Drug Use among a Sample of Federal Drug Crime Defendants: Implications for the Gateway Effect Hypothesis

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Abstract: This study investigated the association between marijuana first before other drugs and alcohol and later hard drug among a convenience sample of federal drug crime defendants from one federal court in the Mid-Atlantic region of the United States. Results from two binomial logistic regression models revealed statistically significant associations between first use of marijuana and regular drug use and hard drug use, respectively. Findings suggests a gateway effect for marijuana within this sample.

INTRODUCTION

Three decades of war on drugs enforcement has created a system in which the United States has witnessed a six-fold increase in Americans under some form of formal social control (Reitzel 2006). With drug sales and possession arrests rising by over 163%, drug related offenses have become a leading cause of incarceration (Bureau of Justice Statistics 2016; Duke 2010). As of the end of 2016, United States Federal Bureau of Prisons (BOP) statistics reveal that incarceration for drug offenses at the federal level accounted for over forty-six percent (82,109) of all inmates; the second closest offense was for Weapons, Explosives, and Arson at 16.9% (29,834). As a drug policy matter, questions arise about the economic utility of contemporary drug enforcement effort and about social justice issues associated with racial and ethnic disparities in drug arrests and sentencing (Turner and Dakwar 2014; Reitzel 2011), and about drug crime enforcement having any significant deterrent effect on usage (Mauer and King 2007).

Within a context of rapidly changing public perception about medicinal and recreational marijuana use and with more than twenty-nine states now permitting marijuana for medicinal purposes and another eight now allowing recreational use, United States drug policies regarding marijuana are in flux and have seemingly led to a renewed concern about marijuana as a gateway drug (Chu 2015; Jones 2015). This concern is based upon the belief that legalizing marijuana means easier access for younger people and rising social acceptability, which in turn might increase the likelihood that earlier exposure or use of marijuana will lead to more people becoming regular drug users or progressing to harder drugs, and thus a potential increase in many different adverse outcomes (Odgers *et al*. 2008). However, a paradox exists regarding the marijuana gateway effect. Despite studies having repeatedly shown that marijuana is often the first drug used in the sequencing of drug use (Choo, Roh, and Robinson 2008) most people who use marijuana do not progress harder drugs (Johnson a Golub 2002). Nevertheless, in seeking investigate further analyze the marijuana gateway effect hypothesis, this study employs a convenience sample of drug offenders convicted from one federal Mid-Atlantic court. Understanding the link between using marijuana first and later regular and hard drug use among known offenders can provide additional knowledge about the validity of the gateway effect hypothesis.

REVIEW OF THE LITERATURE

The relationship between marijuana use and later drug use, termed a gateway effect holds that marijuana and other "soft" drugs such as alcohol and tobacco act as gateways to later, harder drug use (Choo *et al*. 2008; Rebellon and Van Gundy 2006; Kandel, 2002; Kandel and Jessor, 2002; MacCoun 1998; Mackesy-Amiti, Fendrich, Goldstein 1997; Kandel and Yamaguchi 1993; Kandel, Yamaguchi and Chen 1992). The alleged gateway effect for marijuana seems to have received most of the academic attention and has been a central claim of the Office of National Drug Control Policy (ONDCP) since at least the 1950s (Choo

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et al. 2008; Morral, McCaffrey, and Paddock 2002) and appears to have some connection to the fact that drug use data consistently show drug users having engaged in marijuana use prior to using harder drugs (Thies & Register, 1993; DeSimone, 1998; Dinardo and LeMieux 2001). Kandel and Jessor (2002) and Morral and colleagues (2002) note that there is a persistent invariance of marijuana use in the developmental sequence of drug use (see also Rebellon and Van Gundy, 2006 Fergusson & Harwood, 2000; Kandel, Yamaguchi & Chen 1992). In addition, marijuana's position in the progression of drug use is complicated by many factors that link to drug use. For instance, marijuana can come first in the sequence but can also come later in the sequence, behind alcohol, cigarettes, and even prescription drugs (Choo *et al*., 2008). Or, as Cohen argued forty years ago, the stepping stone hypothesis is unable to capture the complexity of drug use from a macro level standpoint, one in which many different drugs are used for many different reasons. In other words, marijuana use occurs within a deviant subculture in which many drugs are socially acceptable, and thus the hypothesis is too narrowly constructed "to do justice" to the complexity of drug use (Cohen, 1972).

Cohen's argument underscores the existence of multiple constructions of the hypothesis as drug use outcomes interact with exogenous factors, which can lead to a progression from softer drugs to harder drugs. It also suggests the existence of more than one pathway to hard drug use (Choo, *et al*. 2008, Cohen, 1972). Yet there are several compelling explanations about marijuana's early position in the development of drug use such as its perceived safety and social acceptance among the public; its pleasurable social and health benefits, and despite when it was illegal everywhere in the United States it has long been easily obtainable and inexpensive (Choo *et al*., 2008; Kandel & Jessor 2002, and Morral *et al*., 2002). Hard drugs, such as heroin and powder cocaine, on the other hand, while also providing pleasurable benefit to users and also being relatively easily obtainable, are more harmful to physical and psychological health; and carry a considerably more severe negative stigma (Cunningham, Sobell, & Chow, 1993).

In recent years, theoretical development and empirical findings about the progression of drug use and the gateway effect has led to the emergence of a more robust knowledge base yet one that continues to have many unknowns and uncertainties, and a hypothesis that has been constructed in several ways

(Choo *et al*., 2008; Kandel & Jessor, 2002; MacCoun, 1998). In 2002, Kandel and Jessor identified three features that define the gateway effect hypothesis. First, there is a "developmental sequence" of drug involvement amongst adolescents that begins with legal drugs, such as alcohol and tobacco, and then is followed by the use of illegal drugs such as marijuana, cocaine, and heroin. Within this sequence, marijuana serves as a bridge between the legal and illegal drugs. Second, using marijuana earlier in the sequence links to an increased risk for using harder drugs later in the sequence. And last, a causal relationship exists between drugs used earlier in the sequential process with those used later in the sequence. Thus, alcohol, tobacco, and marijuana are hypothesized to cause the use of cocaine, heroin, and other harder drugs.

According to Kandel & Jessor (2002), drug use sequencing also follows normative patterns comparable to the development of juvenile delinquency and adolescent sexual behaviors. In total, they identify four different features including that sequential drug-use processes are not invariant. They found that there are multiple pathways in the development of drug use that people can take, which vary demographically by factors such as birth cohort, race/ethnicity, gender, and even the type of drug first used. Second, that earlier initiation into drug use is not necessarily a predictor of harder drug use in later stages of development. Last, that the sequential process of drug use is based on the variety of drugs used during development but is not the result of differences in using similar drugs, and that the sequential drug-use process is based solely on drug use behavior, not on other types of adolescent and/or youthful non-drug related delinquency.

Drawing from Kandel and Jessor's work (2002), while also incorporating other constructions of the gateway hypotheses that have emerged in the literature, Choo and colleagues (2008) determined that there were at least five unique gateway theories (see also Morral *et al*., 2002). They are summarized as follows: 1) marijuana use is a "warning sign" for an increased risk in later harder drug use. In other words, what causes someone to use marijuana will likely also cause them to use other drugs; 2) marijuana is almost always an antecedent to harder drug use and that the use of marijuana itself causes harder drug usage; 3) marijuana use lowers the perceived risks in using other drugs; 4) impairment from marijuana seduces the user into using other drugs; and 5) the illegal nature of marijuana leads to contacts with criminal elements in society, including dealers of harder drugs. In addition,

there exists other drug sequencing theories that we have found. Although these theories are not gateway theories as traditionally conceived, they do appear to have implications for understanding drug use. Emerging from the behavioral genetics literature on comorbidity, these "correlated liabilities theories" or "common factor theories" generally hold that marijuana use, as well as other drug use, have genetic components resulting from phenotypic and environmental factors, which predispose individual differentiation in drug choice, progression, and addiction (Agrawal *et al.*, 2003; Morral, 2002; Klein and Riso, 1994). Correlated liabilities seems to add an a key insight to the literature, ensuring a more dynamic conceptualization of the sequencing process and implications for later drug use by linking potential genetic factors to social behaviors that makes drug addiction and abuse more likely (Agrawal *et al.*, 2003).

Underlying the multiple gateway constructs are assumptions about individual drug use and the social milieu in which escalating drug use proliferates, which call into question the exact nature of gateway effect (Morral *et al.*, 2002). Some economists have argued that an economics-based approach is needed to clarify the gateway effect given the confounding issues that continue to plague gateway studies (Kenkel & Mathios, 2002). Citing Morral *et al.*'s (2002) paper which revealed a progression of drug use from softer drugs to harder drugs that did not support a gateway effect, Kenkel & Mathios (2002) argue that the existence of a *common factor* effect underlies drug use propensity. Conceptualized in this way, drug use is the result of individual propensity to use drugs (of any kind), which in turn mirrors the purported gateway effect. To the individual user, the high felt from marijuana may decrease hesitation or lead toward curiosity of harder drugs or the "euphoria" (Stigler and Becker, 1977) experienced by marijuana users might decrease over time, thus users begin trying other drugs in order to achieve the euphoric effect again (Kleiman, 1992). Nevertheless, whether the progression of drug use is a result of structural and cultural factors that make marijuana the likely first drug of choice by most people, genetic predispositions, or some combination of all such factors, remains opaque. Despite its empirical uncertainty, the gateway effect hypothesis continues to engender some popularity amongst scholars, practitioners, and the public. This popularity extends directly from the strong link between marijuana use and later use of other hard drugs such as cocaine and heroin, and from its relationship to different forms of criminal activity. But it is a fraught proposition to move

from correlations between phenomena to claiming a cause and effect relationship (Kenkel and Mathios, 2002). Most of the studies that we found on the gateway effect hypothesis do not employ the type of experimental designs that allow for making such a claim but many reveal how this alleged effect is still on unstable empirical footing. Toward this end, we review some of the literature on the gateway hypothesis and drug offenders to make better sense of the current state of the hypothesis.

Prior studies of the gateway effect have found mixed results. In one early sutdy, Cohen (1972) found significant links between hashish and other drug use and deviant behavior, arguing however that hashish, like other drugs, provides a social stimulant that puts users in contact with one another, and thus was not necessarily evidence of a gateway effect. Likewise, in studying cocaine users, Golub and Johnson (1994) reported that even while a small minority of people followed the sequence, most people who used marijuana never actually progressed to cocaine, and even fewer went on to use heroin. Their finding suggests that a gateway effect seems to exist for only a very small percentage of people who experiment with drugs while most simply never progress beyond marijuana. Conversely, in a study of adolescent drug users in New Zealand, Fergusson and Harwood (2000), found that most marijuana users do not progress to harder drugs. Only three of the one-hundred and twenty-four subjects had used a hard drug prior to using marijuana. In a study of New York City drug users, only about one-third of those under study used marijuana before moving on in the sequence to harder drugs (Mackesy-Amiti, Fendrich, & Goldstein, 1997). Golub & Johnson (2002) (see also Choo *et al*, 2008) argue that the low rates of marijuana users progression to harder drugs might be because many if not most users only experiment with drugs, never intending to move on to harder drugs or to becoming regular users or abusers.

On the other hand, Mills and Noyes (1984) found a cumulative effect for drug use; once initiating marijuana, users basically just moved through the progression to the next—that is, more serious—drug. This finding emerged from the growing evidence that reveals a large majority of cocaine users, both youth and young adults, previously used marijuana (O'Donnell and Clayton, 1982; Newcomb and Bentler, 1986; Kandel & Yamaguchi, 1993). And more recently, researchers at the Centre for Economic Policy Research in London found no gateway effect for

marijuana in surveying 17,000 drug users over a 10-year period. The researchers reported that marijuana use typically began between the ages of 18 and 20, and cocaine use began between 20 and 25. Moreover, they found that there was not much variance among those who used cocaine in comparison to if they had previously used marijuana. There were substantial numbers of individuals who had used "soft and hard drugs," but the association was related to personal characteristics of users and a tendency to partake in experimentation, further noting that the progressive patterns of drug use were normative and because marijuana is the most widely used and available drug, it is "predictably" first in the drug sequence (besides that of tobacco and alcohol) (Golub & Johnson, 2001).

Among the literature on the risk factors associated with drug use, some research uncovering significant relationships between high-risk factors, such as psychological problems and sexual activity, which purports a progressive increase in drug use. For instance, high risk factors associated with substance abuse, while varying by gender, include delinquency (Newcomb, 1997), psychological problems (Newcomb, 1997) and sexual activity (Jessor & Jessor, 1977). Such high-risk behaviors correlate with varied substance use including alcohol, marijuana, and other drugs (Huizinga, Loeber, & Thornberry, 1993). Friedman *et al*. (1995), revealed that several childhood risk factors could predict the degree of substance use. Among females, childhood psychopathology, relatively low intellectual level, and relatively poor academic performance were found to be associated risk factors. Early aggressive or shy behaviors were found to be the primary risk factors associated with males (Ensminger, et. al., 1982). Hsieh and Hollister (2004) discovered that there were several risk factors associated with substance use, as opposed to only one. Through further investigation, it was revealed that psychological problems, sexual experience, family problems, school, legal issues, lack of religious involvement, attendance of Alcoholics Anonymous/Narcotics Anonymous or other similar self-help support groups, aftercare, and abstinence all contributed to the likelihood of substance abuse among men and women. However, females had psychological difficulties, sexual abuse experience, and family stress, while males had more school and legal problems, and lower involvement in religious activities, which were direct risk factors association with substance use (Hsieh and Hollister, 2004).

Lastly, personal drug use and criminal histories had some importance for investigating current drug use and offending. Numerous studies have uncovered key insights including the relative age at which someone initiates offending (Farrington, 2003). This research generally suggests that the younger a person is when they first get involved in drugs and crime, the longer they will stay involved and the more likely it is that they continue to escalate in criminal activity (Piquero, Farrington, & Blumstein, 2003). Such escalation has become a focal point of recent crime research. But as Kandel and Jessor argue, drug use sequencing does not necessarily follow a similar trajectory of criminal offending. The descriptive analysis of the defendants does show, though, that nearly sixty-six percent actually fell within the peak age of offending or later with respect to their first arrest, suggesting that generally they were not early-onset offenders.[1]

Current Focus

We examine the link between early marijuana use and later drug use in order to determine the possibility of a gateway effect among known drug users or sellers who were convicted of federal drug crimes. The available background and historical data on defendants provides insight into potential control factors that can influence drug using behavior. Although not a direct measure of a gateway effect, this study was framed by this hypothesis due to the information the research team had available about self-reported first drug use and later experiences with other types of drugs as uncovered through presentence background investigations.

Data and Methods

Data for this study were collected from eighty-seven male defendants who were selected through a convenience sample related to the a collaboration between the authors of this paper and a judge at a federal court located in a Mid-Atlantic State from 2011-2012. In order to compile the data, the research team collaborated with two judicial law clerks to collect information directly from electronic Presence Investigation Reports prepared by Federal Probation Officers. Over the course of eighteen months, offenders who were convicted of or plead guilty to drug related offenses such as possession or distribution of illicit drugs and other serious offenses such as illegal

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[1]The aggregate age/crime relationship (i.e. the *age/crime curve*) holds that aggregate crime rates for serious violent and property crimes typically peaks between ages16 and 19. Aged thirteen and younger is generally considered early onset offending as measured by age at first offense or age at first arrest.

firearm possession were included in this convenience sample.[2,3] All defendants were arrested for offenses either in or near the city in which the federal court is located, while the PSI reports revealed that over 95% of the defendants had been living in or near the city at the time of arrest. Drug related offenses for which defendants were charged or convicted included possession and/or distribution of marijuana, possession and/or distribution of cocaine (powder or crack), and criminal conspiracy, while many defendants were also either charged with or convicted of firearms related offenses.

To achieve as much detail in the data as possible and to ensure coding accuracy, personal information provided in the PSI reports were analyzed. However, the data were coded in a way to ensure that individual defendants in the sample could not be personally identified.

Independent & Dependent Variables

Independent variables included in the statistical models were culled from PSI reports containing background information on defendants prior to sentencing. For example, as shown in Table **1** below, the PSI reports had information on the defendant's juvenile and adult criminal and drug use history, family structure (whether defendant had lived with one or both parents, or some other adults) and family drug use history and arrest histories (Coded as 0/1), and other important information such as their employment, marital status and educational attainment (ordinal variable by highest degree to include "some college"). We were also able to obtain some information about whether other family members used drugs or not.

Dependent variables for the study were drawn from the same PSI reports, which includes official history, such as a defendant's record of arrests, self-report history, and reconstructions of information from other official and non-official sources. There were two dependent variables in the study is 1) Regular Drug Use and 2) Hard Drug Use. The first, Regular Drug Use is a dichotomous variable defined as those who as a result of presentence investigations have been determined (whether through self-report or other

evidence) to have used any type of illicit drugs on at least a monthly basis in the months or years prior to arrest such that there is a patterned and frequent dimension to their usage. Presentence investigation did not allow for an exact drug use history, but did provide information that allowed for distinguishing between regular and infrequent drug use. As such, this dichotomous variable was not collapsed from a ratio variable. The second dependent variable, Hard Drug Use, is also a dichotomous variable, indicates whether defendants had used hard drugs such as cocaine, heroin, methamphetamine in the past that was more than single instances, thus it would include frequent and infrequent hard drug use.

Hypotheses

Much of the literature on the marijuana gateway hypothesis assumes a gateway effect based on the ubiquity of marijuana use among adolescents and young adults. Although other drugs such as alcohol, tobacco, and prescription drugs are also considered as gateway drugs given the widespread use among young people, there is ample evidence of marijuana use occurring if not first in the sequencing of drug use, then very early in the progression. Empirical findings supporting this gateway effect can also vary according to the particular construction of the hypothesis. The most prominent of the these, stating that marijuana use acts as a gateway to harder drug use, is based on the assumption that hard drug users will be significantly more likely to have used marijuana first prior to progressing to harder drugs, thus passing through this *gateway*. An alternative gateway effect hypothesis, however, is that marijuana use can be a gateway to regular use of softer drugs. In other words, the gateway is not a progression to harder drugs but to a regularity of drug use indicating possible addiction (Choo et. al, 2008). From this perspective, early marijuana use is possibly associated with the potential development of substance addiction irrespective of the particular substance. This insight leads us to two questions framing our study. The first asks whether there is a gateway effect leading to regular drug use and the second is whether there is a gateway to harder drug use. Answering these two questions can help contribute to the collective knowledge about the gateway effect hypothesis. And based on the above questions, we formulated two hypotheses:

> *H1: Net of controls, using marijuana first in the sequence of drug use will significantly predict regular drug use compared to alcohol and cocaine.*

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[2]Cases in this federal court are purportedly randomly assigned to the various judges. However, because the court would not make the selection process available for examination, there was no way to determine whether assignment of cases were truly random.
[3]The research team requested a more diverse sample of cases appearing before the judge, where defendants were found to have used drugs but were denied this request.

H2: Net of controls, using marijuana first in the sequence of drug use will significantly predict hard drug use compared to alcohol and cocaine

Analysis

Analysis of the data proceeded in three phases. First, descriptive statistics were reported in order to contextualize the composition of offenders with respect to background factors such as family structure, educational attainment, employment status, and prior and current drug use and criminal histories. Second, one-way analysis of variance (ANOVA) models were employed to measure the variability between first using alcohol, marijuana, and cocaine on the two dependent variables. Last, two binomial logistic regression models were constructed to examine the relationship between structural and drug use behavioral antecedents and current drug use. Binomial regression is well suited for measuring limited dependent variables when the parameters allow for only two possible outcomes (Long, 1997).

Descriptive Statistics

Analysis begins with a descriptive breakdown of the sample, providing a sense of defendants' backgrounds across important factors structuring this study. Referring to Table **1** below, the defendants tended to be in their early thirties, unmarried, less educated, and

unemployed. They were also overwhelmingly black males or other minorities. Only twenty-two percent were married at the time of their arrest even though the average age of their most current arrest was thirty-one. The defendants were almost as likely not to have graduated from high school compared to having graduated or to having earned a GED. Only two defendants had earned college degrees while twelve defendants had attended college but did not earn a degree. Also, only fifty-nine percent of the defendants did not have a job at the time of their arrest compared to only forty-one percent who were gainfully employed. No data were available, however, on the types of employment or whether employment was full-time or part-time. An examination of the racial breakdown of defendants revealed that eighty-seven percent were black, while whites comprised only about four percent and Hispanic/Latinos about eight percent. All but nine of the defendants resided in urban areas.

There was some variation in the defendants' family structure. Thirty-seven percent of the defendants had resided with both parents in the household while growing up compared to forty-three percent residing with only one parent. Nearly one in five defendants lived with other relatives or in foster homes. Closer analysis of the data revealed that in many cases, the defendants' family structure changed over time. Most of the defendants were shown to have lived with either both parents or only one parent for long periods in their

Table 1: Descriptive Statistics of Independent and Dependent Variables

Variables	Percent	Mean	Standard Deviation	Minimum	Maximum
Independent Variables					
Age at First Arrest		19.62	6.64	9	39
Age at First Drug Use		15.07	3.66	5	29
First Drug Alcohol	0.22			0	1
First Drug Marijuana	0.54			0	1
First Drug Cocaine	0.22			0	1
Parents' Drug Use	0.41			0	1
Sibling Drug Use	0.30			0	1
Family Structure	0.37			0	2
Number of Siblings		3.09	2.04	0	12
Education		1.07	1.22	0	4
Employment	0.40			0	1
Dependent Variables					
Regular User	0.63			0	1
Hard Drug User	0.70			0	1

lives, but due to divorce, death, or incarceration, their family structure changed during childhood. There was also important variation in family size, a key predictor of juvenile delinquency and adult criminality. The number of siblings' defendants had ranged from zero to twelve. The median was four siblings (n=19), followed closely by two siblings (n=18), and three siblings (n=16). Eighteen defendants were either an only child (n=7) or had only one sibling (n=11), while one defendant had twelve siblings and another defendant had eight siblings.

Individual drug use history played a significant role in understanding the gateway effect. The defendants in this study were regular drug users of at least one drug at various points in their lives, including at the time of their arrests. Ninety-seven percent of the sample had regularly used between one and four different drugs. Defendants were quite young when they initially experimented with drugs other than alcohol; the average age was fifteen and ranged from age five to twenty-nine. Defendants were slightly older than sixteen when they first tried marijuana and considerably older (aged 22) when they first tried a hard drug such as cocaine or heroin. Their age at first use of hard drugs ranged from thirteen at the youngest and forty-nine at the oldest. This is notable since it appears to confirm prior research on the age sequencing of marijuana and cocaine, with the average age of first time marijuana being nearly three to five years younger than the average first time cocaine user (Valenzuela and Fernandez, 2011). Marijuana and alcohol were the substances used most by defendants. Ninety-seven percent were either regular marijuana users or had used marijuana in the past. Cocaine was the third most used drug by the defendants. Fifty percent of the defendants had used cocaine (powder or crack). Fifteen percent had used both. All other drugs, including prescription medications or those not defined in the reports were used by less than one-third of the defendants. Lastly, drug use by family members also appeared to play a role in the defendants own drug use. Nearly forty-one percent of the defendants had one or both parents who were regular users of drugs,

while slightly over thirty-one percent had siblings had regularly drugs. Of the nineteen defendants who were married, only one had a spouse who was known to use or have used drugs. No information was available about the drug use habits of the defendants' friends or non-married partners.

Offending History

The mean age of first arrest for the sample was slightly older than nineteen years. Age at arrest that led to the current conviction was thirty-one years, ranging from the youngest at fifteen years old to the oldest at sixty-nine years. In addition, all of the defendants were convicted of serious drug related crimes. Cocaine possession and/or intent to distribute were the most common offenses, comprising nearly seventy-seven percent of all cases. This was followed by other drug possession/distribution; other crimes at slightly more than seventeen percent and lastly, marijuana possession/intent to distribute at nearly six percent. Notably, many defendants were also convicted for other related crimes. Over twenty percent were convicted of criminal conspiracy while slightly more than seventeen percent were convicted of gun crimes in relation to their drug offenses.

Analysis of Variance

To ensure significant variability between key independent variables, we estimated a one-way ANOVA model for both regular and hard drug use dependent variables. Table **2** below indicates that there was significant variability between whether the defendant used alcohol, marijuana, or cocaine first in predicting regular and hard drug use. According to the mean differences, marijuana was the first drug used by a majority of defendants relative to alcohol and cocaine. This finding indicates some support for our first hypothesis, while also showing marijuana occupying a sort of middle ground between alcohol and cocaine in its effect on regular drug use but being indistinguishable from cocaine in its effect on later hard drug use. We address this in our discussion of the logistic regression findings.

Table 2: One-Way Analysis of Variance for First Drug Used

Dependent Variable	Alcohol Group 1	Marijuana Group 2	Cocaine Group 3	F	Tukey's B
Regular Drug Use	0.63	0.87	0.89	3.25	(1/2,3)
Hard Drug Use	0.42	0.47	0.68	4.46	(1/2,3)

Note: Under Tukey's B (1/2, 3) indicates Group 1 is significantly different than Groups 2 & 3.

Multivariate Results for Regular Drug Use and Hard Drug Use

Table **3** below reports the results of two binomial logistic regression models. Model 1 in Table **3** presents the results estimating whether marijuana as the first drug ever used predicts regular drug use compared to alcohol and cocaine, controlling for other relevant factors. As the model indicates, five variables emerged

as statistically significant at the .05 level. Age at First Arrest and Age of First Drug Use both predicted regular drug use. The negative coefficients of both suggests that defendants who were relatively younger when first arrested or when they first used drugs were, respectively. These two related findings have some accord with research on other criminal behaviors that shows a correlation between early involvement in crime

Table 3:   Binomial Logistic Regression Predicting Regular Drug Use and Hard Drug Use

Independent Variables		Model 1 Regular Drug Use N=86	Model 2 Hard Drug Use N=86
Age at First Arrest	β	**-0.12***	-.04
	SEβ	0.06	.04
	eβ	0.88	.96
Age at first Drug Use	β	**-0.27***	.00
	SEβ	0.13	.07
	eβ	0.77	1.00
First Drug Alcohol *Ref Group: Marijuana*	β	-1.98	-.90
	SEβ	0.93	.62
	eβ	0.14	.41
First Drug Cocaine *Ref Group: Marijuana*	β	**3.15***	**-1.30***
	SEβ	1.54	.64
	eβ	23.43	.28
Parents Drug Use	β	1.15	-.40
	SEβ	0.93	.53
	eβ	3.15	.67
Sibling Drug Use	β	1.35	**1.33***
	SEβ	1.1	.62
	eβ	3.87	3.79
Family Structure	β	0.42	.03
	SEβ	0.88	.53
	eβ	1.51	1.03
Number of Siblings	β	**-0.56****	-.07
	SEβ	0.22	.12
	eβ	0.57	.93
Education	β	0.24	**-.63***
	SEβ	0.34	.28
	eβ	1.27	.53
Employment	β	-0.97	1.08
	SEβ	0.99	.63
	eβ	0.38	2.94
Nagelkerke R-Square		0.56	0.36

β= Beta Coefficient; SEβ= Standard Error; and eβ= Odds Ratio.
Significant variables in each model appear in bold: *p < .05; ** p < .01.

and deviance and continued later involvement (Ge, Donnellan, and Wenk, 2001). Number of Siblings, a family structural predictor, was also significant and negative. This appears to be a confounding outcome, which can be interpreted as having fewer siblings was associated with an increased likelihood to be a regular drug user. However, prior research has shown an association between greater number of siblings and increased likelihood of deviant and criminal behavior.

The last two significant variables in Model 1 have implications for our first hypothesis. Relative to marijuana, both cocaine and alcohol as measures of drugs first used by defendants significantly predicted regular drug use. The negative coefficient for alcohol suggests that compared to marijuana, first using alcohol is less likely to predict to regular drug use. Conversely, the positive sign for cocaine can be interpreted as using cocaine first better predicts regular drug use compared to marijuana. Based on these findings we mixed support for our first hypothesis. Of the three potential gateway drug variables in the model, marijuana was the modal first drug used at fifty-four percent compared to twenty-two percent for both alcohol and cocaine but did not better predict regular drug use compared to cocaine.

Model 2 in Table **3** reports the results from the binomial logistic regression predicting hard drug use. Three variables emerged as significant in the model. The first, sibling drug use, indicates that having a sibling who used illicit drugs of any kind increased the likelihood of the defendant using hard drugs. Education was also significant. The negative sign on the coefficient suggests that less educated defendants were more likely to be hard drug users than more educated defendants. Cocaine as the first drug used was also significant, the negative coefficient suggesting that it was less likely to predict later hard drug use compared to using marijuana first. The finding appears to confirm our second hypothesis. This raises a confounding issue given cocaine is itself a hard drug and in this sample was the hard drug most used by defendants, yet it was not better at predicting later hard drug use relative to marijuana.

DISCUSSION

This study sought to investigate drug use among a sample of federal drug crime defendants who were facing sentencing for drug sales, possession, or related crimes in order determine whether there was any association between first using marijuana and later

regular use of any drugs or using hard drugs, which would have implications for marijuana gateway. Of the defendants in the data, nearly all were unmarried, black males. A slight majority of defendants did not graduate from high school proper and were unemployed at the time of arrest and most of which had considerable drug use histories. To demonstrate the regularity of drug use, we reported how ninety-seven percent of the sample used between one and four drugs while an equal number of defendants were using or had used marijuana and/or alcohol at the time of arrest. Further, slightly less than half of the defendants had ever used cocaine while only a few defendants had been found to have ever used heroin at any point in their lives and an additional few had regularly used any other hard drugs besides cocaine, despite that a majority of the defendants were convicted of cocaine possession and/or intent to distribute. Indeed, of the sample, only six percent were convicted for marijuana related crimes; and seventeen percent for other drug possession crimes. Our investigation also found that cocaine was the drug of choice to distribute, which might have something to do with economics in drug sales.

In this vein, a number of interesting findings emerged. First, we found some support for a marijuana gateway effect predicting hard drug use better than both alcohol and cocaine, but it did not predict regular drug use better than cocaine. Perhaps it is that some of those who engage in marijuana use first are primed for moving on to other drugs since drug usage often occurs within social environments that are conducive to drug-taking behavior, thus reducing the social and psychological barriers that would prevent using harder drugs associated with stronger social stigmas. Second, it could be that defendants' early usage of cocaine was the outcome of isolated circumstances and that the defendants ended up hard drug users later on in life for other reasons. Whether or not this is evidence of a true gateway effect must be placed within this complicated interaction of exogenous factors and drug use.[4]

Our analysis also found that although significant, first use of marijuana prior to using other drugs did not predict regular drug use compared to cocaine, which as stated earlier, was hypothesized as a the first way to construct the gateway hypothesis. This suggests that

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[4]In analysis not shown here, cross tabulations show that fifty-seven percent of those who used cocaine first before any other drugs did not go on to use hard drugs later in life, even though many of these same defendants were convicted of distributing hard drugs.

the association between first using marijuana and later regular use of drugs is weaker than expected. In addition, the results revealed that no background factors were significant across both models. Age at first arrest, age at first drug use, and number of siblings, for example, were all significant in Model 1, but not for Model 2. Yet education and sibling drug use were significant for Model 2, but not for Model 1. This is noted in that more detailed data that includes not only more social and demographic factors but also possible biological antecedents that shape drug using behavior and that can explain why some people go on to use harder drugs or become drug abusers.

CONCLUSION

Findings from this study revealed some support for a marijuana gateway effect across two conceptually distinct dependent variables among a sample of federal drug crime defendants. As prior research suggests, the sequential process of starting with marijuana and then progressing to harder drugs can derive from a confluence of factors—from age of involvement in illicit behaviors and parental socialization, to the specific sequence of drugs taken, and from the particular properties of marijuana itself.

Yet, as some researchers have previously argued (Golub & Johnson, 2002), marijuana's role in the progression of drug use might be an outcome of its widespread availability and social acceptance more than any particular causal properties of marijuana itself. Many adolescents and young adults experiment with marijuana, but most do not go on to be regular drug users or progress beyond using marijuana to harder drugs such as cocaine or heroin. And for those that do become regular drug users or progress to harder drugs, there remains questions about how much of a role marijuana plays in this progression, despite not being able to answer some of these questions, this study provides correlative support for a gateway effect. With these ideas in mind, our findings should be placed within the larger context of changing norms and views regarding marijuana in the United States, reflected in multiple states now having made it legal for recreational use and what this means not only for the gateway effect, but more generally views about other drugs and drug crime policy.

Notably, we are compelled to comment on the racial composition of the sample provided that all but seven defendants were black. The lack of racial variation in the sample despite considerable variation in the general population hints at the broader problems in the criminal justice system where a three-decades long racial disparity in drug crime enforcement persist and are at odds with similarities and small variations across demographic groups in drug using and drug selling (Federal Bureau of Investigation, 2017; US Department of Health and Human Services, 2012). Various studies have sought to make sense of racial differences among drug use including studies on the gateway in order to square them against drug arrest disparities (Keyes *et al*., 2015; American Civil Liberties Union, 2013; Shih *et al*., 2010; Lessem *et al*., 2006; Watts & Wright, 1990). The general leaning of the findings point to a complex picture in which black males relative to other racial or ethnic groups are often not as likely to have used any drugs at all including marijuana and when higher rates of drug use such as marijuana are found, the differences are often small or conditioned on specific social environmental factors (Keyes *et al*., 2015; Shih *et al*., 2010). In moving forward, the key point about this literature is that rather than answering questions about disproportionate arrest statistics, studies have raised more questions. Our particular research endeavor did not set out to answer such questions, and could not due to reasons beyond our control. However, given the above, we believe it is imperative to flesh out these disparities through empirical research in order to better determine the extent to which outcomes in arrests and prosecutions are due to biases in the system or are justified by disproportionate grouped-based differences in drug using and selling behavior.

Our study has some limitations that bear mentioning. First, the data used in the analysis are cross sectional. Given the focus on the gateway effect hypothesis, a longitudinal research design would have been optimal. It was not a possibility due to the time and data limitation constraints placed on our data collection effort by the federal court. However, following Gottfredson & Hirschi's argument that cross sectional data can be used to answer "when" questions and because a link between first drug use and later regular and hard drug use could be retrieved from the information found in the PSI reports, we contend that this is a valid application of cross-sectional data. Second, our analysis was based on secondary data derived from a combination of self-reported information by defendants and investigative information compiled by criminal justice agents regarding drug using behavior of those defendants. And despite the availability of key background factors, there were limits to what information we could glean from presentence

investigations. Last, future research can build on our understanding of the gateway effect by using other data such as the ADD Health to fill in the gaps about the gateway effect. Given the longitudinal structure available in the ADD Health data, a well-designed study can overcome limitations we faced with this study's cross sectional design, notably, to explore potential differences of marijuana's role in the progression of drug use between states that now allow marijuana to be used legally for recreational purposes vs those that do not.

In sum, the development of multiple gateway hypotheses for marijuana points to the need for further clarification and empirical substantiation. In an era marked by rapidly shifting public attitudes toward marijuana use and legislation liberalization, there appears to be an increasing belief that any harm marijuana may pose—including serving as a gateway to regular drug use or dependency—is outweighed by its benefits. Similar to some prior studies, findings from this study suggest a gateway effect. However, the widespread availability of marijuana and increasing public acceptance (despite continued illegality in many states) rather than the properties of the drug itself might better explain why marijuana appears to be a gateway drug. If findings from this study and others suggest anything, it is that uncertainty remains and more research is necessary to fill in the many gaps in knowledge.

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