



Trippin' on Sally D: Exploring predictors of *Salvia divinorum* experimentation

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ABSTRACT

Salvia divinorum is a new recreational drug where few studies have been conducted on its prevalence and predictors of use. Using a sample of undergraduate students, this study investigated these issues. While a small number reported experimenting with salvia, logistic regression models showed that demographics, marijuana use, and self-control are statistically significant predictors. The effect of gender on use was explained by low self-control; but the effect of marijuana use remained. Results also showed that White males who frequently smoke marijuana and have extremely low self-control are most likely to use salvia. Limitations and future research are discussed.

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Introduction

"In my personal opinion, it's like taking acid and mushrooms and ecstasy and slamming a 40 and huffing a nitrous balloon all at the same time" (Blake, 2006). This is how one salvia¹ user in a KCNC TV report in Denver characterized the "trip" produced by smoking *Salvia divinorum*. This type of characterization of a *Salvia divinorum* experience has garnished media attention which makes analogies of salvia use to many types of drugs. These analogies are used with little knowledge of the pharmacology, harm potential, and prevalence of salvia use. The goal of this research was to assess the prevalence of salvia use among college students and evaluate predictors of use.

As new psychoactive substances become increasingly popular among recreational users, it is important that research be conducted on the prevalence of its use and the factors associated with usage. Salvia is a psychoactive substance that has only recently crept into popular culture. Aided by its availability and popularity in "head shops" and Internet sites (Dennehy, Tsourounis, & Miller, 2005; Halpern & Pope, 2001), *Salvia divinorum* has indeed crossed over to recreational circles, but with little known on its prevalence and correlates. The current study assessed these issues using a large sample of university students. Further, the current study was informed by a major criminological theory, the *general theory of crime* (Gottfredson & Hirschi, 1990). Although not meant to be a comprehensive test of Gottfredson and Hirschi's (1990) theory, the current study explained and tested how the construct of self-control should be related to salvia use.

Before discussing the data and results of the present study, a description of *Salvia divinorum* and its uses is provided. This includes addressing how this substance has become a popular culture Internet phenomenon and the prevalence of its recreational use in the few

recent studies to date. Next, and beyond demographic characteristics that may distinguish between users, a discussion of potential correlates of recreational use of salvia that have not been empirically assessed in the existent literature is presented. This discussion focuses largely on how individuals possessing low self-control are more prone to use salvia for recreational purposes and how self-control theory can inform the relationship between demographics and salvia use, as well as the correlation between other drug and salvia use.

Salvia divinorum

Early ethnobotany research found that the active ingredient, salvinin A, has a unique effect on Kappa-opioid receptors. A very selective activation of these receptors result in an intense but short-lived dissociative state (Grundmann, Phipps, Zadezensky, & Butterweck, 2007; Prisinzano, 2005; Siebert, 1994). Traditional use of salvia involved the chewing of leaves or the grinding of leaves into a tea and consumed by ingesting the liquid.² Several sources report the occurrence of oral ingestion of salvia in recreational use, however, it is not common and was not present among the sample of college students in the current study. The primary method of intake is to smoke the leaf product out of a pipe.³ While the effects of salvia are reported to be brief, typically one to ten minutes, an intense dissociative sensation is experienced upon consumption (Prisinzano, 2005).⁴

Over the last decade, salvia has received increasing attention from media sources and state legislatures. Much of the attention has focused upon the lack of regulation surrounding a psychoactive substance, and its wide availability via Internet proprietors and head shops. Media accounts have noted that users have tried it as a supposed legal substitute for marijuana, sparking the attention of legislators. Additional references to salvia have compared the drug to LSD, mescaline, peyote, MDMA, and psilocybin mushrooms. Lastly, many have noted that salvia use appears to be increasing among

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students at American universities (Griffin, Miller, & Khey, 2008; Khey, Miller, & Griffin, 2008; Lange, Reed, Ketchie Croff, & Clapp, 2008).

The federal government and the Drug Enforcement Administration (DEA) have so far declined to take any definitive action to prohibit the use, possession, and/or distribution of *Salvia divinorum* via the scheduling process of the Comprehensive Drug Abuse Prevention and Control Act (1970) (also called the Controlled Substances Act (CSA)). In 2003, a published report from the DEA concluded that many users of salvia indicated that after experimenting once with salvia, they would not try the substance again. Furthermore, the DEA (2003) speculated that salvia use would most likely not become popular among drug users. In the absence of federal regulation or guidance, which is one of the main purposes of the CSA (Spillane, 2004), several states have passed varying legal mechanisms to prohibit or curb salvia use, others are pending within state legislatures, and some have died during various stages of the legislative process. Among these legal mechanisms is the addition of *Salvia divinorum* to their state controlled substances acts, the passage of separate laws prohibiting salvia possession, use, and/or distribution, and laws prohibiting only salvia extract (Griffin et al., 2008). In addition, at least two states have passed legislation prohibiting the sale or transfer of salvia to people under the age of eighteen.⁵

Internet phenomenon

The growing popularity of salvia on Internet sites has been the primary subject of research. In 1998, Halpern and Pope (2001) conducted an Internet search of Yahoo!⁶ using the word “hallucinogen.” They found that *Salvia divinorum* was available for purchase and that hundreds of Web sites existed providing information on the drug. As such, they noted that salvia appeared with warnings about its potential potent effects along with information on synthesis, extraction, identification, and methods of obtaining and ingesting other gray market substances. In February 2004, Dennehy et al. (2005) searched Yahoo!, Google, AOL, and MSN using the terms “buy herbal high” and “buy legal high.” The researchers found that the drug ephedra received the most hits with *Salvia divinorum* having the second most hits. Considering since that time the Federal Drug Administration (FDA) has effectively banned ephedra, one could surmise that salvia now has the distinction of being the most searched, perhaps sought after, legal recreational drug on the Internet.

Recreational salvia use and prevalence

There was a notable lack of research that had estimated the prevalence of *Salvia divinorum* use within any population. In fact, there had only been one study with a nationally representative sample that addresses this issue. In 2006, the National Survey on Drug Use and Health (NSDUH) specifically included questions on *Salvia divinorum* in their annual survey of American households. A 2008 summary report by the Substance Abuse and Mental Health Services Administration (SAMHSA), the agency that administers the NSDUH, revealed that 1.7 percent among their sample of eighteen- to twenty-five-year-olds had used salvia in the previous year. This group had a higher prevalence of use relative to the twelve- to seventeen-year-old group and the twenty-six and over group in their sample. The study also noted that males⁷ reported using salvia nearly four times as much as the females in the sample (SAMHSA, 2008).

Data on prevalence and awareness of the drug among college students were limited to only one other scholarly study. In a general drug survey of 1,571 college students at a southwestern university in a state where *Salvia divinorum* possession, use, and distribution are not prohibited, it was found that 4.4 percent of those surveyed reported that they had used the drug within the last year. Among those reporting use, White males were most likely to have tried the drug and other drug use appeared to be the best predictor of use (Lange et al., 2008).

Salvia use, like many drugs, may be influenced by other drug use. This is a common theme throughout the drug literature (Milani, Parrott,

Turner, & Fox, 2004; Parrott, Milani, Gouzoulis-Mayfrank, & Daumann, 2007; Wish, Fitzelle, O'Grady, Hsu, & Arria, 2006). It was noted in one study that the use of marijuana and other illicit drugs is often closely associated with the use of other drugs which forms a pattern of polysubstance use. The study went on to note that more than nine out of ten used marijuana and other illicit drugs, smoked cigarettes and/or engaged in binge drinking (Mohler-Kuo, Lee, & Wechsler, 2003). Lankenau et al. (2006) found that similar methods of intake have an effect on polysubstance use. They found that injectors of ketamine were more likely to use other injection drugs. Salvia is smoked similar to marijuana, available in head shops (mostly selling marijuana paraphernalia), and directly marketed to marijuana users (as a legal alternative). Indeed, since the popular methods of marijuana consumption mirrors the methods of recreational salvia consumption found in prior literature, it is not a stretch to assume that the typical marijuana user would already own the paraphernalia needed to smoke salvia. Lange et al. (2008) did not make a distinction between marijuana use and other illicit drug use, but congruent with the literature, one would expect to see a strong relationship with marijuana users.

Self-control and drug use

Studies on salvia use have yet to go beyond demographic characteristics and other types of drug use in describing who has used salvia and who has not. A step forward in understanding salvia use can be made by pulling from theories of criminal and deviant behavior, one in particular being the *general theory of crime* (Gottfredson & Hirschi, 1990).

Over a decade ago, Gottfredson and Hirschi described a trait which they argued is the individual level “cause” of criminal and “analogous” deviant behaviors. They argued that low self-control, or the inability to refrain from engaging in acts that produce instant, pleasurable gratification without considering the long-term and contemporaneous consequences of the act(s), develops during childhood as a function of a lack of socialization by primary caregivers. Once developed by the ages of ten to twelve, Gottfredson and Hirschi (1990) argue that this trait remains relatively stable throughout the life-course, and it can explain the differences between individuals that abstain from criminal and/or deviant acts compared to those who lie, cheat, steal, use drugs, and use violence to solve interpersonal problems.

Gottfredson and Hirschi's (1990) theory of low self-control has accumulated an impressive amount of empirical support over the last decade and a half. Pratt and Cullen's (2000) meta-analytic review of this research showed that the effect of self-control was modest and consistent, regardless of how it was operationalized, the type of sample, whether or not other theoretical constructs (e.g., peers) were simultaneously assessed, or the dependent variable (i.e., crime or analogous behaviors). In short, the construct of self-control is robustly related to antisocial behavior. Pratt and Cullen (2000) argued that those who fail to include measures of self-control in models predicting deviance and criminal behavior risk misspecification. Although much empirical support has accumulated in its favor, self-control theory has faced several criticisms that include tautology, measurement issues related to its main construct, and self-control being the individual level cause of crime to name a few (Akers, 1991; Piquero, MacIntosh, & Hickman, 2000; Pratt & Cullen, 2000; Tittle, Ward, & Grasmick, 2003).

Pertaining to drug use, Gottfredson and Hirschi's general theory explains that users prefer immediate gratification and are impulsive risk-takers. Indeed, Gottfredson and Hirschi (1990) note:

Crime and drug use are connected because they share features that satisfy the tendencies of criminality. Both provide immediate, easy, and certain short-term pleasure...The necessary conditions for drug use are easily identified. There must be a drug that is both attractive and available to the offender and there must be an offender who is insufficiently restrained. (pp. 41–42)

Thus, Gottfredson and Hirschi (1990) argued against the notion that drug users tend to use only one drug and suggest that the only method to curb substance use is to instill self-control in individuals within a population. Furthermore, Gottfredson and Hirschi would argue that the only reason a person may use multiple drugs is because he or she has low self-control and will search for a “high” through a variety of substances, regardless of their illicit nature.

Although Gottfredson and Hirschi did not make any specific reference to *Salvia divinorum*, their theory can easily be applied to salvia use. For instance, salvia produces an intense and almost immediate high desirable to those in pursuit of instant gratification. The apparent absence of research on the long- and short-term adverse consequences of salvia, along with stark warnings on salvia products, Internet Web sites, and head shop stores would clearly indicate those willing to experiment with salvia are not deterred by the possible consequences. Salvia use clearly fits the definition presented by Gottfredson and Hirschi of an act that would be appealing to someone with low self-control.

Gottfredson and Hirschi (1990) go further to say that differences in self-control can explain why males engage in more crime and analogous behaviors, including drug use, more so than females. Research to date has supported the notion that males, on average, have lower self-control than females (Gibson, Ward, Wright, Beaver, & DeLisi, 2009); however, findings are mixed regarding whether the self-control gap between males and females can account for why males are more likely to engage in criminal behaviors, drug use, and other analogous behaviors. Less explicitly stated, Gottfredson and Hirschi argued that differences in offending and analogous behaviors between racial groups can also be explained by differences in self-control. They suggested that minorities are more likely than Whites to be subjected to socialization processes that lead to differences in self-control, in turn leading to more involvement in deviance, drug use, and crime among minorities.

Research purpose and summary

The current study used Gottfredson and Hirschi's (1990) theoretical framework to investigate several questions about the prevalence of lifetime salvia use among a large sample of undergraduate university students. First, it was predicted that individuals with lower self-control, net of other correlates, would have a high probability of experimenting with salvia. Second, it has been shown that other drug use is a correlate of salvia use. Therefore, marijuana use, one particular form of substance use that has similarities with the method in which salvia is ingested, will be related to salvia use. The more an individual smokes marijuana, the higher the likelihood of having experimented with salvia. In turn, and relying on Gottfredson and Hirschi's claims regarding self-control and drug use, it is expected that low self-control will not only be a predictor of salvia use, but it should account for the positive relationship between salvia and marijuana use. Third, past studies on salvia uses have shown that males are more likely to have experimented with salvia than females. Based on Gottfredson and Hirschi's theoretical framework, it is expected that gender differences in salvia use would be explained by differences in self-control between males and females. Finally, if Gottfredson and Hirschi are correct, minorities should be more likely to engage in salvia use than Whites and that this too can be explained by differences in self-control between racial groups.

Data

Data for the current study were from a self-report survey created in the fall of 2006 that was administered to a sample of 826 undergraduate students at a large public southeastern university, but due to invalid responses to several survey questions, the analysis sample was reduced to 641 respondents. This survey was designed to measure general forms of deviance, substance use, fear of crime, victimization, and propensities for engaging in criminal and analogous behavior. Important for the current study, specific questions were included to

determine the prevalence (life time and recent) of *Salvia divinorum* among university students.

A convenience sample of diverse liberal arts and sciences courses were recruited in the fall 2006 and early spring 2007.⁸ For each class, the instructor of record was approached and asked if the survey could be administered in his/her class during a specified class period. On the day of administration, the students were informed that the survey to be administered was anonymous and that participation was voluntary.⁹ The vast majority of students that were present in class on that day participated. Of the total students enrolled in the classes sampled, 58.6 percent elected to participate.

Descriptive statistics are shown in Table 1. In this sample, 39 percent were male and 65 percent were White.¹⁰ The average age was approximately twenty years of age and the sample had an average grade point average (GPA) of 3.38, which ranged from a low of 1.75 to a high of 4.00. Further, mean socioeconomic status (i.e., parental income) for the sample was 2.93, which reflected an average of approximately \$80,000 to \$99,999. Finally, 6.7 percent of the sample reported having used salvia in their lifetime.

Marijuana and alcohol prevalence were compared within the past twelve months and thirty days to the university's CORE survey for 2006 which yielded similar results. Alcohol use within the past twelve months was 82.5 percent and past thirty day use was 70.5 percent among the sample versus the university-wide CORE findings of 82.5 percent and 72.2 percent respectively. Marijuana use within the past twelve months was 34.3 percent and past thirty day use was 19.4 percent among the sample versus an overall university reported 26.2 percent and 13.3 percent respectively.¹¹ The slightly higher prevalence of marijuana use among the sample may be partially reflected in the differences in survey methodology. To give another reference, the results of the sample were compared to the Monitoring the Future survey. In 2006, the survey reported that 30.2 percent of college students nationally used marijuana in the past year and 16.7 percent used within the past thirty days (Johnston, O'Malley, Bachman, & Schulenberg, 2007). In the same year, Monitoring the Future reported 82.1 percent use of alcohol in the past year and 65.4 percent use in the past thirty days among its college student sample.

Measures

Dependent variable

Life time salvia use

The portion of the questionnaire asking about salvia was prefaced by a short description of *Salvia divinorum* as follows:

A plant in the mint family, *Salvia divinorum*, more commonly known as just Salvia, is known to have potent psychoactive

Table 1
Descriptive statistics of variables used in models (n = 641)

Variable	Mean	SD	Min	Max
<i>Dependent variable</i>				
Lifetime salvia use	.067	.25	0	1
<i>Independent variables</i>				
Alcohol use in past month	4.90	5.67	0	30
Marijuana use in past month	1.72	5.80	0	30
Self-control (twenty-four items)	46.81	8.81	26	74
<i>Control variables</i>				
Age	19.96	2.10	17	43
Gender (male = 1)	.39	.49	0	1
Race (White = 1)	.65	.48	0	1
SES (parent's income)	2.93	1.09	1	4
GPA (cumulative)	3.38	.44	1.75	4.00

*Note that a mean for dichotomous variables indicates the percentage of subjects who responded with a “1.”

properties—but not much is known about it. Recently, there has been an interest by researchers to better understand this plant and the substances within it. We would like to collect your knowledge of Salvia if you have ever heard of it or come across it.

Salvia use was measured by a dichotomous variable which asked respondents if they had ever tried salvia and was coded a 0 (no) or 1 (yes). Salvia use has a high level of desistance (Khey et al., 2008), thus the current study was more concerned with salvia experimentation rather than continual use. Indeed, given the high cost of salvia and the short-lived experience, it was not surprising that very few habitual users were found. The current study was mainly concerned with predicting experimentation with salvia and not continued use.

Independent variables

Demographic

Several demographic variables were included: (1) age, (2) gender, (3) race, (4) socioeconomic status, and (5) cumulative grade point average. Age was a continuous variable which measured the age of a subject on their most recent birthday. Gender was coded as 0 (female) or 1 (male). Due to limited variation, race was recoded into a dichotomous measure, coded as 0 (non-White)¹² or 1 (White). Socio-economic status was measured by student reports of their parents' combined incomes, which was collapsed into four categories: low-income (less than \$50,000) lower middle-income (\$50,000–\$79,999), upper middle-income (\$80,000–\$99,999), and high-income (over \$100,000).¹³ Grade point average was measured by asking respondents to report their college grade point average.

Marijuana and alcohol use

Marijuana and alcohol use were each measured by one self-report item asking about recent frequency of use. Each respondent was asked in the past thirty days, how many days did you use marijuana (and drink alcohol). Both measures ranged from 0 to 30, with mean marijuana use in the past thirty days being 1.72 days; whereas, mean alcohol use was 4.90 days in the past thirty days.

Self-control

Self-control was measured using Grasmick, Tittle, Bursik, and Arneklev's (1993) twenty-four-item self-report scale. Several studies had found this measure to be both reliable and valid (Nagin & Paternoster, 1993; Piquero & Tibbetts, 1996), although others had questioned its unidimensional properties (Gibson, 2005; Piquero et al., 2000). Nonetheless, staying consistent with past research, the current study summed responses across items to achieve a composite score for each subject ($\alpha = .84$). Responses for each item ranged on a four-point Likert scale from 1 (disagree strongly) to 4 (agree strongly). Higher scores on this measure indicated lower self-control. In agreement with other studies (Brownfield & Sorenson, 1993; Nagin & Paternoster, 1993), a principal component analysis indicated that all items loaded on one factor (see also Arneklev, Grasmick, Tittle, & Bursik, 1993; LaGrange & Silverman, 1999; Piquero & Rosay, 1998).

Analytic plan

The analytic plan unfolds using three general steps. First, correlations were estimated to assess the bivariate relationships between the independent variables and salvia use. Furthermore, bivariate analyses are insightful for assessing relationships between several of the independent variables, such as self-control and gender. Second, a series of logistic regression models were calculated to arrive at a final model predicting lifetime salvia use and also assess whether low self-control can explain the effects of other independent variables previously discussed. Finally, given that estimated coefficients from logistic regression are not readily interpretable, a series of graphs are displayed that show differences in predicted probabilities across various combinations of independent variables to more clearly portray the likelihood of salvia use, and more specifically to discern who has the highest likelihood of having experimented with salvia.

Results

Table 2 shows bivariate correlations between the independent and dependent variables. Of particular interest, several demographic and other individual variables are significantly ($p < .05$) correlated with lifetime salvia use. As for demographic characteristics, gender, race and socioeconomic status are positively and significantly correlated with salvia use. That is, males, White students, and students whose parents have more income are more likely to have used salvia compared to women, non-White students, and students whose parents have less income. Furthermore, alcohol use, marijuana use, and self-control were all positively and significantly correlated with salvia use. Students who drink more often, smoke marijuana more often, and have lower self-control are all more likely to report ever using salvia. Of all the bivariate correlations, recent marijuana use exhibited the strongest correlation with salvia use. These patterns of bivariate correlations may be expected and are similar to the bivariate relationships Lange et al. (2008) found between drug and salvia use among their sample, as well as consistent with self-control theory's expectations.

Table 3 shows a series of logistic regression models predicting the prevalence of lifetime salvia use. Four models are shown in a stepwise fashion. Model 1 includes only demographic characteristics and shows that while controlling for each, a similar picture emerges as seen in the bivariate correlations. Gender, race, and socioeconomic status have positive and statistically significant effects on life-time salvia use, indicating that males are more likely than females to have used salvia; Whites are more likely than non-Whites to have used salvia; and students whose parents have more income are more likely to have used salvia than students whose parents have less income. Model 2 shows only the effects of other drug use on lifetime salvia use. As shown, when both recent alcohol and marijuana use are simultaneously considered, only marijuana use has a positive and statistically significant effect on salvia use. Students who have used marijuana increasingly more in the past thirty days are more likely to have used salvia in their lifetime than those who have used less in the past thirty days.

Table 2
Correlation matrix for all variables in model (n = 641)

	Salvia use	Age	Gender	Race	SES	GPA	Alcohol use	Marijuana use	Low self-control
Salvia use	1								
Age	.023	1							
Gender	.118**	.167**	1						
Race	.132**	.088*	.106*	1					
SES	.116**	-.097*	.070	.322**	1				
GPA	-.003	-.030	-.062	.190**	.224**	1			
Alcohol use	.117**	.110**	.118**	.241**	.235**	-.005	1		
Marijuana use	.317**	.034	.083*	.100**	.076	.010	.305**	1	
Low self-control	.119**	-.097*	.210**	-.016	.017	-.220**	.203**	.115**	1

Two-tailed significance tests: * $p \leq .05$, ** $p \leq .01$.

Table 3
Results of logistic regressions predicting lifetime salvia use (n = 641)

	Model 1	Model 2	Model 3	Model 4
<i>Demographics</i>				
Age	.014		.000	.029
Gender (male = 1)	.786**		.704*	.571
Race (White = 1)	1.223*		1.170*	1.210*
SES (parent's income)	.403*		.390*	.394*
GPA	-.335		-.464	-.222
<i>Drug/alcohol use</i>				
Alcohol use last thirty days		.021	-.009	-.021
Marijuana use last thirty days		.094**	.095**	.094**
<i>Self-control</i>				
Low self-control				.042*
χ^2	25.15*	35.02**	53.55**	57.66**
Pseudo R ²	0.08	0.11	0.17	0.18

Significance testing: * p ≤ .05, ** p ≤ .01.

Models 3 and 4 show logistic regression results for a model with all independent variables excluding self-control and then a full model with self-control, respectively. As shown in Model 3, all previous demographic variables and recent drug use measures (i.e., gender, race, SES, and marijuana use) retain their positive and statistically significant effects on lifetime salvia use when simultaneously considered together. Model 4, illustrates three important findings. First, when self-control is added to the model, the effect of gender on salvia use is reduced to nonsignificance. Second, regardless of demographics and recent drug use, students who have lower self-control are still more likely to have experimented with salvia in their lifetime. Third, self-control (or lack of) could not explain the positive and significant effects of other variables that included race, socio-economic status, and recent marijuana use on lifetime experimentation with salvia.

Since logit coefficients are not readily interpretable, predicted probabilities of lifetime salvia use as a function of selected independent variables and combinations of independent variables are graphically displayed. Fig. 1 shows the predicted probabilities of lifetime salvia use across a continuum of self-control for both males and females, net of the effects of other independent variables. The interplay between gender and self-control on salvia use may give additional insights about gender differences, especially since the direct effect of gender was reduced to nonsignificant after considering self-control. As shown, different patterns emerge for male and female salvia use across the self-control scale. Males at every point on the self-control continuum have a higher probability of using salvia when

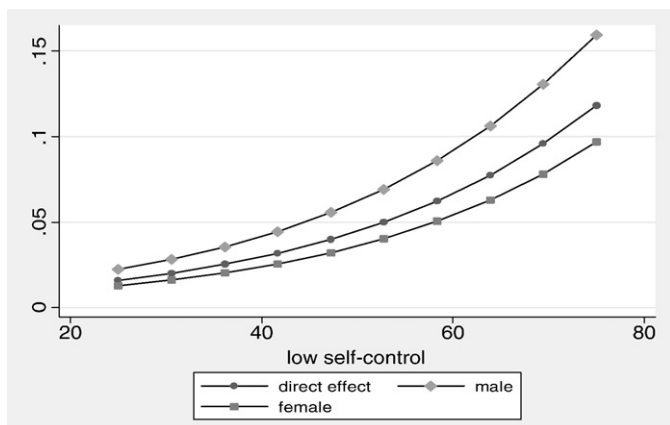


Fig. 1. Predicted probabilities for salvia use across self-control continuum: direct, male, and female effects.

compared to females; however, the difference between males and females is very small when both genders have extremely high self-control. In turn, a much larger difference between males and females exist at the opposite end of the self-control scale. When both have extremely low self-control (very large scores on the measure of self-control), gender differences are much more pronounced in that males have a much larger probability of using salvia than their female counterparts. Overall, the chance of using salvia given extremely low self-control is still only moderate. For instance, males who have the lowest level of self-control only have approximately a 20 percent chance of engaging in salvia use during their lifetime.

Fig. 2 displays predicted probabilities of salvia use across levels of marijuana use, while holding other independent variables constant. Specifically, three predicted probability curves are displayed which include the main effect of marijuana use, the effect of marijuana use for males, and the effect of marijuana use for females. Generally, a positive trend in predicted probabilities is observed indicating that the more days a respondent reported using marijuana in the past thirty days, the higher the probability of experimenting with salvia. This trend is more pronounced for males than for females in that a male who has smoked marijuana almost every day in the past thirty days has almost a 50 percent chance of having experimented with salvia, whereas a female who has similar marijuana smoking habits only has over a 30 percent chance of having experimented with salvia.

Given that self-control could not explain the statistically significant effect of marijuana use on the prevalence of salvia use, it is informative to assess the probability of salvia use for individuals who both used marijuana frequently and had extremely low self-control. Fig. 3 shows the predicted probabilities of salvia use across levels of self-control for high and low marijuana users. High use was defined at the ninetieth percentile, which was three or more days of use in the past thirty days. The predicted probabilities were quite distinct for those who use marijuana at higher versus lower levels across the self-control continuum. Interestingly, individuals who use marijuana most frequently start to accelerate exponentially in their likelihood of salvia use when coupled with having lower and lower self-control; with those having the lowest self-control and highest marijuana use having approximately a 40 percent chance of having experimented with salvia. On the other hand, the predicted probabilities of salvia use for individuals who use marijuana less frequently (or low use) do not exhibit exponential increases in the probability of salvia use with lower and lower self-control.

Finally, given that race, marijuana use, and self-control had independent effects on salvia use, the authors assessed the predicted probabilities of salvia use as a function of various combinations of

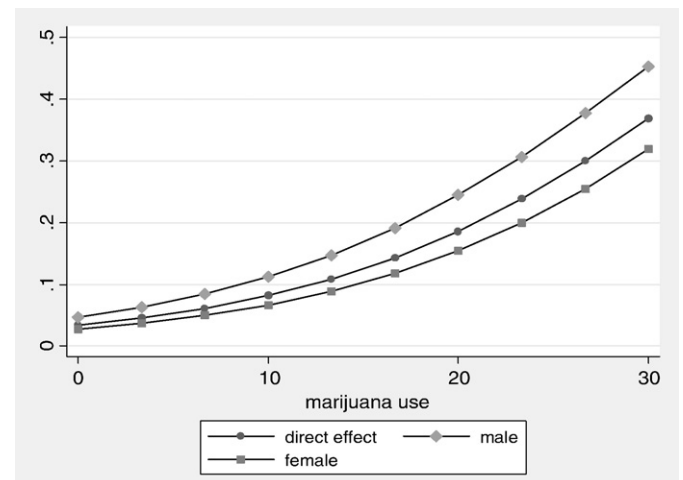


Fig. 2. Predicted probabilities for salvia use across number of days used marijuana in the past month: direct, male, and female effects.

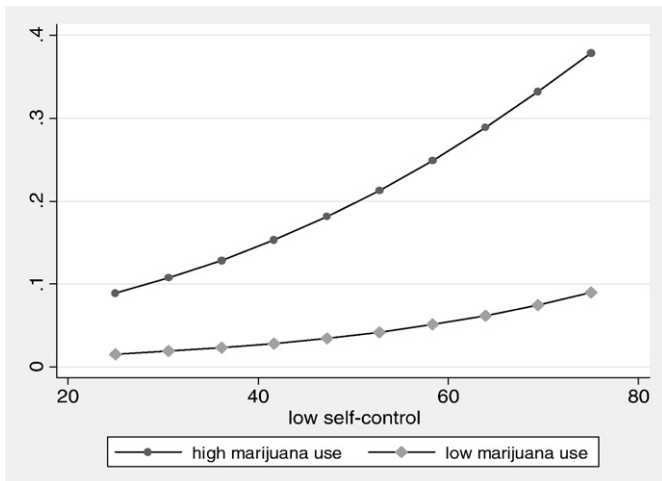


Fig. 3. Predicted probabilities for salvia use across levels of self-control for high and low marijuana users.

these variables along with gender: White males who smoke marijuana at a high frequency; non-White males who smoke marijuana at a high frequency; White males who smoke marijuana at a lower frequency; non-White males who smoke marijuana at a lower frequency; White females who smoke marijuana at a high frequency; non-White females who smoke marijuana at a high frequency; White females that smoke marijuana at a lower frequency; non-White females that smoke marijuana at a lower frequency.¹⁴ As illustrated in Fig. 4, all of these combinations are plotted across the self-control continuum. As one might have anticipated, based on the findings presented thus far, White males possessing the lowest self-control and who smoke marijuana frequently (or three or more days in the past thirty days) have the highest probability (i.e., approximately a 60 percent chance) of having tried salvia. Non-White males who possess the lowest self-control and use marijuana at a high frequency have the next highest probability of having experimented with salvia. Females generally have the lowest probabilities of having tried salvia, but differences among females exist. Specifically, White females who possess the lowest self-control and smoke marijuana frequently have a higher probability of having tried salvia compared to their less frequent marijuana-smoking counterparts. Those who have the lowest probability of having tried salvia are non-White females with the highest self-control and have a lower frequency of smoking marijuana.

Discussion and conclusions

The current study had several objectives related to describing and predicting who uses *Salvia divinorum*. First, the study intended to describe the prevalence of salvia use among a large sample of undergraduate students from a large public university in the southeastern United States. Second, the study intended to identify variables that predict salvia use. To this end, the study not only used correlates of salvia use from past studies to inform the understanding of salvia users, but also relied on theoretical guidance from self-control theory. Finally, the study intended to produce graphs of predicted probabilities of salvia use to assess what type of students are at the most risk for experimenting with salvia.

In sum, the results indicated that approximately 6.7 percent of the sample reported ever using salvia. For comparison, in the past twelve months 3 percent of the sample reported salvia use. This is a slightly lower number than the only other university prevalence study found. Lange et al. (2008) found 4.4 percent of their sample had used salvia in the past year. The difference may be related to regional differences, university demographics, and differences in sampling methodology. The main predictors of having experimented with salvia were race,

socioeconomic status, marijuana use, and low self-control. Students who are White, have parents that make more money, smoke marijuana more frequently, and possess lower self-control were more likely to have reported experimenting with salvia. This differs from the findings of Lange et al. (2008) that only found prior drug use to be a predictor of salvia in a multivariate logistic regression model. They found race, gender, and alcohol use to become insignificant when controlling for drug use.

In relation to Gottfredson and Hirschi's (1990) theory, it was found that individuals with lower self-control had a higher likelihood of having experimented with salvia compared to those possessing more self-control, net of other variables. The effect of self-control, however, was small at best. Those possessing the lowest levels of self-control had less than a 20 percent chance of having tried salvia. This brings into question self-control theory's ability to explain a type of drug use that has not commonly been assessed in the literature. Garnering support for Gottfredson and Hirschi, it was found that low self-control was able to explain that the relationship between gender and salvia use, supporting the proposition that males are more likely to engage in deviance and drug use than females due to males possessing lower self-control. Furthermore, the correlational analysis found that males do have lower self-control than females. On the other hand, low self-control was unable to explain the statistically significant relationship between marijuana and salvia use, as marijuana use remained an important correlate when controlling for levels of self-control. Finally, although it was found that race had a statistically significant relationship with salvia use, it was not in the direction that Gottfredson and Hirschi might predict. Non-Whites were the least likely to have experimented with salvia compared to Whites. Furthermore, self-control could not explain why Whites were more likely to use salvia than non-Whites. In fact, non-Whites were no more likely to possess lower self-control than their White counterparts, which is also a finding that is inconsistent with Gottfredson and Hirschi.

Beyond relating the current findings to self-control theory, the current study was able to arrive at somewhat of a profile of students at most risk for having tried salvia. Specifically, White males who are frequent smokers of marijuana and have extremely low self-control were most likely to have experimented with salvia, whereas those with the lowest likelihood of having experimented with salvia are non-White females with high self-control and less frequently smoked marijuana.

Due to several limitations, caution should be taken when attempting to generalize and interpret the findings. First, the final multivariate model only explains a small amount of variation in salvia use, indicating that many other reasons may exist as to why students use salvia. Most importantly, the current study was unable to account

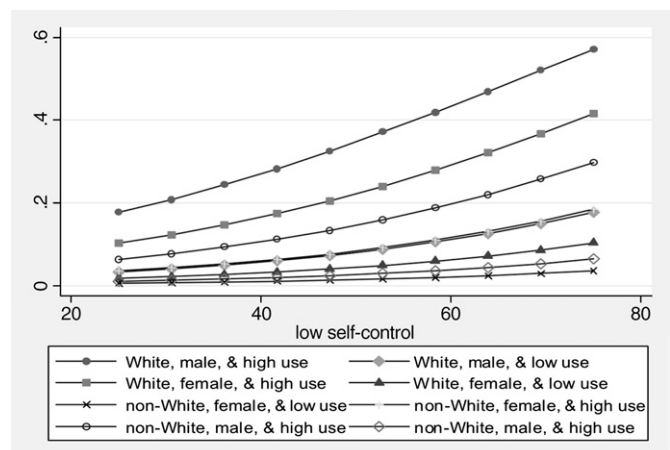


Fig. 4. Predicted probabilities for salvia use: low self-control, gender, race, and marijuana use.

for differential opportunity, which also is an important variable in Gottfredson and Hirschi's theory and a limitation of studies that have tested self-control theory. Although salvia is legal and readily available in head shops near campus, less than a fourth of the sample had ever heard of salvia. Future research in this area should investigate how people find out about salvia and how that may influence their decision to experiment with the substance.

Second, the sample restricted the authors from making many inferences regarding salvia experimentation. Although relatively large, the current sample consisted of college students at one southeastern university who were enrolled in liberal arts and sciences courses. Future research on salvia should aim at determining use and experimentation with various populations, and explore any regional differences especially as more states pass legal prohibitions. As media reports warn about teenagers who may potentially use salvia, research needs to be conducted on diverse populations to include high school aged students to understand the larger picture of who is experimenting with salvia.

Third, the survey used for this study was group administered in a class room setting. As such, this method of administration could have resulted in inaccurate responses to sensitive question regarding drug use and other topics. A search of the literature was conducted for studies on survey response validity when administering surveys in a classroom setting. Evidence suggests that classroom administered surveys can produce valid responses from participants on their self-report drug use among other sensitive topics (see Bachman, Johnston, & O'Malley, 1996). While it is unknown whether responses to the current survey were affected by the classroom setting, caution should still be taken in interpreting the current findings and future research may want to think about this issue beforehand.

Effective July 1, 2008 the state in which the sample was drawn prohibited the possession and sale of *Salvia divinorum*. This creates a unique research opportunity to examine the effects of legal prohibitions on experimentation. Furthermore, the illicit status of the substance may affect the user profile generated by this study. Future research should identify if the predictors of salvia use were affected by legal prohibitions. Lastly, this study only assessed lifetime salvia experimentation. Predictors of habitual salvia use may differ significantly from those of experimentation. The current study found a high level of desistance among salvia users, which perhaps is accounted for by a negative first experience. When asked if salvia users would like to use the substance again, 51 percent of users said no, 32 percent said maybe, and 17 percent of users said yes. Future research needs to investigate habitual use along with desistance from use.

In closing, the current study shed new light on the correlates of salvia use and used a criminological theoretical framework in doing so. The authors believe that this study has advanced the current state of knowledge regarding salvia users and hope that future investigations build on these findings.

Notes

1. The term "salvia" is employed throughout this article to indicate the recreational ingestion of *Salvia divinorum*. The usage of "salvia" in this manner will reflect the drug culture and does not reflect all of the plants in the genus *Salvia*. The authors also use the taxon *Salvia divinorum* to properly refer to the psychoactive plant itself. These terms should not be confused.

2. *Salvia divinorum* was first mentioned in the literature in 1962 (Epling & Jativa, 1962; Wasson, 1962), however, it was not until 1979 that any comprehensive study of the plant was undertaken. Emboden (1979) noted that salvia ingestion originates in the Mazatecan culture, a group of people that live in Oaxaca, Mexico. The Mazatecs continue to use the plant ceremonially in their traditional mystic religion and for medicinal purposes. Salvia is a relative of the mint family, which includes many plants that have a variety of psychoactive effects—some of which are medicinal. Furthermore, Emboden stated "the plant propagates itself by the decumbent branches fallen to the ground and rooting. It seems, however, to be in cultivation and to be absent in areas where it is not under the care of man" (Emboden, 1979, pp. 93–94). Exactly when salvia use began and became commercialized in the United States is unknown, although media accounts (reporting salvia use) first appeared in the late 1990s.

3. The product is commercially available in packages that include the leaf or other absorbent material impregnated with an extract of its own active ingredient, salvinorin A. Rarely do consumers find the unprocessed leaves or leaf products available for sale at local retailers. On the other hand, the recreational salvia products, leaves, and seeds are all available for purchase at online Web sites (Halpern & Pope, 2001) and in tobacco/smoke and head shop stores in states where salvia is not prohibited. It is sold in different levels, or potencies, indicating what level of extract is contained in the leaves.

4. The small amount of pharmacological research conducted on the plant has found that there is no recorded incidence of an overdose (or allergy), no known long-term or short-term adverse health consequences, and no known physical dependence (Gahlinger, 2004). There are also no known cases of injury, death, or DWI/DUID related to salvia use. With one exception, a sixteen-year-old boy in Delaware, Brett Chidester, committed suicide, and because he had written an entry in his online journal relating the salvia experience to a questioning of reality, attempts were made to link the suicide to the drugs effects (see Griffin et al., 2008).

5. The following states have added *Salvia divinorum* to their state controlled substance acts: Delaware, Florida, Illinois, Kansas, Louisiana, Mississippi, Missouri, North Dakota, Oklahoma, and Virginia. California and Maine have banned the sale to minors and Tennessee has passed a law separate from their state Controlled Substance Act banning salvia.

6. At that time Yahoo! was the most utilized Internet search engine.

7. Heavy drug use is typically found more in males than females (Milani et al., 2004).

8. Thirteen total university courses were surveyed.

9. The cover sheet for the survey included informed consent information and included the language "Your participation is completely voluntary and your answers will remain anonymous." In addition, the researchers read the informed consent form out loud to the class in which the surveys were administered. The researchers personally handled the surveys and ensured that they were not kept in any identifiable order. Students did not receive any compensation, but were given class time to finish the surveys.

10. Sample demographics were compared with the college and university. The university undergraduate student body was 59 percent female and 59 percent White. For the College of Liberal Arts and Sciences, they reported 56 percent female and 60 percent White.

11. It should be noted that the university's CORE survey utilized a Web-based administration with a typical response rate of only 20 percent from year to year.

12. Racial categories consisted of Caucasian/White, African American/Black, Hispanic, Asian/Indian, and other. All categories other than White were collapsed into the category non-White.

13. This variable was originally reported on 10,000 level increments starting at zero and going to 100,000. This variable was collapsed due to being skewed towards higher incomes.

14. The authors acknowledge that socioeconomic status does have a statistically significant effect on salvia use, but was not included in this particular analysis, but rather held constant. One reason for this is due to the fact that there was not much variability in socioeconomic status for the sample.

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