Published in final edited form as:

Subst Use Misuse. 2014 May ; 49(6): 661–676. doi:10.3109/10826084.2013.858167.

Addiction, Drinking Behavior, and Driving Under the Influence

Frank A. Sloan, Ph.D.^a, Lindsey M. Chepke, J.D.^a, and Dontrell V. Davis, M.A., M.S.^a

Frank A. Sloan: fsloan@duke.edu; Lindsey M. Chepke: lchepke@duke.edu; Dontrell V. Davis: dontrell.davis@duke.edu

^aDuke University, Department of Economics, Box 90097, Durham, NC 27708, Phone: 919-660-8174, Fax: 919-681-7984

Abstract

Using a survey of drinkers (N=1,634), we evaluated alternative explanations of heavy and binge drinking, driving under the influence (DUI), DUI arrests, speeding citations, and chargeable accidents. Explanations included socializing, short-term decision-making, unrealistic optimism, risk preferring behavior, and addiction. Most consistent relationships were between substance use and alcohol addiction and dependent variables for (1) binge drinking and (2) DUI episodes. Respondent characteristics (age, marital and employment status, race) had important roles for DUI arrests. Drinker-drivers and those arrested for DUI are partially overlapping groups with implications for treatment and policies detecting and incapacitating persons from drinking and driving.

1. INTRODUCTION

1.1 Context

In the United States, driving under the influence (DUI) is the most frequently committed crime after drug possession, creating not only a financial burden, estimated to be \$51 billion in 2000 (Blincoe et al., 2002; U.S. Department of Justice, 2008), but also costs to population health (U.S. Department of Justice, 2008). Of fatal crashes in 2008, 32% were alcohol-related (National Highway Traffic Safety Administration, 2009). Further, the link between binge drinking and alcohol-related death (Sull, Yi, Nam, & Ohrr, 2009) and morbidity (Naimi et al., 2003; Sundell, Salomaa, Vartiainen, Poikolainen, & Laatikainen, 2008) is well established. Binge drinking, defined as more than 4 drinks on 1 occasion for females or 5 drinks for males, occurs in all age groups (Naimi et al., 2003; Wechsler & Austin, 1998).

Several non-mutually-exclusive explanations exist for why individuals are heavy and binge drinkers in general and drive under the influence in particular. Some persons view alcohol as a social lubricant. Alcohol consumption is an integral part of their social experiences, and DUI occurs while or after socializing (Beck, Ahmed, & Farkas, 2011). Some individuals who engage in their behaviors are present-oriented, meaning they discount the future heavily, and/or experience difficulty in executing their plans. Several studies have hypothesized that people engage in risky behaviors because they underestimate the adverse consequences of their actions (Dejoy, 1992; Hansen, Raynor, & Wolkenstein, 1991; Lapham, Baca, McMillan, & Lapidus, 2006; Sullivan, Fiellin, & O'Connor, 2005; Weinstein, 1980, 1987). In particular, some persons may underestimate the adverse consequences of heavy and binge drinking and DUI. Persons differ in the extent that they are averse to risk; for risk-preferers, risk-taking increases their sense of well being, drinking

Please direct all correspondence to: Frank A. Sloan, Duke University, Box 90097, Durham, NC 27708, Phone: 919-660-8174, Fax: 919-681-7984, fsloan@duke.edu.

There are no conflicts of interest associated with this study.

and driving being only one form of risk-taking. Being addicted to alcohol and/or other substances and hence lack control over alcohol consumption is another potential factor in driving under the influence.

This study addresses 3 issues. First, why do individuals drive under the influence of alcohol and other substances? We investigated the relative role of personality factors (e.g., focus on immediate gratification rather than on long-run consequences of present actions), high levels of alcohol consumption and other substance use, and addiction as they relate to the choice to drink and drive. Second, how do the same factors relate to the odds of actually incurring legal consequences of DUI and of other forms of risky driving behavior? Third, what are public policy implications of our findings, especially as they relate to the potential benefit of treatment for substance abuse? Conventional deterrents such as fines and jail terms may be effective if individuals value the benefit of alcohol consumption, for example in promoting their social lives, but only if the individuals are rational and forward-looking and not solely focused on the short-term benefits of alcohol consumption. However, if addiction is the most likely cause of drinking and driving episodes, treatment and measures that prevent the individual from operating a motor vehicle when intoxicated, such as ignition interlock devices, may be indicated. We did not directly assess impacts of specific policies, but rather focused on underlying factors that may make such policies more or less likely to be effective in reducing DUI, whether or not there was an actual arrest.

The data for our study came from a survey recently conducted under our auspices of adults who consumed some alcohol in 8 geographically-dispersed U.S. cities. In contrast to previous surveys, this survey collected information on arrest and citation histories, patterns of consumption of alcohol and other substances, drinking and driving episodes, risk perceptions, and personality factors, all in the same instruments.

2. METHODS

2.1 Data

Battelle Memorial Institute conducted a 3-wave survey of drinkers and drivers on our behalf in 8 cities in 4 states during 2009–2011. This survey, titled the Survey of Alcohol and Driving (SAD), included detailed information on drinking and drinking and driving behaviors, addictiveness, use of substances other than alcohol, risk perceptions, knowledge of statutes and judicial practices with regard to DUI, attitudes, personality and demographic characteristics, and income. When possible the questionnaire design was guided by questions that have been asked in prior surveys, albeit not asked in the same instrument. This study relied on data from the first wave. This wave contained questions on: demographic characteristics/income; alcohol consumption/problems/dependence; health and health behaviors; time preference/planning; cognition; impulsivity; motor vehicle insurance; accident/traffic violation history; and altruism. Complete instruments can be found on the study website (<http://dialog.econ.duke.edu/dapstudy>).

Since the study focus was on DUI, eligibility for the survey required respondents to have driven a car and consumed alcohol during the last month, residence within the metropolitan area of 1 of the 8 study cities, and be age 18 or older. The participant recruitment process was designed to oversample persons who consumed large amounts of alcohol and were prone to DUI in order to study decision-making and behaviors of such individuals in detail. Having had an arrest for DUI was not a prerequisite for participation in the survey. However, questions were asked about prior DUI arrests and convictions, drinking and driving behavior, citations for other traffic offenses, and the resulting penalties. Institutional Review Boards at both Duke University and Battelle approved the survey design, data collection methods, questionnaires, and participant recruitment methods.

We employed several innovative recruitment techniques to elicit survey participation resulting in 1,634 completed responses to wave 1. Recruitment methods, with number of respondents in parenthesis, were: random digit dial (592); court records (7); study flyers in bars and full-service restaurants (17); newspaper advertisements (198); email invitations to participate (703); and individuals who called Battelle to participate after seeing advertisement or being referred by another person (117). In total, 40 respondents reported they had been arrested for DWI in the last 3 years. This number is far fewer than the number of respondents that reported having driven after drinking in the past year (695, 42.5% of respondents). A financial incentive of up to \$90 was offered to all individuals, regardless of recruitment method, for participating in the study. The most effective recruiting method was an emailed invitation to participate based on a random draw of email addresses in the 8 cities. The message described survey eligibility criteria, mentioned the financial incentive for survey participation, and referred the individual directly to our study website, which listed the study objectives and responsibilities of study participants. The website specified how potential participants could volunteer.

The 8 cities were: Raleigh, North Carolina (NC) and Hickory, NC; Philadelphia, Pennsylvania (PA) and Wilkes-Barre, PA; Seattle, Washington (WA) and Yakima, WA; and Milwaukee, Wisconsin (WI) and La Crosse, WI. They represented a broad geographic spread of large and small cities. While data from 8 cities are not nationally representative, the 4 study states in which the cities are located varied in severity of their DUI problems, e.g., in per capita consumption of ethanol in gallons in 2007—NC (2.0), PA (2.2), WA (2.4), and WI (3.0) (National Institute on Alcohol Abuse and Alcoholism, 2009). Arrest to population ratios varied from 0.25% (WA) to 0.67% (WI) in 2009 (our calculation from arrest data we obtained from each state). The 4 states differed in their DUI prevention laws, demographic composition, and histories as applied to race.

2.2. Statistical Analysis: Empirical Specification

2.2.1. Overview—We employed a three-step analytic strategy. First, we assessed determinants of belonging to 1 of 4 mutually exclusive drinker groups. Second, we evaluated relationships between the drinker groups and other factors associated with the number of self-reported drinking and driving episodes during the past year. Third, we evaluated the roles of drinker groups and self-reported drinking and driving and other factors in explaining arrests for DUI, citations for speeding over 15 miles/hour above the speed limit, and chargeable accidents during the last 3 years.

2.2.2. Dependent Variable: Drinker Type—We defined 4 mutually exclusive drinker types. (1) A person was a heavy drinker if during the past year the person had on average consumed 14+ alcoholic beverages weekly for men under age 65 and 7+ beverages for women and for men 65+ and the person did not meet the criteria for being a binge drinker. (2) Binge drinkers consumed 5+ (men) or 4+ (women, men > 65) on 1 occasion but did not average 14+ or 7+ drinks weekly. (3) Heavy binge drinkers both satisfied criteria for binge drinking on 1 occasion and the weekly threshold for heavy drinkers. (4) The remaining category, other drinkers, included persons who consumed alcohol but were not classified in any of the first 3 drinker groups.

2.2.3. Dependent Variables: Number of Drinking and Driving Episodes in Past Year—The second type of dependent variable was the number of self-reported driving under the influence episodes in the past year.

2.2.4. Dependent Variable: Arrests, Citations, and Chargeable Accidents in Last 3 Years—The third group of dependent variables consisted of binary variables for

having been arrested at least once for DUI, cited at least once for speeding 15+ miles per hour over the speed limit, and charged at least once for a motor vehicle accident during the past 3 years.

2.2.5. Explanatory Variables—Explanatory variables measured social drinking, preference for immediate gratification, unrealistic optimism, use of alcohol and other substances and addiction to alcohol, health, demographic characteristics, and household income.

2.2.5.1. Social Drinking: We set a binary variable for social drinker to 1 for respondents who answered that it was slightly important, quite important, or very important to the person's social life to enjoy a few drinks with friends. A response that it was not at all important was set to 0.

2.2.5.2. Preference for Immediate Gratification: We measured respondents' time preference and propensity to plan for the future. "Patient" was a binary variable based on responses of 4 questions designed to measure an individual's willingness to defer returns for a higher payoff or incur losses immediately rather than incur larger losses later: Would you prefer to win \$1000 now or \$1500 later? Would you prefer to win \$20 now or \$30 later? Would you prefer to lose \$1000 now or \$1500 later? Would you prefer to lose \$20 now or \$30 later? Patient individuals, as we defined them, were willing to wait for higher future returns and willing to accept smaller immediate losses. Thus, a person who was patient (set to 1) would be more likely to prefer to win \$1500 later, win \$30 later, lose \$1000 now, or lose \$20 now than others (set to 0). These questions have been used in previous research to examine present orientation according to the size of the stakes involved (see e.g., Benzion, Rapoport, & Yagil, 1989; Lowenstein, 1987; Thaler, 1981).

The length of the planning horizon should capture such factors as planning ability or more generally ability to control one's behaviors (Ameriks, Caplin, & Leahy, 2003). People who do not plan may be less likely to arrange for alternate drivers and not be able to anticipate situations in which they may be tempted to drink heavily. We selected questions on the propensity to plan from a previous survey of smokers conducted for research by one of the authors. The study based on these data showed that persons with short planning horizons were more likely to smoke currently than were never smokers (Khwaja, Silverman, & Sloan, 2007). We included 2 measures of planning as explanatory variables. The first was an index of financial planning, which measured the length of the planning horizon. The planning horizon question asked the respondent to choose the most appropriate answer among 5 mutually exclusive categories, each describing a period that the individual considered in his or her planning. In constructing the index, we took the midpoint of each interval as the value for constructing the index. We assigned a value of 20 to the open-ended interval of 10+ years. The variable had values from 0.5 to 20.

The second planning variable referred to saving and spending. We defined a variable for "plans ahead," which was 1 if: the person engaged in both types of planning; 0.5 if s/he engaged in only 1 type of planning; and 0 if s/he did not engage in either type.

Impulsive persons tend to be less likely to be deterred by various sanctions against prohibited activities, such as drinking and driving, and can be seen as acting with diminished concern for the consequences (Keane, Maxim, & Teevan, 1993). Our survey measured impulsivity using a series of 12 statements such as I act on impulse; I finish what I start; I often do things on the spur of the moment; I plan for the future; I always consider the consequences before I take action. Respondents were asked whether they disagreed strongly, disagreed, neither disagreed nor agreed, agreed, or strongly agreed. We created an index of

impulsivity by converting responses to each statement to a 5-point scale with disagree strongly equal to 1 and agree strongly equal to 5 and summed the scores for individual items. The score varied from 12 to 60 with higher values indicating greater impulsivity. In a study of smoking using the same measure of impulsivity, Khwaja et al. (2007) found that current and former smokers had higher values on the impulsivity index than never smokers did.

2.2.5.3. Unrealistic Optimism: Our survey asked a series of questions about subjective beliefs about survival, onset of liver disease, extent to which alcohol consumption leads to a blood alcohol content (BAC) above the legal limit, and legal consequences of DUI. Legal consequences were the probabilities of being stopped for DUI, being convicted for DUI conditional on having been stopped, fined or jailed conditional on being convicted for DUI, and fine and jail amounts conditional on being fined or jailed. Each individual was asked 10 questions. In a separate analysis, we analyzed responses to each question comparing subjective beliefs with objective evidence on the same issue. A person was optimistic if s/he underestimated the adverse outcome and was pessimistic if s/he overestimated it. Our optimism index was defined as the number of optimistic answers divided by the total number of questions to which the respondent provided answers. Thus, the index varied from a minimum of 0 to a maximum of 1.

2.2.5.4. Alcohol, Other Substance Use, and Addiction: A positive relationship between drinking and driving and drinking has been documented previously, albeit with exceptions (Birdsall et al., 2012), with less detailed specifications of drinker types than used here (see e.g., Nochajski & Stasiewicz, 2006; Sloan, Reilly, & Schenzler, 1995). We included binary variables for drinker type, with other drinker type, the omitted reference group, as explanatory variables in our analysis of drinking and driving episodes in the past year and arrests, citations, and chargeable accidents in the last 3 years.

Positive correlations between excess alcohol consumption and the use of other drugs are well documented (Grant et al., 2004; McCutcheon et al., 2009; Stinson et al., 2006). We included a binary variable set to 1 for current smokers. We defined a binary variable for hard drug users as those individuals reporting using licit drugs without a physician's prescription or using illicit drugs during the past year: stimulants; sedatives; tranquilizers; cocaine; heroin; inhalants; or other narcotic drugs. Marijuana users were those persons who reported smoking marijuana or using hashish 100+ times in their lifetimes. The SAD did not ask about marijuana use in the next year.

We used 3 indexes to measure the respondents' level of alcohol addiction. The CAGE (U.S. Department of Health and Human Services, 2005) is a simple test used to screen for alcohol problems. The acronym CAGE represents 4 topics that comprise the instrument: Have you ever felt you should Cut down on your drinking? Have people Annoyed you by criticizing your drinking? Have you ever felt bad or Guilty about drinking? Have you ever had a drink first thing in the morning (Eye-opener) to calm your nerves or to get over a hangover? Individual item responses are summed and the CAGE is scored on a range of 0 or 4, with a high score (score greater than 2) indicating the presence of an alcohol problem. One study reported the CAGE as having the highest sensitivity (84%), specificity (90%), positive predictive value (82%), and negative predictive value (91%) in comparison to 3 other screening instruments (Soderstrom et al., 1997).

The second index assessed alcohol dependence by measuring increased alcohol tolerance, inability to stop drinking or drinking more than intended, and after-effects an individual may experience when cutting down on alcohol consumption. It consisted of 15 questions coded as 1 if the answer is yes and 0 otherwise. Did you ever in the last year: (1) Have trouble

falling asleep or staying asleep? (2) Find yourself shaking? (3) Feel anxious or nervous? (4) Feel sick to your stomach or vomit? (5) Feel more restless than usual? (6) Find yourself sweating or your heart beating fast? (7) See, feel, or hear things that weren't really there? (8) Have fits or seizures? (9) Find that your usual number of drinks had much less effect on you than it once did? (10) Increase your drinking because the amount you used to drink didn't give you the same effect anymore? (11) More than once want to stop or cut down on your drinking? (12) More than once try to stop or cut down on your drinking but found you couldn't do it? (13) Have an episode when you ended up drinking more than you meant to? (14) Have an episode or period when you kept on drinking for longer than you had intended to? (15) Have a drink first thing in the morning to steady your nerves or get rid of a hangover (eye-opener)?

The alcohol dependence index ranged from 0–4 with a higher score indicating a higher level of alcohol dependence. Positive responses to any of questions 1–8 and 15 were scored 1. Positive responses to combinations of questions 9–10, 11–12, and 13–14 were scored 1 each. The 1's were then summed to form the index.

The third index assessed alcohol abuse by measuring the impact that alcohol has had on an individual's life. The index was based on responses to 4 questions regarding events that happened during the person's entire life. Questions asked about: job or school troubles from drinking; dangerous behaviors from drinking that could lead to harm to self; impact on personal relationships from drinking; and arrests, citations, or other legal problems from drinking. Scores ranged from 0 to 4.

Questions used to construct the indexes of dependency (second index) and abuse (third index) were taken from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (Grant et al., 2006). The reliability of these alcohol dependence and abuse indexes range from good to excellent. Validation methods have shown that alcohol use disorders and criteria have good to excellent validity (Hasin & Beseler, 2009). In addition, we conducted factor analysis of the 3 indexes. In results not presented here, each of the indexes loaded positively on the first factor. The second factor distinguished between alcohol dependence and abuse with a factor loading near zero for the CAGE. The third factor distinguished between the CAGE and the other two indexes.

Other indicators of the respondents' alcohol dependence or abuse, also from NESARC, were measured using drinking patterns not part of a formal index. Drink < 3 p.m. and drinking > 1x/day both measured the extent of daily alcohol use. Drink < 3 p.m. was a binary variable set to 1 if individuals answering affirmatively to drinking alcohol before 3 p.m. in the last 12 months and otherwise to 0. Drinking > 1x/day was a binary equal to 1 if individuals answered affirmatively to drinking multiple times throughout the course of a day in the past 12 months and 0 otherwise. A risk factor for alcohol use disorders is early age of drinking onset (Nochajski and Stasiewicz, 2006). Age at which the respondent started drinking was a continuous variable reporting the age an individual first started drinking alcohol once weekly.

2.2.5.5. Health: Persons in fair/poor health tend to consume less alcohol (Liang & Chikritzhs, 2011; Valencia-Martín, Galán, & Rodríguez-Artalejo, 2009). We included a binary set to 1 if individuals reported their current health as fair or poor. Self-reported health is a valid predictor of future health events (Mossey & Shapiro, 1982).

Depression has been linked to high levels of alcohol consumption in general (Sullivan et al., 2005) and to DUI in particular (Lapham et al., 2001). We based our depression measure on 11 psychological characteristic questions, a screener known as SIG: E CAPS. These

questions asked whether the individual had any of the symptoms described in the following questions for a period of two weeks or longer during the last 12 months: (1) Have you been having problems with your Sleep? (2) Have you experienced decreased Interest in things you usually are interested in? (3) Have you had feelings of Guilt or worthlessness? (4) Has your Energy level been lower than usual? (5) Have you had problems with concentration or your memory (Cognition)? (6) Has your Appetite changed? (7) Have you felt sluggish, like you are moving more slowly than usual? (8) Much of the time you felt that everything you did was an effort? (9) Have you been feeling restless, like you have to move around more than you usually do? (10) Have you had thoughts about dying (Suicide)? (11) Have you had a depressed mood or been feeling down? In constructing the depression measure, answers to questions 7–9 were combined with a 1 being assigned if any one of these questions was answered affirmatively. In clinical applications where the index is in widespread use, patients who answer affirmatively to at least 5 of the questions are considered depressed (Carlat, 1998; Lieberman, 2003). We specified the variable on a 9-point scale with higher values signifying higher numbers of symptoms of depression.

2.2.5.6. Demographic Characteristics: Age was a continuous variable defined as the respondents' age at the survey date. Educational attainment in years was a continuous variable coded as: below a high school diploma/General Education Development (GED) 11, high school diploma/GED 12; some college or an Associate's degree 14; college graduate 16; and a graduate degree 18. We included binary variables for female gender, black, other race, and Hispanic ethnicity, married, student, unemployed, and out of labor force. Hispanic was specified as an ethnicity; individuals may have self-identified as black and Hispanic or white or other race and Hispanic. Only those respondents who self-reported being full time students were considered students. Persons out of the labor force consisted of retirees and homemakers.

2.2.5.7. Income: Household income was a continuous variable expressed in \$100,000s.

2.3. Statistical Analysis

We employed 3 different regression techniques in our analysis: logit; multinomial logit; and ordered logit. When an outcome can only have 2 values, e.g., dead or alive, logit analysis is used. An odds ratio is the ratio of the odds of an event occurring in 1 group to the odds of it occurring in another group. An odds ratio of 1 indicates that the event being studied is equally likely to occur in both groups. An odds ratio over 1 indicates that it is more likely to occur in the first group and conversely for an odds ratio below 1. The 95% confidence interval gives the range of odds ratios that have a 95% chance of being the true odds ratio. Multinomial logit is a regression model, which generalizes logit analysis, allowing more than 2 outcomes, in our study, 4 drinker types. The relative risk ratios reported below reflect the odds of being in a drinker category other than other drinker (i.e., heavy, binge, or heavy binge) to the odds of being an other drinker. Ordered logit is a regression model for ordinal dependent variables, which are variables based on multiple ordered response categories, e.g., number of drinks consumed daily in integers.

With Stata 11 SE software, we used multinomial logit for the drinker type analysis with other drinkers, the omitted reference group. Ordered logit regression was used to assess which factors influenced respondents' number of drinking and driving episodes. To analyze factors leading to arrests for a DUI, citations for speeding, and having been charged for an accident, we used logit analysis.

3. RESULTS

3.1. Distinctions in Responses from Respondents to SAD and BRFSS

Overall, consumption of alcohol was appreciably higher among respondents to SAD than to the Behavioral Risk Factor Surveillance System (BRFSS), a large national survey conducted analysis, which monitors alcohol use among its subjects. Nearly a third of respondents to SAD (31.4%) were in the other drinker category (Table 1). Among the remaining persons, 40.5% were binge, 23.7% heavy binge, and 4.4% heavy drinkers. Compared to this distribution of persons by drinker type, respondents to the 2009 BRFSS in the 8 study cities were distributed: 71.7% other drinkers; 13.5% binge drinkers; 7.2% heavy binge drinkers; and 7.6% heavy drinkers.

Respondents to SAD reported a mean of 1.09 episodes during the past year that they drove after having had too much to drink. The large associated standard deviation (1.46) reflected a few respondents reporting a high number of such episodes during the past year. By contrast, when we used drinker category weights based on BRFSS responses by drinker type for the 8 study cities but within-type values for driving episodes for each type from the SAD, the mean number of drinking and driving episodes during the past year was about half as large, 0.58.

Heavy drinkers, binge drinkers, and heavy binge drinkers reported higher numbers of drinking and driving episodes than did other drinkers. Mean self-reported drinking and driving episodes rose monotonically by drinking category from 0.30 for other drinkers to 2.04 for heavy binge drinkers.

Relative to the number of DUI episodes reported for the past year, the probabilities of having been arrested for DUI, or cited for speeding and accidents during the past 3 years were low. Only 3.3% were arrested for DUI, 1.6% using proportions by drinker type from BRFSS as weights for computing this percentage. Over 5 times as many persons were cited for speeding and about the same percentage were charged in a motor vehicle accident as were arrested for DUI. The BRFSS weighted sample means for citations for speeding and accidents were much closer to the raw means from SAD since the probability of being cited for speeding/accidents did not differ nearly as much by drinker type as did DUI arrests. However, binge and heavy binge drinkers were more likely to have been cited for speeding than other drinkers were.

3.2. Distinctions Among the Eight Cities

Respondents from the 8 cities differed substantially in terms of drinker category, number of self-reported drinking and driving episodes in the last year and in the number of arrest citations and chargeable accidents (Table 2). Hickory was highest in the fraction of drivers in the other drinker category, DUI arrests, speeding more than 15 mph above the speed limit, and chargeable accidents. Although highest in the fraction of binge drinkers, La Crosse was lowest in fractions of heavy and heavy binge drinkers and citations for speeding, and in number of drinking and driving episodes.

3.3. Drinker Types

The multinomial logit analysis of drinker type provides evidence on associations of specific attributes with each drinker type (Table 3). Being a social drinker was consistently positively related to being a heavy, binge, and a heavy binge drinker. The relative risk ratios (RRR) ranged from 2.16 (95% confidence interval (CI): 1.60–2.92) for binge drinkers to 3.29 for heavy binge drinkers (95% CI: 2.21–4.89), which implies that being a social drinker more than doubles (for binge drinker) and even more than triples (for heavy binge drinker)

the odds of various forms of high alcohol consumption relative to the odds of being a light or moderate (“other”) drinker. We found no significant differences among groups in being patient, financial planning horizon, or in propensity to plan. More impulsive persons were more likely to be binge than other drinkers (RRR=1.03; 95% CI: 1.00–1.05). The relative risk ratio of 1.03 implies that the probability of being a binge drinker relative to being an other drinker, the omitted reference group, rose by 3% for each point increase in the impulsivity index, which could vary from 12 to 60. This implies a substantial difference in the odds of being a binge drinker between persons who are impulsive versus those who are not impulsive. The corresponding results for heavy drinkers and heavy binge drinkers were not quite statistically significant at conventional levels but the relative risk ratio was the same as for binge drinkers. Optimism did not predict drinker type.

Binge drinkers and even more so heavy binge drinkers were much more likely to consume other addictive substances and show signs of addiction to alcohol than other drinkers were. There were fewer statistical differences between heavy drinkers and other drinkers in terms of use of other substances and alcohol addiction than for the binge and heavy binge groups. Hard drug use (RRR=2.93; 95% CI: 1.63–5.27) and marijuana use (RRR=1.86; 95% CI: 1.20–2.90) raised the odds of being a heavy binge drinker relative to being an other drinker. Alcohol dependence almost doubled the odds of being a binge drinker (RRR=1.90; 95% CI: 1.60–2.25) and a heavy binge drinker (RRR=1.94; 95% CI: 1.58–2.38). Holding other factors constant, there was no relationship between alcohol abuse and drinker type. Persons reporting that they consumed alcohol before 3 p.m. were almost 3 times more likely to be binge drinkers (RRR=2.98; 95% CI: 2.09–4.27) and almost 4 times more likely to be heavy binge drinkers than other drinkers were (RRR=3.83; 95% CI: 2.57–5.70). Drinking more than once a day made being a heavy binge drinker 49% more likely (RRR=1.49; 95% CI: 1.00–2.23). The age at which the persons started drinking was also positively related to being a heavy binge drinker (RRR=1.03; 95% CI: 1.01–1.06) as well as being positively related to being a heavy drinker (RRR=1.04; 95% CI: 1.01–1.07).

More clinically depressed individuals were less likely to be heavy binge than other drinkers (RRR=0.83; 95% CI: 0.77–0.90). The relative risk ratio of 0.83 applies to a depression scale with a range of 0–9 with each unit increase implying a 17% reduction in the odds of being a heavy binge drinker. The corresponding relative risk ratio for being a binge drinker was higher (RRR=0.88; 95% CI: 0.83–0.94), implying a somewhat lesser association between the extent of depression and being a binge drinker.

Each additional year of schooling lowered the odds of being a heavy binge drinker relative to being an other drinker by 15% (RRR=0.85; 95% CI: 0.78–0.94). The relationship between schooling and being a binge drinker was similar. Currently married persons were 42% less likely to be heavy binge than other drinkers (RRR=0.58; 95% CI: 0.40–0.85).

Older persons were more likely to be heavy drinkers and less likely to be binge and heavy binge drinkers. Consistent with this finding, heavy drinkers were more likely to be out of the labor force (RRR=2.56; 95% CI: 1.20–5.47).

3.3. Episodes of Driving under the Influence in the Past Year

In the full specification, being a social drinker made future drinking and driving much more likely (col. 3, Table 4, odds ratio (OR)=1.91; 95% CI: 1.47–2.48). Impulsivity increased the odds of such behavior (OR=1.03; 95% CI: 1.01–1.05). Being patient and a planner were unrelated to drinking and driving. Given that social drinker was defined as a binary variable and impulsivity could vary from 12 to 60 and based on their relative odds ratios, social drinker and impulsivity were about of equal importance in predicting the number of drinking and driving episodes.

Being too optimistic about the adverse consequences of drinking and drinking and driving increased the odds of drinking and driving (OR=1.72; 95% CI: 1.04–2.85). An individual who was optimistic about all the outcomes SAD asked about was 72% more likely to drink and drive than an otherwise similar individual who was optimistic about no outcomes.

Without controlling for other explanatory variables (col. 1), compared to other drinkers, the odds of drinking and driving episodes more than doubled for heavy (OR=2.26; 95% CI: 1.29–3.96), more than quintupled for binge (OR=5.75; 95% CI: 4.34–7.62); and increased over 15 times for heavy binge drinkers (OR=15.20; 95% CI: 11.12–20.77).

In the full specification (col. 3), which controlled for use of other substances and alcohol addiction and other factors, being a heavy drinker was not statistically significant at conventional levels. However, holding other factors constant, being a binge drinker increased the odds of drinking and driving relative to that for other drinkers over 3-fold (OR=3.25; 95% CI: 2.37–4.48) and being a heavy binge drinker increased the odds by over 5 times (OR=5.36; 95% CI: 3.74–7.68).

Even with drinker types included as explanatory variables, use of other addictive substances and addiction measures explained the propensity to expect to drink and drive. Hard drug and marijuana users were almost twice as likely to report drinking and driving episodes (hard drug user OR=1.89; 95% CI: 1.41–2.54; marijuana user OR=1.90; 95% CI: 1.47–2.46). Additionally, alcohol dependence, but not alcohol abuse, drinking before 3 pm, and drinking more than once a day were positively associated with drinking and driving (alcohol dependence OR=1.22; 95% CI: 1.07–1.39; drink < 3 pm OR=1.62; 95% CI: 1.28–2.04; drinking > once a day; OR=1.36; 95% CI: 1.07–1.72).

Neither physical health nor depression was associated with drinking and driving episodes in the past year. Driving under the influence was less common among females and among married persons. There were no statistical differences according to educational attainment and black race. Dropping the drinker type variables (col. 2) only affected statistical significance of 1 explanatory variable; the odds ratio for educational attainment became significant. Odds ratios for the statistically significant measures of substance use and addiction increased somewhat.

3.4. Arrests Citations, and Chargeable Accidents in the Past 3 Years

Next we examined the extent to which persons who self-reported drinking and driving episodes was reflected in legal consequences to the motor vehicle operator in the past 3 years (Table 5): any arrests for DUI (cols. 1 and 2); any citations for speeding (col. 3); and any chargeable accidents (col. 4). Our survey did not ask whether the DUI arrests, citations for speeding, and other chargeable accidents co-occurred.

In a specification limited to drinker type explanatory variables (not shown in table), binge and heavy binge drinking, but not heavy drinking, increased the odds of having been arrested for DWI in the last 3 years 6-fold for binge (OR=6.11; 95% CI: 1.83–20.48) and 12-fold for heavy binge drinkers (OR=12.23; 95% CI: 3.67–40.71). Overall, the results differ substantially from the previous table. In particular, even with the number of self-reported drinking and driving episodes omitted as an explanatory variable (col. 1), drinker type, use of other substances, and alcohol dependence were not statistically significant, which implies that people who were arrested for DUI were not predominantly the persons who drank excessively or were addicted to alcohol.

Results for DUI arrests differed from those for speeding citations and chargeable accidents, which implies that drinkers and drivers are not simply risk takers in the driving domain.

Also, when included as an explanatory variable, the number of drinking and driving episodes in the past year was positively associated with having had a DUI arrest (OR=1.29; 95% CI: 1.02–1.64) and a chargeable accident (OR=1.25; 95% CI: 1.02–1.54).

Holding other factors constant, being a social drinker was not statistically significant in any of the Table 5 regressions. Explanatory variables for preference for immediate gratification were generally insignificant with 1 exception. Impulsivity was positively associated with having been cited for speeding (OR=1.03; 95% CI: 1.00–1.06). Unrealistic optimism was not statistically associated with any of the legal consequences. When included (Table 5, col. 1), drinker type did not explain differences in the odds of a prior DUI arrest. Only 2 of the explanatory variables for substance use and addiction were statistically significant in the analysis of DUI arrest (col. 1): alcohol abuse (OR=2.67; 95% CI: 1.83–3.89) and age started drinking (OR=1.08; 95% CI: 1.02–1.14).

The odds of an arrest for DUI were significantly decreased for older (OR=0.96; 95% CI: 0.93–0.99) in contrast to results for the number of self-reported drinking and driving episodes for which no association was found for age; the odds of arrest were about a fifth as high for married as for unmarried persons (OR=0.21; 95% CI: 0.070–0.65). However, the odds of an arrest for DUI were substantially increased for blacks (OR=3.42; 95% CI: 1.46–8.00) while blacks did not differ from whites in terms of drinking and driving episodes. Unemployed also had much greater odds of having been arrested for DUI than employed persons (OR=3.30; 95% CI: 1.37–7.96), again in contrast to drinking and driving episodes for which no statistical difference was obtained.

Higher rates of arrest for DUI of unemployed persons as distinct from persons not in the labor force which we also measured have been documented by others (Bernhoft, Hels, & Hansen, 2008; Vaez & LaFlamme, 2005). While married persons in our analysis of DUI arrests were also less likely to drink and drive, a result reported previously (Arnett, 1998), the odds ratio was much lower for DUI arrests, perhaps because married persons, like older individuals, tend to drive at times that are less heavily patrolled, e.g., during the day and in the early evening.

Depression was positively related to having had a citation for speeding (OR=1.08; 95% CI: 1.01–1.15) but not to DUI arrests or chargeable accidents

4. DISCUSSION

Drinking in social contexts mainly distinguished other drinkers from heavy, binge, and heavy binge drinkers. Social drinkers were over 2 to over 3 times as likely to be in the latter 3 than in the other drinker category, which included light and moderate drinkers. They were also much more likely to drink and drive, even controlling for drinker type. However, drinking being important in social situations was not statistically related to previous DUI arrests, citations for speeding, or chargeable accidents.

Factors associated with a preference for immediate gratification, as a group, did not provide much explanation for heavy and/or binge drinking or DUI. Impulsivity was associated with being a binge drinker; the relative risk ratio linking impulsivity to being a heavy binge drinker was the same as for being a binge drinker, but it was not quite statistically significant at conventional levels. More impulsive persons were more like to report driving under the influence episodes, but in the analysis of arrests, citations, and chargeable accidents, impulsivity only predicted having been cited for speeding.

If anything, respondents to our survey overestimated the negative consequences to themselves of excess drinking and drinking and driving, as reflected in the mean value of

0.41 for our optimism index (i.e., they were pessimistic 0.59 of the time). The only statistically significant relationship between optimism and behavior in our study was for self-reported drinking and driving episodes.

We did not include a measure of individuals' risk preferences in our study. However, we analyzed 3 distinct measures of reckless driving. While drinking and driving episodes in the past year were positively related to have had a chargeable accident in the past 3 years, this was not so for having been cited for speeding 15 miles per hour above the speed limit. Such citations were far more common than were either DUI arrests or chargeable accidents.

The most distinct and frequent statistical relationships were between measures of substance use and addiction to alcohol and dependent variables for (1) binge and heavy binge drinking and (2) self-reported drunk driving episodes. In particular, substance use and alcohol addiction variables—use of illicit drugs, alcohol dependence, drinking before 3 pm, and drinking more than once daily—predicted heavy binge and binge drinking and the number of self-reported drinking and driving episodes in the past year. This is so even after accounting for drinker type. Substance use and alcohol addiction variables were generally not statistically significant in our analysis of arrests, citations, and chargeable accidents. Possibly alcohol dependent individuals are more adept at avoiding police patrols. Or arrests for DUI are so rare that a much larger sample would be needed to detect a link between dependence and DUI arrests.

The terms “dependence” and “abuse” as used here reflect DSM-IV criteria. Abuse describes a pattern of drinking that interferes with daily activities, including those at work and at home. Dependence describes interference with daily activities as well as tolerance, withdrawal, failed attempts to quit using alcohol and other criteria (American Psychiatric Association, 1994). Our results indicate that many drinkers and drivers have a serious addiction, which may not be responsive to traditional criminal deterrents administered alone, i.e., without treatment. There is evidence that most individuals with alcohol use disorders never utilize treatment (Ilgen et al., 2011). Although analysis of administrative data on arrests indicates that imposing penalties for DUI offenses deter future offenses (Sloan, Platt, & Chepke, 2011), such data contain no information on alcohol consumption or addiction. The SAD did ask questions on such penalties, but the sample size was insufficient to recruit separate analysis of DUI recidivism by alcohol consumption and addiction. Such research is a high priority.

Our study has several strengths. We presented results from a recently conducted survey, which contains potentially important questions related to drinking and driving not included in other surveys. Major alternative sources of recent data on drinking and driving behavior are the BRFSS and NESARC. The BRFSS contains questions on drinking and driving and alcohol consumption within the last month, but does not measure arrests or citations, chargeable accidents, addictions, use of other substances, and personality factors. NESARC is the most comprehensive survey of drinking patterns, addiction, psychiatric factors, and family history in the U.S. (Chou et al., 2006; Vaughn et al., 2011). However, drinking and driving questions refer to driving multiple times after having too much to drink. In our survey, 22.5% of those that drove drunk in the past year did so once. Also, NESARC contains no questions on arrests or citations for driving violations or on time preference, impulsivity, and risk perceptions.

An alternative measure of drinking and driving comes from arrest records. However such records have at least 3 disadvantages. First, they are limited to those that are arrested for DUI. Second, they are dependent on levels of law enforcement (Nochajski & Stasiewicz,

2006). Third, arrest records contain no information on personal attributes, except for a few basic demographic characteristics.

We studied both self-reported drinking and driving episodes and arrests for DUI and other potential legal consequences of reckless driving. Oversampling high alcohol consumers permitted us perform more detailed analysis on drinker types who are especially prone to drive under the influence. Our analysis linked drinking styles, use of substances other than alcohol, addiction, and personality factors to driving behaviors.

A major limitation is reliance on self-reports. Reliance on self-reports of drinking is common in alcohol research. Self-reports of driving under the influence and of arrests and citations may understate true rates. A classic study based on experimental data (Beitel, Sharp, & Glauz, 2000) found that the probability of an arrest, while driving at a blood alcohol level over 10% was 0.0058 or about 1 in 200 trips with BACs at this level. This arrest probability is consistent with our results. Another source gave DUI arrest rates in the 300–1,000 trip range (Voas & Lacey, 1990). In sensitivity analysis, we used the U.S. Department of Justice estimate of 1.44 million arrests for DUI in 2009 in alternative comparisons. Under various assumptions, the annual rates of arrest for DUI from this source were appreciably higher than the ones we report.

Our survey did not examine psychiatric conditions other than those directly related to alcohol use and depression. Previous research has established a link between psychiatric diagnoses and reckless driving (Vaughn et al., 2011), but to our knowledge, no study has studied the specific relationship to drinking and driving episodes.

The reference periods used in our survey differed. Current smoking referred to the time of the interview as did binge and heavy drinking. Self-reported episodes of drinking and driving referred to the past year, and those for arrest, citation, and chargeable accidents referred to the past 3 years. We used a 3-year look-back for legal consequences because these events tend to occur rarely. A possible consequence of using different reference periods is that arrests, citations, and/or chargeable accidents occurring 2 or 3 years before the interview may have deterred drinking and driving episodes in the past year. To the extent that this is so, our estimates relating drinking and driving episodes to legal consequences may be biased toward 0, and hence be overly conservative. Our finding of a positive relationship, even under these circumstances, suggests that persistence in drinking and driving offsets any deterrent effect that may have occurred.

Although widely used in previous empirical research and often statistically related to the dependent variables, psychometric properties of several explanatory variables used in our analysis are not known. The explanatory variable for unrealistic optimism was used in this study for the first time.

In our study, blacks had unusually high rates of DUI arrest, but they did not differ from whites in terms of the number of drinking and driving episodes during the past year. Previous research has reported relatively high rates of DUI arrest for Hispanics, but not blacks (Caetano & Clark, 2000). Unfortunately, we experienced difficulty in recruiting Hispanic participants to our study. This could be due, in part, to the fact that illegal aliens face a threat of deportation following a conviction (Brown, 2011). Hispanics who are illegal aliens would understandably be reluctant to self-report drinking and driving and prior arrests for this reason.

Particularly because drinkers and drivers are heterogeneous as this study indicates, devising effective public policy strategies for reducing DUI rates is challenging. The results on substance use and addiction imply an important role for treatment and incapacitation. Choice

of specific policies depends on policy effectiveness, a review of which is beyond the scope of our study. At the opposite end of the spectrum, the association between social drinking and DUI suggests a focus on curbs in social drinking situations, such as dram shop and social host liability. Our survey did not include persons under age 18 and college students only constituted a small minority of respondents. Our result linking optimism to drinking and driving suggests a possible role for information provision; our optimism index spanned many outcome dimensions, far too many to be included in single information messages.

While drinkers and drivers are heterogeneous, they differ from drivers who engage in other forms of reckless driving behavior. Treatment programs, such as 12-step programs or intensive outpatient treatment, which succeed in reducing DUI rates, are not likely to reduce rates of speeding. The strong relationship between alcohol addiction and driving under the influence implies important roles for treatment and mechanisms to restrain addicted individuals from DUI, such as ignition interlock devices. However, a limitation of treatment is that few alcohol-addicted individuals undergo treatment (Cohen, Feinn, Arias, & Kranzler, 2007).

Driving under the influence is a common occurrence on U.S. roadways. Persons who drink and drive often suffer from addictions, but addiction provides a better explanation of drinking and driving than it does of the probability of experiencing an arrest for DUI. At the same time, demographic characteristics, including age, race, and marital status, which may reflect driving patterns relative to patrolling and hence in the probability of being apprehended, have more of a role in explaining variations in DUI arrest rates than in rates of drinking and driving. This presents a challenge for public policy in that the population that the judicial system only partially overlaps with the population of drinkers and drivers. Effective deterrence and incapacitation strategies require detection; however, current detection mechanisms do not appear to capture the full spectrum of DUI offenders. Given these challenges, it would be useful to implement approaches, which place a barrier to driving under the influence. While technology exists to monitor alcohol consumption of every driver, e.g., on-board alcohol detection systems with integrated sensors (Fu & Wang, 2012; Verster, Pandi-Perumal, Ramaekers, & de Gier, 2009), such technology is currently costly. Universal application of such devices, while likely to attract manufacturers of such devices due to increased market size and lead to cost reductions due to economies of scale, would require legislative action, similar to laws requiring air bags in cars and penalties for failure to utilize seat belts.

Acknowledgments

This research was supported by a grant from the National Institute on Alcohol Abuse and Alcoholism, 1R01AA017913-01A1. This sponsor had no involvement in study design, collection, analysis and interpretation of data, in the writing of the manuscript or in the decision to submit the manuscript for publication.

References

- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington, DC: American Psychiatric Association; 1994.
- Ameriks J, Caplin A, Leahy J. Wealth Accumulation and the Propensity to Plan. *Quarterly Journal of Economics*. 2003; 118(3):1007–1047.
- Arnett JJ. Risk Behavior and Family Role Transitions During the Twenties. *Journal of Youth and Adolescence*. 1998; 27(3):301–320.10.1023/A:1022851003328
- Beck KH, Ahmed A, Farkas ZA. A Descriptive Analysis of the Social Context of Drinking Among First-Time DUI Offenders. *Traffic Injury Prevention*. 2011; 12(4):306–311. [PubMed: 21823937]

- Beitel GA, Sharp MC, Glauz WD. Probability of Arrest While Driving Under the Influence of Alcohol. *Injury Prevention: Journal of the International Society for Child and Adolescent Injury Prevention*. 2000; 6(2):158–161. [PubMed: 10875678]
- Benzion Y, Rapoport A, Yagil J. Discount Rates Inferred from Decisions: an Experimental Study. *Management Science*. 1989; 35:270–284.
- Bernhoft IM, Hels T, Hansen AS. Trends in Drink Driving Accidents and Convictions in Denmark. *Traffic Injury Prevention*. 2008; 9(5):395–403. [PubMed: 18836949]
- Blincoe, L.; Seay, A.; Zaloshnja, E.; Miller, T.; Romano, E.; Luchter, S.; Spircer, R. U.S. Department of Transportation. *The Economic Impact of Motor Vehicle Crashes*. Washington D.C: National Highway Traffic Safety Administration; 2002. p. 1-94.
- Brown D. Why Padilla Doesn't Matter (Much). *UCLA Law Review*. 2011; 58
- Caetano R, Clark CL. Hispanics, Blacks and Whites Driving Under the Influence of Alcohol: Results from the 1995 National Alcohol Survey. *Accident Analysis & Prevention*. 2000; 32(1):57–64. [PubMed: 10576676]
- Carlat DJ. The Psychiatric Review of Symptoms: A Screening Tool for Family Physicians. *American Family Physician*. 1998; 58(7):1617–1624. [PubMed: 9824959]
- Chou SP, Dawson DA, Stinson FS, Huang BJ, Pickering RP, Zhou Y, Grant BF. The Prevalence of Drinking and Driving in the United States, 2001–2002: Results from the National Epidemiological Survey on Alcohol and Related Conditions. *Drug and Alcohol Dependence*. 2006; 83(2):137–146.10.1016/j.drugalcdep.2005.11.001 [PubMed: 16364565]
- Cohen E, Feinn R, Arias A, Kranzler HR. Alcohol treatment utilization: Findings from the national epidemiologic survey on alcohol and related conditions. *Drug and Alcohol Dependence*. 2007; 86(2–3):214–221.10.1016/j.drugalcdep.2006.06.008 [PubMed: 16919401]
- Dejoy DM. An Examination of Gender Differences in Traffic Accident Risk Perception. *Accident Analysis and Prevention*. 1992; 24(3):237–246.10.1016/0001-4575(92)90003-2 [PubMed: 1605809]
- Fu L, Wang J. A Vehicle On-Board Alcohol Detection System Based on Integrated Multi-Sensors. *Advanced Materials Research*. 2012; 490–495:91–94.
- Grant BF, Dawson D, Stinson F, Chou P, Dufour M, Pickering R. The 12-month Prevalence and Trends in DSM-IV Alcohol Abuse and Dependence: United States, 1991–1992 and 2001–2002. *Alcohol Research & Health*. 2006; 29(2):79–91.
- Grant BF, Stinson FS, Dawson DA, Chou SP, Ruan WJ, Pickering RP. Co-occurrence of 12-Month Alcohol and Drug Use Disorders and Personality Disorders in the United States: Results From the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry*. 2004; 61(4):361–368.10.1001/archpsyc.61.4.361 [PubMed: 15066894]
- Hansen WB, Raynor AE, Wolkenstein BH. Perceived Personal Immunity to the Consequences of Drinking Alcohol: The Relationship Between Behavior and Perception. *Journal of Behavioral Medicine*. 1991; 14(3):205–224.10.1007/bf00845452 [PubMed: 1875402]
- Hasin DS, Beseler CL. Dimensionality of Lifetime Alcohol Abuse, Dependence and Binge Drinking. *Drug and Alcohol Dependence*. 2009; 101(1–2):53–61.10.1016/j.drugalcdep.2008.10.025 [PubMed: 19095379]
- Ilgen MA, Price AM, Burnett-Zeigler I, Perron B, Islam K, Bohnert ASB, Zivin K. Longitudinal predictors of addictions treatment utilization in treatment-naïve adults with alcohol use disorders. *Drug and Alcohol Dependence*. 2011; 113(2–3):215–221.10.1016/j.drugalcdep.2010.08.006 [PubMed: 20828944]
- Keane C, Maxim PS, Teevan JJ. Drinking and Driving, Self-Control, and Gender: Testing a General Theory of Crime. *Journal of Research in Crime and Delinquency*. 1993; 30(1):30–46.
- Khwaja A, Silverman D, Sloan F. Time Preference, Time Discounting, and Smoking Decisions. *Journal of Health Economics*. 2007; 26(5):927–949. [PubMed: 17574694]
- Lapham SC, Baca JCD, McMillan GP, Lapidus J. Psychiatric Disorders in a Sample of Repeat Impaired-Driving Offenders. *Journal of Studies on Alcohol*. 2006; 67(5):707–713. [PubMed: 16847539]

- Lapham SC, Smith E, Baca JCD, Chang I, Skipper BJ, Baum G, Hunt WC. Prevalence of Psychiatric Disorders Among Persons Convicted of Driving While Impaired. *Archives of General Psychiatry*. 2001; 58:943–949. [PubMed: 11576032]
- Liang W, Chikritzhs T. Reduction in Alcohol Consumption and Health Status. *Addiction*. 2011; 106(1):75–81.10.1111/j.1360-0443.2010.03164.x [PubMed: 21054616]
- Lieberman JA. The Differential Diagnosis of Fatigue and Executive Dysfunction in Primary Care. *Journal of Clinical Psychiatry*. 2003; 64:40–43. [PubMed: 14658935]
- Lowenstein G. Anticipation and the Valuation of Delayed Consumption. *Economic Journal*. 1987; 97(387):666–684.
- McCutcheon VV, Heath AC, Edenberg HJ, Grucza RA, Hesselbrock VM, Kramer JR, Bucholz KK. Alcohol Criteria Endorsement and Psychiatric and Drug Use Disorders Among DUI Offenders: Greater Severity Among Women and Multiple Offenders. *Addictive Behaviors*. 2009; 34(5):432–439. [PubMed: 19167170]
- Mossey J, Shapiro E. Self-Rated Health: A Predictor of Mortality Among the Elderly. *American Journal of Public Health*. 1982; 72(8):800–808. [PubMed: 7091475]
- Naimi TS, Brewer RD, Mokdad A, Denny C, Serdula MK, Marks JS. Binge Drinking among U.S. Adults. *Journal of the American Medical Association*. 2003; 289(1):70–75.10.1001/jama.289.1.70 [PubMed: 12503979]
- National Highway Traffic Safety Administration. Traffic Safety Facts 2008 Data: Alcohol-Impaired Driving. Washington, D.C: National Center for Statistics and Analysis; 2009.
- National Institute on Alcohol Abuse and Alcoholism. National Institute on Alcohol Abuse and Alcoholism. Per Capita Ethanol Consumption for States, Census Regions, and The United States, 1970–2007. (Gallons of Ethanol, Based on Population Age 14 and Older). 2009.
- Nochajski TH, Stasiewicz PR. Relapse to Driving Under the Influence (DUI): A Review. *Clinical Psychology Review*. 2006; 26(2):179–195.10.1016/j.cpr.2005.11.006 [PubMed: 16364523]
- Sloan, F.; Platt, A.; Chepke, L. *Journal of Empirical Legal Studies*. 2011. Deterring Rearrests for Drinking and Driving. Under review
- Sloan F, Reilly B, Schenzler C. Effects of Tort Liability and Insurance on Heavy Drinking and Drinking and Driving. *Journal of Law and Economics*. 1995; 38(1):49–77.
- Soderstrom C, Smith G, Kufera J, Dischinger P, Hebel J, McDuff D, Read K. The Accuracy of the CAGE, the Brief Michigan Alcoholism Screening Test, and the Alcohol Use Disorders Identification Test in Screening Trauma Center Patients for Alcoholism. *Journal of Trauma*. 1997; 43(6):962–969. [PubMed: 9420113]
- Stinson F, Grant BF, Dawson DA, Ruan WJ, Huang B, Saha T. Comorbidity Between DSM-IV Alcohol and Specific Drug Use Disorders in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Alcohol Research & Health*. 2006; 29(2):94–106.
- Sull JW, Yi SW, Nam CM, Ohrr H. Binge Drinking and Mortality From All Causes and Cerebrovascular Diseases in Korean Men and Women: A Kangwha Cohort Study. *Stroke*. 2009; 40(9):2953–2958. [PubMed: 19556525]
- Sullivan LE, Fiellin DA, O'Connor PG. The Prevalence and Impact of Alcohol Problems in Major Depression: A Systematic Review. *American Journal of Medicine*. 2005; 118(4):330–341.10.1016/j.amjmed.2005.01.007 [PubMed: 15808128]
- Sundell L, Salomaa V, Vartiainen E, Poikolainen K, Laatikainen T. Increased Stroke Risk Is Related to a Binge Drinking Habit. *Stroke*. 2008; 39(12):3179–3184. [PubMed: 18832741]
- Thaler R. Some Empirical Evidence on Dynamic Inconsistency. *Economic Letters*. 1981; 8(3):201–207.
- U.S. Department of Health and Human Services. Screening for Alcohol Use and Alcohol Related Problems. 2005. Retrieved October 12, 2011, from <http://pubs.niaaa.nih.gov/publications/aa65/AA65.htm>
- U.S. Department of Justice. Crime in the United States, Table 29: Estimated Number of Arrests. 2008. Retrieved October 12, 2011, from http://www2.fbi.gov/ucr/cius2008/data/table_29.html

- Vaez M, LaFlamme L. Impaired Driving and Motor Vehicle Crashes Among Swedish Youth: An Investigation into Driver's Sociodemographic Characteristics. *Accident Analysis & Prevention*. 2005; 37(4):605–611. [PubMed: 15949450]
- Valencia-Martín JL, Galán I, Rodríguez-Artalejo F. Alcohol and Self-Rated Health in a Mediterranean Country: The Role of Average Volume, Drinking Pattern, and Alcohol Dependence. *Alcoholism: Clinical and Experimental Research*. 2009; 33(2):240–246.
- Vaughn MG, Define RS, DeLisi M, Perron BE, Beaver KM, Fu Q, Howard MO. Sociodemographic, Behavioral, and Substance Use Correlates of Reckless Driving in the United States: Findings from a National Sample. *Journal of Psychiatric Research*. 2011; 45(3):347–353.10.1016/j.jpsychires.2010.06.016 [PubMed: 20673673]
- Verster, JC.; Pandi-Perumal, SR.; Ramaekers, JG.; de Gier, JJ. *Drugs, Driving and Traffic Safety*. Basel: Birkhauser; 2009.
- Voas, RB.; Lacey, JH. *Drunk Driving Enforcement Adjudication and Sanctions in the USA*. New York, New York, USA: Guilford Press; 1990.
- Wechsler H, Austin S. Binge Drinking: The Five/Four Measure. *Journal of Studies on Alcohol*. 1998; 59(1):122–124. [PubMed: 9498324]
- Weinstein ND. Unrealistic Optimism about Future Life Events. *Journal of Personality and Social Psychology*. 1980; 39(5):806–820.
- Weinstein ND. Unrealistic Optimism about Susceptibility to Health Problems: Conclusions from a Community-Wide Sample. *Journal of Behavioral Medicine*. 1987; 10(5):481–500. [PubMed: 3430590]

Table 1

Means and Standard Deviations of Drinking and Driving Behavior and Addiction

Variables	All (1)	All w/BRESS weights (2)	Heavy Drinkers (3)	Binge Drinkers (4)	Heavy Binge Drinkers (5)	Other Drinkers (6)
Self-Reported Behavior						
Drinking and driving episodes	1.09 (1.46)	0.58	0.63*** (1.12)	1.20*** (1.41)	2.04*** (1.65)	0.30 (0.81)
Self-reported Legal Citations						
DUI (0–1)	0.033 (0.18)	0.016	0.028* (0.17)	0.035*** (0.18)	0.067*** (0.25)	0.0059 (0.076)
Speeding > 15mph (0–1)	0.17 (0.47)	0.14	0.11 (0.40)	0.20*** (0.50)	0.20** (0.51)	0.13 (0.38)
Charged in accident (0–1)	0.036 (0.19)	0.031	0.028 (0.17)	0.038 (0.19)	0.044 (0.21)	0.029 (0.17)
N	1629		72	660	386	511

Means, top line; standard deviations in parentheses.

*
p<0.10,**
p<0.05,***
p<0.01. Reference group is other drinkers.

Table 2

Differences in Drinking and Driving Behavior and the 8 Cities*

Variable	Highest	Lowest
Drinker category		
Heavy drinker	Seattle 0.062	LaCrosse 0.000
Binge Drinker	LaCrosse 0.56	Yakima 0.33
Heavy binge drinker	Wilkes-Barre 0.35	La Crosse 0.14
Other drinker	Hickory 0.40	Wilkes-Barre 0.11
No. of drinking and driving episodes	Yakima 1.45	LaCrosse 0.86
Arrests, citations, and chargeable accidents		
DUI arrest	Hickory 0.059	Philadelphia 0.016
Speeding >15 mph citation	Hickory 0.31	LaCrosse 0.088
Chargeable accident	Hickory 0.099	Milwaukee 0.011

* All differences between highest and lowest mean values are statistically significant at the 5 percent level or higher.

Except for number of drinking and driving episodes, all estimates are fractions of binary variables.

Table 3**Multinomial Logit Analysis of Drinking Types**

Variables	All (1)	Heavy Drinkers (2)	Binge Drinkers (3)	Heavy Binge Drinkers (4)
Social Drinker				
Social drinker (0–1)	0.69 (0.46)	2.51 (1.36–4.64)	2.16 (1.60–2.92)	3.29 (2.21–4.89)
Short-Term Orientation				
Patient (0–1)	0.21 (0.41)	0.77 (0.39–1.54)	0.79 (0.56–1.11)	1.01 (0.67–1.52)
Financial planning horizon (0.5–20 years)	6.04 (6.98)	1.01 (0.97–1.05)	1.00 (0.98–1.02)	1.00 (0.98–1.03)
Plans ahead (0–1)	0.65 (0.36)	1.81 (0.79–4.12)	1.24 (0.83–1.86)	1.33 (0.82–2.17)
Impulsivity (12–60)	29.37 (6.34)	1.03 (0.98–1.08)	1.03 (1.00–1.05)	1.03 (1.00–1.06)
Optimism Bias				
Optimism (0–1)	0.34 (0.21)	0.52 (0.13–2.12)	1.77 (0.89–3.49)	1.91 (0.86–4.27)
Alcohol and Other Substance Use and Alcohol Addiction				
Hard drug user (0–1)	0.16 (0.36)	2.28 (0.75–6.90)	1.86 (1.07–3.21)	2.93 (1.63–5.27)
Marijuana user (0–1)	0.24 (0.43)	1.21 (0.52–2.82)	1.34 (0.89–2.00)	1.86 (1.20–2.90)
Current smoker (0–1)	0.19 (0.39)	0.52 (0.17–1.66)	1.21 (0.78–1.88)	1.16 (0.70–1.91)
CAGE (0–4)	1.24 (1.24)	1.22 (0.85–1.75)	0.85 (0.71–1.03)	1.09 (0.88–1.34)
Alcohol dependence (0–4)	2.40 (1.27)	1.20 (0.87–1.66)	1.90 (1.60–2.25)	1.94 (1.58–2.38)
Alcohol abuse (0–4)	0.81 (1.06)	0.68 (0.43–1.08)	1.05 (0.86–1.28)	0.96 (0.77–1.20)
Drink < 3 p.m. (0–1)	0.36 (0.48)	1.81 (0.92–3.54)	2.98 (2.09–4.27)	3.83 (2.57–5.70)
Drink > 1x/day (0–1)	0.29 (0.45)	1.43 (0.75–2.69)	0.89 (0.61–1.28)	1.49 (1.00–2.23)
Age started drinking	21.68 (7.31)	1.04 (1.01–1.07)	1.02 (1.00–1.04)	1.03 (1.01–1.06)
Health				
Fair/poor health (0–1)	0.090 (0.29)	1.78 (0.63–5.00)	0.97 (0.55–1.71)	1.29 (0.68–2.44)
Depression (0–9)	2.41 (2.59)	0.90 (0.78–1.03)	0.88 (0.83–0.94)	0.83 (0.77–0.90)
Demographic Characteristics				
Age	42.63 (12.55)	1.04 (1.01–1.07)	0.94 (0.93–0.96)	0.96 (0.94–0.98)
Female (0–1)	0.52 (0.50)	1.03 (0.57–1.86)	1.11 (0.82–1.51)	0.60 (0.42–0.86)
Educational attainment (years)	15.48 (2.00)	1.10 (0.93–1.30)	0.88 (0.81–0.95)	0.85 (0.78–0.94)
Black (0–1)	0.11 (0.32)	1.10 (0.45–2.69)	0.74 (0.47–1.15)	0.67 (0.39–1.17)
Other race (0–1)	0.039 (0.20)	0.48 (0.10–2.37)	0.77 (0.38–1.54)	0.54 (0.22–1.32)
Hispanic (0–1)	0.028 (0.17)	2.07 (0.39–11.00)	1.30 (0.53–3.18)	0.97 (0.33–2.86)
Married (0–1)	0.46 (0.50)	0.92 (0.50–1.70)	1.02 (0.74–1.41)	0.58 (0.40–0.85)
Student (0–1)	0.045 (0.21)	3.71 (0.67–20.69)	1.04 (0.43–2.54)	1.07 (0.39–2.93)
Unemployed (0–1)	0.10 (0.31)	1.17 (0.41–3.33)	0.69 (0.41–1.16)	0.76 (0.42–1.37)
Out of labor force (0–1)	0.082 (0.27)	2.56 (1.20–5.47)	0.69 (0.38–1.24)	1.22 (0.61–2.43)
Income				
Household income (hundred thousands \$)	0.77 (0.64)	0.85 (0.52–1.38)	0.93 (0.71–1.21)	0.90 (0.65–1.25)
N	1629	72	660	386

of observations for Other Drinker category: 511

Bold-faced values are significant at the 5% level or higher.

Covariates for missing values not shown

Table 4

Ordered Logit Analysis of Self-Reported Drinking and Driving Episodes in Past Year

Variables	Limited Specification (1)	Limited Specification w/o Drinker Categories (2)	Full Specification (3)
Social Drinker			
Social drinker (0–1)		2.24 (1.74–2.88)	1.91 (1.47–2.48)
Short-Term Orientation			
Patient (0–1)		0.86 (0.66–1.13)	0.87 (0.66–1.15)
Financial planning horizon (0.5–20 years)		1.01 (0.99–1.03)	1.01 (1.00–1.03)
Plans ahead (0–1)		1.04 (0.77–1.39)	0.99 (0.74–1.33)
Impulsivity (12–60)		1.03 (1.01–1.05)	1.03 (1.01–1.05)
Optimism Bias			
Optimism (0–1)		2.05 (1.24–3.36)	1.72 (1.04–2.85)
Alcohol and Other Substance Use and Alcohol Addiction			
Heavy (0–1)	2.26 (1.29–3.96)		1.52 (0.84–2.77)
Binge (0–1)	5.75 (4.34–7.62)		3.25 (2.37–4.48)
Heavy binge (0–1)	15.20 (11.12–20.77)		5.36 (3.74–7.68)
Hard drug user (0–1)		2.07 (1.54–2.78)	1.89 (1.41–2.54)
Marijuana user (0–1)		2.02 (1.56–2.61)	1.90 (1.47–2.46)
Current smoker (0–1)		1.14 (0.85–1.52)	1.14 (0.85–1.53)
CAGE (0–4)		1.01 (0.89–1.14)	1.02 (0.90–1.16)
Alcohol dependence (0–4)		1.37 (1.21–1.55)	1.22 (1.07–1.39)
Alcohol abuse (0–4)		0.92 (0.81–1.04)	0.93 (0.82–1.05)
Drink < 3 p.m. (0–1)		1.94 (1.55–2.44)	1.62 (1.28–2.04)
Drink > 1x/day (0–1)		1.38 (1.09–1.74)	1.36 (1.07–1.72)
Age started drinking		1.01 (0.99–1.02)	1.00 (0.98–1.02)
Health			
Fair/poor health (0–1)		0.92 (0.62–1.36)	0.90 (0.60–1.34)
Depression (0–9)		0.99 (0.95–1.04)	1.02 (0.97–1.07)
Demographic Characteristics			
Age		1.00 (0.99–1.01)	1.01 (1.00–1.02)
Female (0–1)		0.67 (0.53–0.83)	0.69 (0.55–0.87)
Educational attainment (years)		0.93 (0.87–0.98)	0.95 (0.90–1.01)
Black (0–1)		1.06 (0.75–1.49)	1.10 (0.78–1.56)
Other race (0–1)		0.32 (0.17–0.63)	0.34 (0.17–0.66)
Hispanic (0–1)		0.91 (0.50–1.65)	0.93 (0.51–1.71)
Married (0–1)		0.70 (0.55–0.89)	0.73 (0.57–0.93)
Student (0–1)		0.68 (0.41–1.14)	0.72 (0.43–1.20)
Unemployed (0–1)		0.74 (0.51–1.06)	0.72 (0.50–1.05)
Out of labor force (0–1)		0.86 (0.56–1.34)	0.93 (0.59–1.46)
Income			

Variables	Limited Specification (1)	Limited Specification w/o Drinker Categories (2)	Full Specification (3)
Household income (hundred thousands \$)		1.02 (0.83–1.24)	1.03 (0.84–1.26)
N	1629	1629	1629

Bold-faced values are significant at at the 5% level or higher.

Covariates for missing values not shown

Table 5
Logit Analysis of 1 + Self-Reported DUI Arrest, Speeding Citation, or Chargeable Accident

Variables	DUI w/Drinker Categories (1)	DUI w/Drinking and Driving (2)	Speeding w/Drinking and Driving (3)	Chargeable Accident w/ Drinking and Driving (4)
<u>Drinking and Driving Behavior</u>				
Number of drunk driving episodes		1.29 (1.02–1.64)	1.04 (0.93–1.16)	1.25 (1.02–1.54)
<u>Social Drinker</u>				
Social drinker (0–1)	1.51 (0.64–3.57)	1.35 (0.58–3.18)	0.93 (0.65–1.32)	0.97 (0.50–1.88)
<u>Short-Term Orientation</u>				
Patient (0–1)	0.45 (0.12–1.74)	0.44 (0.11–1.69)	1.20 (0.83–1.75)	0.78 (0.35–1.73)
Financial planning horizon (0.5–20 years)	0.96 (0.90–1.02)	0.96 (0.90–1.02)	1.00 (0.98–1.02)	0.96 (0.91–1.01)
Plans ahead (0–1)	1.90 (0.69–5.24)	1.90 (0.70–5.16)	1.13 (0.75–1.73)	1.55 (0.71–3.40)
Impulsivity (12–60)	0.94 (0.89–1.00)	0.94 (0.88–1.00)	1.03 (1.00–1.06)	1.02 (0.97–1.07)
<u>Optimism Bias</u>				
Optimism (0–1)	0.71 (0.17–2.96)	0.63 (0.15–2.64)	0.51 (0.26–1.03)	1.00 (0.29–3.47)
<u>Alcohol and Other Substance Use and Alcohol Addiction</u>				
Heavy (0–1)	6.44 (0.84–49.19)			
Binge (0–1)	2.90 (0.73–11.47)			
Heavy binge (0–1)	2.44 (0.58–10.28)			
Hard drug user (0–1)	1.90 (0.89–4.07)	1.71 (0.79–3.69)	0.76 (0.49–1.19)	1.98 (0.99–3.97)
Marijuana user (0–1)	1.77 (0.82–3.79)	1.71 (0.80–3.66)	1.41 (0.97–2.04)	0.91 (0.46–1.78)
Current smoker (0–1)	1.70 (0.80–3.60)	1.57 (0.74–3.34)	0.97 (0.63–1.47)	1.52 (0.76–3.04)
CAGE (0–4)	1.01 (0.70–1.46)	1.01 (0.70–1.46)	1.06 (0.89–1.26)	1.03 (0.74–1.42)
Alcohol dependence (0–4)	0.74 (0.48–1.15)	0.79 (0.50–1.23)	1.02 (0.86–1.21)	1.20 (0.84–1.69)
Alcohol abuse (0–4)	2.67 (1.83–3.89)	2.67 (1.84–3.86)	0.87 (0.72–1.04)	1.01 (0.73–1.39)
Drink < 3 p.m. (0–1)	1.01 (0.46–2.22)	0.90 (0.40–2.02)	1.32 (0.94–1.85)	1.11 (0.58–2.11)
Drink > 1x/day (0–1)	0.83 (0.39–1.79)	0.81 (0.37–1.74)	0.96 (0.67–1.35)	1.02 (0.53–1.98)
Age started drinking (7–65)	1.08 (1.02–1.14)	1.08 (1.03–1.15)	1.00 (0.97–1.02)	0.97 (0.92–1.02)
<u>Health</u>				
Fair/poor health (0–1)	1.16 (0.42–3.17)	1.17 (0.43–3.21)	1.27 (0.75–2.16)	2.57 (1.16–5.70)
Depression (0–9)	0.94 (0.81–1.08)	0.92 (0.80–1.06)	1.08 (1.01–1.15)	0.95 (0.84–1.07)

Variables	DUI w/Drinker Categories (1)	DUI w/Drinking and Driving (2)	Speeding w/Drinking and Driving (3)	Chargeable Accident w/ Drinking and Driving (4)
Demographic Characteristics				
Age	0.96 (0.93–0.99)	0.96 (0.93–0.99)	0.97 (0.95–0.98)	1.00 (0.98–1.03)
Female (0–1)	0.50 (0.25–1.03)	0.52 (0.25–1.06)	0.81 (0.59–1.11)	1.46 (0.79–2.68)
Educational attainment (years)	0.84 (0.69–1.02)	0.83 (0.68–1.01)	1.05 (0.96–1.14)	1.07 (0.91–1.26)
Black (0–1)	3.42 (1.46–8.00)	3.59 (1.54–8.42)	1.40 (0.90–2.18)	0.84 (0.35–2.01)
Other race (0–1)	2.67 (0.63–11.22)	3.14 (0.73–13.52)	0.53 (0.20–1.38)	0.74 (0.16–3.42)
Hispanic (0–1)	0.98 (0.11–8.87)	0.96 (0.10–9.09)	1.54 (0.73–3.27)	– (–)
Married (0–1)	0.21 (0.070–0.65)	0.24 (0.081–0.74)	0.86 (0.61–1.22)	0.74 (0.37–1.44)
Student (0–1)	0.66 (0.16–2.65)	0.75 (0.18–3.09)	0.94 (0.50–1.80)	1.56 (0.54–4.53)
Unemployed (0–1)	3.30 (1.37–7.96)	3.44 (1.43–8.24)	0.60 (0.34–1.06)	0.78 (0.31–1.94)
Out of labor force (0–1)	4.52 (0.78–26.27)	4.51 (0.81–24.97)	0.98 (0.50–1.93)	1.42 (0.49–4.13)
Income				
Household income (hundred thousands \$)	1.47 (0.65–3.34)	1.48 (0.63–3.49)	1.16 (0.89–1.51)	0.99 (0.55–1.79)
N	1623	1623	1623	1577

Bold-faced values are significant at the 5% level or higher.

Covariates for missing values not shown