

# Driving After Use of Alcohol and Marijuana in College Students

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Driving after use of marijuana is almost as common as driving after use of alcohol in youth (P. M. O'Malley & L. D. Johnston, 2003). The authors compared college students' attitudes, normative beliefs and perceived negative consequences of driving after use of either alcohol or marijuana and tested these cognitive factors as risk factors for substance-related driving. Results indicated that youth perceived driving after marijuana use as more acceptable to peers and the negative consequences as less likely than driving after alcohol use, even after controlling for substance use. Results of zero-inflated Poisson regression analyses indicated that lower perceived dangerousness and greater perceived peer acceptance were associated with increased engagement in, and frequency of, driving after use of either substance. Lower perceived likelihood of negative consequences was associated with increased frequency for those who engage in substance-related driving. These results provide a basis for comparing how youth perceive driving after use of alcohol and marijuana, as well as similarities in the risk factors for driving after use of these substances.

**Keywords:** drinking and driving, alcohol, marijuana, college students, cognitions

In 2003, motor vehicle accidents were the leading cause of death in college-age youth in the United States (Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2003). In 2002, 29% of drivers aged 15 to 20 years killed in traffic accidents were intoxicated (National Highway Traffic Safety Administration, 2003). More than a third (35.5%) of U.S. college student drivers reported drinking and driving in the past month (Wechsler, Lee, Nelson, & Lee, 2003).

Marijuana is the most commonly used illicit drug by U.S. youth. In a nationally representative survey, more than half (53.8%) of those age 18–25 reported lifetime use of marijuana (Office of Applied Studies, 2004). Marijuana was the second most frequently used drug, after alcohol, in samples of reckless drivers (Brookoff, Cook, Williams, & Mann, 1994) and of those involved in vehicle accidents resulting in injury or fatality (Soderstrom, Dischinger, Kerns, & Trifillis, 1995; Terhune et al, 1992). The Monitoring the Future study found that the percentage of U.S. high school seniors who received tickets or had accidents after use of marijuana was comparable to that of alcohol (O'Malley & Johnston, 2003). Rates of self-reported driving after use were also similar for alcohol and

marijuana. Given the differences in prevalence of use, these results suggest that youth are relatively more likely to drive after using marijuana than alcohol.

Empirical research has long documented impairment in driving abilities from use of marijuana (Crancer, Dille, Delay, Wallace, & Haykin, 1969; Moskowitz, 1985). Recent studies have demonstrated that marijuana can increase brake latency (Liguori, Gatto, & Robinson, 1998), lateral position errors, and distance variability (Ramaekers, Robbe, & O'Hanlon, 2000; Robbe, 1998) in simulated and closed-road driving tasks.

Considerable research has focused on identifying individual difference factors associated with drinking and driving behavior. For example, disinhibited personality constructs have been correlated with drinking and driving behavior and arrest (Cavaiaola, Strohmets, Wolf, & Lavender 2003; Donovan, Queisser, Umlauf, & Salzberg, 1986; Turrissi, Jaccard, & McDonnell, 1997). Cognitive factors, such as perceived norms (Armitage, Norman, & Connor, 2002), the perceived dangerousness of drinking and driving (Grube & Voas, 1996), and risk appraisal (Gerrard, Gibbons, Benthin, & Hessling, 1996), have also been found to be associated with increased likelihood of drinking and driving in adolescents and young adults.

In contrast, relatively little is known about risk factors and perceptions of driving after use of marijuana. A study of intravenous drug users found that alcohol was rated as the most dangerous drug to use prior to driving, whereas marijuana was rated as the least dangerous (Darke, Kelly, & Ross, 2004). Studies of marijuana users found that they did not perceive marijuana use as affecting their driving ability (Aitken, Kerger, & Crofts, 2000) and perceived driving after use as less impairing than driving after drinking (Terry & Wright, 2005). It is unclear if perceptions are

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similar for nonusers or if these perceptions are associated with marijuana-related driving.

The present study was designed to improve our understanding of college students' perceptions of driving after use of marijuana. Our first goal was to compare perceptions of driving after marijuana use with perceptions of driving after use of alcohol. Parallel questions assessed normative beliefs, attitudes, and perceived negative consequences for driving after use of alcohol and marijuana. We hypothesized that participants would rate driving after use of marijuana as more acceptable to peers, less dangerous, and less likely to have negative consequences than driving after use of alcohol. Analyses were also conducted controlling for frequency of alcohol and marijuana use.

A second goal was to test cognitions as risk factors for substance-related driving and to evaluate differences in prediction of driving after use of alcohol and marijuana. We hypothesized that greater acceptance by peers, lower perceived dangerousness, and lower perceived probability of negative consequences would be associated with increased likelihood and frequency of self-reported driving after use of alcohol and marijuana. Frequency of use and gender were included as covariates in these analyses.

## Method

### Participants

Participants were recruited from introductory psychology classes at the University of Missouri-Columbia. The sample ( $N = 599$ ) was 59% women, with a mean age of 18.54 years ( $SD = 0.86$ ). The sample was primarily Caucasian (87%), with 7% African American, 3% Asian American, and 3% of mixed or other race; 3% reported their ethnicity as Hispanic.

### Procedures

Participants were recruited using the introductory psychology subject pool. Data were collected in groups of 10–25. Participants received partial credit toward meeting a research requirement for their introductory psychology course for participating. Procedures were approved by the University of Missouri-Columbia Institutional Review Board.

### Measures

**Demographic information.** A self-report questionnaire was used to collect demographic information, including age, gender, religion, and ethnicity.

**Normative beliefs.** Drinking and driving cognition questions were adapted from prior studies (Grube & Voas, 1996) and have been used in previous research in our laboratory (McCarthy, Pedersen, Thompson, & Leuty, 2006; McCarthy, Pedersen, & Leuty, 2005). For normative beliefs, participants were asked how many (0–3) of their three closest friends disapprove of drinking and driving and how many would refuse to ride with a driver who had been drinking. Parallel questions were used to assess normative beliefs about driving after use of marijuana. Items were recoded so that higher scores indicated greater acceptance of substance-related driving. Internal consistency was .80 for alcohol questions and .91 for marijuana questions.

**Attitudes.** Three questions were used to assess attitudes towards drinking and driving. These questions asked participants how dangerous they think it is to drive within 2 hours of consuming one drink, three drinks, and five or more drinks. Questions used a four-point Likert scale and were coded so that higher scores indicated lower perceived dangerousness. Internal consistency in this sample was .83. For driving after marijuana use, a single question was used, asking how dangerous it is to drive within 2 hours of using marijuana.

**Perceived negative consequences.** For both alcohol and marijuana, four questions asked participants the likelihood a driver their age would be stopped by police, be breath or drug tested, be arrested, and have an alcohol- or marijuana-related accident. Questions used a four-point Likert scale and were coded so that higher scores indicated lower perceived probability of negative consequences. A mean composite was used for study analyses. Internal consistency was .84 for the alcohol questions and .90 for the marijuana questions.

**Alcohol and marijuana use.** The Drinking Styles Questionnaire (Smith, McCarthy, & Goldman, 1995) was used to assess alcohol use behavior. This measure has demonstrated good reliability and validity in adolescent and college samples (McCarthy, Miller, Smith, & Smith, 2001; Smith et al., 1995). In the present study, drinker/nondrinker status, past month quantity and frequency of use, and past month frequency of heavy drinking were used as measures of alcohol involvement. Similar questions were used for marijuana use. Questions assessed lifetime use of marijuana, age of first use, and frequency of use in the past year and month.

**Driving after substance use.** Drinking and driving was assessed with three open-ended questions asking participants to report how many times in the past 3 months they had driven within 2 hours of drinking one drink, three drinks, and five or more drinks. Driving after use of marijuana was assessed with a single question asking how many times participants had driven within 2 hours of smoking marijuana in the past 3 months.

## Results

### Substance Use and Driving Behavior

Table 1 presents descriptive statistics for substance use and driving after use by gender. Comparisons across gender were made using either chi-square or  $t$  tests. Men were more likely to report use of marijuana and to drive after use of alcohol or marijuana. Men also reported higher frequency and quantity of alcohol use.

Forty-three percent of the sample reported driving after drinking, whereas 13% reported driving after use of marijuana. However, these differences may be a function of differences in rates of current use. Of current drinkers, 55% reported driving after alcohol use in the past 3 months, whereas 47% of current marijuana users reported driving after smoking marijuana.

Alcohol and marijuana use were associated,  $\chi^2(1, N = 599) = 44.18, p < .01$ , with current drinkers more likely to use marijuana in the past month (30%) than nondrinkers (2%). There was also an association between driving after marijuana use and driving after one drink,  $\chi^2(1, N = 599) = 66.66, p < .01$ ; three drinks,  $\chi^2(1, N = 599) = 67.73, p < .01$ ; and five or more drinks,  $\chi^2(1, N = 599) = 61.08, p < .01$ .

Table 1  
Descriptive Statistics for Alcohol and Marijuana Use and Driving After Use

Characteristic	Men ( <i>n</i> = 243)		Women ( <i>n</i> = 356)	
	%	<i>M</i> ( <i>SD</i> )	%	<i>M</i> ( <i>SD</i> )
Current drinker (past month)	81		77	
Frequency of drinking (past month)		6.00 (6.06)		5.61 (5.74)
Quantity of drinking (past month)		4.98 (4.25)		3.41 (2.58)**
Frequency of heavy drinking (past month)		4.35 (5.37)		2.95 (4.25)**
Marijuana use (lifetime)	50		41*	
Marijuana use (past month)	33		18**	
Driving after drinking (past 3 months)				
1 drink				
Percent reporting	50		39*	
Frequency		5.92 (9.02)		3.84 (5.96)
3 drinks				
Percent reporting	35		24**	
Frequency		6.02 (8.91)		3.96 (6.25)
5 drinks				
Percent reporting	25		13**	
Frequency		6.25 (8.52)		4.02 (6.53)
Driving after marijuana use (past 3 months)				
Percent reporting	17		9**	
Frequency		16.83 (26.37)		12.16 (15.14)

Note. For driving after drinking and marijuana, means and standard deviations for frequency are presented for that portion of the sample who engaged in the behavior (non-zero cases).

\*  $p < .05$ . \*\*  $p < .01$ .

### Cognitions About Driving After Use

Table 2 presents correlations between substance use and cognitions about driving after use. Greater alcohol use was associated with perceiving drinking and driving as more acceptable to peers and less dangerous. The perception of negative consequences of drinking and driving as less likely was only weakly correlated with greater quantity of alcohol use. For cognitions about driving after marijuana use, frequency of use was associated with all driving cognition variables.

Repeated measures analyses of variance were then used to compare cognitions for driving after use of alcohol with those for marijuana. In each analysis, substance type (marijuana, alcohol) was used as a within-subjects factor and gender as a between-subjects factor. For normative beliefs, there was a significant main effect of substance type,  $F(1, 597) = 62.17, p < .01; \eta^2 = .10$ , with participants perceiving their peers as being more accepting of driving after use of marijuana than alcohol. There was a main effect of gender,  $F(1, 597) = 6.18, p < .05; \eta^2 = .01$ , with men rating both behaviors as more acceptable. There was no Substance Type  $\times$  Gender interaction. When frequency of marijuana and alcohol use were added to the analysis, the main effect of substance type was not as strong but remained significant,  $F(1, 595) = 6.11, p < .05; \eta^2 = .01$ .

For perceived negative consequences, there was a main effect of substance type,  $F(1, 597) = 240.54, p < .01; \eta^2 = .29$ , with

participants perceiving negative consequences to be less likely for driving after use of marijuana than alcohol. There was a main effect of gender,  $F(1, 597) = 11.38, p < .01; \eta^2 = .02$ , with men rating consequences for both behaviors as less likely. There was no Substance Type  $\times$  Gender interaction. When controlling for alcohol and marijuana use, the main effects of substance type,  $F(1, 595) = 9.04, p < .05; \eta^2 = .02$ , and gender,  $F(1, 595) = 5.79, p < .05; \eta^2 = .01$ , remained significant.

We then compared the perceived dangerousness of driving after one drink, three drinks, and five drinks with the perceived dangerousness of driving after use of marijuana. Driving after use of marijuana was rated as more dangerous than driving after one drink,  $F(1, 597) = 599.29, p < .01; \eta^2 = .51$ , and slightly more dangerous than three drinks,  $F(1, 597) = 4.20, p < .05; \eta^2 = .01$ , but less dangerous than driving after five drinks,  $F(1, 597) = 366.42, p < .01; \eta^2 = .39$ . There were significant main effects of gender for each analysis (all  $ps < .01$ ), indicating that men viewed both behaviors as less dangerous. No Substance  $\times$  Gender interactions were significant. The pattern of results was the same when frequency of alcohol and marijuana use were included as covariates, with driving after marijuana use rated as more dangerous than driving after one,  $F(1, 595) = 393.91, p < .01; \eta^2 = .41$ , and three,  $F(1, 595) = 15.74, p < .01; \eta^2 = .03$ , drinks, but less dangerous than after five drinks,  $F(1, 595) = 54.05, p < .01; \eta^2 = .09$ .

### Cognitions as Predictors of Driving After Use

We then tested whether cognitions were associated with driving after use of alcohol and marijuana. We estimated zero-inflated Poisson regression models using Mplus 3 (Muthén & Muthén, 2004). This model is appropriate when the dependent variable is a count variable with a high proportion of zero values. The dependent variable was number of times driving after use of alcohol or marijuana in the past 3 months. Mplus estimates two components in this type of model. The first, a zero-inflation component, estimates the odds of being in the zero class, or of not engaging in the behavior. This is similar to logistic regression, and an odds ratio is obtained for each independent variable. To simplify reporting, odds ratios were inverted so that higher values indicated greater likelihood of engaging in the behavior. The second component of

Table 2  
Correlations Between Substance Use and Driving Cognitions

Variable	Attitudes	Normative beliefs	Perceived negative consequences
Alcohol (past month)			
Frequency	.36**	.24**	.02
Quantity	.46**	.28**	.10*
Heavy drinking	.40**	.30**	.02
Marijuana			
Frequency (past month)	.47**	.48**	.31**
Frequency (past year)	.52**	.58**	.38**

Note. Values are Pearson correlations ( $r$ ).  $N = 599$ . For cognition variables, higher scores reflect perceptions that substance-related driving is less dangerous (Attitudes), more acceptable to peers (Normative beliefs) and the negative consequences less likely (Perceived negative consequences). \*  $p < .05$ . \*\*  $p < .01$ .

the model provides a Poisson regression coefficient of the association between the independent variables and frequency of the dependent variable for those able to assume nonzero values. This coefficient is used to calculate the predicted rate of increase in the dependent variable for a one-unit increase in each independent variable (Cohen, Cohen, West, & Aiken, 2003).

For each model, frequency of substance use (either alcohol or marijuana), gender, and all three cognition variables were included as independent variables. For drinking and driving, the pattern of results was the same when each of the three drinking and driving variables (after one, three, or five drinks) was used as the dependent variable. Results are presented for driving after three drinks. For attitudes, perceived danger of driving after three drinks was used, as this variable was most similar to the parallel question for marijuana.

Table 3 presents odds ratios and predicted rate for substance use frequency and cognition variables. Frequency of substance use was associated with engagement and increased frequency of driving after use of either substance. Gender was related only to frequency of driving after use of marijuana. Lower perceived dangerousness and greater perceived peer acceptance were uniquely associated with both increased likelihood and increased frequency of driving after use of either substance. Lower perceived likelihood of negative consequences was associated with increased frequency of driving after use of either substance but not with engagement in either behavior.

### Discussion

One goal of this study was to compare students' perceptions of driving after drinking with those of driving after the use of marijuana. Previous studies (Terry & Wright, 2005) demonstrated that marijuana users perceive driving after smoking marijuana as less impairing than driving after drinking. Our results support this finding, as marijuana use was strongly correlated with cognitions about driving after use. However, our results also indicate that college students in general perceived driving after smoking marijuana as more acceptable to their peers and the negative consequences to be less likely, even after controlling for frequency of use of these substances. When comparing perceived dangerousness of driving after marijuana use to driving after specific amounts of

alcohol, youth viewed driving after marijuana use as slightly more dangerous than driving after three alcoholic drinks.

Our results also support substance-related driving cognitions as risk factors for driving after use of either alcohol or marijuana. Despite mean differences between cognitions, results were consistent for driving after use of alcohol and marijuana. Normative beliefs and attitudes had unique associations with both engagement in, and frequency of, driving after use of either substance. For perceived negative consequences, youth who engaged in these behaviors and viewed the negative consequences as less likely reported greater frequency of driving after use.

There are several reasons why youth may perceive driving after use of marijuana as more acceptable and the negative consequences less likely than those of drinking and driving. For over 20 years, the dangers of driving after use of alcohol have been the subject of public advertising campaigns and the focus of legal and public policy changes. Despite research evidence that marijuana impairs driving ability (Ramaekers et al., 2000), similar campaigns have only recently been targeted at driving after use of marijuana. The Office of National Drug Control Policy (2006) has expressed concern about the public image of marijuana as benign and includes information on marijuana's negative effects on driving skills in its youth media campaign.

In general, youth who reported greater involvement with a substance viewed driving after use as less risky. However, although perceived negative consequences were correlated with use of marijuana, these questions were largely not correlated with alcohol involvement. This may indicate that knowledge of the consequences of drinking and driving are not a function of personal use, perhaps due to the broader exposure to the potential consequences of drinking and driving in public discourse and media campaigns.

Differences between perceived negative consequences of driving after use of marijuana and alcohol may also reflect actual differences in legal enforcement between these two substances. The establishment of a per se standard has had a significant impact on reducing drinking and driving behavior (Giesbrecht & Greenfield, 2003). One mechanism by which such policy changes can influence behavior is by altering perceptions about the behavior, such as perceptions of risk and social norms (Greenberg, Morral, & Jain, 2004). In contrast, there is at present no parallel standard for marijuana use, in part due to lack of roadside and definitive testing of marijuana intoxication. Given this, it may be that youth are aware of these differences in enforcement standards, and their perceptions to some extent reflect actual lower probability of receiving negative consequences for driving after use of marijuana.

There are several limitations to the present study. The cross-sectional nature of the data limits inferences about the direction of the association between cognitions and driving behavior. To our knowledge, this study is the first to demonstrate associations between cognitions specific to driving after marijuana use and driving after such use. Finding cross-sectional associations, however, is only a first step toward demonstrating that these factors are important prospective predictors of behavior. Longitudinal studies would be required to examine whether these cognitions influence later substance-related driving behavior, driving behavior influences the development of cognitions, or a combination of both processes.

Table 3

*Zero-Inflated Poisson Regression Analyses of Driving After Use of Alcohol and Marijuana*

Variable	Alcohol		Marijuana	
	OR	PR	OR	PR
Frequency (past month)	1.07**	0.73**	2.62**	1.14**
Gender	0.95	0.73	0.81	0.75*
Attitudes	3.03**	0.97**	1.79**	0.80**
Normative beliefs	2.14**	0.97**	1.73**	0.78**
Perceived negative consequences	1.09	0.50**	1.01	0.54**

Note. OR = odds ratio; PR = predicted rate of increase in frequency from Poisson regression.

\*  $p < .05$ . \*\*  $p < .01$ .



The sample used was of college students, which limits the generalizability of findings to other populations. In addition, epidemiological evidence indicates that the prevalence of drinking and driving is higher at large (>10,000 student), public universities (Wechsler et al., 2003). Results of this study may not generalize to college settings with lower drinking and driving rates. The study is also limited by the use of self-report. However, self-report measures of substance-related behavior can be valid in youth, particularly when data collection is confidential or anonymous and when no consequences are associated with the report (Wilson & Grube, 1994).

An additional limitation of this study is that we did not include an assessment of quantity of marijuana use. Unlike alcohol, standardized self-report methods are generally not used to assess the amount of marijuana consumption. Therefore, although questions assessed driving or perceived danger of driving after different amounts of alcohol, parallel questions for marijuana did not specify an amount. This lack of specificity increases error variance due to individual differences in question interpretation. Future studies can use standardized interviews (Brown et al., 1998) to assess quantity of marijuana use and adapt these quantity measures to assess quantity of marijuana use prior to driving.

Results of this study also indicated significant overlap in youth who drive after use of alcohol and use of marijuana. Co-use of alcohol and marijuana prior to driving may be a particularly dangerous behavior, as co-use is associated with greater impairments in driving skills (Lamers & Ramaekers, 2001; Robbe, 1998). Future studies are required to examine youth cognitions and driving behavior associated with co-use of alcohol and marijuana.

The results of this study highlight cognitions about driving after use of marijuana as potential targets of prevention and intervention efforts. For drinking and driving, cognitive factors, such as perceived legal sanctions and normative beliefs, are associated with reduced drinking and driving in offenders receiving treatment (Greenberg et al., 2004). Drinking and driving offenders also cite legal sanctions as their primary motivation for avoiding drinking and driving (Wiliszowski, Murphy, Jones, & Lacey, 1996). Challenging youths' perceptions about the danger and potential negative consequences of driving after marijuana use may be an important technique for reducing this prevalent risk-taking behavior.

## References

- Aitken, C., Kerger, M., & Crofts, N. (2000). Drivers who use illicit drugs: Behavior and perceived risks. *Drugs: Education, Prevention and Policy*, 7, 39–50.
- Armitage, C. J., Norman, P., & Conner, M. (2002). Can the theory of planned behavior mediate the effects of age, gender and multidimensional health locus of control? *British Journal of Health Psychology*, 7, 299–316.
- Brookoff, D., Cook, C. S., Williams, C., & Mann, C. S. (1994). Testing reckless drivers for cocaine and marijuana. *The New England Journal of Medicine*, 331, 518–522.
- Brown, S. A., Myers, M. G., Lippke, L. F., Stewart, D. G., Tapert, S. F., & Vik, P. W. (1998). Psychometric validation of the customary drinking and drug use record (CDDR): A measure of adolescent alcohol and drug involvement. *Journal of Studies on Alcohol*, 59, 427–439.
- Cavaiaola, A. A., Strohmets, D. B., Wolf, J. M., & Lavender, N. J. (2003). Comparison of DWI offenders with non-DWI individuals on the MMPI-2 and the Michigan Alcoholism Screening Test. *Addictive Behaviors*, 28, 971–977.
- Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. (2003). *WISQARS leading causes of death reports, 2003* [Data file]. Retrieved February 28, 2006 from <http://webapp.cdc.gov/sasweb/ncipc/leadcaus10.html>
- Cohen, J., Cohen, P., West, S., & Aiken, L. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Hillsdale, NJ: Erlbaum.
- Crancer, A., Dille, J. M., Delay, J. C., Wallace, J. E., & Haykin, M. D. (1969). Comparison of the effects of marijuana and alcohol on simulated driving performance. *Science*, 164, 851–854.
- Darke, S., Kelly, E., & Ross, J. (2004). Drug driving among injecting drug users in Sydney, Australia: Prevalence, risk factors and risk perceptions. *Addiction*, 99, 175–185.
- Donovan, D. M., Queisser, H. R., Umlauf, R. L., & Salzberg, P. M. (1986). Personality subtypes among driving-while-intoxicated offenders: Follow-up of subsequent driving records. *Journal of Consulting & Clinical Psychology*, 54, 563–565.
- Gerrard, M., Gibbons, F. X., Benthin, A. C., & Hessling, R. M. (1996). A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescents: What you do shapes what you think and vice versa. *Health Psychology*, 15, 344–354.
- Giesbrecht, N., & Greenfield, T. K. (2003). Preventing alcohol-related problems in the US through policy: Media campaigns, regulatory approaches and environmental interventions. *Journal of Primary Prevention*, 24, 63–104.
- Greenberg, M. D., Morral, A. R., & Jain, A. K. (2004). How can repeat drunk drivers be influenced to change? Analysis of the association between drunk driving and DUI recidivists' attitudes and beliefs. *Journal of Studies on Alcohol*, 65, 460–463.
- Grube, J. W., & Voas, R. B. (1996). Predicting underage drinking and driving behaviors. *Addiction*, 9, 1843–1857.
- Lamers, C. J., & Ramaekers, J. G. (2001). Visual search and urban city driving under the influence of marijuana and alcohol. *Human Psychopharmacology: Clinical and Experimental*, 16, 393–401.
- Liguori, A., Gatto, C. P., & Robinson, J. H. (1998). Effects of marijuana on equilibrium, psychomotor performance, and simulated driving. *Behavioural Pharmacology*, 9, 599–609.
- McCarthy, D. M., Miller, T. L., Smith, G. T., & Smith, J. A. (2001). Disinhibition and expectancy in risk for alcohol use: Comparing Black and White college samples. *Journal of Studies on Alcohol*, 62, 313–321.
- McCarthy, D. M., Pedersen, S. L., & Leuty, M. E. (2005). Negative consequences and cognitions about drinking and driving. *Journal of Studies on Alcohol*, 66, 567–570.
- McCarthy, D. M., Pedersen, S. L., Thompson, D. M., & Leuty, M. E. (2006). Development of a measure of drinking and driving expectancies for youth. *Psychological Assessment*, 18, 155–164.
- Moskowitz, H. (1985). Marijuana and driving. *Accident Analysis & Prevention*, 17, 323–345.
- Muthén, L. K., & Muthén, B. O. (1998–2004). *Mplus user's guide* (3rd ed.). Los Angeles: Muthén & Muthén.
- National Highway Traffic Safety Administration. (2003, August). *Traffic safety facts 2002: Young drivers*. Retrieved September 2, 2005, from <http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSF2002/2002ydrfacts.pdf>
- Office of Applied Studies. (2004). *Results from the 2003 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 04–3964, NSDUH Series H-25). Rockville, MD: Substance Abuse and Mental Health Services Administration.
- Office of National Drug Control Policy (2006). *Marijuana myths and facts*. Retrieved March 22, 2006, from [http://www.whitehousedrugpolicy.gov/publications/marijuana\\_myths\\_facts/](http://www.whitehousedrugpolicy.gov/publications/marijuana_myths_facts/)
- O'Malley, P. M., & Johnston, L. D. (2003). Unsafe driving by high school seniors: National trends from 1976–2001 in tickets and accidents after

- use of alcohol, marijuana and other illegal drugs. *Journal of Studies on Alcohol Use*, 64, 305–312.
- Ramaekers, J. G., Robbe, H. J., & O'Hanlon, J. F. (2000). Marijuana, alcohol and actual driving performance. *Human Psychopharmacology: Clinical and Experimental*, 15, 551–558.
- Robbe, H. (1998). Marijuana's impairing effects on driving are moderate when taken alone but severe when combined with alcohol. *Human Psychopharmacology: Clinical and Experimental*, 13, S70–S78.
- Smith, G. T., McCarthy, D. M., & Goldman, M. S. (1995). Self-reported drinking and alcohol-related problems among early adolescents: Dimensionality and validity over 24 months. *Journal of Studies on Alcohol*, 56, 383–394.
- Soderstrom, C. A., Dischinger, P. C., Kerns, T. J., & Trifillis, A. L. (1995). Marijuana and other drug use among automobile and motorcycle drivers treated at a trauma center. *Accident Analysis & Prevention*, 27, 131–135.
- Terhune, K. W., Ippolito, C. A., Hendricks, D. L., Michalovic, J. G., Bogema, S. C., Santinga, P., et al. (1992). *The incidence and role of drugs in fatally injured drivers* (Report Number DOT HS 808 065). Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration.
- Terry, P., & Wright, K. A. (2005). Self-reported driving behaviour and attitudes towards driving under the influence of cannabis among three different user groups in England. *Addictive Behaviors*, 30, 619–626.
- Turrisi, R., Jaccard, J., & McDonnell, D. (1997). An examination of the relationships between personality, attitudes, and cognitions relevant to alcohol-impaired driving tendencies. *Journal of Applied Social Psychology*, 27, 1367–1394.
- Wechsler, H., Lee, J. E., Nelson, T. F., & Lee, H. (2003). Drinking and driving among college students: The influence of alcohol-control policies. *American Journal of Preventive Medicine*, 25, 212–218.
- Wiliszowski, C., Murphy, P., Jones, R., & Lacey, J. (1996). *Determine reasons for repeat drinking and driving* (DOT HS 808 401). Washington, DC: National Highway Traffic Safety Administration.
- Wilson, D. K., & Grube, J. (1994). Role of psychosocial factors in obtaining self-reports of alcohol use in a DUI population. *Psychology of Addictive Behaviors*, 8, 139–151.

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