

Does Marijuana Use Serve as a Gateway to Cigarette Use for High-Risk African-American Youth?

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Abstract: *Background/Objectives:* The purpose of this investigation was to test whether the gateway hypothesis of drug initiation sequencing applies equally well to high-risk African-American and Caucasian youth. *Methods:* The study sample (N = 618, mean age = 15.5, SD = 1.2) represented the population of residents in the Missouri Division of Youth Services (DYS) who had initiated marijuana and nicotine use. *Results:* As hypothesized, African-American youth were significantly more likely to initiate marijuana use before cigarette use. Over one-third of African Americans reported initiating marijuana before cigarettes (37.9%), compared to less than one-quarter of youth in the other ethnic groups (Caucasian = 17.3%, Latino/Latina = 21.7%, Biracial/Other = 20.8%). Further, multinomial simulation and logistic regression models revealed that African-American youth were significantly more likely than other ethnic groups to initiate marijuana before cigarettes (Adjusted OR = 3.53, CI = 1.92–6.46). *Conclusions/Scientific Significance:* Findings suggest that the hypothesized gateway sequence may not apply equally well to African-Americans, and that prevention efforts based on this theory may need to be amended for these youth.

Keywords: Adolescent drug use, marijuana use, race disparities, smoking

1. INTRODUCTION

The use of tobacco, alcohol, and other substances are widespread among American youth. By their senior year in high school, 47% have used tobacco, 73% have used alcohol, and 48% have used an illicit drug (1). Although licit and illicit drugs are used by substantial proportions of young people, some researchers have hypothesized that tobacco and alcohol serve as “gateways” to

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the use of the illicit drugs like cocaine and heroin, for which there is substantial potential for dependence (2–4). According to the gateway hypothesis, there exists a consistent progression of adolescent substance use beginning with alcohol or cigarettes, moving on to illicit substances initiating with marijuana and progressing to “hard” drugs like cocaine.

As a result of the relatively widespread acceptance of the definitive sequence posited by the gateway hypothesis, most efforts to prevent adolescent substance use focus on preventing young people from going through the “gateways” (e.g., using tobacco) so that they will not progress to the use of illicit drugs. Implicit in this prevention strategy is the assumption that all young people, irrespective of their sociodemographic characteristics (e.g., race/ethnicity), proceed sequentially through the same pattern of substance use. If this assumption is correct, existing prevention approaches might be equally effective for all young people. Unfortunately, the findings of recent research suggest that this assumption may not be true. More specifically, epidemiological data on substance use among nationally representative samples of 8th, 10th, and 12th graders indicate that although Caucasian youths’ patterns of substance use initiation are consistent with the gateway hypothesis, African-American youth have used the illicit drug, marijuana, more than they have used cigarettes (1). In light of the substantial racial differences in adverse substance-related health and social consequences (5), investigating the extent to which there are racial differences in the sequence in which young people initiate the use of illicit drugs may suggest the need for race-specific approaches to substance use prevention particularly for high risk youth.

Although the finding of racial differences in the prevalence of marijuana and tobacco use suggest possible differences in patterns of drug use initiation, such data do not explicitly examine the question of whether there are racial differences in the order in which young people initiate different substances of abuse. Accordingly, the purpose of the present study is to explicitly test whether the gateway hypothesis applies equally well to Caucasian and African-American youth in a high risk sample of juvenile offenders. Specifically, this study presents novel findings on the comparative sequencing of cigarette and marijuana use in a large sample of adolescents. Our objectives were to examine the extent to which marijuana use preceded tobacco use among African-American youth and to determine whether any notable differences were observed in the sequencing of nicotine and marijuana initiation across racial groups.

2. MATERIALS AND METHODS

2.1. Sample and Procedures

The present study sample ($N = 723$) represents virtually the population of residents (97.7%) in the Missouri Division of Youth Services (DYS) at the

time the study was conducted. Participation in the study was voluntary. The Missouri DYS is the legal guardian of all residents who are committed, for a variety of transgressions, to its care by the state's 45 juvenile courts. All youth providing written informed consent completed the structured, face-to-face interview assessing demographic characteristics, lifetime and annual use of illicit and illicit substances, substance-related problems, current and lifetime psychiatric symptoms, and externalizing behaviors.

All interviewers completed an intensive one-day training session and an interview editor was on-site at each facility as youth were interviewed to minimize interviewer omissions and errors. The sample recruitment protocol ensured that no youths who had completed the interview at one facility, then attempted to complete or were successful in completing the interview at another facility. This study was approved by DYS, the Washington University Human Studies Committee Institutional Review Board, the federal Office of Human Research Protection, and was granted a Certificate of Confidentiality by the National Institute on Drug Abuse (NIDA). Youth received \$10.00 for their participation. Additional information on the study sample and procedures has been published elsewhere (6–8).

The study sample had a mean age of 15.5 ($SD = 1.2$). Although there were 238 (32.9%) African-Americans, the majority was White ($N = 400$, 55.3%), male (629, 87.1%), and 40.4% reported being from a household that received public assistance. Other ethnic groups were comprised of Biracial ($N = 56$, 7.7%), and Latino/Latina ($N = 28$, 3.8%) youth. Not surprisingly, most youth reported smoking tobacco (85.5%), using alcohol (84.8%) and marijuana (86.6%). The analytic sample was comprised of youth who had used marijuana ($N = 625$) and nicotine ($N = 618$), reflecting 86.4% of the total sample.

2.2. Measurement of Study Variables

Survey data were collected on demographic characteristics including gender, age, self-reported racial status, family receipt of public assistance, and geographical area of family residence (i.e., urban, suburban, small town, rural). The instrument contained a comprehensive assessment of various substances, including a composite index of past year use ($\alpha = .88$) and age of initiation for each substance.

Lifetime substance-related problems were assessed with the 8-item Alcohol/Drug Use Scale of the Massachusetts Adolescents Screening Instrument—2nd Version (MAYSI-2) developed for use with juvenile justice populations (9). Scores could range from 0–8. Grisso and Barnum (2000) found the scale to be internally consistent ($\alpha = .86$) in their norming sample; the α coefficient in this study was .83. The Self-Report of Delinquency (SRD) was used to assess the nature and frequency of offending in the prior year, see (10, 11). The SRD has been used to assess property and violent delinquent acts for over 20 years

and demonstrated adequate reliability in the present study ($\alpha = .84$). Youth were also asked to estimate the age at which they committed their first crime.

2.3. Analytic Strategy

One-way analysis of variance (ANOVA) was used to test differences in mean ages of onset for cigarettes and marijuana across the different ethnic groups. Chi-square (χ^2) analysis was used to conduct bivariate tests in temporal ordering of substance use. Effect sizes for ANOVA were summarized using eta-square (η^2); for chi-square (χ^2), effect sizes were unadjusted odds ratios and Cramer's *V*. As a further test of the gateway hypothesis, multinomial, and logistic regression models were fitted to test whether race/ethnicity was associated with temporal ordering of substances while controlling for other variables. After fitting the multinomial regression, bootstrap simulation procedures were implemented to obtain predicted probabilities to facilitate interpretation. All analyses were carried out using the R statistical language (version 2.4.1). Bootstrap simulations were implemented using the Zelig package (version 3.0.1) for R (12, 13).

3. RESULTS

3.1. Age of Onset

The average age of onset for marijuana use across ethnic groups ranged from 10.8 to 11.7 (Mean = 11.3, Median = 12, *SD* = 2.2). For cigarettes, age of onset ranged from 9.8 to 11.9 (Mean = 10.6, Median = 11, *SD* = 2.6). One-hundred seventy subjects reported initiation of nicotine and marijuana at the same time, hereafter referred to as "consecutive onset." Age of initiation of nicotine and marijuana among subjects with a consecutive onset ranged from 10.6 to 11.8 (Mean = 11.3, Median = 12, *SD* = 2.1). Table 1 summarizes age of onset for each substance by ethnicity. ANOVA and Tukey's post hoc comparisons revealed significant differences across ethnic groups. Regarding cigarette use, Caucasian subjects reported a significantly earlier age of onset compared to African Americans, and a slightly later age of onset compared to Latino/Latinas and youth classified as Biracial/Other. Caucasian youth reported a significantly earlier age of onset compared to African Americans. No differences were observed among subjects with consecutive onset of cigarettes and marijuana.

3.2. Temporal Ordering

The central hypothesis of this study was first tested using a chi-square analysis. This involved comparing subjects who reported use of both cigarettes and marijuana. The proportions of subjects reporting use were compared across different

Table 1. Race comparisons of mean age of onset for cigarettes and marijuana

Substance	African American mean (<i>SD</i>)	White mean (<i>SD</i>)	Latino/Latina mean (<i>SD</i>)	Biracial mean (<i>SD</i>)	Test statistics
Cigarettes	11.9 (2.6)	10.1 (2.5) ^a	10.0 (2.6) ^b	9.8 (2.1) ^c	$F(3, 613) = 22.9, p < .001$
Marijuana	11.7 (2.2)	11.1 (2.3) ^a	10.9 (2.0)	10.8 (2.1)	$F(3, 620) = 3.34, p = .02$
Consecutive onset of cigarettes and marijuana	11.8 (2.2)	11.2 (2.0)	10.6 (1.8)	10.6 (2.0)	$F(3, 166) = 2.05, p = .11$

Note: Tukey's post-hoc comparison used to identify differences in mean age of onset ($p < .05$).

^a = White and African-American subjects are different.

^bWhite and Latino/Latina subjects are different.

^cWhite and Biracial/Other subjects are different.

†No differences observed.

ethnic groups (see Table 1). Substance use was classified as “Cigarettes first,” “Marijuana first,” and “Consecutive onset of cigarettes and marijuana.” The overall test was significant ($\chi^2[6] = 36.8, p < .001$), with a Cramer’s *V* effect size ($V = .18$) indicating a moderately strong relationship between onset and ethnicity. As hypothesized, African Americans were significantly more likely to use marijuana before cigarettes. More specifically, over one-third of African Americans reported using marijuana first (37.9%), compared to less than one-quarter of subjects in the other ethnic groups (White = 17.3%, Latino/Latina = 21.7%, Biracial/other = 20.8%). The proportions for consecutive onset were similar among African Americans (32.8%), Whites (28.9%), and Biracial/Other (31.3%), but comparatively lower among Latino/Latinas (21.7%).

A more stringent test of the hypothesis was conducted by fitting a multinomial logistic regression model, with the onset categories (cigarettes first, marijuana first, and consecutive age of onset) as the outcome variables. Ethnicity was entered as a primary predictor, in addition to several control variables (i.e., gender, urbanicity, public assistance, BSI sum score—log transformed, MAYSI—substance abuse problems index, total delinquency score—square-root transformed, and age of first crime). The model exhibited a good fit with the data (Log-likelihood = -551.8, Residual deviance = 1104, $df = 1,084$). To facilitate interpretation of the model, a series of predicted probabilities were computed using bootstrapping via the Zelig package for R. This involved taking random draws from the posterior distribution of the model ($N = 1,000$), fixing the ethnicity variable to its desired value, and holding the other covariates constant. Predicted probabilities for temporal ordering of substances for each ethnic group are summarized in Table 2.

Whites had the highest predicted probability of using cigarettes first (.51; 95% CI = .43–.60), whereas the predicted probability for African Americans was significantly lower (.29; 95% CI = .22–.37). The non-overlapping confidence intervals indicate that the differences in point estimates between these two groups are statistically significant. Although the predicted probabilities for using cigarettes first among Latino/Latina and Biracial/Other subjects were relatively high compared to African Americans, their confidence intervals overlap with each group.

African Americans were significantly more likely to use marijuana first, based on a predicted probability of .40 (95% CI = .32–.49), which was almost twice as large the predicted probability of Caucasian youth (.21; 95% CI = .15–.29). Again, Latino/Latina, and Biracial/Other subjects had wide confidence intervals, making their differences nonsignificant. There were no significant ethnic differences among subjects with consecutive onset of cigarettes and marijuana.

A further test of the relationship between race and temporal ordering of substance initiation was conducted using logistic regression. In this model, subjects with a concurrent age of onset were excluded from the analysis. The primary outcome was marijuana initiation first (vs. cigarette initiation first). The overall

Table 2. Predicted probabilities of temporal ordering of cigarette and marijuana initiation based on multinomial logistic regression and simulations

Temporal Ordering	N (%) [†]	Predicted probability	95% Confidence Interval
Cigarettes first			
White	171 (53.8)	.51	.43
African Americans	52 (29.4)	.29	.22
Latino/Latina	13 (56.5)	.54	.32
Biracial/Other	23 (47.9)	.43	.30
Marijuana first			
White	55 (17.3)	.21	.15
African Americans	67 (37.9)	.40	.32
Latino/Latina	5 (21.7)	.24	.10
Biracial/Other	10 (20.8)	.24	.12
Consecutive onset of cigarettes and marijuana			
White	92 (28.9)	.27	.20
African Americans	58 (32.8)	.31	.23
Latino/Latina	5 (21.7)	.22	.09
Biracial/Other	15 (31.3)	.32	.20

Note: [†]Values represent N (%) of subjects in each race/ethnic group. Predicted probabilities were computed based on a multinomial logistic regression model and bootstrap resampling procedures. Probabilities are adjusted for gender, urbanicity, public assistance, BSI sum score (log transformed), MAYSI—substance abuse problems index, total delinquency score (square-root transformed), and age of first crime.

model exhibited a good fit with the data (Likelihood Ratio $\chi^2(10) = 55.79$, $p < .001$, Pseudo $R^2 = .18$). African Americans were significantly more likely to report marijuana initiation first compared to Caucasians (OR = 3.53, 95% CI = 1.93–6.46). No other ethnic differences were observed. Subjects who reported receipt of public assistance were also significantly more likely to report using marijuana first (OR = 2.09, 95% CI = 1.30–3.35).

4. DISCUSSION

Despite the influence of the gateway hypothesis as an explanation for the progression of adolescent drug use and as the conceptual foundation for many current prevention approaches (14), the data presented here suggest that the gateway theory may not be equally applicable to African-American young people in high risk samples. Findings of this study support notions that marijuana can serve as a gateway drug for nicotine use and potential dependence (15, 16). Furthermore, Denise Kandel, the originator of the gateway hypothesis

notes, "the pattern of progression is less regular among blacks and nobody really knows why." (17).

Assuming that the gateway hypothesis does not apply equally to White and African American young people, the question remains, "Why?" A possible explanation can be found in the results of a recent study that examined the predictors of substance use among young people who used marijuana prior to using licit drugs (18). The researchers found that youth who used marijuana before they used legal drugs, "lived in a neighborhood with a poorer physical environment, had greater exposure to drugs in their neighborhood, and had more neglectful parents" (18, p. 2137). These findings suggest that racial differences in contextual environmental factors in conjunction with a general propensity on the part of vulnerable youth toward deviance, rather than anything associated with race per se, should be taken into account in future research that seeks to understand race differences in the sequence of substance use initiation.

In the present study, we also found that study participants who reported receipt of public assistance were twice as likely to report using marijuana first. Although clearly African-American youth were more likely than other ethnicities to use marijuana prior to cigarettes, a continuing vexing issue in drug disparities research will continue to involve the confounding of race and class. Given segregation patterns resulting in pronounced concentrated disadvantage experienced by African-Americans, cultural adaptations in patterned drug use sequences may shed light on ethnic differences being identified. In other words, marijuana initiation prior to smoking cigarettes may just be a cultural artifact. Moreover, there is no developmental reason to believe that the gateway sequence is invariant. The practical implication is that universal prevention strategies predicated on specified gateway sequences might need to be amended for African-American youth. For example, a greater focus on preventing marijuana initiation as a means for interrupting future nicotine dependence may be of utility. This is especially true among high risk samples since these youth are most likely to be in need of drug prevention and intervention efforts.

Despite its contributions to our knowledge about race differences in the progression of substance use among young people, this study has a number of limitations. The first set of limitations concern the generalizability of the findings. Because the data are drawn from a cross-sectional sample of adjudicated young people, present study findings may only be generalizable to delinquent youth. Similarly, because the data are drawn from young people residing in a single state, the extent to which the findings would generalize to young people in other states is unclear. Another limitation is that the age of initiation variable does not capture frequency or duration of problematic drug use. Although we subjected the research hypothesis to a number of bivariate and multivariate methods, a more rigorous test of the gateway hypothesis would assess young people prior to their initiation of any substance and follow them prospectively over time to determine the order and specific substance they first used. Future research should attempt to replicate these findings using both population based

studies such as Monitoring the Future and the National Survey of Drug Use and Health as well as high risk samples of juvenile offenders.

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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