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Do Preferences of Drinker-Drivers Differ?

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Abstract

Why people engage in illegal activities is not well understood. Using data collected for this research from eight cities in four states, this study investigates alternative explanations as to why people drive while intoxicated (DWI). We find that preferences and subjective beliefs about arrest/incarceration of persons who drink and drive do differ systematically from others in terms of benefits and costs of drink and driving, and in their risk tolerance. While most findings imply that DWI is a deliberate choice, we do find that drinker drivers tend to be more impulsive and lack self-control in their drinking.

Keywords

Driving while intoxicated; preferences; drinker drivers; rational choice; decision-making

1. Introduction

Injury from motor vehicle accidents is the leading cause of death in the U.S. among persons aged 1 to 34 (Quinlan et al., 2005). In 2005, nearly 40,000 persons in the U.S. died from motor vehicle crashes and a far greater number were injured (National Center for Statistical Analysis, 2007). Of fatal car crashes, 39 percent were alcohol related; of the fatal crashes occurring between midnight and 3 a.m., alcohol was involved in 75 percent (US Department of Transportation, 2005). The cost of such deaths and injuries is substantial (Levitt and Porter, 2001). Given substantial negative externalities from reckless driving, both Federal and state governments have enacted and enforced laws: (1) to reduce heavy alcohol use, e.g., by imposing excise taxes on beer, wine, and liquor, bans on underage drinking, and limiting entry of alcohol sellers; and (2) have promoted safe driving by enforcing laws against driving while intoxicated (DWI) and enacting laws specifying minimum criminal penalties for DWI, including fines, jail terms, and use of devices designed to detect use of alcohol by DWI offenders (SCRAM devices) and use of a motor vehicle when the driver is intoxicated.

There have been numerous evaluations of the effects of these laws on roadway safety (e.g., Sloan et al., 1995; Ruhm 1996; Chang et al., 2012; Nelson et al., 2013; and Silver et al., 2013). These evaluations have generally assessed changes in drinking and driving behaviors

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and motor vehicle deaths resulting from enactment of statutory changes designed to deter DWI. While these studies have been useful, the underlying mechanisms linking imposition of specific public policies designed to raise the cost of heavy drinking and DWI to decisions individual consumers make about alcohol use in general and DWI in particular is lacking.

In the traditional economic framework, people decide to engage in risky and illegal acts when the anticipated gain exceeds or equals the expected loss.[1] The net expected gain differs among individuals because of differences in subjective beliefs about the probability of success or failure and in the utilities attached to each outcome. Driving while intoxicated is unlikely to yield utility in its own right. Rather people differ in the value they attach to alcohol and illicit drugs for various reasons, e.g., for enjoyment, to relax, as a social lubricant, the cost of precautions undertaken to avoid DWI, and in their valuations of adverse negative outcomes from engaging in the activity. As with many other illegal activities, losses from DWI are pecuniary and non-pecuniary, the latter including the cost of pain and suffering to self and others persons injured and disutility from being incarcerated.

While rational choice remains the dominant assumption in economic analysis, hence our use of the term “traditional,” this assumption has been questioned in general and specifically in the context of law-breaking in the behavioral economics literature (e.g., Jolls et al., 1998). In these non-traditional economic frameworks, which most frequently amend rather than replace traditional frameworks, scholars prefer to specify bounds on individuals’ capacity to make decisions due to cognitive limitations (e.g., Simon, 1955) and on willpower to fully carry out intentions reflecting lack of self control (e.g., Elster, 1979; O’Donoghue and Rabin, 2003) These latter types of studies have emphasized the importance of impatience, including hyperbolic discounting (Angeletos et al., 2001; Laibson, 1997) and visceral influences rather than pure logical reasoning in decision-making (Loewenstein, 1996). The applicability of the non-traditional frameworks is likely to be context-specific. For example, they may be more appropriate for analysis of behaviors related to alcohol consumption (e.g., Bernheim and Rangel, 2004) than for decisions about educational or occupational choices, which are more likely to reflect an explicit weighing of pecuniary and non-pecuniary returns from investment versus cost (see e.g., Keane and Wolpin, 1997).

Answers to questions about which framework best fits the data have important implications for public policy. Various penalties, including the deterrence rationale for incarceration and fines for DWI, implicitly assume that people make calculations based on benefits and costs to themselves, risk and time preferences, as they do in making decisions about licit activities, including consumption of legal addictive goods (Becker, 1968; Becker and Murphy, 1988). Similarly, excise taxes may be imposed to reduce negative externalities of alcohol consumption (Manning et al., 1989; Cook et al. 2011), which presumes deliberate calculations by individual consumers in response to increases in excise taxes as well as a revenue-raising motive.

[1]One can use different terms to describe these frameworks. In a recent review of the economics of health behavior, Cawley and Ruhm (2012) use the terms “traditional” for the standard neoclassical framework commonly used in economics and “non-traditional” for frameworks employed in the behavioral economics literature. We use Cawley and Ruhm’s terms in this study. Other classification systems have been used. For example, Nochajski and Stasiewicz (2006) call our traditional approach “criminal justice models.” They also describe “addiction models,” which incorporate psychological concepts including addiction.

Policies such as restricting the availability of alcoholic beverages or incapacitation strategies designed to achieve deterrence and incapacitation, such as driver's license revocation, incarceration, and devices that keep the vehicle from starting if a certain blood alcohol content level is detected--ignition interlock (Nochajski and Stasiewicz, 2006) and Secure Continuous Remote Alcohol Monitoring (SCRAM) alcohol sensors designed to alert the court when the individual convicted of DWI has consumed high amounts of alcohol (Barnett et al., 2014), may be viewed as self-control devices. These self-control policies intend to prevent actions when individuals are impulsive and fail to consider negative longer-term consequences of present actions because of how present benefits and future costs of current actions are discounted (Gruber and Köszegi, 2001).

Policy strategies involving alcohol and drug treatment, including specialized drug and DWI courts, are based on the presumption that consumption stems from an underlying disease; and by treating the disease, negative internalities and externalities may be reduced. An unsettled issue is whether treatment focusing on addiction can reduce rates of DWI or whether preferences of persons engaging in drinking and driving behaviors generally differ, irrespective of addiction levels. If the latter, an emphasis on treating addiction as a disease will not accomplish much in terms of reducing incidence of DWI.

The study draws from both frameworks to explain variation in the number of episodes of drinking and driving in which people engage. Using data collected for this research, this study makes four contributions to the literature on criminal behavior in general and on health behavior in particular. First, rather than focus on a single factor such as time preference, we assess a wide range of possible alternative explanations of why people drink and drive. Second, we explicitly account for differences in individual preferences rather than relegate these differences to "unobserved heterogeneity." Our survey reveals information on individual preferences and other attributes that in other study would be part of unobserved heterogeneity. Third, we measure subjective beliefs about the probability of being apprehended and jail penalties conditional on a conviction for DWI (and other aspects of state DWI laws) and distinguish these subjective beliefs and knowledge of the law from the values individuals place on the negative consequences of the decision to drink and drive. Fourth, although this study does not evaluate specific public policies, it provides information about the direction public policies should take. For example, since we find that drinker-drivers are more, not less, knowledgeable about DWI laws in their states, provision of information about such laws is unlikely to reduce drinking and driving. Conversely, consistent with the traditional framework, subjective beliefs about incarceration length are negatively related to the probability of future drinking and driving.

We find that preferences of persons who drink and drive do differ systematically from others'. But other results, in particular, that drinker-drivers tend to be more impulsive in domains other than drinking-driving and experience difficulty in limiting alcohol consumption, which leads to increased frequency of drinking and driving, imply that the traditional framework fits the context of drinking and driving decisions only imperfectly. Effective policymaking in this context should be based on concepts not traditionally used in economic analysis of choice.

In Section 2, we present conceptual economic frameworks for traditional and non-traditional decision-making in the context of drinking and driving. Section 3 describes our data and Section 4 our empirical specification. Section 5 presents our empirical results. Section 6 discusses implications of our findings and conclusions of our study.

2. Theory of Precaution-Taking

2.1.1. Traditional Model

A risk-neutral individual engages in an activity that yields utility and in precaution-taking to avoid negative outcomes associated with the activity.[2] Let z be the level of the activity, in this context, quantity of alcohol consumed on an occasion.[3] Let b(z) be the benefit the person (driver) obtains from z. Let e (for effort) be the units of precaution—for example, obtaining a sober (or more sober) driver to drive the person home at a price per unit s, and h is the person's internal cost of an accident and/or being arrested for DWI. Included in "injury cost" are pecuniary and non-pecuniary legal, health, and health care costs associated with an accident/arrest,[4] including the cost of defending a civil lawsuit by an injured party, costs of loss of work time and criminal penalties--being incarcerated, fines, and other costs following arrest, including non-pecuniary cost such as embarrassment to family and friends. The probability (p) of paying a penalty for a DWI violation depends on effort e (higher e leads to a lower p) and z. Alcohol consumption per episode leads to a higher probability of paying a penalty. The price of z is r, that is, for a drink.

Then the sum of precaution cost and expected harm from drinking and driving is $C = rz + se + p(e,z)h$. The individual selects levels of z and e which maximize utility $U = b(z) - C$.

The first order conditions (FOCs) are:

$$\partial U/\partial z = \partial b/\partial z - r - (\partial p/\partial z)h = 0 \text{ and}$$

$$\partial U/\partial e = -s - (\partial p/\partial e)h = 0.[5]$$

From the FOC for z, the marginal utility of alcohol consumption is set equal to the alcoholic beverage price plus the change in the individual's expected loss from a unit change in consumption. Alcohol consumption increases when: the marginal utility of alcohol consumption increases; the price per drink decreases; injury or arrest cost decreases;; and the effect of alcohol consumption on the probability of paying a penalty of drinking and driving decreases.

Precaution levels are lower when the price of a unit of precaution, e.g., the price of a taxi, the implicit price of asking a friend for a ride home, is higher, while the marginal product of effort is lower. That is, the marginal effect on the probability of being apprehended for DWI

[2]See Shavell, (2007), especially pp. 144–48, which describes this type of model which applies in both a civil and criminal law context.
[3]Another activity is driving. One study reports that higher gasoline prices reduce the frequency of motor vehicle crashes, especially less severe crashes while alcohol consumption has a greater effect on frequency of more severe crashes (Chi, 2010).
[4]Among the stylized facts is the real excise tax on alcoholic beverages has been falling in the U.S. and that the probability of being arrested for DWI conditional on driving while intoxicated is very low, estimated at 0.001–0.002 conditional on driving while intoxicated (Bertelli and Richardson, 2008; Dowling et al., 2011).
[5]See (Sloan et al., 1995) for a discussion of the comparative statics of a similar model.

or being involved in an accident ($\partial p/\partial e$) is lower, and having a negative outcome, such as an accident, an arrest, is lower.

The utility function is defined for a single period,[6] but all injury costs are brought to present value with a discount rate reflecting the individual's rate of time preference. Since much of the unit cost of driving while intoxicated is incurred in later months or years, e.g., the cost of jail time following conviction on a DWI charge (months) or disability (years), and most of the benefit accrues immediately, an increase in the discount rate should increase alcohol consumption and decrease precaution levels.

The common intuition about the effect of relaxing risk neutrality to allow for risk aversion and risk loving is that risk averters should have lower activity levels and exercise more precaution and conversely for risk lovers. However, demonstrating this theoretically is complicated by (1) the existence of two choice variables, which allows for the possibility that e and z are substitutes, (2) the possibility that rather than self-insure against risk, the individual may purchase insurance, and undertake less precaution on account of moral hazard, and (3) risk preferences may be domain specific. That is, while risk aversion is traditionally modeled in terms of wealth changes, people may think differentially about risk in the financial and driving domains. Hence, how risk preferences affect driving under the influence is best left to empirical evidence.[7]

This framework allows for distinct but related decisions to be made about alcohol consumption and precautions the individual takes to avoid a DWI arrest and/or accident. The above analysis describes a private optimum. The social optimum reflects the cost of other drivers' taking increased precautions because some drivers fail to do so, costs of law enforcement and associated penalties, and other persons' injury costs.

A DWI violation reflects a combination of a high level of z and a low level of e. If little or no alcohol is consumed on the occasion, the marginal product of effort is zero. Similarly, if the individual consumes a large amount of alcohol, but orders a taxi, the marginal effect of the person's drinking level on the probability of being arrested and convicted of DWI is zero. Thus, if s is pushed so low, e.g., there is a subsidy for taxis at bars, that every drinker obtains a taxi or r is so high that no one consumes alcohol, no drinking and driving will occur. But assuming interior solutions for z and e, the individual should be less likely to drink and drive when r is high, s is low, the probability of an arrest given z and e is high, and h is high.

2.2. Non-Traditional Framework

People may lack the ability to compute expected utility accurately, especially when faced with highly complex problems (e.g., Simon, 1955; Akerlof, 1991; Rubenstein, 2003), because they lack knowledge of penalties conditional on being convicted and/or the ability to assess the probabilities of adverse consequences of drinking and driving. A person's skill

[6]Decisions about z and e occur almost simultaneously since the individual's blood alcohol content diminishes soon after alcohol consumption ceases. So it is appropriate to treat these decisions as joint and simultaneous.

[7]Conceptual analysis of risk preferences in the context of deterrence has focused on the relationship of risk preferences to the relative effectiveness of certainty versus severity of punishment (see e.g., Becker, 1968 and Friesen, 2012).

in solving expected utility problems may vary systematically with cognitive ability. Not mutually exclusive with the first reason, individuals may lack self-control, i.e., have difficulty executing choices made in a sober state (e.g., Thaler and Shefrin, 1981). This lack of self-control may reflect an addiction and hence that they are more likely to exhibit irrational behavior in failing to take effective actions to prevent behavior based on their own predictions as to how they will act in the future (Rachlin, 2007) and/or an emotional nature —"visceral factors" (Loewenstein, 2000), which interferes with executing prior plans. Lack of self-control may be reflected in hyperbolic discounting, which applied to drinking and driving is assessed in another study (Sloan et al., 2014). Another possibility is that preferences may be state dependent (Burghart et al., 2013). That is, preferences and hence choices may differ when one is intoxicated, a possibility we cannot evaluate with our data.

2.2.1. Lack of Knowledge—Individuals may lack information about penalties or probabilities of being apprehended for drinking and driving conditional on drinking levels. Although such information is available at a cost—the cost of search is often part of models based on traditional assumptions, the cost of learning about such probabilities may be high, especially considering the large number of types of criminal violations.

2.2.2. Low Cognitive Ability or Inability to Compute Probabilities—Persons may lack the ability to think about choice-based probabilities or compute expected values. Cognitive ability also affects the cost of obtaining information needed for rational decision-making (Rachlinski, 2006, 2011). Cognitive ability is correlated with educational attainment (see e.g., Cutler and Lleras-Muney, 2010). We control for educational attainment in some of our specifications.

2.2.3. Lack of Self Control—Persons may be able to make utility-maximizing choices but lack the ability to carry them out. Using the same data as in this study, Sloan et al. (2014) documented that drinker-drivers are more likely to be hyperbolic discounters in the financial domain (Sloan et al. 2014). Addiction to alcohol may adversely affect individuals' ability to exercise self-control in situations in which heavy drinking is likely to occur (Rachlin, 2007). Even if becoming addicted can be viewed as an informed long-run choice, conditional on becoming addicted, addiction can adversely affect self-control. Emotions may interfere with rational decision-making calculations (Loewenstein and Lerner, 2003).

2.3. State-Specific Preferences

Another possibility is that individual preferences depend on the amount of alcohol consumed on a given occasion. For example, people could become less risk averse while or after drinking. Or they could become time inconsistent when drunk while being time consistent when sober. These changes could lead to different choices than would have been made if the person had refrained from consuming alcohol. The distinction is that of the sophisticate in the context of time-inconsistent preferences who anticipates that he will lack self-control in the future and thus employs a self-control strategy in advance which will keep him from executing his plans and the naïf who does not anticipate lack of future self control and therefore succumbs to his time inconsistent preferences (O'Donaghue and Rabin, 1999). In the context of drinking and driving, the sophisticate would refuse an invitation to party in

which large quantities of beer will be served or arrange for ride home in advance of attending the party. By contrast, the naïf would not anticipate his impaired ability to make rational forward-looking decisions when intoxicated and therefore would be trapped in a situation in which sound decision-making was infeasible.

We did not attempt to elicit knowledge of the law, cognitive ability, preferences, and decision-making processes from persons when in an intoxicated state. For one, doing this would raise important ethical concerns. Our analysis is subject to the limitation that we elicited responses from persons when sober. We did not monitor decision-making during specific episodes when a drinking and driving decision was made. Thus, we could not observe intoxication-dependent changes in responses or track particular DWI episodes.

2.4. Empirical Strategy

Our empirical analysis includes covariates based on each framework. We estimate an equation for the number of drinking and driving episodes during the follow-up year based on the traditional and non-traditional frameworks separately and then combine covariates from the two frameworks.

3. Data

Battelle Memorial Institute conducted a three-wave survey of drinkers and drivers on our behalf in eight cities in four states during 2009–2012, the Survey of Alcohol and Driving (SAD). When possible the questionnaire design was guided by questions that have been included in prior surveys, albeit not all asked in the same survey. This study relies on data from all three waves conducted during 2010–12. The first wave, administered by telephone, included questions on: demographic characteristics/income; alcohol consumption/problems/dependence; health and health behaviors, including the number of DWI episodes in the past year; accident/traffic violation history; and altruism. The second wave, administered by computer a few weeks after the first wave, elicited information for which visual displays are helpful, e.g., for eliciting willingness to pay to avoid paralysis from a motor vehicle accident. The third wave, also administered by computer, was conducted about a year after the first wave. The explanatory variables come from the first two waves and the dependent variable, the number of drinking and driving episodes in the previous year, comes from the third wave. There is minimal overlap between the dates at which the first two waves were administered and the follow-up year over which drinking and driving episodes were measured. Survey instruments for the SAD can be found at (http://dialog.econ.duke.edu/dapstudy).

Since the study focus was on drinking and driving, eligibility for the SAD required respondents to have driven a car and consumed alcohol during the last month, be a resident of one of eight study cities, and be age 18 or older. Although all respondents said that they consume alcohol and they drive a motor vehicle, only a minority of respondents reported driving after having had too much to drink in the past year.

The mean age of the study participants is 43. The eight cities are: 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. These represent a broad geographic spread of large and small cities. While data from eight cities are not representative of the U.S., the four study states in which the cities are located varied in alcohol consumption, DWI arrest rates, criminal laws pertaining to DWI, and demographic composition.[8] Mean educational attainment is 15.6 years, implying that on average, respondents nearly had a college degree. Mean household income is $77,800. Over half of the sample is female (54.6%); 11.1 percent are black, and 46.4 percent are married. The participant recruitment process was designed to oversample persons who consumed large amounts of alcohol in order to study DWI decision-making and behaviors of such individuals in detail. Nevertheless, 64 percent of respondents reported no drinking and driving episodes in the year prior to the Wave 3 interview.

4. Empirical Specification

4.1. The Dependent Variable: Number of Episodes of Driving While Intoxicated in a Year

Wave 3 asked about the number of times during the previous year the person had driven after having had too much to drink. The dependent variable is the number of DWI episodes in the year immediately prior to Wave 3. The SAD elicited DWI episodes in categories, 0, 1, 2, 3, 4, and 5+. This is a self-assessed measure of alcohol intoxication and may not coincide with the states' statutory standards for DWI.

Since the dependent variable is a set of ordered categories for number of drinking and driving episodes in a year, we estimate the equation for the number of episodes with ordered logit analysis. We present odds ratios from this analysis with associated 95% confidence intervals. Alternatively, we estimate drinking and driving episode equations with ordinary least squares (OLS) setting the number of episodes for the 5+ category at 7. OLS results are not shown. Results are generally quite similar; a few parameter estimates that are statistically significant with logit are not significant with OLS. Data for the explanatory variables were collected at the start of the year for which the dependent variable is observed.

3.2. Explanatory Variables: Traditional Framework

3.2.1. Marginal Utility of a Drink—One reason that people may drink and drive is that they obtain more utility from a drinking episode than others. The SAD asked respondents about several potential alcohol consumption benefits. They were asked to rate each benefit on a scale from 0 to 10 with 0 being "not at all important" and 10 being "extremely

[8]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 percent (WA) to 0.67 percent (WI) in 2009 (our calculation from arrest data we obtained from each state). The four large cities—Seattle, Philadelphia, Raleigh, and Milwaukee—have populations 380,000–1.4 million. The smaller cities—Yakima, Hickory, Wilkes-Barre, and La Crosse—have populations 37,000–82,800. The racial makeup of each city varies, e.g., Philadelphia and Milwaukee with large African-American populations, 43 and 37 percent, respectively, Yakima with a large Hispanic population, 34 percent. Further, auto insurance varies greatly among the cities. In an article entitled "Why is Automobile Insurance in Philadelphia So Damn Expensive?" Smith and Wright (1992) found that automobile liability insurance premiums in Philadelphia were about twice as high as they were in Seattle. Seattle's were about 50 percent higher than those in Milwaukee. Raleigh/Durham did not make the list. The authors attributed high premiums in some cities, at least in part, to large numbers of uninsured motorists in some markets. Ratios of uninsured motorist to bodily injury claims varied from 0.38 in Philadelphia, 0.14 in Milwaukee, to 0.089 for Seattle. Wisconsin is a particularly interesting state for this study as it is one of only three states that did not have compulsory auto insurance laws (at the time of the survey). Another statutory difference among the four study states is that North Carolina, Pennsylvania, and Wisconsin, but not Washington, have a key statute in DWI control—allowing sobriety checkpoints.

important." We construct an index of drinking utility by summing the scores for each of the items; the index has a possible range from 0 to 60 with a mean value of 24.8 (std. dev.= 11.5). The SAD also asked "How important is it for your social life to be able to enjoy a few drinks with your friends?" Response options were: 1. not at important; 2. slightly important; 3. quite important; or 4. very important. We define a binary variable set to 1 if the person said that enjoying a few drinks was quite or very important and is 0 otherwise.

3.2.2. Drinking and Driving Cost—We measure five costs of drinking and driving to the individual: (1) the individual's subjective probability of being pulled over after having too much to drink; (2) the person's subjective belief about the number of days the person would spend in jail following an arrest or conviction for DWI;[9] (3) the internal cost to the individual of being arrested for DWI; (4) the non-pecuniary loss (other than out-of-pocket medical cost) to the individual of being paralyzed from a motor vehicle accident; and (5) the non-pecuniary cost to the individual of harming strangers, which reflects the person's altruistic tendencies. Persons facing a higher cost of being arrested, being paralyzed, and who internalize costs imposed on strangers to a greater extent are hypothesized to be less likely to drink and drive.

Subjective beliefs about the legal consequences of drinking and driving should affect the probability that individuals engage in this activity. There is empirical evidence that a higher perceived probability of arrest reduces criminal participation (Lochner, 1997). The SAD elicited subjective beliefs about various legal consequences including the probability of "being pulled over when you have had too much to drink." and jail time conditional on being convicted of DWI in days. We include explanatory variables for subjective beliefs about being stopped and jail time for a DWI conviction in days based on these responses. Analysis of the accuracy of subjective beliefs about penalties of DWI revealed that SAD respondents tended to be reasonably accurate on average (Sloan et al., 2013).

Not only are the probabilities of being pulled over, convicted, and incarcerated potentially important deterrents, but various other pecuniary and non-pecuniary costs associated with being pulled over, arrested, and penalized for DWI may deter such behavior. An arrest for DWI may have several adverse consequences for the arrestee in addition to the pain and suffering of the arrest per se (e.g., spending the night in a small space, boredom, aggravations of dealing with other prisoners). Being arrested may cause reputation loss, problems with an employer, and conflict with family members. If convicted, the person may face a fine, jail time, driver license suspension, and/or surcharges on motor vehicle insurance premiums, (Sloan and Githens, 1994). The internal cost of arrest depends on the probability of each of these adverse outcomes, the amount of the penalties in the case of penalties, and the person's marginal valuation of these penalties. The marginal valuation of a fine may, as a first approximation, reflect the marginal utility of wealth. However, the probability of an adverse consequence such as the probability of problems with an employer or other family members, plausibly depends on employment status and family structure.

[9]Spending a night in jail following arrest but prior to a conviction is common for DWI arrests.

Data from the SAD do not allow us to assess specific consequences of an arrest other than respondents' subjective beliefs about penalty levels, but the SAD did ask a general question about the cost to the respondent of being arrested for DWI. In response to a question about the effect of being arrested for DWI, the SAD provided these response categories: 1. almost ruin my life; 2. hurt me badly; 3. hurt me quite a bit; and 4. It would be no great problem. We define a binary variable set to 1 if the person responded that being arrested for DWI would almost ruin the person's life.

Persons who place a lower value on avoiding injury and/or disability should be more prone to take risks that increase the probability of personal injury, including driving while intoxicated. We focus on the role of differences in willingness to pay to avoid an injury that leads to paralysis as an explanation of why some people drive under the influence, and others do not.

The SAD included a set of questions designed to value the non-pecuniary loss from a motor vehicle accident that results in permanent paralysis. The question design sought to avoid common pitfalls in contingent valuation research and was based on questions one of us has used in previous surveys of willingness to avoid multiple sclerosis, a disability, and smoking-related diseases (Khwaja et al., 2009; Perreira and Sloan, 2002; Sloan et al., 1998).

Respondents were asked to compare two areas: Area A which has the same monthly cost of living as the place where the respondent currently lives and is assumed to have a 0.01 probability of a person getting into a motor vehicle accident per year that results in the person becoming paralyzed. Area B has a $X per month higher cost of living per year and a 0.008 probability of being involved in a motor vehicle accident resulting in the person being paralyzed. The starting values of $X were randomly assigned. Based on several rounds of questions, the SAD provided information sufficient to compute a value for the person's willingness to pay to avoid a 0.002 probability of being paralyzed from a motor vehicle accident.

The primary rationale for DWI laws is to reduce the negative health and financial externalities from driving while intoxicated. The purpose of imposing criminal sanctions (and other sanctions such as experience rating of motor vehicle insurance premiums) is to make individuals who are prone to drink and drive internalize the external cost of such behavior. In its most basic form, the traditional framework assumes purely self-interested decision makers. This framework is inconsistent with evidence from a large number of laboratory experiments, which indicates that people care about the wellbeing of others (DellaVigna, 2009). The traditional framework can easily be extended to incorporate the notion that many persons may be intrinsically motivated to drive cautiously because they care about the wellbeing of others. Others may drink and drive in part, because they care less about the welfare of others, particularly strangers from whom they can expect no reciprocity from being careful.[10]

[10]Our notion of altruism thus does not incorporate the motive of reciprocity. This cannot be expected in the context of driving. On this motive, see Fehr and Gächter (1998).

The SAD made nine statements relative to altruism toward non-family members, none of which reference alcohol consumption or DWI. Cet. par., we expect persons who are more altruistic toward non-family members, i.e., internalize the externalities involving harm to others without incentives to be less likely to drink and drive. The nine statements were: 1. I am hurt if what I do isn't recognized; 2. I help so I can live with myself; 3. I am resentful when I do things for others; 4. people think I am selfish; 5. people think I am cold; 6. I'm not known for generosity; 7. I try to be thoughtful; 8. I think of myself as charitable; and 9. I go out of my way to help others. Response options were: 1. agree; 2. neutral; and 3. disagree. The SAD phrased the statements so that some imply altruism while others imply selfishness. This was done to encourage respondents to read and consider each item. To construct an altruism index, we reverse code items phrased to imply altruism. Our index assigns a 3 for each item that implies the least selfish response to 0 for the most selfish response. The index varies from 13 to 27 with the latter value being least selfish (mean: 23.01; std. dev. 2.6).

3.2.3. Risk Preference and Time Preference—Benefits from drinking and driving while intoxicated are likely to accrue immediately, before much of the cost of this activity is realized, e.g., incarceration cost other than on the day of arrest, pain and suffering from paralysis which is likely to become apparent weeks or months after the injury occurs. Thus, persons with relatively high rates of time preference are more likely to drink and drive, cet. par. The empirical literature on time discounting reports a predominance of high implicit discount rates--,far exceeding market rates of interest (Frederick et al., 2002). These high rates may reflect the difficulty in accurately measuring rates of time preference.

Persons who are more risk tolerant may be more prone to drink and drive. There is no direct empirical support for this relationship for driving while intoxicated. The SAD used the same measure of risk tolerance as in the Health and Retirement Study (HRS). Using the HRS measure, Barsky et al. (1997) found that risk tolerance increases monotonically with the number of drinks consumed per day. Likewise, the authors reported that risk tolerant persons are more likely to smoke, lack insurance, and hold stock. Similar results to Barsky et al. on alcohol consumption and smoking have been reported for drug users (Blondel et al., 2007)

Following the HRS, the SAD posed a hypothetical set of questions to gauge the respondent's financial risk tolerance. The questions posed a gamble between a 50 percent probability of doubling a lifetime income if the person wins the gamble and a 50 percent probability, alternatively, of losing half, one third, or one tenth of lifetime family income. The SAD expanded on the HRS questions to provide a more detailed measure of risk tolerance. Based on the responses to the SAD questions on risk tolerance, we group respondents into three mutually exclusive categories: (1) least risk tolerant (omitted reference group)—respondents who rejected a gamble involving a 50/50 chance of doubling income or reducing income by 10 percent; (2) medium risk tolerant—accepted gamble when odds are doubling income and losing anywhere from 10 to 50 percent of income; (3) most risk tolerant—accepted gamble involving doubling income versus losing all income (risk neutral to risk lover) or accepted gamble involving loss of all income versus increasing income by 67 to 100 percent (risk lover).

We evaluate the role of time preference in decisions to drink and drive in two ways. We assess a person's financial planning horizon based on his or her response to the question, In planning your savings and spending, which of the following time periods is most important to you and your household? A proxy for time preference, responses indicate the timeframe an individual considers when planning their financial future, measured in years. Response choices were the next: few months; year; few years; 5–10 years; and longer than 10 years. We use values of 0.5, 1, 2.5, 7.5, and 10 for each of these response categories to construct an explanatory variable for financial planning horizon measured in years. Although not a direct measure of time preference, this type of question avoids the cognitive burden of complex questions used to elicit time preference.

Second, we construct a measure of high time preference from responses to four questions. Would you rather win $1,000 now or $1,500 a year from now? Would you rather win $20 now or $30 a year from now? Would you rather lose $1,000 now or $1,500 a year from now? Would you rather lose $20 now or $30 a year from now? The sequence of questions was designed to account for the "sign effect"—gains are discounted more than losses and the "magnitude effect," small outcomes are discounted more than large ones (Frederick et al., 2004). The binary variable is set equal to 1 if the person selected the present as opposed to the future alternative. We sum these values based on the four questions to construct a summary explanatory variable for short-term orientation.

Using the same discounting question as in the SAD, Khwaja et al. (2007) did not find that discount rates vary by smoking status—a result consistent with Fuchs (1982). Vuchinich and Simpson (1999) conducted two studies focusing on alcohol consumption. In contrast to Khwaja and coauthors and Fuchs, heavy social drinkers in the first study and problem drinkers in the second study were more present-oriented than were light social drinkers. There is some empirical evidence that discount rates rise when a person has an addiction and fall once the addiction has ended, which suggests that variation in discount rates can partially be explained by the neurochemical properties of addiction (McCabe et al., 2005).

Previous research indicates that time preference may domain specific, although findings on differences in financial and health discount rates are mixed (see e.g., Chapman, 2002). The SAD measured time preference in the health domain with the question, 20 extra days in perfect health this year would be just as good as _____ days in perfect health a year from now. We create two variables for the health discount rate. The first is for the number of healthy days a year from now that is equivalent to 20 healthy days now. A minority of respondents gave answers that imply an implausible negative discount rate. We recode every response of less than 20 days (11% of respondents) to 20. The second variable is a binary set to 1 if the person supplied a value of less than 20 days.

3.3. Explanatory Variables: Non-Traditional Framework

3.3.1. Lack of Knowledge—One reason that people might engage in illegal activites is ignorance of the law. The SAD asked five questions to determine the respondent's knowledge of the law in his or her state. The five questions were: (1) To the best of your knowledge, what percentage of alcohol in the blood is required before a person can be considered "legally drunk" in your state? Enter a percentage of 0.01 to 0.20. As with the

other questions, respondents could give answers of don't know or refuse to answer. (2) Can a person be convicted of drunk driving just for exceeding a certain blood alcohol limit or does the court require proof of impaired driving, such as weaving all over the road? Response options were: Exceeding a blood alcohol content is enough or, Must show impaired driving. (3) Suppose that a driver were convicted for driving with a fairly high blood alcohol level—say about 0.15%. According to the laws in your state, can this driver's license be suspended for a first offense conviction of drunk driving? Answers were yes or no. (4) What is the fine for a first DWI conviction in your state? The last question in this set was (5) Can this same driver be required to serve some time in jail for a first offense? An incorrect answer can be a wrong answer, a missing value, a refusal to answer, or a "don't know." To construct an index of ignorance of the law, we obtain correct answers from state statutes. If the person answered incorrectly, we set a binary variable for the response equal to 1. The index is the sum of incorrect responses, which ranges from 0 to 5.[11]

3.3.2. Low Cognitive Ability or Inability to Compute Probabilities—Persons may lack the ability to think about choice-based probabilities or compute expected values. Cognitive ability also affects the cost of obtaining information needed for evaluating consequences of choices.

The SAD asked three sets of questions about cognitive ability, all drawn from the HRS. To measure memory, SAD asked by telephone in Wave 1: How would you rate your memory at the present time? Would you say it is excellent, very good, good, fair, or poor? Questions on numeracy were: If the chance of getting a disease is 10%, how many people out of 1,000 would be expected to get the disease? If 5 people all have winning numbers in the lottery and the prize is two million dollars, how much will each of them get? Let's say you have $200 in your savings account. The account earns 10 percent interest per year. How much would you have in the account at the end of one year? Third, a set of cognitive questions were designed to measure cognitive status from questions to object naming (e.g., What do you call the kind of prickly plant that grows in the desert?) and current events (Who is the Governor of (your state) right now?), and a backwards subtraction test. Ranges of scores were 1–5 for memory, 0–3 for numeracy, and 0–13 for cognitive status.

3.3.3. Addiction—Addicted persons are likely to have less self-control over the consumption of the addictive good. We measure level of addiction to alcohol by the CAGE, which has been shown to be a reliable predictor of alcoholism (Dhalla and Kopec, 2007). This index is based on affirmative answers to four questions. In your life: did you more than once want to stop or cut down on your drinking? (C in CAGE); Have people annoyed you by criticizing your drinking?; (A) Have you ever felt bad or guilty about your drinking? (G); Have you had a drink first thing in the morning to steady your nerves or to get rid of a hangover? (eye-opener=E). The mean CAGE score is 1.18, which implies that many persons responded affirmatively to at least one CAGE question.

[11]We obtain the laws from various sources to judge whether or not respondents' answers are correct. Washington: Rev. Code Wash. (ARCW) § 46.61.5055; North Carolina: N.C. Gen. Stat. § 20–179; Pennsylvania: 75 Pa. C.S. § 3804; Wisconsin: Wis. Stat. § 346.65.

Drinker-drivers and consumers of large amounts of alcohol are more likely to have co-addictions, several of which could also lead to DWI (Dhalla and Kopec, 2007). To measure use of other substances, we include a covariate for being a hard drug user, defined as someone who used at least one of the following drugs in the past year: licit psychotropic drugs without a prescription; amphetamines or stimulants; barbiturates or sedatives; tranquilizers; psychedelics; cocaine; heroin; other narcotics; inhalants; or any other illicit drugs not specifically named.

3.3.4. Lack of Self-Control over own Alcohol Consumption—To measure self-control over alcohol consumption directly, the SAD asked about how easy it is to limit drinking. Responses were elicited on a scale from 1 to 5. The question was: If you have to drive home from some place where drinks are being served, do you find it: 1. very easy; 2. somewhat easy; 3. somewhat difficult; 4. very difficult; or 5. impossible to limit your drinking? Only one respondent chose “impossible;” this response was combined with the “very difficult” response. We construct an index for ease of limiting drinking with a response of 1 for very easy to 4 for very difficult. Individuals with a lesser ability to control their drinking face a higher cost of not drinking and driving, i.e., face a higher marginal cost of self-control in part because of greater cognitive resources needed to resist temptations to drink, (e.g., Fudenberg and Levine, 2012).

Some papers emphasize the importance of emotions in many types of decision-making contexts (Madden and Bickel, 2010). There is a vast psychological literature on impulsivity, some of which specifically relates discounting to the concept of time preference.

To measure impulsivity, the SAD incorporated impulsivity questions developed by Loewenstein et al. (2001). To conserve time, the SAD used a condensed version of the Loewenstein et al. scale; their survey instrument includes 22 questions. In the SAD, respondents were asked in the first interview to respond on a five-point scale to 12 statements designed to measure impulsivity. The scale ranged from strongly agree with the statement to strongly disagree. The statements to which respondents were to respond were: 1. I do things on impulse that I later regret; 2. I act on impulse; 3. I finish what I start; 4. I often do things on the spur of the moment; 5. I plan for the future; 6. I always consider the consequences before I take action; 7. I control my angry feelings; 8. There are so many little jobs that need to be done that I sometimes just ignore them all; 9. I fly off the handle; 10. I never seem to be able to get organized; 11. I rarely make hasty decisions; and 12. I am not a worrier. We reverse-coded items so that higher scores on each item implied greater impulsivity, sum the scores, and normalize so that the impulsivity index varies from 1 to 5. We drop “I am not a worrier” from our analysis since our factor analysis reveals little association with the other 11 items.

3.4. Other Explanatory Variables

We also include covariates for: demographic characteristics; educational attainment in years; household income; currently married; black race; other race, with white race omitted; age; number of children in the household under age 18; and household income in some specifications.[12] Including these covariates as controls may over-control for effects of

covariates of greater interest to this study. But excluding them may under-control for these other influences.

4. Results

4.1. Descriptive Findings

4.1.1. Traditional Framework—Drinker-drivers derive a higher marginal utility from a drink on average (Table 1). The mean values of the drinking benefit index are 29.0 for persons reporting 5+ drinking and driving episodes during the follow-up year, followed by 28.3 for persons with 1–4 episodes, and 22.4 for non-drinker-drivers. Similarly, drinker-drivers, especially persons in 5+ drinker-driver group, attach greater importance of drinking to their social lives than do non-drinker-drivers; 52 percent of 5+ episode drinker-drivers said that drinking is “quite important” or “very important” to social life, but only 17 percent of non-drinker-drivers did. The 1–4 drinker-driver group falls in between (35%). The drinking benefit index is significantly higher for drinker-drivers than for non-drinker-drivers, but there is no statistical difference between 1–4 and 5+ episode drinker-drivers. All differences in quite important to social life are statistically significant.

The subjective probability of being pulled over declines monotonically with the frequency of drinking and driving during the follow-up year, but only the difference in means between the 1–4 and 0 episode group are statistically significant at the one percent level (Table 2). Similarly, expected jail time falls monotonically as the number of drinking and driving episodes during the follow-up year increases, but the difference in mean jail days between the 1–4 and the 5+ group is very small.

As for internal cost, there are large differences in the costs of drinking and driving given an arrest, becoming disabled as a consequence of a motor vehicle accident, and harming a stranger in the even of an accident. Overall, the internal cost of being arrested for DWI (as measured by the response that “being arrested would almost ruin my life”) is higher among non-drinker-drivers, with 20 percent responding affirmatively; for drinker-drivers, 14 and 16 percent in the 1–4 and 5+ groups respond in this way. The only statistically significant difference is between non-drinker drivers and those who reporting 1–4 drinking and driving episodes during the follow-up year.

Drinker-drivers attach a lower value to avoiding paralysis from a motor vehicle crash. There are only minor differences in maximum willingness to pay (WTP) between the two drinker-driver groups. On average, respondents are willing to pay $36.88 per month to avoid a 0.002 probability of becoming paralyzed from a motor accident in a year. This implies a WTP of $221,280 to avoid permanent paralysis.

Non-drinker-drivers would incur a higher internal cost of harming other non-family members, but again there is no statistical difference in such internal cost between the two

[12]The SAD asked for educational attainment and household income in the past year in mutually-exclusive categories. To develop continuous variables for educational attainment, we translate descriptions of highest grade or year of school completed into years. For example, we assume that “less than a high school graduate” equals 11 years and “graduate education” equals 18 years. Income was asked in income categories. For income, we take the mid-point of each category. The open-ended category for income was $250,000+. We set income of persons in such households at $350,000.

drinker-driver groups. In particular, non-drinker-drivers perceive themselves as less selfish and more charitable.

Differences in time preference among the three groups are minor (Table 3). Drinker-drivers have somewhat shorter financial planning horizons on average: 4.5 years for non-drinker-drivers; 3.9 for 1–4 and 4.3 for 5+ episode drinker-drivers, but the only statistically significant difference is between the first two groups.

The results imply that persons in all groups have very high discount rates in the financial domain. The sums of affirmative responses to the discount rate questions, where a "yes" implies a discount rate of 0.5 or higher, rise monotonically from 1.75 for non-drinker drivers to 1.83 for 1–4 to 1.98 for 5+ episode drinker-drivers, but none of the differences in means are statistically significant.

Responses to the healthy day tradeoff question for which the payoff for waiting accrues to the respondent in a year also imply high discount rates. The implicit discount rate reflected by the sample mean response of 32.67 days exceeds 0.6. This rate is slightly overstated in that 10 percent of respondents gave negative discount rates, which are set to zero for the purpose of computing the number of healthy days in a year considered equivalent to 20 days now. There are no statistical differences between drinker-driver groups in the mean number of healthy days a year from now equivalent to 20 days now. However, non-drinker-drivers are more likely to give a response of less than 20 days a year from now than 1–4 episode drinker-drivers are.

Drinker-drivers tend to be more risk tolerant than non-drinker-drivers. Thirty-nine percent of non-drinker drivers are in the least risk tolerant group; by contrast, 28 and 31 percent of 1–4 and 5+ episode drinker-drivers are least risk tolerant. Most risk tolerant (risk neutral to risk loving) range from 4 percent for non-drinker-drivers to 5 percent of 1–4 to 6 percent of 5+ episode drinker-drivers. The lack of statistical differences among the groups between the 0 and 5+ group reflects lack of statistical power to detect differences in the minority of persons who are most risk tolerant.

4.1.2. Non-Traditional Framework—Drinker-drivers tend to be more, not less, knowledgeable of DWI laws (Table 4). On average, non-drinker-drivers answered slightly more than one of the five questions incorrectly (mean = 1.07). For 1–4 and 5+ episode drinker-drivers, the mean values are 0.98 and 0.75, respectively. The most often missed question was "what is the blood alcohol content level at which a driver is in violation of state law?" Although 31 percent of non-drinker-drivers answer this question incorrectly, only 14 percent of 5+ episode drinker-drivers do. Drinker-drivers tend to be more knowledgeable than others about the minimum blood alcohol content level for DWI, and there is a significant difference (5% level) in the accuracy of answers to this question between the two drinker-driver groups.

Persons reporting 1–4 drinking and driving episodes in the follow-up year are much more likely to report self-control problems in limiting alcohol consumption than are non-drinker-drivers (Table 5). The differences between 5+ episode drinker-drivers and non-drinker-

drivers are smaller. There is no statistical differences between 1–4 and 5+ drinker-drivers on self-control of drinking.

Impulsivity rises monotonically with the number of drinking and driving episodes in the follow-up year, and the vast majority of differences in mean values are statistically significant (Table 6). The largest t-values are for “I do things I later regret,” “I act on impulse,” and “I do not consider consequences.” Also, drinker-drivers are less likely to plan for the future.

4.2. Results: Determinants of the Number of Drunk Driving Episodes in the Follow-up Year

The main study goal is to determine the relative importance of risk factors for drinking and driving (Table 7). There are six specifications. Columns 1 and 2 show results for a specification based on the traditional framework; columns 3 and 4 show results based on the non-traditional framework. The final two columns show results with both specifications are combined. Results in odd numbered columns are for specifications excluding covariates for demographic and income controls. Those in the even-numbered columns include these controls. Overall, results are robust to inclusion of covariates for controls; however, statistical significance of odds ratios on main covariates of interest is sometimes affected. As anticipated, females, currently married, and older persons are much less likely to drink and drive. For example, women are less than half as likely to report having driven after having had too much to drink than men are.

In the specification including covariates based on the traditional framework, all odds ratios on covariates for the marginal utility of a drink exceed 1 and all odds ratios on drinking and driving cost have odds ratios are less than 1. Both sets of findings are consistent with expectations. Some odds ratios lose statistical significance (percent chance of being pulled over and willingness-to-pay) when covariates for demographic characteristics and household income are included (col. 2). However, the odds ratios are not sensitive to this change in specification.

A higher willingness-to-pay to avoid disability from a motor vehicle accident reduces the number of drinking and driving episodes. In the specification in which the odds ratio is statistically significant at conventional levels (col. 1), a $10 increase in willingness to pay per month to avoid a 0.002 probability per year of permanent paralysis from a motor vehicle accident, which translates into a lump sum payment of $60,000, would reduce the odds of engaging in drinking and driving by 0.05 on average. The corresponding effect in the specification with controls is almost the same, 0.04.

Persons who internalize the cost of harm to others are also less likely to have driven after having too much too drink in the follow-up year, as indicated by the results for the altruism index (higher index values imply greater altruism). The odds ratios on “arrest for drunk driving would almost ruin life” are not statistically significant in either specification, but they are substantially below 1.0.

By contrast, risk preference and time preference in the health domain have no statistical effect on the number of drinking and driving episodes. Persons who equate 20 healthy days

now to fewer than 20 days later are less likely to drink and drive. This result implies an implausible negative rate of time preference but these implausible responses only apply to 10 percent of the analysis sample, perhaps an indication that such persons were extremely cautious and, in some cases, did not understand the time preference concept.

In the specification that focuses on covariates associated with the non-traditional framework, consistent with results reported in Table 4 above, drinker-drivers tend to be *more*, not less, knowledgeable of the law. However, the result is only statistically significant when controls are excluded. Among the measures of cognitive ability, drinking and driving is only more frequent among persons with poorer self-reported memory. Perhaps we would have obtained more statistically significant findings if we had obtain a sample with proportionately less education persons or used tougher questions to gauge cognitive ability.

Addiction as measured by the CAGE index leads to more frequent drinking and driving episodes during follow-up only when the covariates demographic factors and income are excluded. Being a hard drug user consistently predicts drinking and driving episodes. Odds ratios on covariates for self-control uniformly imply that individuals with self-control problems were more likely to drink and drive.

Combining the two specifications, there are no important changes in findings for coefficients on covariates associated with the traditional framework. There are losses in statistical significance but the odds ratios tend to be insensitive to these changes in specification (compare cols. 5 and 6 with cols. 1 and 2). The only statistically significant odds ratio among the explanatory variables in the full specification for covariates from the non-traditional framework is the ratio for the impulsivity index (col. 5) when covariates for the controls are excluded.

5. Discussion

People drink and drive in part because they derive more benefit from alcohol consumption and such consumption is more important to their social lives.[13] Higher rates of alcohol consumption in turn lead to greater frequency of driving while intoxicated. Balanced against such benefit is the private cost of drinking and driving to the individual. Such cost takes the form of the intrinsic motivation not to harm others and to avoid the cost to oneself of injury as well as the cost of criminal sanctions. Some but not all of these determinants of drinking and driving frequency are amenable to intervention by policymakers. Increased excise taxes on alcoholic beverages reduce alcohol consumption, and restraints on availability, such as zoning laws and restrictions on sale of alcoholic beverages, decrease use. Policymakers can increase enforcement and penalties for DWI to raise the private cost of drinking and driving.

Specific public policies cannot be linked to other findings on the benefits and costs of drinking and driving. For example, there is interpersonal variation in the disutility of becoming disabled. One reason that some persons drink and drive is that value their health less, as measured in our study by the maximum willingness-to-pay to avoid an injury leading

[13]The SAD did not ask follow-up questions about social interactions, including peer effects. While potentially important, this line of questioning would have taken a lot of survey time, which budget and survey time constraints precluded.

to permanent paralysis. Another is that some people have internalized the cost of harm to others more than others have. A strength of our study is that both willingness-to-pay and altruism are measured by questions that do not refer to drinking and driving.

This study's results provide no empirical support for the roles of risk and time preference in the drinking and driving decision. However, such preferences are difficult to measure accurately at best, and our failure to find statistical relationships between drinking and driving and risk and time preference may reflect the quality of the questions our survey asked.

On the other hand, this study also provides some empirical support for the notion that drinking and driving is not based on an explicit ex ante calculation. In particular, persons who say that they have more difficulty in controlling their alcohol consumption are more much more likely to have reported more drinking and driving episodes during the follow-up year. The effect size is large, and the result is highly statistically significant. Here the distinction between sophisticates, individuals who can anticipate their future self-control problems and naïfs, who cannot or do not, is useful. Some respondents to our survey indicated that they have a self-control problem, but evidently did little or nothing about it in that they actually drank and drove during follow-up, i.e., exhibited behavior more analogous to that of naïfs. Our survey measured self-control of drinking *before* the dependent variable for number of drinking and driving episodes in the past year was measured.

Similar considerations apply to our results on impulsivity. A sophisticate could presumably employ a self-control device to assure that s/he does not alter his or her decision to drink in moderation on the spur of the moment. Unlike the question about control over drinking, the SAD's questions on impulsivity do not refer to alcohol consumption or to driving.

We reported results of our analysis of hyperbolic discounting—namely that hyperbolic discounting is more prevalent among drinker-drivers than among non-drinker drivers in another paper (Sloan et al., 2014). This finding reinforces findings from the present study that self-control is a problem for many drinker-drivers. By contrast, we do not find variation in effects of proxies for exponential discounting in this study.

This study does not provide direct empirical tests of the effectiveness of specific public policies to reduce drinking and driving. Rather the results suggest some policy directions. Because drinker-drivers are if anything more, not less, knowledgeable about DWI laws, general campaigns to inform the public of the laws regarding DWI are unlikely to be effective. However, our results are not sufficiently specific to indicate how learning about DWI laws takes place. Whether people learned from friends or from a careful reading about the laws cannot be determined from our data. Few respondents reported having been arrested on a DWI charge during the three years prior to the initial interview.

Based on the survey responses, we estimate that sample persons committed a total of 1,239 self-reported drinking and driving episodes in the year before the final interview. But there were only nine arrests and six convictions for DWI during the same time period. Thus, the probability of being arrested for DWI conditional on drinking and driving was 0.73 percent, far below the respondents' mean subjective probability of nearly 10 percent. Since subjective

probabilities of being pulled over for drunk driving far exceed their objective probability counterparts, increased enforcement may not reduce drunk driving, even though we found some empirical support in this study for the notion that higher subjective probabilities about being pulled over negatively affect the odds of drunk driving.

The fact that persons who had knowledge of their problems in controlling their own drinking drank and drive more frequently in the following year indicates that (1) persons can predict such self-control problems, but (2) cannot fully implement self-control devices on their own to prevent driving under the influence. The results on the self-control problems in limiting drinking and impulsivity suggest a role for compulsory self-control devices such as ignition interlock or SCRAM devices. A shortcoming of these approaches to incapacitation is that they are likely to be effective while court-mandated use of these devices is mandated, but not after the required period of use elapses (see e.g., Nochajski and Stasiewicz, 2006). Another approach some courts and treatment programs use is medications that remove the benefit of drinking such as Naltrexone or Anabuse (Knudsen and Abraham, 2012; Freeman et al., 2011). Still another approach is dram shop and social host liability (Sloan et al., 2000). Both types of liability are based on tort law and make the bar owner, bartender, and the host responsible for interceding in situations in which drinking and driving is likely to occur in the near future.

Alcohol addiction is only one of several determinants of driving while intoxicated; thus, treatment of the addiction as a purely medical issue is not likely to be effective. Effective treatment should address the whole range of differences between drinker-drivers and others, recognizing that there is a fine line between treatment to reduce negative externalities and an intervention that violates the doctrine of consumer sovereignty, particularly in view of the wide range of preference differences between drinker-drivers and others. Treatment may reduce precaution cost in that drinker-drivers find cutting down alcohol consumption more difficult. To the extent that drinker-drivers are less altruistic than others, public information programs that demonstrate hardships imposed on victims of crashes *may* make persons more sensitive to the harms they impose on others by drinking and driving.

Alternative interpretations of our findings are (1) that the preference differences we observe are *caused* by alcohol consumption, albeit observed when the respondent was sober, (2) reflect some unobserved factor(s), or (3) represent a justification of behaviors that persons surveyed view as socially undesirable. Alcohol consumption at some level could affect preferences in virtually every domain, but most sample persons did not consume extremely large amounts of alcohol regularly. Many of the questions in the SAD from which we infer preferences are general rather than alcohol-specific, e.g., gambles, healthy day tradeoffs, and being charitable in domains other than alcohol use. It seems far-fetched to attribute most of the preference differences we document solely to excess alcohol consumption.

Endogeneity is a potential issue on account of unobserved factors that affect both drinking and driving and the included covariates. The use of instrumental variables is impractical with as many covariates as we include. Patterns in our findings provide some indication of likely effects of including additional personal attributes as covariates if SAD had measured them.

Gauged in terms of magnitudes of effect, the covariates for preferences and self-control, e.g., for impulsivity, are quite robust to changes in specification. Standard errors are higher in the full than in the limited specifications. However, the robustness of the findings on the covariates for preferences makes it less likely that the results reported in Table 7 would change substantially if the additional influences had been measured and included in the empirical analysis. Effect sizes may be somewhat reduced, but reversals in direction of effect are unlikely. The most notable changes when we increased the number of covariates was in statistical significance levels rather than in magnitudes of the odds ratios.

The third possibility, that the pattern of responses to the SAD reflect attempts by respondents to justify high levels of alcohol consumption and driving while intoxicated is not likely. The SAD posed too many questions that were not directly linked to alcohol or driving, which were asked at different points in time, for the responses to be simple rationalizations for drinking and drinking and driving behaviors that respondents believe to be undesirable.

Overall, our findings support the view that driving while intoxicated partially reflects lack of self control. Lack of self-control limits the potential effectiveness of just getting tough on drinker-drivers by increasing patrolling and legislating higher criminal sanctions except to the extent that such public policies increase incapacitation of such drivers. But as already noted, incapacitation is effective as long as individuals are incapacitated, but not subsequently. While there appears to be a role for therapeutic interventions, these interventions should not be narrowly focused on reducing or eliminating alcohol consumption, but also on lack of self-control as a cause of drinking and driving. In sum, there is no singlet magic bullet. Rather recognizing that drinking and driving results from multiple causes, there are multiple solutions. As we learn more about attributes of offenders, it should be possible to better personalize interventions.

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Table 1

Marginal Utility of a Drink

	Drinker-driver Groups[a]						
	Total	0	1–4	5+	0 vs. 5+	0 vs. 1–4	1–4 vs. 5
VARIABLES	**Means**	**Means**	**Means**	**Means**	**t-test**	**t-test**	**t-test**
Drinking benefit index[b]	24.57	22.43	28.29	29.00	4.39**	8.12**	−0.48
Drink to forget troubles	2.81	2.48	3.34	3.78	−3.52**	−4.8**	−1.13
Drink to get a buzz	4.08	3.51	5.00	5.61	−5.33**	−7.68**	−1.56
Drink to socialize more easily	4.39	3.84	5.41	5.05	−3.28**	−8.58**	0.92
Drink because I like the taste	5.78	5.63	6.07	5.84	−0.55	−2.35*	0.62
Drink to relax	5.68	5.30	6.35	6.34	−2.76**	−5.76**	0.01
It would be inappropriate not to drink	1.88	1.72	2.13	2.38	−2.09*	−2.65**	−0.69
Importance of drinking for social life[c]	0.24	0.17	0.35	0.52	−6.95**	−6.77**	−2.61**
Not important	0.30	0.37	0.18	0.16	3.52**	6.54**	0.51
Slightly important	0.46	0.46	0.47	0.33	2.02*	−0.42	2.14*
Quite important	0.16	0.13	0.21	0.33	−4.46**	−3.39**	−2.18*
Very important	0.08	0.04	0.14	0.19	−5.19**	−6.11**	−0.98
N	1168	748	356	64			

** Significant at the 1 percent level

* Significant at the 5 percent level

[a] Respondents are grouped according to the number of drunk driving episodes they reported having in the previous year. The column “total” contains all respondents, the column “0” contains those repsondents who reported 0 drunk driving episodes for the past year, etc.

[b] Drinking benefit index components take values from 0 to 10, where 0 is “not at all important” and 10 is “extremely important.”

[c] The variable “importance of drinking for social life” is a binary variable equal to 1 if drinking was “very important” or “quite important” to social life and equal to 0 otherwise.

Table 2

Costs Associated with Drunk Driving

	Drinker-driver Groups						
	Total	0	1–4	5+	0 vs. 5+	0 vs. 1–4	1–4 vs. 5+
VARIABLES	**Means**	**Means**	**Means**	**Means**	**t-test**	**t-test**	**t-test**
Legal Penalties for Drunk Driving							
Percent chance a person is pulled over after having too much to drink[a]	9.86	10.75	8.37	7.65	1.61	2.65**	0.47
Jailtime served for DWI (in days)[a]	50.37	60.23	32.87	32.39	1.23	2.64**	0.03
Internal Cost of Arrest							
Arrest for drunk driving would almost ruin life[b]	0.18	0.20	0.14	0.16	0.78	2.40*	−0.39
Internal Cost of Paralysis							
Willingness-to-pay ($/month)[c]	36.88	39.33	32.35	33.38	1.30	3.18**	−0.23
Internal Cost of Harming Non-Family							
Altruism index[d]	23.01	23.31	22.51	22.23	3.21**	4.90**	0.75
Hurt if what I do isn't recognized	2.11	2.15	2.01	2.08	0.71	2.66**	−0.57
I help so I can live with myself	1.99	2.02	1.95	1.88	1.23	1.20	0.62
Resentful when I do things for others	2.87	2.90	2.82	2.84	1.13	3.13**	−0.41
People think I'm selfish	2.39	2.45	2.30	2.16	2.59**	2.62**	1.16
People think I'm cold	2.59	2.64	2.49	2.50	1.43	2.98**	−0.07
I'm not known for generosity	2.53	2.57	2.48	2.42	1.50	1.81	0.55
I try to be thoughtful	2.96	2.97	2.94	2.92	1.75	2.02*	0.52
I think of myself as charitable	2.75	2.78	2.70	2.59	2.72**	2.26*	1.33
I go out of way to help others	2.83	2.84	2.81	2.84	0.00	1.17	−0.54

** Significant at the 1 percent level

* Significant at the 5 percent level

[a] The survey phrased these two variables from a third-person perspective, i.e. "What is the percent chance *a person* will be pulled over when they are driving under the influence?"

[b] This variable is a binary equal to 1 if a DWI arrest would "almost ruin [the respondent's] life" and equal to 0 otherwise.

[c]The variable willingness-to-pay measures the willingness-to-pay per month to reduce the annual probability of being paralyzed by a motor vehicle accident by 0.2 percent.

[d]Each of the individual questions used to construct the indices is coded on a scale from 0 to 3, with 0 being the most selfish response and 3 being the least selfish response.

Table 3

Risk and Time Preference

	Drinker-driver Groups						
	Total	0	1–4	5+	0 vs. 5+	0 vs. 1–4	1–4 vs. 5+
VARIABLES	Means	Means	Means	Means	t-test	t-test	t-test
Risk Preference[a]							
Least risk tolerant	0.35	0.39	0.28	0.31	1.17	3.54**	−0.56
Medium risk tolerant	0.59	0.56	0.66	0.59	−0.46	−2.95**	0.98
Most risk tolerant	0.04	0.04	0.05	0.06	−0.92	−0.91	−0.39
Time Preference							
Financial planning horizon (yrs.)[b]	4.26	4.45	3.86	4.27	0.38	2.49*	−0.81
Short-term orientation: financial[c]	1.79	1.75	1.83	1.98	−1.31	−0.87	−0.81
Win 1000†	0.42	0.42	0.41	0.50	−1.23	0.21	−1.28
Win 20	0.69	0.69	0.69	0.75	−1.07	−0.16	−0.96
Lose 1000	0.37	0.35	0.41	0.33	0.41	−1.87	1.27
Lose 20	0.31	0.30	0.32	0.41	−1.78	−0.64	−1.38
Short-term orientation: health[d]	32.67	33.25	31.80	30.64	0.44	0.51	0.21
Dummy: less than 20 days	0.10	0.12	0.08	0.08	1.01	2.25*	−0.06

** Significant at the 1 percent level

* Significant at the 5 percent level

[a] The binary variables for risk tolerance are mutually exclusive and generated from a set of 5 questions that ask respondents to choose between staying with their current job or taking a new job that may raise or lower lifetime income by different degrees. The variables “medium risk tolerant” and “most risk tolerant” are included in table 6.

[b] This variable indicates the time frame an individual considers when planning their financial future. It takes values of 0.5, 1, 2.5, 7.5, or 10.

[c] This variable is an index ranging from 0–4, where 0 indicates extreme long-term orientation and 4 indicates extreme short-term orientation. In each of the 4 component questions, the respondent indicates whether they prefer to win/lose a smaller sum of money now or a larger sum of money later.

[d] This variable displays how many days of perfect health *next* year the respondent would value equally as much as 20 more days of perfect health *this* year.

Table 4

Knowledge of DWI Laws

	Drinker-driver Groups						
	Total	**0**	**1–4**	**5+**	**0 vs. 5+**	**0 vs. 1–4**	**1–4 vs. 5+**
VARIABLES	**Means**	**Means**	**Means**	**Means**	**t-test**	**t-test**	**t-test**
Ignorance of DWI Law[a]	1.02	1.07	0.98	0.75	2.43*	1.44	1.56
BAC level at which legally drunk	0.29	0.31	0.26	0.14	2.90**	1.85	2.04*
Convict DWI just for exceeding BAC	0.07	0.06	0.08	0.08	−0.53	−1.23	0.09
First DWI: Suspend driver's license	0.15	0.16	0.14	0.08	1.71	0.87	1.31
First DWI: Fine	0.26	0.26	0.25	0.22	0.71	0.23	0.58
First DWI: Jail	0.27	0.28	0.25	0.23	0.77	1.13	0.22

**Significant at the 1 percent level

*Significant at the 5 percent level

[a]The index "ignorance of the law" ranges in value from 0 to 5, where 0 indicates more knowledge of the law and 5 indicates less knowledge. The five component questions used to construct the index are binary variables equal to 0 if the respondent answered the questions correctly and equal to 1 if they answered incorrectly.

Table 5

Lack of Self-Control Over Alcohol Consumption

	Drinker-driver Groups						
	Total	**0**	**1–4**	**5+**	**0 vs. 5+**	**0 vs. 1–4**	**1–4 vs. 5+**
VARIABLES	**Means**	**Means**	**Means**	**Means**	**t-test**	**t-test**	**t-test**
Difficulty of limiting drinking[a]	1.51	1.35	1.78	1.91	−6.88**	−10.33**	−1.24
Very easy	0.59	0.70	0.39	0.36	5.69**	10.28**	0.47
Somewhat easy	0.31	0.24	0.44	0.41	−2.96**	−7.04**	0.56
Somewhat difficult	0.09	0.04	0.15	0.20	−5.37**	−6.44**	−0.97
Very difficult	0.01	0.01	0.01	0.03	−2.04*	−0.32	−1.55

** Significant at the 1 percent level

* Significant at the 5 percent level

[a] This variable is coded on a scale of 1–4, where a response of 1 indicates “very easy” and a response of 4 indicates “very difficult.”

Table 6

Role of Emotions in Decision-Making

	Drinker-driver Groups						
	Total	0	1–4	5+	0 vs. 5+	0 vs. 1–4	1–4 vs. 5+
VARIABLES	Means	Means	Means	Means	t-test -	t-test -	t-test
Impulsivity index[a]	26.25	25.46	27.32	29.53	5.17**	4.74**	−2.47*
I do things I later regret	2.56	2.43	2.75	3.11	−4.54**	−4.36**	−2.25*
I act on impulse	2.65	2.53	2.79	3.14	−4.15**	−3.59**	−2.21*
I finish what I start	1.94	1.88	2.01	2.13	−2.25*	−2.43*	−0.88
I do things on spur of moment	3.17	3.10	3.26	3.52	−2.98**	−2.28*	−1.84
I plan for the future	1.93	1.89	1.95	2.23	−3.04**	−0.96	−2.46*
I am not a worrier	2.69	2.71	2.66	2.61	0.66	0.71	0.29
I do not consider consequences	2.23	2.12	2.35	2.84	−5.98**	−3.72**	−3.57**
I control my angry feelings	2.18	2.12	2.29	2.25	−1.16	−3.05**	0.31
I ignore little jobs	2.50	2.42	2.61	2.77	−2.36*	−2.58**	−0.99
I fly off the handle	2.09	2.03	2.20	2.28	−2.05*	−2.85**	−0.54
I never get organized	2.35	2.30	2.46	2.44	−1.02	−2.36*	0.14
I rarely make hasty decisions	2.65	2.64	2.66	2.83	−1.38	−0.37	−1.20

** Significant at the 1 percent level

* Significant at the 5 percent level

[a] Each of the individual questions used to construct the index is coded on a scale from 1 to 5, with 1 being the least impulsive response and 5 being the most impulsive response.

Table 7

Factors Affecting the Decision to Drink and Drive

		Traditional		Non-Traditional		Both	
VARIABLES	**Means**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
A. Traditional Framework							
Marginal Utility of a Drink							
Drinking benefit index	24.574	1.039** (1.026 – 1.052)	1.031** (1.018 – 1.044)			1.023** (1.009 – 1.036)	1.016* (1.002 – 1.030)
Importance of drinking for social life	0.241	2.176** (1.633 – 2.898)	2.223** (1.654 – 2.989)			1.559** (1.148 – 2.118)	1.584** (1.153 – 2.178)
Drinking and Driving Cost							
Percent chance a person is pulled over after having too much to drink	9.856	0.989* (0.979 – 1.000)	0.990 (0.979 – 1.001)			0.991 (0.980 – 1.002)	0.992 (0.981 – 1.003)
Jailtime served for DWI in days	50.367	0.998* (0.997 – 1.000)	0.999* (0.997 – 1.000)			0.998* (0.997 – 1.000)	0.998* (0.997 – 1.000)
Arrest for drunk driving would almost ruin life	0.176	0.723 (0.511 – 1.022)	0.801 (0.559 – 1.148)			0.687* (0.482 – 0.979)	0.778 (0.538 – 1.125)
Willingness-to-pay ($/month)	36.883	0.995* (0.991 – 0.999)	0.996 (0.992 – 1.000)			0.996* (0.992 – 1.000)	0.997 (0.993 – 1.001)
Altruism index	23.009	0.924** (0.881 – 0.969)	0.934** (0.889 – 0.981)			0.949* (0.903 – 0.996)	0.956 (0.909 – 1.006)
Risk Preference							
Medium risk tolerant	0.594	1.231 (0.930 – 1.629)	1.227 (0.913 – 1.649)			1.295 (0.967 – 1.736)	1.288 (0.951 – 1.744)
Most risk tolerant	0.044	1.347 (0.736 – 2.466)	1.150 (0.609 – 2.171)			1.384 (0.747 – 2.564)	1.125 (0.585 – 2.162)
Time Preference							
Financial planning horizon	4.265	0.990 (0.956 – 1.026)	1.003 (0.966 – 1.041)			1.002 (0.966 – 1.040)	1.011 (0.972 – 1.051)
Short-term orientation: financial	1.788	1.068 (0.974 – 1.171)	1.086 (0.987 – 1.196)			1.032 (0.939 – 1.135)	1.057 (0.957 – 1.166)
Short-term orientation: health	32.665	1.000 (0.997 – 1.003)	1.000 (0.997 – 1.003)			1.000 (0.997 – 1.003)	1.000 (0.997 – 1.004)
Binary: less than 20 days health	0.104	0.599* (0.386 – 0.928)	0.570* (0.363 – 0.895)			0.624* (0.400 – 0.973)	0.584* (0.369 – 0.924)

		Traditional		Non-Traditional		Both	
VARIABLES	**Means**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
B. Non-Traditional Framework							
Knowledge of DWI Laws							
Ignorance of DWI law	1.025			0.860* (0.760 – 0.974)	0.904 (0.794 – 1.029)	0.838* (0.729 – 0.962)	0.886 (0.767 – 1.023)
Low Cognitive Ability							
Self-evaluated memory	3.610			0.918 (0.801 – 1.053)	0.846* (0.732 – 0.977)	0.911 (0.791 – 1.050)	0.865 (0.746 – 1.004)
Numeracy	2.465			1.095 (0.914 – 1.313)	1.056 (0.869 – 1.282)	0.994 (0.817 – 1.209)	1.001 (0.815 – 1.229)
Mental status	12.015			1.026 (0.923 – 1.140)	1.029 (0.919 – 1.152)	1.018 (0.909 – 1.141)	1.037 (0.920 – 1.170)
Addiction							
CAGE	1.184			1.149* (1.032 – 1.280)	1.103 (0.987 – 1.234)	1.124* (1.005 – 1.257)	1.081 (0.963 – 1.213)
Hard drug user	0.135			1.897** (1.360 – 2.646)	1.718** (1.212 – 2.435)	1.602** (1.124 – 2.283)	1.578* (1.092 – 2.281)
Lack of Self-Control							
Difficulty of limiting drinking	1.513			2.100** (1.749 – 2.522)	1.933** (1.599 – 2.337)	1.671** (1.361 – 2.051)	1.671** (1.351 – 2.067)
Role of Emotions							
Impulsivity index	26.247			1.021* (1.000 – 1.042)	1.028* (1.006 – 1.051)	1.017 (0.995 – 1.039)	1.024* (1.000 – 1.047)
C. Demographic, Health, and Income							
Edu. attainment (yrs.)	15.634		0.889** (0.827 – 0.956)		0.922* (0.858 – 0.992)		0.904** (0.838 – 0.975)
Married	0.467		0.615** (0.447 – 0.847)		0.717* (0.523 – 0.984)		0.698* (0.504 – 0.968)
Female	0.548		0.452** (0.345 – 0.592)		0.426** (0.327 – 0.553)		0.465** (0.352 – 0.615)
Black	0.111		0.934 (0.596 – 1.464)		0.757 (0.485 – 1.181)		1.005 (0.623 – 1.621)
Other race	0.038		0.379* (0.164 – 0.876)		0.438* (0.197 – 0.974)		0.422* (0.181 – 0.987)

		Traditional		Non-Traditional		Both	
VARIABLES	**Means**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Age	43.483		0.99 (0.978 – 1.002)		0.983 ** (0.972 – 0.995)		0.991 (0.979 – 1.004)
# of children<18	0.665		1.166 (0.938 – 1.450)		1.22 (0.989 – 1.505)		1.171 (0.939 – 1.459)
Fair or poor health	0.069		0.942 (0.824 – 1.078)		0.914 (0.801 – 1.043)		0.925 (0.806 – 1.061)
Household income, in $10,000	0.786		0.810 (0.483 – 1.360)		0.502 * (0.292 – 0.862)		0.517 * (0.294 – 0.907)
Observations	1168	1,137	1,114	1,157	1,134	1,127	1,106
Pseudo R-squared		0.0691	0.0947	0.0617	0.0923	0.0936	0.116

** Significant at the 1 percent level

* Significant at the 5 percent level (95% confidence interval)