MAGIC MINT, THE INTERNET, AND PEER ASSOCIATIONS: A TEST OF SOCIAL LEARNING THEORY USING PATTERNS OF SALVIA DIVINORUM USE

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As new drugs are introduced into the market, it becomes the role of policy makers to assess the dangers associated with each drug and its potential to be misused by the populace. The focus of this research is to better understand how young adults learn about a new drug and subsequently engage in its use. Salvia divinorum is a plant species whose leaves contain psychoactive components. Its recreational use among teenagers and young adults has received increased media and policy attention. Several states have taken the initiative to ban this substance. Despite this legal action, little is known about why this substance has gained in popularity and what factors contribute to its use. Akers' social learning theory offers one explanation for why individuals experiment with drugs. We employ a sample of college students from a large public university to test Akers' propositions, finding support for his theory.

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INTRODUCTION

Effective July 1, 2008, the state of Florida banned the possession and sale of *Salvia divinorum*. Florida is one of twelve states that have passed legal prohibitions on salvia.[1] One of the driving forces for the passage of these regulations are growing concerns over the prevalence of salvia use among teenagers and young adults and its widespread popularity on the Internet (Griffin, Miller, & Khey, 2008). These and other actions have been put in place even though very little is known about why teenagers and young adults are experimenting with *Salvia divinorum*. A better understanding of why individuals are using salvia can better direct policies and education/prevention programs. The more a policy or program is based on and informed by sound theory and research, the better its chances of having the intended effects (see Akers, 2005; Barlow & Decker, 2010).

The primary goal of this research is to test competing theories of drug use to assess which theory can best explain salvia experimentation. This research is important for several reasons. This is the first research to test Akers' social learning theory as it pertains to salvia experimentation. In addition, it assesses social learning theory relative to other explanations of drug use offered by other prominent social psychological theories as applied to drug use such as self-control and strain theories. This assessment can offer insights into influential factors in the etiology of salvia experimentation and thereby provide some theoretical and empirical background for policies or programs that could control or prevent initiation and minimize harms associated with the use of such substances.

SALVIA

Salvia divinorum is a member of the mint family (Lamiaceae) within a genus of plants (Salvia) that includes several therapeutic species. Early ethnobotany research found that the primary active component, salvinorin A, has a unique effect on Kappa-opioid neuroreceptors in the brain. Activation of these receptors results in a very intense but short-lived dissociative state (Prisinzano, 2005). At this point, no pharmacodynamic research suggests that salvinorin A has any substantial impact in the mesolimbic dopamine reward center of the brain. Activation of this system is endemic of substances of repeated use irrespective of their overarching effects on the body (e.g., CNS stimulant, depressant, etc.).

Salvia divinorum is native to the forest ravines of Oaxaca, Mexico. The consumption of this plant originated in the Mazatecan culture where its ceremonial use had historic ties to the traditional mystic religion and medicine practiced by its people (Wasson, 1962). In this context, the substance is ingested orally, typically by drinking a beverage brewed with the leaves of *Salvia divinorum* (Weitlaner, 1952).

The point in time when the use of the plant as a recreational intoxicant was first found in the United States is unclear. However, it does seem that transition to

recreational use was gradual and began in the late 1990s. The primary method of intake among modern recreational users is to smoke the leaf product out of a pipe (Miller, Griffin, Gibson, & Khey, 2009). In many states, the product is commercially available in packages that include the leaf impregnated with an extract of its own active ingredient, salvinorin A. It is sold in different potencies indicating what level of extract is contained in the leaves. The effects of salvia when smoked are brief (one to ten minutes) but there is an intense dissociative sensation upon consumption (Prisinzano, 2005).

Over the last decade, salvia has received increasing attention from media sources and state legislatures. Much of the attention has focused upon its lack of regulation as a psychoactive substance and its wide availability via Internet proprietors and head shops. Media accounts have suggested that users have employed it as a legal substitute for marijuana, a charge that has caught the attention of policy-makers. Additional references to salvia have compared it to other hallucinogenic drugs such as LSD, MDMA, mescaline, peyote, and psilocybin mushrooms (Miller et al., 2009).

The Drug Enforcement Administration (DEA) and the federal government have so far declined to regulate or to lobby for legislative control or prohibition of *Salvia divinorum*'s use, possession, and/or distribution. In the absence of federal regulation, several states (and one municipality) have passed various legal mechanisms to prohibit salvia use. These legal mechanisms include: 1) the addition of *Salvia divinorum* to their state's controlled substances acts, 2) the passage of separate laws prohibiting salvia possession, use, and/or distribution, 3) laws prohibiting only salvia extract, and 4) laws prohibiting the sale or transfer of salvia to people under the age of eighteen (Griffin et al., 2008).

INTERNET PHENOMENON

Salvia divinorum has become prevalent on a number of Internet websites providing content on its use, effects, cultivation, legal status, and information on purchasing. In addition, a number of websites advocate its use for both traditional and recreational purposes (Griffin et al., 2008). Thus, early research on *Salvia divinorum* focused on its availability and prevalence as indicated on various Internet sites. Halpern and Pope (2001) performed a Yahoo! search on the keyword "hallucinogen" and found listings for the sale of *Salvia divinorum* on the now defunct "Ethnobotany" website (http://www.ethnobotany.com) as part of their larger study. Dennehy, Tsourounis, and Miller (2005) used a similar methodology searching Google, Yahoo!, AOL, and MSN using the keywords "buy herbal high" and "buy legal high." They found *Salvia divinorum* to be the second-most commonly available substance (after various ephedra products) from these sources. It is important to note that during the same time period of this study the Food and Drug Administration banned products containing ephedra. Hoover et al. (2008) performed a search for the term "*Salvia divinorum*"

in June 2005, October 2005, November 2005, February 2006, and May 2006 on Google. For each of these searches the authors thoroughly evaluated the content of the first 20 links displayed. They found that 78% of the websites were pro-use, and that over half (58%) of the websites were commercial sites either selling salvia products or linking to other websites marketing the substance. In addition, they note that a number of these websites, "emphasized the legal status of S. divinorum and asserted that it was safe and enjoyable to use. Many sites misinterpreted the absence of scientific data on the possible toxicity or negative side effects of S. divinorum as evidence that there are no such effects," (Hoover et al., 2008, p. 25).

In addition to websites promoting salvia, hundreds of videos depicting teenagers and young adults using salvia have been posted on the popular website, YouTube. Lange et al. (2010) analyzed these videos. They selected a sample of 34 videos displaying the full salvia trip, and coded the effects the drug had on the user. They found that the, "coordination loss, emotional and cognitive effects of the drug were… profound, yet of short duration," (Lange et al., 2010, p.140).

Presently, hundreds of websites sell *Salvia divinorum* on the Internet, while many more provide information on use, cultivation, and legal status (Griffin et al., 2008). The question is what effect the widespread Internet promotion of salvia has on its use.

SALVIA PREVALENCE

To date, only a few studies have appeared in peer-review journals attempting to generalize about the salvia user population. Only one nationally representative sample of salvia users exists. Starting in 2006, the National Survey on Drug Use and Health (NSDUH) included questions on *Salvia divinorum* in their nationally representative annual survey. The Substance Abuse and Mental Health Services Administration (SAMHSA), the agency that administers the NSDUH, noted in a 2008 report that 1.7% of their 18–25 year-old sample engaged in salvia use in the prior year. This group had a much higher prevalence of use than any other age group (SAMHSA, 2008). Indeed, as this study suggests, salvia use appears to be concentrated among college-age young adults.

Several studies have further investigated salvia use specifically among college student populations. In a general drug survey of 1,571 college students at a southwestern university, in a state where *Salvia divinorum* is not prohibited, the researchers found that 4.4% of those surveyed had used the drug within the past year. Additionally they found that White males were most likely to have used the drug and other drug use seemed to be the best predictor of salvia use (Lange et al., 2008). In a survey of 826 undergraduate students at a southeastern university in a state in which salvia use was not prohibited at the time found that 6.7% the respondents reported salvia experimentation. Furthermore, this study found that as self-reported marijuana

use increased and levels of self-control decreased,[2] the higher the probability that a person surveyed had used *Salvia divinorum* (Miller et al., 2009).

With the exception of this study by Miller et al. (2009), studies of salvia have been limited to evaluating demographic characteristics and prior drug use, without attention to general criminological theory to explain experimentation with *Salvia divinorum*. The goal of this research is to fill these lacunae in previous studies by applying to salvia use theoretical explanations that are considered to be at the core of criminological theory and have received empirical validation for other forms of substance use and deviance. The focus is on "core" perspectives in the field (Cullen, Wright, & Blevins, 2006), specifically on Akers' social learning theory of crime and deviance, but also on alternative criminological theories as found in Gottfredson and Hirschi's (1990) self-control theory and Agnew's (1992) general strain theory to assess their relative ability to predict salvia experimentation.

DRUGS AND SOCIAL LEARNING

Since its formative years, Akers has specified social learning theory to explain the initiation of drug and alcohol use, continued use, abuse, and cessation. According to social learning theory, a constellation of related (but independent) factors can align to explain these events:

> Whether individuals will abstain from or take drugs (and whether they will continue or desist) depends on the past, present, and anticipated future rewards and punishments perceived to be attached to abstinence and use (differential reinforcement). The physiological effects of drugs and alcohol on the nervous system can function as direct non-social reinforcers and punishers. These effects also acquire secondary or conditioned reinforcing effects (even though they may be initially aversive) by being experienced in the context of group approval and other sources of social reinforcement for use. Individual variations in the probability of social reinforcement, exposure to definitions favorable or unfavorable to drug use, and observation of using and abstinent behavioral models (imitation) comes from differential association with primary groups of family and friends, other reference groups and significant others, including to some extent distal groups and models portrayed in the mass media. Through these processes the person learns attitudes, orientations, or evaluative knowledge which are favorable or unfavorable to using drugs (definitions) as well as the behavior needed to acquire and ingest drugs in a way that produces effects. The more individuals define use as good, permissible, or excusable

rather than holding to general or specific negative attitudes toward drugs, the more likely they are to use them (Akers, 1998, p. 171).

Social learning theory has received tremendous empirical support over the years, and routinely has a consistent, moderate to strong ability to predict crime and deviance (e.g., Lanza-Kaduce, Akers, Krohn, & Radosevich, 1984; Warr, 2002). Notably, the effects of the four main social learning constructs (imitation, definitions, differential association, and differential reinforcement), individually and combined, are especially robust predictors of cigarette smoking (Akers & Lee, 1996; Krohn, Skinner, Massey & Akers, 1985), alcohol use (Akers, La Greca, Cochran, & Sellers, 1989; Lanza-Kaduce et al., 1984;), and illicit drug use (Akers & Cochran, 1985; Akers, Krohn, Lanza-Kaduce, & Radosevich, 1979; Kandel, 1973; 1978; Kandel & Davies, 1991).

Perhaps the reason why social learning theory is so relevant to drug use is that the recreational use of substances such as marijuana and alcohol normally takes place in the presence of peers, thus lending particularly high support to differential association (Warr, 2002). Although it appears that the prevalence of salvia is much lower in the general population than other illicit substances like marijuana (Khey, Miller, & Griffin, 2008; Lange et al., 2008; Miller et al., 2009), its similar status as a 'social drug' should classify it as the type of drug that would be used in the presence of, and influenced by, others.

The current study seeks to fill in gaps in prior literature in several ways. First, we apply social learning theory, a very relevant and robust theory for recreational drug use, to the use of *Salvia divinorum*. Since salvia is primarily a social drug (Miller et al., 2009), utilizing a theory that stresses peer influences among young people to explain its use allows us to derive policy implications that immediately tap the drug's social-use nature. This is advantageous, as prior literature has not been able to provide practitioners with policy implications that account for the fact that the drug is used within the context of a peer network. The goal of the current study is to determine whether the constructs of social learning theory can help explain the reasons why people experiment with *Salvia divinorum* while controlling for other leading theories of drug use.

DATA

This study uses a sample of 544 undergraduate students at a major southeastern university. While this sample is not generalizable to all young adults, it is quite useful in the study of salvia use for two reasons. First, salvia has been shown to have very low use rates (Khey et al., 2008) and a general sample would have likely yielded very few users. Second, because previous works examining salvia use rates have used similar undergraduate samples (see Khey et al., 2008; Lange et al., 2008; Miller et al., 2009), we will be able to easily compare findings.

Participants were recruited using departmental participant pools during the 2009–2010 academic year; students earned study credits in exchange for participation. Participants signing up for the study were asked to fill out a short online survey that largely focused on life stress and academic honesty, but also included items related to deviance, substance use, and peer associations. It is important to note that salvia possession and use was illegal in the state at the time of the survey administration, but had been legal until 18 months prior to initial data collection.

Participation was voluntary and students could withdraw at any time. Of the 544 participants, 534 completed the items related to salvia, yielding a response rate of 98% for these items. Those ten with missing data for these items were dropped from the analysis. The resulting sample was 32.4% male, 58.2% White, 15.7% Black, 17.2% Hispanic, 5.6% Asian, and 3.2% of students identified themselves as "other." This resembles the demographic makeup of the college which is 41.7% male, 55.6% White, 13.1% Black, 16.8% Hispanic, 10.3% Asian, and 4.2% of students identified themselves as "other." The mean age of those in the sample was 19.94 and the mean GPA was 3.33. Participants also reported estimated family incomes on an ordinal scale. This variable had a median value which represented an income between $75,000 to $99,999 per year.

MEASURES
DEPENDENT VARIABLE

Salvia divinorum experimentation was measured using a single dichotomous item. Participants were asked if they had ever used salvia. Those responding yes were coded 1 and those responding no were coded 0. A number of the participants responded to a previous question that they had never heard of salvia. These cases skipped the use item but were recoded as a 0 for the dependent variable since those who had never heard of the substance would not have knowingly used it. In the present sample, 4.9% of students had experimented with salvia which is consistent with results from previous studies examining the prevalence of salvia use among college students (see Khey et al., 2008; Lange et al., 2008).

SOCIAL LEARNING

Social learning measures specific to substance abuse were adapted from the work of Lee, Akers, and Borg (2004). A dichotomous measure of *differential peer association* was included using an item that asked the respondent if any of their close friends used salvia. Those who responded yes were given a score of 1 and others were coded as 0. This measure is preferable to a more general drug differential association measure due to the rarity of salvia use (Khey et al., 2008), which means many of those who use substances or with substance using friends may not have come into contact with salvia users. Having *definitions* (attitudes) in favor of substance use was

measured using three items that asked the respondent to report their level of approval for using marijuana, other illicit drugs, or misusing pharmaceuticals. These items were measured on a five-point Likert scale that ranged from "strongly disapprove" to "strongly approve." This scale was coded so that higher scores indicate definitions in favor of substance use and showed adequate reliability (α=.736). A measure of *definitions* that focused on drug use in general rather than specifically on salvia was utilized since a number of participants were unaware of salvia's existence, were thus unable to answer items that assessed their approval of the drug, and therefore skipped such salvia specific items. *Differential reinforcement* was measured using three items that assessed how the participant perceived the balance of positive (rewarding) and negative (punishing) consequences of substance use. Participants selected option choices ranging from "almost completely positive" to "almost completely negative." Higher scores indicate that they viewed substance use as more beneficial whereas lower scores indicated they perceived the negative consequences of use to outweigh the benefits (α=.794). As was the case with *definitions* and for the same reasons, a general drug use *differential reinforcement* measure was used for models involving the entire sample. Additional indicia of reinforcement were obtained for those participants with experience using salvia. These single item measures and their relationship to continued salvia use are discussed within the results section.

No measure of imitation was included in the present analysis. While previous research has suggested that the concept of imitation is important in explaining the initiation and experimentation of drug use (see Akers & Lee, 1996), measuring this concept remains elusive and difficult to isolate as the other components of social learning theory typically wash out the impact of imitation when measured concurrently. The present research takes the initial approach of testing social learning theory's most robust components in direct comparison with competing theories.

According to social learning theory the greater the differential association with using friends, the more favorable one's definition of use, and the greater differential reinforcement for use, the greater the likelihood that the respondent will report having used salvia.

SELF-CONTROL AND GENERAL STRAIN AS ALTERNATIVE EXPLANATIONS

Gottfredson and Hirschi (1990) stress that self-control is formed in childhood through family socialization (primarily involving parental monitoring and punishing of children's deviant behavior), and specifically downplays any role for the influence of peers (other than trivial facilitative effects). Self-control theory is presented by Gottfredson and Hirschi (1990) as diametrically opposed to both social learning and strain theory, claiming that the latter two ask only why individuals deviate from norms while control theory asks only why they do not. Therefore, self-control theory may be seen as offering a competing explanation to social learning theory. Although

Akers (2009) has long argued that the two theories are not incompatible and indeed overlap to some extent, we place measures of self-control into the analysis as a plausible alternative approach to accounting for salvia experimentation.

Agnew (2001) does not argue that strain theory is competitive with social learning theory; rather he sees the effects of strain as operating through learning, control, and other mechanisms. Therefore, strain theory is not stated as directly competitive with social learning explanations. However, it does offer an alternative or additional set of social psychological processes as an explanation of substance use which should be examined in testing the tenets of social learning theory.

In order to test for the net effects of variables drawn from these competing or alternative theories of substance use, measures of low self-control (Gottfredson & Hirschi, 1990) and general strain (Agnew, 1992) were created. Low self-control was measured using a scale first utilized by Grasmick et al. (1993). Participants responded to twenty-four Likert-type items that assessed their impulsivity, penchant for risk taking, and preference for physical activities. The items were coded so that higher values indicate lower self-control and the scale showed good reliability (α=.887). According to this theory, the lower one's self-control the higher the probability that the respondent will report salvia use (as an instance of what Gottfredson & Hirschi, 1990, refer to as behavior that is "analogous" to crime).

The measure of general strain was created using the Perceived Stress Scale (see Cohen & Williamson, 1988) that includes ten items each with five response choices ranging from "never" to "very often." These items assess the amount of stress the individual has experienced in the last month and specifically ask if recent life events have caused stress, led them to feel overwhelmed, or caused them to feel behind in their tasks. This scale was used rather than traditional strain measures because the population sampled is unlikely to experience many of those strains Agnew claims are most connected to crime (see Agnew, 2001). More specifically, almost all of those within this sample of college students are not homeless, do not live in a disadvantaged community, are no longer under their parents' supervision, and have achieved goals of autonomy and education. This measure, therefore, differentiates between levels of strain within the study population more effectively. These items were coded so that higher scores indicate that the individual has experienced more stress or strain and the scale shows good reliability (α=.822). The hypothesis from general strain theory is that the greater the amount of strain experienced by individuals the more likely it is they will have used salvia.[3]

CONTROLS

Three controls were included in the regression analysis—gender (coded female=0, male=1), age, and race. Due to the relative infrequency of some categories (Asians 5.6% and Other 3.2%) and to maintain consistency with prior

salvia works (Miller et al., 2009), the race variable was dichotomized into White (coded 0) and Nonwhite (coded 1).

Initial Findings

Prior to exploring models explaining *Salvia divinorum* experimentation, it is important to examine several characteristics of the population relevant to social learning theory. First, participants who had heard of salvia were asked where they first learned of the drug. Salvia has been categorized as a drug popularized by the Internet and YouTube videos (Hoover et al., 2008; Lange et al., 2010) but only 10.7% of this sample learned of the drug through the media (6.5% via the Internet, 3.3% via television, and .9% from a newspaper). A friend was the source of information for 67.8%, while other personal relationships accounted for the rest. Among those who reported salvia use, only one person first learned of the drug online while 88.5% learned of it from someone they classified as a friend. This would seem to indicate that peers are the most common source of information that affects an individual's definitions and readiness to use; the fear that use is driven by Internet sites strongly promoting its use is largely unsubstantiated by these findings.

Every respondent that reported using salvia had at least one friend who had used salvia. When users were asked with whom and in what situations they used salvia, all users reported that they used with friends or significant others. Only two reported ever using alone and these were individuals who reported using multiple times and having used with peers more often than alone. This suggests that using salvia is a group activity but does not necessarily indicate that peer behavior is affecting individuals' behaviors. It is necessary to examine social learning variables in light of controls and other variables from strain and self-control theories.

Analytic Strategy

Salvia divinorum experimentation is a relatively rare phenomenon even in a population that heavily uses both legal and illegal substances. While approximately three-quarters of those in the sample have tried alcohol and one third have used marijuana, less than one in twenty have used salvia. Salvia's prevalence is also exceeded by other illicit drugs (8.2%) and the recreational use of pharmaceuticals (13.7%). The low experimentation rate suggests that salvia has yet to become a popular drug among college students. This low rate also necessitates the use of analytic techniques modified for outcomes that are somewhat rare. King and Zeng (2001) have outlined problems arising from using traditional logistic regression models on binary outcomes in which the events occur far fewer times than the nonevents. In short, they argue that traditional regression models significantly underestimate the probability of the event in these cases and support using a rare

events logistic regression that corrects for these biases. The potential biases vary with the relative frequency of the event and the size of the sample, which unfortunately prevents the establishment of definite guidelines for when a rare events logistic regression model should be utilized over standard models. King and Zeng (2001), however, clearly state that corrections for rare events are necessary when the sample does not exceed a thousand and the event occurs in fewer than five percent of the cases. A rare events logistic regression will therefore be utilized in the exploration of factors that may affect salvia experimentation.

RESULTS
SALVIA EXPERIMENTATION

The results of a series of rare events logistic regression models are presented in Table 1. The first model includes only social learning measures as predictors of salvia experimentation. Two of the three measures, definitions and differential association, were significant at the .05 level and the third, differential reinforcement, was marginally significant. This indicates that those respondents having definitions more favorable to drug use and those with close friends who had used the substance were more likely to report salvia experimentation.

The second model introduces commonly utilized controls into a model with the three social learning items. The effects of the social learning measures remain largely unchanged. Definitions and differential association are still both significant at the .05 level in the theoretically expected direction. In addition, differential reinforcement remains significant at the .10 level. This indicates that social learning constructs have an effect when controlling for age, gender, and race.[4] Of the three controls, only age has a significant effect on salvia experimentation. The odds ratio exceeding one indicates that older participants are more likely to have reported salvia experimentation.

TABLE 1. RARE EVENTS LOGISTIC EXPLAINING SALVIA EXPERIMENTATION (N=534)

	Model 1	Model 2	Model 3	Model 4
Social Learning Measures				
Differential Association	7.815*	8.837*	9.309*	9.281*
Definitions	1.297*	1.261*	1.259*	1.261*
Differential Reinforcement	1.958†	2.100†	2.022†	2.046†
Gender (1=Male)		1.320	1.280	1.223
Race (1=Nonwhite)		0.946	0.946	0.955
Age		1.174*	1.172*	1.172*
Low Self-Control			1.230	1.292
General Strain				0.862

Odds ratios are reported with * indicating $p < .05$ and † indicating $p < .10$

The final two models explore the effect of social learning constructs controlling for measures representing two other leading criminological theories. Low self-control is added in Model 3 and general strain is added to Model 4. In both models, definitions, differential association, and age remain significant. Similarly, differential reinforcement remains marginally significant. Interestingly, neither low self-control nor the experience of strains is a significant predictor of salvia experimentation, controlling for social learning measures. In all of the models, the measure of differential association is significant and has the largest odds ratio. In the final model, it has an odds ratio of 9.281, which can be interpreted as having a close friend that has used salvia increases the likelihood that an individual reported salvia use by more than nine-fold.

Because many participants reporting not having any knowledge of salvia, we also estimated models only using the subsample that had heard of salvia.[5] Using the entire sample is warranted because rarely are such qualifiers used in research examining other drugs or types of deviance. Furthermore, each theory assumes that the theoretical constructs that it argues will lead to deviance also leads to knowledge of that form of deviance. For example, differential association with deviant peers increases the likelihood that an individual will become familiar with a form of deviance, thus increasing the likelihood that they will engage in it. Similarly, those experiencing strain will seek out ways to cope with the strain and those with low self-control will likely be exposed to more deviant opportunities than those with high self-control.

DIFFERENTIAL REINFORCEMENT AND REPEAT USE OF SALVIA DIVINORUM

While strong support is found for both definitions and differential association, differential reinforcement is only marginally significant in the previous models explaining experimentation. This is not wholly unexpected as reinforcement may not be as strong of a predictor for initial use as it would be for repeated use. Potential users may have expectations of rewards prior to the initial experimentation, but they may not be very confident in these expectations, and they have not had the experience of the actual physical and social consequences of use. Following initial use, however, they have experienced the rewards and consequences and can then draw on these experiences to create their expectations of reinforcement for future use (see Akers, 1992). Therefore, in order to take a more detailed look at the effects of reinforcement, we turn to comparing those who have used salvia once to those who have chosen to use multiple times.

With salvia use being rare and repeated use far more rare, the sample does not include enough users for advanced analyses. It is possible, however, to examine the differing response patterns for items inquiring about their first use. Of those 26 respondents who used salvia at least once, twelve reported the experience as

pleasurable. Of these, three (25%) used salvia again. This is in contrast to only 7.7% of those who did not find using it again pleasurable. Similarly, 27.2% of participants who rated their level of enjoyment of the initial use as 7 or greater on a scale ranging from 1 to 10 used again while only 7.1% of those choosing ratings 6 or lower did. While the number of repeat users makes significance testing problematic, these findings would suggest that being positively reinforced during the first use has an effect on future use.

PROPENSITY SCORE MATCHING

A common criticism of social learning theory is that individuals seek out others with similar interests, propensities, and experiences and that associating with deviant peers is an effect of deviance rather than a cause (see Gottfredson & Hirschi, 1990). Social learning theory, however, does not rule out that previous behavior affects associations (see Akers, 1998). Instead, it views it as possible for previous interests and behaviors to affect associations and those associations to in turn influence future behavior and future associations (Akers, 1991; Warr, 1993). This possibility makes delineating differential association's effect challenging. Since the same traits that influenced an individual's decision to associate with peers that use salvia may affect the decision to use it, it becomes difficult to affirm that differential association is a true effect.

Certain individuals are more likely to associate with salvia users than others. This makes comparing those with friends who use salvia to those without such friends in bivariate or multivariate analyses problematic. A propensity score matching approach corrects for such a situation and allows for a comparison of treatment (those with friends who use salvia) and control groups (without friends who use salvia). More specifically, utilizing techniques developed by Rosenbaum and Rubin (1984, 1985) we can create samples that are similar in all relevant variables except for the treatment (being exposed to a peer who used salvia). This minimizes selection bias and can help determine whether differential association is truly an effect.

Propensity scores were estimated for each participant by regressing whether an individual had a peer who used salvia on 16 covariates. These covariates were gender, age, race, low self-control, strain, delinquency, definitions, differential reinforcement, GPA, dichotomous alcohol use, marijuana use, hard drug use, recreational use of pharmaceuticals, Greek membership, living on campus, and family income. Each participant's propensity score was their conditional probability of having a salvia using peer. Comparison groups were then created using a one-to-one nearest neighbor matching algorithm with a .055 caliper (calculated as $.25\sigma$ of the propensity scores, see Guo & Fraser, 2009).

A comparison of the non-matched and matched samples is shown in Table 2. In the unmatched samples, the treatment and control groups are significantly

different for eleven of the sixteen covariates. Matching corrected for these potential selection biases as only one is significantly different in the matched sample. In the unmatched sample, 19.6% of those with a friend who have used salvia have themselves experimented with salvia as compared to none of those in the control group. When the samples are matched, an average treatment effect (ATE) of .1784 ($t=4.65, p<.01$) is obtained. This indicates salvia use between the two groups is still significantly different following matching. Put another way, more of those with a friend that has used salvia chose to experiment with the drug than those without such a friend due to the existence of the friendship rather than an underlying propensity. That is, 17.84% more of those with friends who had used salvia would be expected to experiment with salvia if that group was equivalent to those without salvia using friends. While this is less than the 19.6% difference in proportions noted earlier, it should be viewed as strong support for social learning theory, specifically its predictions about the effects of differential peer association.

TABLE 2. COMPARISON OF MATCHED AND NON-MATCHED SAMPLES

	Non-Matched Sample			Matched Sample		
	Peer Used	No Peer Use	p	Peer Used	No Peer Use	p
Age	20.174	19.897	.186	20.148	20.086	.920
Alcohol Use	.932	.678	.000*	.912	.965	.179
Definitions	2.225	1.677	.000*	2.045	2.333	.021*
Delinquency	1.124	1.084	.065	1.112	1.106	.087
Differential Reinforcement	1.997	1.643	.000*	1.934	2.040	.403
Family Income	4.909	4.53	.049*	4.884	5.017	.684
Gender (1=Male)	.379	.299	.090	.378	.293	.347
General Strain	2.761	2.778	.779	2.763	2.813	.581
GPA	3.475	3.279	.007*	3.444	3.474	.602
Greek membership	.265	.164	.011*	.223	.259	.528
Living On-campus	.242	.340	.037*	.272	.276	.996
Low Self-Control	2.102	2.064	.356	2.104	2.058	.612
Marijuana Use	.598	.247	.000*	.505	.638	.056
Other Illicit Drug Use	.204	.041	.000*	.136	.189	.255
Race (1=Nonwhite)	.265	.474	.000*	.320	.276	.432
Recreational Use of Pharmaceuticals	.311	.079	.000*	.194	.293	.055

Note. Values listed are means of the groups prior to and following matching. Significant p values indicate that those with peers who use salvia are significantly different from those without peers who use salvia with regard to that specific variable.

DISCUSSION

The results of this analysis lend support to Akers' social learning theory in explaining salvia experimentation. These findings are important because this is the first study to test the ability of multiple criminological theories to explain salvia experimentation. Further, using a similar sample as Miller et al. (2009), we find that social learning theory explains salvia experimentation much better than low self-control. In addition, social learning theory variables are more robust than general strain theory's tenets, lending further support to the social nature of salvia use. Several limitations of this study are worthy of mention, including the small sample size, use of only a college population, and only evaluating salvia users in one state. Future research should aim to confirm these findings using larger samples, including both college and non-college adolescents, and in states with various legal prohibitions.

On July 1, 2008, the state in which this survey was administered banned the possession and sale of salvia. One of the questions asked on the survey instrument inquired whether the respondent had used salvia after the July 1, 2008 date. Very interestingly, not a single respondent in our sample used salvia after this time period. There are several explanations for this finding. One reason, extrapolating from social learning theory, for the desistance in use by previous users and the lack of initiation by new users could be due to the deterrent effect of prohibition and other negative consequences related to using a banned substance. Therefore, for most the balance of both anticipated and actual punishing consequences would be sufficient to move the overall differential reinforcement balance toward negative outweighing positive consequences that would prevent initiation and motivate desistence if use has already begun. Unfortunately, our interview instrument did not include questions directly addressing this issue. Future research should evaluate the effect of this prohibition on use. Research needs to evaluate the number of salvia arrests and prosecutions and assess the impact this has on experimentation.

In our sample, the majority (69.2%) of those who experimented with salvia had also used marijuana. This finding indicates that for many salvia users, the illicit status of the drug may not matter in isolation but is weighed against other social and physical effects of a particular substance. This balance of rewarding and punishing consequences of salvia use (differential reinforcement) may be a major factor in the decline in use of salvia is that the drug has become less popular among college students. Similar to Miller et al. (2009), we found that many of the users reported having negative or neutral experiences. The hypothesis is that use of a substance such as marijuana may have greater reinforcing drug effects and social support than use of a substance such as salvia. That is, the psychopharmacological effects of salvia and its short history of use in a social context may be enough to sustain some

level of use as long as it carries no legal risk, but not enough to sustain the same prevalence in the face of legal prohibition. In contrast, the effects of marijuana and its long history of use in reinforcing social contexts are sufficient to sustain a higher prevalence than salvia, even in the face of possible negative legal consequences.

Another probable explanation for this decline is the removal of a supply chain. Unlike marijuana, there appears to be no sizable or sophisticated illicit market for salvia. Although trafficking salvia from bordering states where the substance is legal would not be difficult, there seems to be no large-scale market for this diversion. One reason for this may be because salvia (purchased legally) is expensive relative to marijuana and may price itself out of the illicit market. These and similar hypotheses await further research looking into the behavioral effects of illicit status as a deterrent or preventive mechanism. For instance, future research could compare states that have not passed legal prohibitions of salvia with those that have prohibited it to better isolate the impact of the policy change from fluctuations in drug use patterns. Future research should also further evaluate the illicit market for salvia. Research is also needed to test more directly the differential reinforcement hypothesis by examining the extent to which the perceived and actual balance of reinforcement for users and potential users of salvia is affected by legal regulation and sanctions. Finally, more research is needed along the line of the current study to test the effects of all of the social learning variables of differential association, differential reinforcement, definitions, and imitation on salvia use in other populations and contexts.

This research suggests that salvia experimentation is tied to intimate peer networks. Given its lack of black market share, regulating Salvia divinorium in a manner which interrupts its licit sale will most likely hamper its use substantially. Substance use and abuse practitioners should therefore pay special attention to the prevalence of salvia use in states that have prohibited its sale and possession. Policy-makers should take note that the disruption of licit sale can be achieved by the lowest common denominator of regulation. That is, this and previous research (see Khey et al., 2008; Miller et al., 2009) suggests youth obtain and use salvia from their peers in which the purchase originates in a local shop, not the Internet. The development of an underground market for salvia is yet to be documented. Keeping regulations to a minimum will allow for scientific exploration into *Salvia divinorum* for possible medicinal properties as with other species in its genus (see Grundmann, Phipps, Zadezensky, & Butterweck, 2007).

The support for social learning variables as factors in salvia experimentation in this research suggests another line of policy initiatives beyond specifically legal or criminal justice policy, namely school or community based prevention/education programs. This can be done by developing new or enhancing current prevention programs. While there are often prevention/education programs (such as DARE)

that do not have the intended outcomes, there are programs such as those developed by the Oregon Social Learning Center and the Social Development Research Group in Seattle based on social learning (cognitive-behavioral) approaches that have demonstrated at least modest success in short-term and longer-term prevention of substance use/abuse (see Akers, 2010).

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. As defined by Gottfredson and Hirschi (1990) and tested via scale items developed by Grasmick et al. (1993).

3. A measure of negative affect was created in order to determine if strain's potential effect was mediated by emotionality as Agnew would suggest. This measure was originally designed to be added to the final regression model in the initial portion of the work's analysis, but was later excluded due to strain's insignificance as it would be inappropriate to test for mediation if the initial variable had no significant relationship with the outcome variable.

4. Use of other drugs was not included as a control for several reasons. First, it is theoretically expected to be a result of the same processes as salvia use and not be a cause of salvia use. Second, using cross sectional data prevents us from determining whether use of alcohol, marijuana, or other drugs preceded, followed, or occurred at the same time as salvia experimentation. Longitudinal data are thus necessary to evaluate drug sequencing.

5. A separate analysis was run only using the portion of the sample that reported knowledge of salvia (N=214). The results were largely similar, with the following exceptions. While differential reinforcement had a marginally significant effect in the overall model predicting salvia use, its effect was insignificant in the subsample. Low self-control, which had an insignificant effect in the full model using the total sample, had a marginally significant effect in the subsample. No effects that were significant at the .05 level were reduced to insignificance and no previously insignificant effects were significant at the .05 level once the sample was reduced. This demonstrates the robustness of our results and justifies use of the larger sample. Please note that these subsample findings are of logistic regression models rather than rare events logistic models due to the percentage of those with knowledge of salvia reporting use exceeding cutoffs for rare events models

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