



# EXAMINING THE GATEWAY DRUG HYPOTHESIS IN HISPANIC YOUNG ADULTS: A HURDLE MODEL APPROACH

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## Abstract

The gateway drug theory suggests that the use of “less harmful” drugs will lead to future use of “more harmful” drugs. For example, adolescents who smoked cigarettes used alcohol and marijuana more frequently than non-smoking adolescents. Further, age of initiation of “less harmful” drugs has been shown to predict future alcohol and drug abuse and dependence. This study examined the effects that age of first use of alcohol and tobacco had on future use of these substances in addition to marijuana in an understudied population of Hispanic college students.

Participants completed a range of demographic and self-report measures including age of initiation of each substance, the Depression, Anxiety, and Stress Scale, and the Short Acculturation Scale for Hispanics. These covariates were entered into three 2-part hurdle models predicting the gateway drug hypothesis. Marijuana age of initiation was excluded in predicting alcohol and cigarette use. For past 30 day use of cigarettes, female gender, and lesser acculturation, as well as past 30-day use of alcohol were associated with past 30-day smoking. Age of first use of cigarettes was not predictive of past 30-day smoking. Family income between \$15k and \$30k, and U.S. citizenship increased the rate of smoking in the past 30 days. Female gender and reported age of first use of cigarettes were the most potent negative predictors of the rate of cigarette use in the past 30 days. Examining the same sets of covariates in hurdle models did not provide adequate explanation of either past 30-day use of alcohol or marijuana.

These findings are inconsistent with studies observing earlier onset of licit drug use increases the risk of future alcohol and/or drug dependence. Further, it may be that Hispanic college students’ tobacco, alcohol, and drug use demonstrates different patterns from other groups. Finally, the cross sectional nature of this study is a methodological limitation. Future studies in Hispanic college student samples should be prospective in nature and extend the length of time between substance initiation and study completion.

## Introduction and Hypotheses

### Gateway drug theory

- Gateway drug theory posits a natural progression from use of one type of substance to another. The proposed stages progress in the following order:
  - “light” alcohol (beer and wine), cigarettes and/or hard alcohol, marijuana, other illicit drugs (Kandel, 1975).
- Other predictors may contribute or be used as an alternative explanation for predictions of substance use including the age of initiation and other substance use habits.

### Age of Initiation

- A negative relationship between age of initiation and future substance use of marijuana, alcohol, and tobacco has been found (Anthony & Petronis, 1995; Bailey, 1992; Chen, Storr, & Anthony, 2009).
- Nevertheless, some studies suggest that the age of initiation does not have a significant effect on future substance use (King & Chassin, 2006).
- Other Predictors of Substance Use*
- Smoking cigarettes has shown to be a predictor of marijuana and alcohol consumption (Chen et al., 2002; Grant, 1998; Perez, Ariza, Sanchez-Martines, & Nebot, 2010).
- A reciprocal relationship between use of legal and illicit drugs has been found, such that the use of legal drugs precedes the use of illicit drugs (Best, Rawaf, Rowley, Floyd, Manning, & Strang, 2000; Fleming, Leventhal, & Ershler, 1989), and the use of illicit drugs, increases the chance of using legal substances (Mohler-Kuo, Lee, & Wechsler, 2003).
- Individuals that are more sensitive to anxiety are more likely to use marijuana (Bonn-Miller, Zvolensky & Bernstein, 2007).
- Finally, past studies have found higher acculturation to be associated with higher substance use (Epstein, Botvin, & Diaz, 2001).
- Predictors for substance use are particularly unclear for Hispanic young adults.

### Hypotheses

- A negative relationship between the age of onset and past 30 day use of substances.
- Lifetime tobacco use will be the strongest predictor of past 30 day use of marijuana, alcohol, and tobacco.
- A positive relationship between acculturation and past 30 day use of marijuana, alcohol, and tobacco.

## Measures

**Alcohol, Tobacco, and Drug Use Frequency:** This questionnaire used in recent and current studies both at UTEP and in the community asks participants to report past and present patterns of substance use including age of initiation for each substance. The Depression, Anxiety, and Stress Scale (DASS): (Lovibond & Lovibond, 1995) This set of three self-report scales with 14 items each (42 total) assesses the constructs of depression ( $\alpha = .95$ ), anxiety ( $\alpha = .87$ ), and stress ( $\alpha = .92$ ). The range of each sub-scale is 0 to 42 with higher scores indicating more symptoms and/or more severe symptoms.

**The Short Acculturation Scale for Hispanics (SASH):** (Marín, Sabogal, VanOss, Otero-Sabogal, & Pérez-Stable, 1987) This survey contains 12 items assessing degree of adoption of American culture. Items are summed and averaged to obtain an acculturation score. Scores can range from 1 to 5 with higher numbers indicating greater acculturation ( $\alpha = .88$ ).

## Methods and Approach to Analysis

*Participants:* A sample ( $n = 426$ , 59% female) of Hispanic college students were asked to fill out a questionnaire including past drug use behaviors and demographics: Gender (59% female), age, ethnicity (Hispanic 87%, Mexican citizen 13%), and income (13% <\$15,000; 32% \$15,000-29,999; 26% \$30,000-49,999; & 29% >\$50,000). Drug use was measured by asking how many days the substance has been used within a period of time (lifetime, year, 30 days).

- Outcomes of interest were past 30 day reported rates of smoking, alcohol consumption, and marijuana use.
- Primary covariates of interest (i.e., gateway hypothesis covariates) were prior substance use history variables.
  - For smoking, these history variables included age of first cigarette, age of first alcoholic drink, and past 30 day use of alcohol.
  - For alcohol consumption, these history variables included age of first alcoholic drink, age of first cigarette, and past 30 day use of cigarettes.
  - For marijuana use, covariates were age of first cigarette, past 30 day cigarette use, age of first alcoholic use, past 30 day alcohol use, and age of first use of marijuana.
- A Hurdle (logit/poisson) model estimated the amount of use in the past 30 days (count) after accounting for the fact that not all substance users have used the respective substance in the past 30 days (i.e., a dichotomous “hurdle”).
- Model estimation was assessed in 5 separate models: a demographic covariates model including age, gender, household income level, citizenship status, and SASH acculturation level; a DASS model including depression, anxiety, and stress symptoms; a first age of use of the substance (1 covariate) model, a substance use history model, and a full model containing all covariates.

**Table 1: Continuous descriptive characteristics ( $n = 426$ )**

Variable	Mean	SD	Med.	Min.	Max.
Age	20.14	3.97	19.00	18.00	57.00
SASH acculturation level	3.25	0.77	3.33	1.08	4.67
DASS depression symptoms	5.25	7.54	2.00	0.00	41.00
DASS anxiety symptoms	5.13	5.85	3.00	0.00	33.00
DASS stress symptoms	8.92	8.01	7.00	0.00	42.00
Age of first cigarette	15.76	2.33	16.00	8.00	28.00
Age of first drink	15.27	2.32	15.00	5.00	21.00
Age of first marijuana use	16.50	2.67	16.00	9.50	29.00
Past 30 day smoking rate	2.14	5.81	0.00	0.00	30.00
Past 30 day alcohol consumption rate	3.83	5.43	2.00	0.00	50.00
Past 30 day marijuana use rate	0.88	4.80	0.00	0.00	60.00

Note: Med. = Median; Min. = Minimum; Max. = Maximum

**Table 2: Hurdle (logit/poisson dual estimation) model fit statistics**

Model	$n$	df	AIC	BIC	Wald $\chi^2$
<b>Past 30 day smoking rate</b>					
Demographics	413	16	1719.58	1783.95	<b>22.21</b>
DASS variables	393	8	1679.57	1711.36	0.42
Substance use history	266	8	1650.57	1679.24	<b>23.11</b>
First age of smoking	273	4	1690.75	1705.18	0.03
<u>Full model</u>	234	28	<u>1374.08</u>	<u>1470.83</u>	<b>36.68</b>
<b>Past 30 day drinking rate</b>					
Demographics	413	16	2590.72	2655.10	4.33
DASS variables	393	8	2498.38	2530.17	<b>7.66</b>
Substance use history	266	8	1811.47	1840.14	5.83
First age of alcohol use	390	4	2497.40	2513.26	2.18
Full model	234	28	<u>1609.19</u>	<u>1705.94</u>	13.15
<b>Past 30 day marijuana use rate</b>					
Demographics	413	16	802.81	867.19	<b>15.35</b>
DASS variables	393	8	911.86	943.65	1.38
Substance use history	130	12	638.13	672.54	8.37
First age of marijuana use	156	4	850.66	862.86	0.01
Full model	120	32	<u>448.09</u>	<u>537.29</u>	13.69

Note: **Bold** models were statistically significant ( $p < .05$ ); Underlined models best fit the data

**Table 3: Hurdle model predicting past 30 day smoking rate**

Logistic Function	OR	95% CI	$p$
<b>Demographics</b>			
Age	0.90	0.81 - 1.01	0.06
<b>Female</b>	<b>0.44</b>	<b>0.24</b> - <b>0.82</b>	<b>0.01</b>
<b>Income (ref. = &lt; \$15,000USD)</b>			
\$15,000 to 29,999USD	1.54	0.55 - 4.31	0.41
\$30,000 to 49,999USD	1.44	0.49 - 4.27	0.51
>\$50,000USD	1.95	0.67 - 5.71	0.22
Citizen (vs. legal resident)	0.65	0.20 - 2.04	0.46
<b>SASH acculturation level</b>	<b>0.54</b>	<b>0.35</b> - <b>0.85</b>	<b>0.01</b>
<b>DASS psychological symptomology</b>			
Depression symptoms	1.03	0.93 - 1.14	0.53
Anxiety symptoms	1.03	0.95 - 1.11	0.47
Stress symptoms	0.97	0.90 - 1.05	0.47
<b>Substance use history</b>			
Age of first cigarette	1.13	0.96 - 1.32	0.13
Age of first drink	0.95	0.82 - 1.10	0.52
<b>Past 30 day alcohol use rate</b>	<b>1.17</b>	<b>1.09</b> - <b>1.26</b>	<b>0.01</b>
Rate Function	IRR	95% CI	$p$
<b>Demographics</b>			
<b>Age</b>	<b>1.03</b>	<b>1.00</b> - <b>1.06</b>	<b>0.04</b>
<b>Female</b>	<b>0.63</b>	<b>0.54</b> - <b>0.73</b>	<b>0.01</b>
<b>Income (ref. = &lt; \$15,000USD)</b>			
<b>\$15,000 to 29,999USD</b>	<b>1.36</b>	<b>1.04</b> - <b>1.77</b>	<b>0.02</b>
\$30,000 to 49,999USD	0.89	0.66 - 1.20	0.44
>\$50,000USD	1.15	0.87 - 1.52	0.32
<b>Citizen (vs. legal resident)</b>	<b>1.82</b>	<b>1.35</b> - <b>2.47</b>	<b>0.01</b>
<b>SASH acculturation level</b>	<b>0.83</b>	<b>0.75</b> - <b>0.92</b>	<b>0.01</b>
<b>DASS psychological symptomology</b>			
Depression symptoms	1.01	0.98 - 1.04	0.44
Anxiety symptoms	1.02	1.00 - 1.04	0.12
Stress symptoms	0.99	0.97 - 1.00	0.13
<b>Substance use history</b>			
<b>Age of first cigarette</b>	<b>0.95</b>	<b>0.91</b> - <b>0.99</b>	<b>0.01</b>
Age of first drink	1.01	0.97 - 1.06	0.50
Past 30 day alcohol use rate	1.00	0.99 - 1.01	0.64

Note: OR = Odds Ratio; CI = Confidence Interval; IRR = Incidence Rate Ratio;  $p < .05$

## Results

- Continuous descriptive characteristics of the sample are presented in Table 1.
- Not all participants reported prior smoking ( $n = 153$ , 36%), alcohol consumption ( $n = 36$ , 8%), or marijuana use ( $n = 270$ , 63%) in their lifetime. These individuals were not always excluded from inferential models (including lifetime use) and were responsible for the substantial reductions in effective sample size in full models, especially that of marijuana use.
- The fit of each of the 5 hurdle models within the three substance use behaviors are presented in Table 2.
  - Hurdle models predicting amount of past 30 day alcohol and marijuana use did not provide consistent results; full covariate adjusted models were not statistically significant indicating that prior use of cigarettes and alcohol do not predict past 30 day alcohol or marijuana use ( $p$ 's > .44).
  - The hurdle model predicting amount of past 30 days smoking produced a significant full model which also best fit to the data,  $Wald \chi^2 (13) = 36.68, p < .01$  (See Table 3).
- Significant predictors of past 30 day smoking are presented in Table 3; The odds of any past month smoking were lower for females ( $OR = .44, p < .05$ ) and for more highly acculturated participants ( $OR = .54, p < .05$ ) and greater for those who reported consumption of more alcohol in the past month ( $OR = 1.17, p < .05$ ).
- U.S. citizenship was positively associated with the rate of past 30 day smoking ( $IRR = 1.82, p < .01$ ), yet higher levels of SASH acculturation were negatively related to rate of past 30 day smoking ( $IRR = .83, p < .01$ ). Age of first cigarette use also was negatively associated with current rate of smoking ( $IRR = .95, p < .01$ ).
- No other potential correlates were significantly associated with other substance use.

## Discussion

- Findings do not support the gateway drug hypothesis.
  - Our findings are also inconsistent with past research (Chen, Storr, & Anthony, 2009); past 30 day rates of use of alcohol and marijuana cannot be adequately accounted for by the age of initiation of marijuana, alcohol, or tobacco.
    - However, for many current participants, short lag time between age of initiation and study completion may suggest the effects observed in past studies have not yet developed.
  - There was no association between age of first cigarette and past 30 day smoking which may suggest that young adult Hispanics who start smoking later in life do not necessarily exhibit lower likelihood of smoking at a future point in time; however, earlier age of onset of smoking is associated with a slightly greater past 30 day rate of smoking; which is supported by addiction models and studies which suggest more time smoking promotes addiction (Anthony & Petronis, 1995; Sneed, Morisky, Rotheram-Borus, Ebin, & Malotte, 2001). The situation may be nuanced in that experimentation of substances does not necessarily translate into increased risk of smoking later, though for young adult Hispanics who continue to smoke, they are at a potential increased likelihood of transitioning into greater rates of smoking.
  - Interventions that target adolescents may not result in meaningful impact of reducing the number of future substance users in the Hispanic population but may help future users with reduced rates of use.
  - This study found no support for potential anxiety sensitivity in this population.
    - The population of college students may be a high functioning group; other subgroups may yield different results.
  - Inconsistent with prior research (e.g., Epstein, Botvin, & Diaz, 2001), acculturation findings with regard to smoking cigarettes suggest that those most at risk of smoking are lesser acculturated. Hispanic young adult U.S. citizens who are lesser acculturated exhibited a higher rate of past 30 day smoking.
  - There was no association between acculturation and alcohol or marijuana use.
    - The use of other acculturation measures or the assessment of other cultural constructs may result in a better understanding of college student substance use on the border.
  - Limitations of this study are the use of self reported measures that require recollection of past experiences (e.g., recall inaccuracies).
- Future Directions*
- Use of other cultural constructs in assessing border region substance use
  - A longitudinal study, allowing assessment of temporal relationships
  - Further research on sub-classes of marijuana users
  - The development and assessment of future interventions designed to reduce substance abuse in Hispanic populations.

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