
Marijuana	2.2*** (1.56, 3.02)	2.2*** (1.60, 2.89)

aOR = adjusted odds ratio; CI = confidence interval; PCP = phencyclidine.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

crimes. Psilocybin was unassociated with motor vehicle theft, fraud, drug possession/sale, or public drunkenness. Peyote conferred lowered odds of motor vehicle theft and DUI, while mescaline conferred lowered odds of drug possession/sale. LSD shared no relationships to our outcomes of interest.

No other substances were associated with a pattern of decreased odds of crime outcomes. Inhalants were, in one instance, associated with decreased odds of past year arrest (drug possession/sale). Besides this singular association, both illegal and legal/medicinal substances either shared no relationship to the past year arrest variables or increased odds of these outcomes. Notably, heroin was associated with increased odds of nearly all of our outcomes, and in some cases (e.g. burglary, robbery, larceny) conferred very large increases (5–6 times) in odds. Cocaine and marijuana use also were associated with substantial increases in odds (2–3 times) of several outcomes.

Discussion

The objective of this study was to test whether individual classic psychedelic compounds (psilocybin, LSD, mescaline, peyote) are associated with lowered odds of criminal outcomes. This study sought to not only replicate findings from Hendricks et al. (2018), but also expand upon them by providing insight into how individual classic psychedelics conferred lowered odds of specific criminal outcomes.

Results showed that individuals with a lifetime history of psilocybin use reported significantly lowered odds of seven of the 11 crime arrest outcomes (larceny, burglary, robbery, simple assault/battery, serious violence, DUI, and miscellaneous crimes). These findings add to the growing literature suggesting salutary outcomes associated with psilocybin use. The granular approach of this study (examining each type of psychedelic separately) yielded particularly strong associations that exceeded those of previous work. Hendricks et al. (2018) found that classic psychedelics decreased odds of criminal outcomes by 12–27%, whereas this study found that psilocybin in particular decreased odds of crime arrests by 27–70%, while other psychedelics examined in the NSDUH study showed weaker associations with crime arrests. For instance, LSD, which was the most commonly used classic psychedelic substance (11% prevalence), shared no relationships to any of our outcomes. Looking at classic psychedelics in aggregate may have weakened or eliminated the observed associations. Future population-based studies should make sure to study the effects that individual classic psychedelics share with criminal outcomes of interest.

Table 4. Results of multivariable logistic regressions predicting past year alcohol and substance use crime arrests (drug possession/sale, public intoxication, DUI).

Lifetime use	Drug possession/sale	Drunkenness	DUI
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Psilocybin	0.85 (0.65, 1.11)	0.75 (0.51, 1.11)	**0.73* (0.55, 0.98)**
LSD	1.0 (0.73, 1.29)	1.1 (0.72, 1.66)	1.0 (0.77, 1.33)
Peyote	1.0 (0.58, 1.55)	0.95 (0.50, 1.79)	**0.52* (0.30, 0.89)**
Mescaline	**0.51* (0.31, 0.84)**	1.6 (0.84, 2.98)	1.3 (0.71, 2.30)
MDMA/Ecstasy	2.1*** (1.71, 2.67)	1.2 (0.83, 1.64)	1.5** (1.17, 1.82)
Cocaine	1.6** (1.22, 1.99)	2.3*** (1.69, 3.08)	2.3*** (1.87, 2.94)
Heroin	3.9*** (3.00, 5.15)	1.2 (0.82, 1.64)	1.3* (1.04, 1.67)
PCP	1.2 (0.86, 1.70)	1.6 (0.89, 2.80)	1.4* (1.04, 1.97)
Inhalants	**0.75* (0.61, 0.93)**	1.1 (0.77, 1.53)	0.93 (0.74, 1.17)
Pain relievers	0.90 (0.70, 1.16)	1.2 (0.89, 1.49)	1.1 (0.92, 1.36)
Tranquilizers	1.8*** (1.44, 2.13)	1.3 (0.98, 1.61)	1.1 (0.94, 1.38)
Stimulants	1.2 (0.99, 1.52)	1.5* (1.10, 1.98)	1.3 (1.01, 1.61)
Sedatives	0.82 (0.65, 1.04)	0.91 (0.67, 1.24)	1.0 (0.78, 1.28)
Marijuana	6.0*** (3.90, 9.12)	2.1*** (1.55, 2.96)	2.5*** (1.97, 3.11)

DUI = driving under the influence; aOR=adjusted odds ratio; CI=confidence interval; PCP = phencyclidine.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 5. Results of multivariable logistic regression predicting miscellaneous crimes.

Miscellaneous crimes	
Lifetime use	aOR (95% CI)
Psilocybin	**0.73*** (0.62, 0.86)**
LSD	0.93 (0.74, 1.18)
Peyote	0.88 (0.52, 1.50)
Mescaline	1.2 (0.89, 1.62)
MDMA/Ecstasy	1.3* (1.07, 1.57)
Cocaine	1.6*** (1.35, 1.91)
Heroin	2.7*** (2.19, 3.44)
PCP	1.0 (0.72, 1.43)
Inhalants	0.88 (0.72, 1.07)
Pain relievers	1.0 (0.82, 1.12)
Tranquilizers	1.2* (1.06, 1.40)
Stimulants	1.1 (0.89, 1.25)
Sedatives	1.2 (0.98, 1.44)
Marijuana	2.4*** (2.02, 2.74)

aOR=adjusted odds ratio; CI=confidence interval; PCP = phencyclidine.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The granular approach of this study also allowed us to observe the relationships that peyote shares with motor vehicle theft (aOR=0.30) and DUI (aOR=0.52), as well as the relationship that mescaline shares with drug sale/possession (aOR=0.51). Although each of these substances was associated with only one or two of our 11 crime arrests outcomes, these findings represent some of the first that specifically link peyote and mescaline to reduced odds of criminal outcomes. Research on peyote and mescaline has been extremely limited, even when considering their Schedule 1 designations. Peyote is a small cactus that contains psychoactive properties and mescaline is the primary active compound found within peyote; both peyote and the derivative isolate mescaline are primarily used by indigenous North Americans. There are only few historical studies (Albaugh and Anderson, 1974; Bergman, 1971; Blum et al., 1977) and modern studies (Halpern et al., 2005; Prince et al., 2019) exploring peyote and mescaline use and psychological outcomes within Native American populations and even fewer that that explore the potentially salutary effects of these specific compounds in the population more broadly (Agin-Liebes et al., 2021; Uthaug et al., 2021). Future research that explores whether peyote and mescaline confer lowered odds of other adverse outcomes would fill critical gaps in our knowledge about these compounds.

It is important to note that the correlational nature of this study precludes us from making any causal claims about the potential of psilocybin, mescaline, or peyote for reducing criminal behavior. As has been named in numerous population-based studies, there are likely third variable factors (e.g. personality factors, liberal political leanings) that strongly contributed to the findings within our study related to crime arrests (Hendricks et al., 2018; Jones and Nock, 2021; Lerner and Lyvers, 2006; Lyvers and Meester, 2012; Móró et al., 2011; Nour et al., 2017). Furthermore, "crime" is a social construct dictated by cultural norms and government policies; thus, third variable factors related to the law and the criminal justice system inherently shape our results as well.

In addition, as has been stated within Jones and Nock (2021), these data preclude us from controlling for temporality, as psilocybin, peyote, or mescaline use may have taken place subsequent to arrest within our sample. Therefore, reverse causal explanations of our findings are also possible: crime arrests may instead drive patterns of psychedelic use within our study. On balance, given that our outcomes are assessed over the past year and substance use is assessed over an entire lifetime, it is unlikely that the observed findings are the result of crime arrests temporally predicting substance use in this case.

Furthermore, there are important limitations in our study related to the NSDUH sample as well. As previously stated, the

NSDUH does not included incarcerated individuals or individuals experiencing homelessness in the survey; these two populations are important to investigate to fully understand the relationship between psychedelic use and criminal behavior. Future research should ensure the inclusion of these populations to maximize the fidelity of the results.

Given the limitations named above, a natural next step is to more directly test whether psilocybin, and potentially peyote and mescaline, reduce the odds of criminal arrests. Future research should also explore the third variable factors (e.g. personality traits, political leanings) that may underlie our observed associations, as they too may allow us to better understand risk factors and protective factors for criminal behavior.

An important point raised within Hendricks et al. (2018) that we wish to reiterate is that great care should be taken when considering testing these compounds within incarcerated or vulnerable populations. These risks are further amplified by the fact that incarcerated populations are largely Hispanic and Black, as minority populations have historically been subject to mistreatment and abuse within medical research (Brandt, 1978). Coercive experimentation on the incarcerated can have can have deleterious effects (Brecht et al., 2005), and there is a history of state agencies inappropriately and coercively testing psychedelic compounds to manipulate behavior (Passie and Benzenhöfer, 2018; Savage, 1952). Therefore, rigorous ethical frameworks are essential when seeking to further explore the link between psychedelics and crime.

Prior to investigations involving individuals within the criminal justice system, research can explore the effects of psilocybin on the antecedents of criminal behavior. Psilocybin and potentially other classic psychedelic substances may affect some of the mental health conditions that often underlie criminal behavior. Despite the Schedule 1 designation of all classic psychedelic compounds (no accepted medical value and a high risk for abuse), recent studies have demonstrated preliminary associations between these compounds and the alleviation of a host of mental health disorders. Clinical trials and epidemiological research have linked hallucinogenic compounds to the alleviation of mood disorders (Davis et al., 2021; Griffiths et al., 2016), alcohol and substance use disorders (Bogenschutz and Johnson, 2016; Johnson et al., 2014; Pisano et al., 2017), anxiety disorders (Danforth et al., 2018; Dos Santos et al., 2016; Gasser et al., 2014; Griffiths et al., 2016), and trauma-related disorders (Mithoefer et al., 2016, 2011, 2013, 2019; Ot'alora et al., 2018). In addition, given that psychedelic and hallucinogenic substances have been found to create lasting changes in personality structure (MacLean et al., 2011), these substances may support individuals with personality pathologies as well (Domínguez-Clavé et al., 2016).

Many of the mental health disorders that psychedelics may alleviate are found in high rates in criminal offenders. Upward of ~10% of prisoners have mood disorders, ~40–60% have personality disorders (including ~20–50% who have antisocial personality disorder), ~30% have alcohol use disorder, and ~50–60% of prisoners have substance use disorders (Fazel and Baillargeon, 2011; Fazel et al., 2006). In addition, the prison population has trauma exposure and posttraumatic stress disorder rates that are roughly 10 times the average population (Fazel and Baillargeon, 2011) and trauma exposure has been linked to antisocial and criminal behavior (Krischer and Sevecke, 2008). The research on psychedelic compounds is in its early stages and thus much remains to be discovered about whether these substances alleviate conditions that confer risk for criminal behavior. Future investigations can shed more light on the relationship that psychedelic compounds share with crime.

In addition, future investigations exploring how structural/legal factors impact the relationship between psychedelic compounds and crime will also be critical. The 500% increase in incarceration rates in the United States that has occurred in the past 40 years is largely attributed to shifts in drug policies, rather than increases in criminal behavior (The Sentencing Project, 2020). As previously stated, existing laws necessarily dictate how actions and behaviors are criminalized and thus how psychedelics impact criminal behavior. Future investigations into the impact of legislation on classic psychedelics and crime would further enhance our understanding of the associations reported in this study.

Finally, it feels important to note that these findings add yet more evidence suggesting that the Schedule 1 designation (no medical value and a high potential for abuse) of psilocybin and other hallucinogenic compounds should be reviewed and potentially updated to facilitate further investigation into these compounds. The decisive results yielded by this study, linking psilocybin to reduced arrest rates, starkly challenge traditional narratives that suggest all illegal compounds necessarily confer greater odds of adverse, antisocial outcomes. The next directions invited by this research are virtually impossible given the legal status of these substances. Hopefully, updated legislation can allow us to develop deeper insight into how exactly psilocybin, mescaline, and peyote are associated with reduced criminal behavior.

Conclusion

This study revealed an association between classic psychedelics—primarily psilocybin and to a lesser extent peyote and mescaline—and reduced odds of criminal arrests. Future experimental research is needed to test whether there is a causal link between these compounds and reduced criminal behavior. Given the ethical issues that are inherent to testing these substances within incarcerated populations, investigations that explore the impact of classic psychedelics on risk factors for crime and longitudinal studies featuring criminal outcomes may represent propitious next steps for this line of research. Overall, psilocybin and potentially peyote and mescaline are compounds that warrant further investigation due to their link with lowered odds of criminal outcomes.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Nock receives publication royalties from Macmillan, Pearson, and UpToDate. He has been a paid consultant in the past year for Microsoft Corporation, the Veterans Health Administration, Cerebral, and a legal case regarding a death by suicide. He is an unpaid scientific advisor for Empatica, Koko, and TalkLife.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Grant M Jones https://orcid.org/0000-0002-2426-310X

References

Albaugh BJ and Anderson PO (1974) Peyote in the treatment of alcoholism among American Indians. *The American Journal of Psychiatry* 131(11): 1247–1250.

Alper M, Durose M and Markman J (2018) *2018 Update on Prisoner Recidivism: A 9-Year Follow-Up Period (2005–2014)*. Washington, DC: Bureau of Justice Statistics.

Agin-Liebes, G., Haas, T. F., Lancelotta, R., Uthaug, M. V., Ramaekers, J. G., & Davis, A. K. (2021). Naturalistic use of mescaline iIs associated with self-reported psychiatric improvements and enduring positive life changes. *ACS Pharmacology & Translational Science*, *4*(2), 543–552. https://doi.org/10.1021/acsptsci.1c00018

Bergman RL (1971) Navajo peyote use: Its apparent safety. *American Journal of Psychiatry* 128(6): 695–699.

Binswanger IA, Stern MF, Deyo RA, et al. (2007) Release from prison—A high risk of death for former inmates. *The New England Journal of Medicine* 356(2): 157–165.

Blum K, Futterman SFL and Pascarosa P (1977) Peyote, a potential ethnopharmacologic agent for alcoholism and other drug dependencies: Possible biochemical rationale. *Clinical Toxicology* 11(4): 459–472.

Bogenschutz MP and Johnson MW (2016) Classic hallucinogens in the treatment of addictions. *Progress in Neuro-Psychopharmacology and Biological Psychiatry* 64: 250–258.

Brandt AM (1978) Racism and research: The case of the Tuskegee syphilis study. *Hastings Center Report* 8(6): 21–29.

Brecht M-L, Anglin MD and Dylan M (2005) Coerced treatment for methamphetamine abuse: Differential patient characteristics and outcomes. *The American Journal of Drug and Alcohol Abuse* 31(2): 337–356.

Kyckelhahn T (2015) *Justice Expenditure and Employment Extracts, 2012—Preliminary*. Washington, DC: Bureau of Justice Statistics. Available at: https://www.bjs.gov/index.cfm?ty=pbdetail&iid=5239

Carhart-Harris R, Giribaldi B, Watts R, et al. (2021) Trial of psilocybin versus escitalopram for depression. *New England Journal of Medicine* 384(15): 1402–1411.

Danforth AL, Grob CS, Struble C, et al. (2018) Reduction in social anxiety after MDMA-assisted psychotherapy with autistic adults: A randomized, double-blind, placebo-controlled pilot study. *Psychopharmacology* 235(11): 3137–3148.

Davis AK, Barrett FS, May DG, et al. (2021) Effects of psilocybin-assisted therapy on major depressive disorder: A randomized clinical trial. *JAMA Psychiatry* 78(5): 481–489.

Domínguez-Clavé E, Soler J, Elices M, et al. (2016) Ayahuasca: Pharmacology, neuroscience and therapeutic potential. *Brain Research Bulletin* 126(Part 1): 89–101.

Dos Santos RG, Osório FL, Crippa JAS, et al. (2016) Antidepressive, anxiolytic, and antiaddictive effects of ayahuasca, psilocybin and lysergic acid diethylamide (LSD): A systematic review of clinical trials published in the last 25 years. *Therapeutic Advances in Psychopharmacology* 6(3): 193–213.

Fazel S and Baillargeon J (2011) The health of prisoners. *Lancet (London, England)* 377(9769): 956–965.

Fazel S, Bains P and Doll H (2006) Substance abuse and dependence in prisoners: A systematic review. *Addiction* 101(2): 181–191.

Gasser P, Holstein D, Michel Y, et al. (2014) Safety and efficacy of lysergic acid diethylamide-assisted psychotherapy for anxiety associated with life-threatening diseases. *The Journal of Nervous and Mental Disease* 202(7): 513–520.

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. *Journal of Psychopharmacology (Oxford, England)* 30(12): 1181–1197.

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(3): 268–283.

Grob CS, Danforth AL, Chopra GS, et al. (2011) Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. *Archives of General Psychiatry* 68(1): 71–78.

Halpern JH, Sherwood AR, Hudson JI, et al. (2005) Psychological and cognitive effects of long-term peyote use among Native Americans. *Biological Psychiatry* 58(8): 624–631.

Harrison JL, O'Toole SK, Ammen S, et al. (2020) Sexual offender treatment effectiveness within cognitive-behavioral programs: A meta-analytic investigation of general, sexual, and violent recidivism. *Psychiatry, Psychology and Law* 27(1): 1–25.

Harrison LD, Martin SS, Enev T, et al. (2007) *Comparing Drug Testing and Self-Report of Drug Use among Youths and Young Adults in the General Population: (637122007–001)* [Data set]. Washington, DC: American Psychological Association. Available at: https://doi.org/10.1037/e637122007-001

Hendricks PS, Clark CB, Johnson MW, et al. (2014) Hallucinogen use predicts reduced recidivism among substance-involved offenders under community corrections supervision. *Journal of Psychopharmacology* 28(1): 62–66.

Hendricks PS, Crawford MS, Cropsey KL, et al. (2018) The relationships of classic psychedelic use with criminal behavior in the United States adult population. *Journal of Psychopharmacology* 32(1): 37–48.

Hendricks PS, Johnson MW and Griffiths RR (2015) Psilocybin, psychological distress, and suicidality. *Journal of Psychopharmacology (Oxford, England)* 29(9): 1041–1043.

Johnson MW, Garcia-Romeu A, Cosimano MP, et al. (2014) Pilot study of the 5-HT2AR agonist psilocybin in the treatment of tobacco addiction. *Journal of Psychopharmacology (Oxford, England)* 28(11): 983–992.

Jones G and Nock MK (2021) MDMA/ecstasy and psilocybin use are associated with lowered odds of psychological distress and suicidal thoughts in a sample of U.S. adults. *Journal of Psychopharmacology* (in press).

Kettrey HH and Lipsey MW (2018) The effects of specialized treatment on the recidivism of juvenile sex offenders: A systematic review and meta-analysis. *Journal of Experimental Criminology* 14(3): 361–387.

Krischer MK and Sevecke K (2008) Early traumatization and psychopathy in female and male juvenile offenders. *International Journal of Law and Psychiatry* 31(3): 253–262.

Lerner M and Lyvers M (2006) Values and beliefs of psychedelic drug users: A cross-cultural study. *Journal of Psychoactive Drugs* 38(2): 143–147.

Lumley T (2020) Survey: Analysis of complex survey samples. R package version 4.0 [Computer software]. Available at: https://CRAN.R-project.org/package=survey

Lyvers M and Meester M (2012) Illicit use of LSD or psilocybin, but not MDMA or nonpsychedelic drugs, is associated with mystical experiences in a dose-dependent manner. *Journal of Psychoactive Drugs* 44(5): 410–417.

McLaughlin M, Pettus-Davis C, Brown D, et al. (2016) *The economic burden of incarceration in the U.S.* Working Paper #CI072016. St. Louis, MO: Concordance Institute for Advancing Social Justice.

MacLean KA, Johnson MW and Griffiths RR (2011) Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *Journal of Psychopharmacology (Oxford, England)* 25(11): 1453–1461.

Mithoefer MC, Feduccia AA, Jerome L, et al. (2019) MDMA-assisted psychotherapy for treatment of PTSD: Study design and rationale for phase 3 trials based on pooled analysis of six phase 2 randomized controlled trials. *Psychopharmacology* 236(9): 2735–2745.

Mithoefer MC, Grob CS and Brewerton TD (2016) Novel psychopharmacological therapies for psychiatric disorders: Psilocybin and MDMA. *The Lancet Psychiatry* 3(5): 481–488.

Mithoefer MC, Wagner MT, Mithoefer AT, et al. (2011) The safety and efficacy of ±3,4-methylenedioxymethamphetamine-assisted psychotherapy in subjects with chronic, treatment-resistant posttraumatic stress disorder: The first randomized controlled pilot study. *Journal of Psychopharmacology* 25(4): 439–452.

Mithoefer MC, Wagner MT, Mithoefer AT, et al. (2013) Durability of improvement in post-traumatic stress disorder symptoms and absence of harmful effects or drug dependency after 3,4-methylenedioxymethamphetamine-assisted psychotherapy: A prospective long-term follow-up study. *Journal of Psychopharmacology* 27(1): 28–39.

Móró L, Simon K, Bárd I, et al. (2011) Voice of the psychonauts: Coping, life purpose, and spirituality in psychedelic drug users. *Journal of Psychoactive Drugs* 43(3): 188–198.

Nour MM, Evans L and Carhart-Harris R (2017) Psychedelics, personality and political perspectives. *Journal of Psychoactive Drugs* 49(3): 182–191.

Ot'alora GM, Grigsby J, Poulter B, et al. (2018) 3,4-Methylenedioxymethamphetamine-assisted psychotherapy for treatment of chronic posttraumatic stress disorder: A randomized phase 2 controlled trial. *Journal of Psychopharmacology* 32(12): 1295–1307.

Passie T and Benzenhöfer U (2018) MDA, MDMA, and other "mescaline-like" substances in the US military's search for a truth drug (1940s to 1960s). *Drug Testing and Analysis* 10(1): 72–80.

Pisano VD, Putnam NP, Kramer HM, et al. (2017) The association of psychedelic use and opioid use disorders among illicit users in the United States. *Journal of Psychopharmacology* 31(5): 606–613.

Prince MA, O'Donnell MB, Stanley LR, et al. (2019) Examination of recreational and spiritual peyote use among American Indian youth. *Journal of Studies on Alcohol and Drugs* 80(3): 366–370.

Savage C (1952) Lysergic acid diethylamide; a clinical-psychological study. *The American Journal of Psychiatry* 108(12): 896–900.

Spaulding AC, Seals RM, McCallum VA, et al. (2011) Prisoner survival inside and outside of the institution: Implications for health-care planning. *American Journal of Epidemiology* 173(5): 479–487.

The Sentencing Project (2020) *Trends in U.S. Corrections*. Washington, DC: The Sentencing Project, August. Available at: https://www.sentencingproject.org/wp-content/uploads/2021/07/Trends-in-US-Corrections.pdf

Thiessen MS, Walsh Z, Bird BM, et al. (2018) Psychedelic use and intimate partner violence: The role of emotion regulation. *Journal of Psychopharmacology* 32(7): 749–755.

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality (2015) National survey on drug use and health, 2015. Available at: https://datafiles.samhsa.gov/

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality (2016) National survey on drug use and health, 2016. Available at: https://datafiles.samhsa.gov/

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality (2017) National survey on drug use and health, 2017. Available at: https://datafiles.samhsa.gov/

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality (2018) National survey on drug use and health, 2018. Available at: https://datafiles.samhsa.gov/

United States Department of Health and Human Services. Substance Abuse and Mental Health Services Administration. Center for Behavioral Health Statistics and Quality (2019) National survey on drug use and health, 2019. Available at: https://datafiles.samhsa.gov/

Uthaug, M. V., Davis, A. K., Haas, T. F., Davis, D., Dolan, S. B., Lancelotta, R., Timmermann, C., & Ramaekers, J. G. (2021). The epidemiology of mescaline use: Pattern of use, motivations for consumption, and perceived consequences, benefits, and acute and enduring subjective effects. *Journal of Psychopharmacology*, 02698811211013583. https://doi.org/10.1177/02698811211013583

Walmsley R (2018) *World Prison Population List*. International Centre for Prison Studies.

Walsh Z, Hendricks PS, Smith S, et al. (2016) Hallucinogen use and intimate partner violence: Prospective evidence consistent with protective effects among men with histories of problematic substance use. *Journal of Psychopharmacology* 30(7): 601–607.

Weidner RR and Schultz J (2019) Examining the relationship between U.S. incarceration rates and population health at the county level. *SSM—Population Health* 9: 100466.

Yukhnenko D, Sridhar S and Fazel S (2020) A systematic review of criminal recidivism rates worldwide: 3-year update. *Wellcome Open Research* 4: 28.

Author Biographies

Grant M Jones is a PhD Candidate in Clinical Psychology at Harvard University studying with Dr. Matthew Nock. His research explores around how altered states of consciousness play a role in the flourishing of underserved and vulnerable populations.

Dr. Matthew K Nock is the Edgar Pierce Professor of Psychology at Harvard University. His research is focused on advancing the understanding of why people behave in ways that are intentionally harmful to themselves (e.g., engage in suicidal and non-suicidal self-injury).