

Drinking and Driving and Public Transportation:

A Test of the Routine Activity Framework

by

Joshua Broyles

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Graduate Supervisory Committee:

Justin Ready, Chair  
Cody Telep  
Michael Reisig

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## ABSTRACT

Driving under the influence (DUI) is a problem in American society that has received considerable attention over recent decades from local police agencies, lobby groups, and the news media. While punitive policies, administrative sanctions and aggressive media campaigns to deter drinking and driving have been used in the past, less conventional methods to restructure or modify the urban environment to discourage drunk driving have been underused. Explanations with regard to DUIs are policy driven more often than they are guided by criminological theory. The current study uses the routine activities perspective as a backdrop for assessing whether a relatively new mode of transportation – an urban light rail system – in a large metropolitan city in the Southwestern U.S. can alter behaviors of individuals who are likely to drive under the influence of alcohol. The study is based on a survey of undergraduate students from a large university that has several stops on the light rail system connecting multiple campuses. This thesis examines whether the light rail system has a greater effect on students whose routines activities (relatively unsupervised college youth with greater access to cars and bars) are more conducive to driving under the influence of alcohol. An additional purpose of the current study is to determine whether proximity to the light rail system is associated with students driving under the influence of alcohol, while controlling for other criminological factors

## DEDICATION

This thesis is dedicated to the faculty of Arizona State University, who never set a limit to what I could accomplish. It is dedicated to my peers in the School of Criminology and Criminal Justice, who kept me focused and provided a solid learning environment wherein I could flourish. It is further dedicated to the soldiers of the 860<sup>th</sup> Military Police Company, who reminded me that academia, while important, isn't everything; to my friends who have kept me sane throughout the years; finally, to my family, who never gave me a path to follow, but instead gave me the tools to find my own way.

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## INTRODUCTION

Crime statistics and self-report data show that college students are one of the most likely groups to drive intoxicated (Nagin, & Paternoster, 1993; Cohen, 1990). Drunk driving has been a notable scourge in recent American history. In Arizona specifically, 28% of fatalities on streets and highways in 2009 were linked to drunk driving (National Highway Traffic and Safety Administration, 2010). Since the establishment of highly visible advocacy and lobby groups in the 1980s, such as Mothers Against Drunk Driving (MADD), the public health problem of drunk driving has been a concern of those responsible for public safety. Likewise, MADD has influenced lawmakers to “crack down” on drunk driving, and they have facilitated the development of other subsidiary organizations that have taken up the cause of discouraging and sanctioning DUIs, such as Students Against Drunk Driving (SADD) (Wooster, 2000).

Recently, as of December 2008, an inner city light rail system was implemented in the Phoenix metropolitan area to provide a broader network of alternative public transportation routes and to connect the cities of Phoenix, Tempe, and Mesa. Tempe and downtown Phoenix house the Arizona State University (ASU) campuses, as well as densely populated drinking areas near both campuses and several college and professional sports arenas. Furthermore, it has been established that most DUI arrests take place as motorists are returning from a licensed drinking location (Helander, 2002; Shults et al. 2001; O’Donnell, 1985). Because of this fact, it is important to investigate whether building and operating a new light rail system in these areas changes students’ “routine activities” as they relate to drinking and driving. Does giving this population of



ASU students a relatively cost effective alternative to driving while intoxicated change their routine activities and make them more likely to use the safer alternative? And if the new transportation system does affect student behavior, do certain students benefit more from the light rail system (i.e., students whose routine activities are more conducive to driving impaired)? On the other hand, will college students maintain their normal activity patterns and drive to and from drinking establishments while intoxicated despite the new light rail system?

It is also helpful to draw from the routine activities perspective as a theoretical backdrop to investigate what lifestyle and activity patterns are associated with driving while intoxicated. For instance, to what extent does proximity to the light rail system affect drinking and driving? How does access to alcohol and alternative modes of transportation affect students' self-reported drunk driving patterns? And to what degree does unsupervised time and social attachments (i.e., intimate handlers) affect DUI risk taking behavior? It is important to gather this information because there are notable policy implications if the light rail system shows a reduction in drunk driving among certain subgroups of college students. First, it will represent a potential reduction in the loss of life and property damage attributed to drunk-driving accidents in the greater Phoenix area. Second, other municipalities could capitalize on this research and encourage high-risk individuals to take advantage of public transportation systems. Further, it may be useful to eventually extend the light rail lines into the Phoenix metropolitan area so that a greater segment of the resident population can benefit from proximity to the light rail as well. To date, while studies suggest that using public

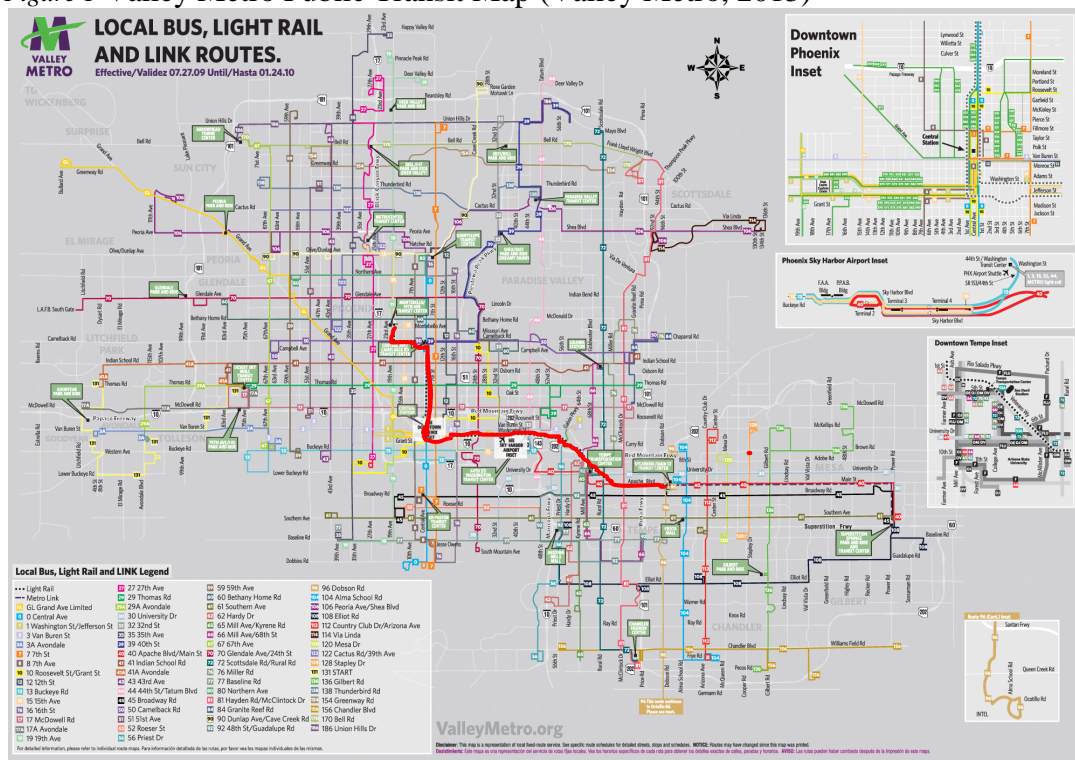
transportation reduces DUI offenses (see Wiliszowski, Murphy, Jones, & Lacey, 1996; Grohosky, Moore, & Ochshorn, 2007), the amount of literature focusing on the effects of public transportation on DUI is limited. This thesis builds upon this literature.

### **DRUNK DRIVING AND PUBLIC TRANSPORTATION**

A substantial amount of legislation has focused on the deterrence of drunk driving by increasing criminal and administrative penalties for intoxicated drivers, but the logic of increasing punitive sanctions for driving impaired may be flawed. For example, state-level legislation has attempted to impose steep fines, jail time, shaming practices, license revocation, ignition interlock devices and zero tolerance practices (Ornstein, & Hanssens, 1985; Shore & Maguin, 1988; Carpenter, 2003; Raub, Lucke & Warke, 2003). While these statutes have created harsher penalties and have been paired with aggressive campaigns to make it known that it is not prudent to drive impaired, they have not provided alternatives to driving under the influence of alcohol. Suggested alternatives include using a designated driver, taking a cab, or simply not drinking to the point of intoxication. These alternatives, however, may not be practical in the mind of likely offenders. A cab ride may be expensive depending on income and where the individual lives, and it is a social taboo to call a friend in the middle of the night while one is intoxicated (Grohosky, Moore, & Ochshorn, 2007; Pratt & Reisig, 2011). Furthermore, it may be seen as inconvenient to individuals who feel they cannot rely on friends or family to pick them up. A designated driver is more practical and cheaper, but some research shows that designated drivers are still likely to drink in social atmospheres, despite serving the role of the designated driver (Helander, 2002; Timmerman, Geller,

Glindeman, Fournier, 2003). For example, Timmerman et al. (2003) found that designated drivers typically abstain from drinking more than non-designated drivers, but their average blood alcohol content was still .06, which is barely under the legal limit in most states. In fact, in the state where the current research was conducted, an individual can still be charged with a DUI if their blood alcohol content is over .05 (Arizona Revised Statutes 28-1381.1, 2007).

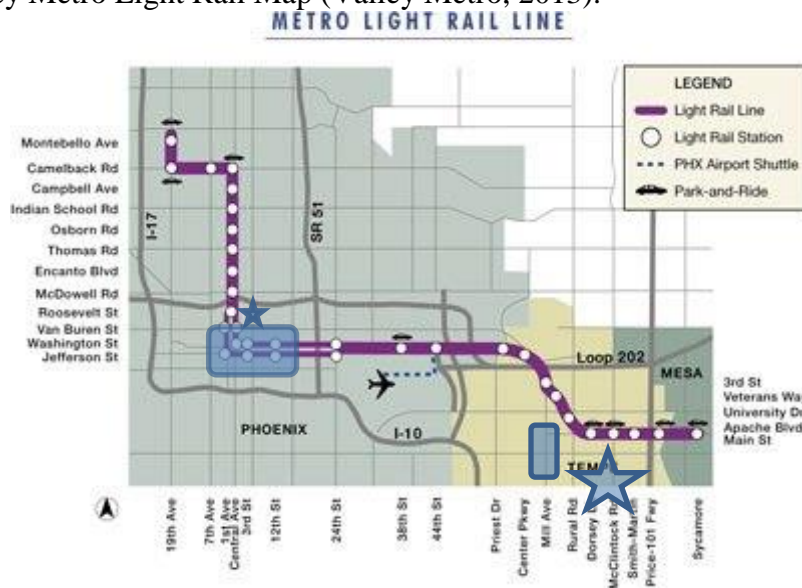
Figure 1 Valley Metro Public Transit Map (Valley Metro, 2013)



With respect to mobility in the Phoenix metropolitan area, a more reliable alternative to driving intoxicated is public transportation, such as the bus system. Taking the bus, however, may be complicated for some individuals who are not familiar with bus routes, who are intimidated by using the transportation system, or who are fearful for their safety at night or in certain neighborhoods. This complication is illustrated in a map

of the bus system in the Phoenix metropolitan area (see Figure 1). According to Valley Metro, there are over 90 different bus routes in the greater Phoenix area. These routes are complicated by the times at which each bus arrives and the direction each bus travels. In fact, lack of knowledge and availability of public transportation has been cited as a major reason for driving drunk or without a license (Ross & Gonzales, 1988). The light rail system, on the other hand, may still be intimidating, but is arguably easier to understand and use given that there is only one line, and the light rail stops at every platform roughly every 10 to 20 minutes (Valley Metro, 2011). The map of the light rail is presented in Figures 1 and 2.

Figure 2 Valley Metro Light Rail Map (Valley Metro, 2013).



Key for Fig. 2: ★ = ASU Campuses. □ = Heavy drinking locations.

In December 2008, the light rail system was opened to the public in Phoenix, Tempe and Mesa (Náñez, 2008). Originally, the concept of a light rail was not as well-accepted in cities such as Phoenix because of the hot, dry weather. Early in the city's history a small trolley system did exist. It consisted of approximately 12 miles of track

that crisscrossed the downtown area and 17 additional miles of tracks that reached into the suburbs. This trolley system began running in 1887 before the advent of buses and it was originally powered by mules and horses. It continued to expand with the use of electric motors but ceased running in 1948 after a carbarn fire destroyed 12 of 18 trolley cars. This carbarn fire inadvertently made way for the new, more technologically advanced buses already being put in use, and by 1948 there was no need to further invest in the rail system (Fleming, 1977).

The hot, dry summers had continued to make it unsuitable for Phoenix to invest heavily in a more extensive public transportation system because the general public would be discouraged from waiting for long periods of time in the heat for their bus or train (Kuby, Barranda, & Upchurch, 2004). To overcome this obstacle, city planners developed shortened waiting times and the provision of structures that created shade at light rail platforms in order to make riding the light rail and its 28 two-directional stops more practical (Valley Metro, 2011; Kuby, et al., 2004). Furthermore, light rail systems are useful for moving large populations to and from central business districts. Because the Phoenix metropolitan area has a population distributed across 16,573 square miles, the light rail became a more worthwhile project from a city planning perspective (Joshi, Guhathakurta, Konjevod, Crittenden & Li, 2006; Kuby et al, 2004). Additional public benefits of a light rail include the improvement of air quality, reduction of traffic congestion, increased property value around the light rail, as well as an influx of employment opportunities. With seven stops near ASU campuses and reduced prices for students, the light rail system is made even more accessible to students (Valley Metro,

2011; Arizona State University, 2012). This paper intends to further research the potential benefits of the light rail in Phoenix by testing the association between use of and proximity to the light rail and drunk driving among the ASU student population.

### **College Drinking**

College students have higher rates of DUI than many other demographic groups. This is due, in part, to the fact that the most frequent offenders of drunk driving are between the ages of 18 and 24 (Stewart, 2008; McCartt, Hellinga, & Wells, 2008). Additionally, college students have been shown to be more dangerous than their non-college counterparts while drinking and driving due to binge drinking that frequently occurs on college campuses (Robertson & Marples, 2008). In addition to being a subpopulation at a more likely age for driving intoxicated (Stewart, 2008) college students routinely participate in social drinking activities (Clapp, Johnson, Voas, Shillington, Lenge, & Russel, 2005; Fisher, Sloan, Cullen, & Lu, 1998). Even when drinking and driving is taken out of the equation, drinking on its own routinely causes social and health-related problems on college campuses. Drinking games and a competitive drinking environment result in more frequent victimizations, including sexual assaults and theft, as well as a greater propensity for aggression, violence, and other crimes (Fisher et al., 1998; Zhang, Wieczorek, & Welte, 1997). Fortunately, it has been demonstrated that campaigns to curb drunk driving have a considerable effect on college students at the target age of 18-24 (McCartt, Hellinga & Wells, 2008). According to ASU's demographic profile, as of 2009 82% of the undergraduate population was under the age of 25 which, all things considered, makes it an ideal target population for

this study (2010). Given the above information, this thesis intends to capitalize on the fact that college students are typically at a higher risk for drinking and driving due to their propensity to binge drink. This study will investigate if there is an association between binge drinking and light rail use.

### **Prior Research**

One of the few studies to investigate the effects of a rail system on drinking and driving was conducted in Washington, DC by Jackson and Owens (2011). Washington, DC's metro system is a more extensive system of rail networks relative to the size of the light rail in Phoenix. It is concentrated in the center of the Washington, DC and extends outbound in multiple directions into the neighboring states of Maryland and Virginia. The DC Metro comprises five lines and 86 unique stops. Prior to 1999, the DC rail system ran its last trains from the center of the city out bound at midnight. However, in November 1999, the metro remained open an additional hour on Fridays and Saturdays with the intent of catering to college students from the University of Maryland, George Washington University, American University, George Mason University, and Georgetown University who were likely to be in DC to socialize and congregate at popular restaurants and drinking locations. After finding an increase in ridership during the extended time period, the DC metro system again extended the late night hours to 2:00 am on Fridays and Saturdays (technically Saturday and Sunday mornings) in 2000. Finally, in 2003 city administrators changed the final departure time to 3:00 am for the last train leaving central DC (Jackson & Owens, 2011). Jackson and Owens capitalized on these schedule changes which provided a natural experiment to examine whether

drunk driving arrest rates and accidents in the DC area were reduced as a result of the operating time changes. Furthermore, they tested whether the distance a bar is from a metro station stop affected the rate at which citizens are arrested for DUI in that area. That analytic approach provides the framework for this study.

While Jackson and Owens found that the metro exerted no direct effect on general DUI arrest rates and drunk driving accidents, spatial analyses showed a positive association. That is, the proximity to a drinking establishment was correlated with lower DUI arrest rates. In addition, neighborhoods with a bar within 100 meters of a metro station stop had a 14% reduction in DUI arrest rates (Jackson & Owens, 2011). This suggests that a relationship exists between distance traveled to drinking establishments and access to public transportation. It is important to reiterate that one of the main reasons for extending the train hours was attributed to college students socializing and drinking alcohol. Therefore, though it was not captured in the data, it is possible that the lower rate of DUIs was a result of less drunk driving by college students.

### **ROUTINE ACTIVITIES AND DRUNK DRIVING**

Studies linking criminological theory to drinking among college student populations are not new (See Lanza-Kaduce, 1988; Durkin, Wolfe, & Clark, 1999). Most theories, however, have focused on the effects of drinking on being victimized or committing predatory crimes. Many of these studies are guided by theories of rational choice and routine activities (Fisher et al., 1998; Lauritsen, Sampson, & Laub, 1991). Cohen and Felson (1979) explained that crime exists, in part, because a person's daily routines occur in a social environment where crime is able to thrive. The theory is often



used to describe patterns of victimization and predatory crimes, and it does not typically explain criminality or criminal motivation (Cohen & Felson, 1979; Sherman, Gartin, & Buerger, 1989; Holtfreter, Reisig & Pratt, 2008). It assumes, rather, that criminal motivations already exist, especially among certain subgroups of the population. As Felson and Cohen stated in their paper on the ecology of crime, their study takes criminality "...as given and examines how social structure allows people to translate their criminal inclinations into action. [They] treat criminal violations as routine activities which share many attributes of and are interdependent with other activities" (1980, p. 390). Even though the present study is examining binge drinking and drunk driving, both non-predatory acts of deviance, routine activities theory is still an applicable framework for examining the distribution of DUIs around the college community and light rail system. Indeed, according to the theory, changes in technology – specifically transportation and communication – are seen as seminal processes that impact the convergence of likely offenders and suitable targets in the absence of capable guardianship.

It is expected that young people may experience the urge or motivation to drink and drive (Gruenewald, Mitchell, & Treno, 1996; Gruenewald, Johnson & Treno, 2002). This is the result of two intersecting social patterns. People over the age of 21 congregate at establishments where alcohol is sold legally, and people in large sprawling cities like Phoenix and LA must routinely drive to locations of interest and necessity. It is, of course, reasonable to assume that drinkers will still want to have mobility despite being intoxicated, so will therefore be tempted to drive after drinking. Social structures –both

formal and informal – have contributed to the elements necessary for an individual to drive under the influence of alcohol. This partly explains why drunk driving is relatively commonplace, and in fact only about 1 in 200 to 1 in 1,500 drunk drivers on the road are ever arrested (Kingsnorth, 1993; Vinglis, Adlaf, & Chung, 1982).

As previously shown, however, municipalities and criminal justice agencies have attempted to create a level of deterrence in relation to drinking and driving via harsh criminal sanctions (Ornstein, & Hanssens, 1985; Carpenter, 2003). While formal criminal sanctions exist against mainstream crimes like burglary and motor vehicle theft, there are also informal, situational crime prevention techniques that empower citizens to discourage motivated offenders from pursuing these crimes. In the case of conventional crimes like theft, if efforts to “harden” targets, reduce access and increase natural surveillance around targets are used, offenders should be less tempted to engage in the crime because of change in the opportunity structure (Felson & Cohen, 1979; Clarke, 1995). Additionally, despite the fact that society has favorable views toward harsh punishments for drunk driving, the threat of sanctions alone do not contribute to decision making with regard to drinking and driving (Applegate, Cullen, Link, Richards, & Lanza-Kaduce, 1996; Schell, Chan, & Morral, 2006).

Furthermore, it has been shown that methods for deterrence are not as salient as they were once believed to be (Lanza-Kaduce, 1988; Pratt & Cullen 2005; Pratt, Cullen, Blevins, Daigle & Madensen, 2008). If fines and jail time do not deter drunk driving, how then can private citizens play a role in reducing the magnitude of this problem? Since the consumption of alcohol is legal for those over the statutory age limit,

opportunity reducing techniques and situational diversions are not always feasible. Advisory campaigns use publicity to admonish individuals to use a designated driver, or taking away the keys of an impaired driver (Shore & Maguin, 1988; Wiliszowski, Murphy, Jones, & Lacey, 1996). These methods, however, are sometimes idealistic as they are ineffective for younger, high-risk segments of the population (Adebayo, 1988; Timmerman et al., 2003). This demonstrates the primary difference between preventing drunk driving and other consensual crimes as opposed to controlling predatory crimes; there is a greater onus on encouraging the potential offender to play an active role in preventing the criminal act from occurring. This makes the rational decision making process particularly important.

The most important aspect about rational choice theory is that decisions and information play a pivotal role in how the criminal act is planned and executed (Clarke, 1995). In the instance of drunk driving, the likely offender must know his or her options – or the choice structuring properties associated with the act – and make a decision according to the anticipated costs and benefits of potential outcomes. Based on the rational choice framework, the offender’s decision making process is “bounded” or limited by time constraints surrounding the criminal opportunity, the availability of information, and the cognitive state of the individual. These limitations are particularly salient for thinking about and designing alternatives for DUI offenders. Jackson and Owens (2011) referred to this as the “safer option” which is defined as giving people a chance to opt out of committing crimes. This is where alternative public transportation options may come into play. If there is an inexpensive and easily accessible method of

public transportation, and it can fulfill the impaired person's primary motivations – getting to their destination quickly – then the intoxicated person may avoid driving under the influence of alcohol, particularly in high risk areas such as college campuses, instead opting to use the light rail system to reach their destination.

### **SELF-CONTROL AND DRUNK DRIVING**

Self-control is an important element in the DUI offender's decision making process with regard to use of the light rail system. Self-control theory argues that individuals with low levels of self-control are more likely to be short sighted, risk seeking, prefer immediate gratification to long-term goals, and have an inability to self-regulate their behavior (Gottfredson & Hirschi, 1990). This predisposition has been shown to be a precursor to criminal and deviant behaviors (Pratt & Cullen, 2000). It follows that individuals with low self-control would have a greater inclination toward drinking and driving (Keane, Maxim, & Teevan, 1993; Piquero, & Tibbetts, 1996). Because those with low self-control tend to be short sighted, however, the theory would predict that these individuals are also less likely to plan ahead to use the light rail system. If, however, the light rail schedule and stop locations become familiar to city dwellers, and the rail becomes an integral part of how people move about the city, low self-control may be offset by the familiarity, easy and patterned use of the light rail system. It is also likely that many people (i.e., students) who are impaired will still rely on the light rail, despite not planning ahead - particularly if they are familiar with, and fear, the risks and penalties associated with driving under the influence of alcohol. In essence the light rail may still be a viable option to those with low levels of self-control even after the point of

inebriation. It follows that it is necessary to measure this control variable in order to test whether opportunities to restructure student's routine activity patterns outweigh the effects of low self-control (Piquero & Tibbetts, 1996; Tibbetts & Myers, 1999; Wright, Caspi, Moffitt, & Paternoster, 2004).

Within the framework of this study, one possibility is that self-control is a depletable resource, comparable to a muscle (Baumeister, 2002; Baumeister & Heatherton, 1996). While Baumeister (2002) contends that there are many ways that an individual's self-control may be depleted, it is important to note specifically, that this process of depletion often leads to alternative forms of criminal and deviant behaviors (Muraven, Pogarsky, & Shmueli, 2006). Additionally, alcohol has the ability to be the catalyst to self-control depletion (Baron & Dickerson, 1999; Fillmore & Vogel-Sprott, 1999; Muraven, Collins & Nienhaus, 2002). This is important because it is possible there will be a compounding effect. Those who have low self-control are more likely to binge drink, which in turn triggers more deviant behaviors such as an increased likelihood of driving under the influence of alcohol (Baumeister & Heatherton, 1996; Piquero, Gibson & Tibbetts, 2002; Gibson, Schrek & Miller, 2004). Considering this potential outcome, self-control may be particularly influential in this study. While routine activities are modifiable, those individuals with low self-control and a predisposition to drink excessively may be less inclined to take advantage of the light rail system. Accordingly, the survey instrument includes measures of binge drinking in addition to measurements of self-control and self-reported drunk driving.

## **HYPOTHESES**

The purpose of this research is to determine whether the existence of the light rail system in the Phoenix Metro area is associated with self-reported drunk driving among ASU students. Furthermore, the author attempts to discover if student binge drinking is predicted by use of and proximity to the light rail. It is anticipated that the light rail will be associated with student binge drinkers because those students will find it easier to drink to excess, since they have guaranteed transportation home. Therefore, it is additionally expected that the light rail will be associated with reduced frequency of drunk driving among the sample of ASU students. Tests of these hypotheses would serve as a first step in demonstrating that the light rail alters student routine activities.

Moreover, there is also an expectation that those who live close to the light rail system are less likely to drive intoxicated than students who do not live in close proximity to the rail. Finally, it is suspected that these effects will remain, even after controlling for self-control and routine activities that are conducive to driving under the influence of alcohol. Stated formally, the hypotheses tested in this study are as follows:

- 1) A positive relationship will exist between frequency in which ASU students use the light rail system and their self-reported binge drinking activity.
- 2) A significant negative relationship will exist between the frequency in which ASU students use the light rail system and their self-reported DUI activity.
- 3) A significant negative relationship will exist between residential proximity to the light rail system and self-reported drunk driving.

- 4) Use of, and proximity to, the light rail system will be positively associated with students binge drinking, even after controlling for self-control, social learning, and routine activity patterns.
- 5) Use of, and proximity to, the light rail system will be negatively associated with drunk driving, even after controlling for the effects of self-control, social learning, and routine activity patterns.

## **METHODS**

A cross-sectional research design was used to answer the above questions by surveying 563 undergraduate students at ASU in addition to 50 online students. A total of 93.5% of students who were administered the survey responded to the survey creating a sample size of 573 undergraduate students. Each hard copy survey was entered into the corresponding online program, Qualtrics, in order to ensure the answers were coded consistently.<sup>1</sup> Students were surveyed on both the West campus in west Phoenix and the downtown campus located in south Phoenix. While the main body of students surveyed (539 students) were surveyed at the downtown campus, the large size and sprawling nature of the Phoenix metropolitan area allowed for a great dispersion of students. Therefore the sample population is composed of 37.2% of respondents who live less than a mile from the light rail, and 54.1% who live further than 2 miles from the light rail.<sup>2</sup>

Students were included in the sampling frame and solicited to participate in the survey based on a two stage process. First, the author selected a convenience sample of

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<sup>1</sup>Qualtrics is a web based platform that allows for the survey to be created in topical sections each answer provides for a precoded response. Additionally, the system allows for steps to be taken to ensure that the IP addresses from which the online students submit the survey are not visible to the authors or any other parties

<sup>2</sup> The remaining 8.7% of students reported living between 1 and 2 miles from the light rail.

17 classes<sup>3</sup> from the two previously mentioned campuses using known contacts who were teaching during the testing period. The instructors were informed of the study and the corresponding survey and asked if they would allow the author to survey the classes during the first 20 minutes of the period. Since the greatest risk of drunk driving is posed by people who are returning home from bars (Shults et al., 2001; O'Donnell, 1985), classes that were at the 300 level or higher were targeted for selection to increase the chances of students being at least 21 years of age. This study is cross-sectional, so the behaviors and attitudes of students will be captured only at the point in time when the survey is completed. In an attempt to increase response rates, the respondents were given the opportunity to enter their email address into a raffle for a pair of headphones.<sup>4</sup>

### **Survey Instrument**

The survey instrument contained 90 items organized within 9 topic areas.<sup>5</sup> Many items were adapted from previous survey instruments such as a 13 point scale measuring self-control from Tangney, Baumeister, & Boone (2008) in addition to questions regarding alcohol use from the Harvard College Alcohol Survey (CAS) (Wechsler, 1997). Due to the specific nature of this research, however, most items were created by the author in a straightforward attempt at gathering the necessary information about the variables from the respondents. Furthermore, in some instances multiple variations of questions were asked to ensure reliability of the survey items. For instance, “Do you

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<sup>3</sup> 15 of the 17 classes surveyed were criminal justice courses, therefore this survey was primarily guided by students in criminal justice classes. The remaining 2 classes were philosophy classes.

<sup>4</sup>In addition to the raffle, 3 professors offered their students extra credit for participating in the survey. This was done independent from any requests by the author.

<sup>5</sup>The 9 topic areas respectively were self-control, drinking behaviors, drinking and driving behaviors, use of transportation, frequency of use and proximity to the light rail, drinking routines (places, days and times), beliefs regarding the light rail, and demographical questions.



believe you live within reasonable distance from the light rail?"; "About how many minutes would it take you to walk to the nearest light rail stop from home?" and "About how far from the light rail do you live?" were all questions that measured proximity to the light rail.<sup>6</sup> It is also worth noting that several other situational measures were considered. These measures included whether or not the light rail system is accessible, if the rail was used at all by the individual (regardless of whether or not they had been consuming alcohol) and if so how often was it used.

The hard copy of the survey instrument provided no legitimate skip questions; therefore, respondents saw and answered all of the items appropriately. Because the survey focuses on drinking behaviors and 15.4% of students (88 students) indicated abstaining from alcohol in the past year, a N/A response was provided for a majority of the questions. This aided the author in two ways. First, because the survey was done in a large group setting, providing a N/A option slowed down the respondents who did not drink. This helped to avoid drinkers and non-drinkers from self-identifying themselves to their peers as they turned in the survey. Second, it provided extra context to some responses. For example, a person who indicates that they have had a DUI in the past and marks N/A on owning, borrowing and renting a vehicle likely has had their license suspended.

In the online survey, however, one contingency question caused a skip pattern to occur. If the respondent did not indicate that they had consumed alcohol in the past year, their survey skipped most questions relating to alcohol consumption. To keep the data

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<sup>6</sup> The survey attached in the appendix section illustrates the response options to these questions.

and responses consistent, the hard copy surveys were entered into the online survey manually by the author. Self-control measures, demographic information and transportation use were still recorded using the software, however.

### **Control Variables**

*Demographics.* Basic demographic information was collected from the sample. The information relevant to the analysis is as follows: age, gender (male = 1; female = 0), race (0 = white; 1 = nonwhite). Additional demographics were recorded and are discussed in the following section on routine activities measurements since the variables appropriately measure guardianship.

*Measures of Routine Activities.* A major group of control variables in this study relate to routine activities conducive to drunk driving. More specifically, it is reasonable to expect that individuals who have routine activities that are conducive to, or facilitate, DUI will report driving under the influence of alcohol more frequently. Accordingly, guardianship is measured by how much time in a typical day the respondent is supervised – or in the presence of family members, teachers, or supervisors at work. The options for this were measured using employment (0 = unemployed; 1 = employed), time spent with family,<sup>7</sup> and how many credit hours a student is enrolled in.<sup>8</sup> Access to suitable targets is measured by identifying alcohol consumption, specifically with regard to binge drinking. Additionally three simple yes/no items were asked to obtain access to personal transportation. Does the respondent own a car, do they have access to a car that could be

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<sup>7</sup>Time spent with family was categorized and coded from 0-5; respectively the response options were “never,” “once a month or less,” “2 or 3 days a month,” “1 or 2 days a week,” “3 or 5 days a week,” and “every day or almost every day”

<sup>8</sup>Credit hours were categorized as well and measured 1-5. The options given were “8 credits or less,” “9-12 credits,” “13-17 credits,” “18-21 credits” and “22 or more credits.”

borrowed, and do they rent cars for their own personal use?<sup>9</sup> These items were turned into a single dichotomous variable which indicated driver or non-driver.

*Self-control Scale.* Self-control was included as a control variable in order to measure the individual's ability to abstain from binge drinking and driving under the influence of alcohol. A composite measure of self-control (based on an additive scale) was drawn from a brief self-control scale (Tangney, Baumeister, & Boone, 2008). The respondents were asked 13 items that assess levels of self-discipline, impulsivity, work ethic, and health habits, using a scale ranging from 1 to 4, where 1 signifies "very much like me" and 4 represents "not at all like me." Items that measure high levels of self-control were automatically reverse coded so that all items have consistent directionality where high scores on the ordinal scale reflect high levels of self-control (Pratt & Reisig, 2011). The mean score for every individual was used. This allowed for easy imputation on individuals who did not respond to one or more questions.

*Social Learning.* Social learning was expected to be a factor and was therefore included in the analysis (DiBlasio, 1986; DiBlasio, 1987). Several questions on the survey instrument determine whether or not the individual has peers or family members who drink and drive frequently. It was expected that if an individual had close peers and family members who frequently drive intoxicated, they may also drink and drive frequently. Additional questions ask about DUIs among family and friends, as well as if they have been personally affected by a drunk driver, but no significance relationships were found among these factors with regard to the dependent variables.

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<sup>9</sup>Renting a car was included into the driver variable because 7.5% (43) of the respondents indicated renting a car to get around for personal use. This is likely due to the fact that many students are out of state students that only need a vehicle on the occasions they go out (likely to drink).

## **Independent Variables**

*Proximity to the Light Rail.* Multiple items were used to gauge proximity to the light rail, including approximately how many minutes it would take to walk to the light rail from home, and an ordinal scale that asked if the respondent lived within a block from the light rail, several blocks from the light rail, one to two miles from the light rail, or more than 2 miles away. In the end a dichotomous yes/no item was preferred due to its simplicity and specificity. This question asked if the respondent believed they lived within a reasonable walking distance of the light rail. Asking the question in this manner avoided any issues with the respondent being unsure of how many blocks they lived from the rail and it made intuitive sense from the standpoint of a commuter.

*Use of the Light Rail.* Again, multiple items measured frequency of use of the light rail. Three items, however, asked generally about how often the respondent used the light rail. In the question relevant to this analysis, students were asked to indicate on a five point likert scale how often they use the light rail to get around.<sup>10</sup> This question allowed the author to investigate in a more precise manner how much a respondent relied on, and was familiar with the light rail system. Having a reasonable level of dispersion across the response options, and only one missing case added to the practical utility of this variable.

## **Dependent Variables**

*Binge Drinking.* Binge drinking was used as a dependent variable to predict an individual's behavioral routines with regard to drinking. The author used binge drinking to ascertain if students drank more alcohol because they could rely on the light rail to get

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<sup>10</sup> The response options ranged from "Not at all" (coded as 0) to "Very often" (coded as 4).

them home. Binge drinkers were determined using the items from the CAS (Wechsler, 1997) and a more streamlined version of the clinical definition of binge drinking<sup>11</sup>, which is 4 or more drinks in a single occasion (Wechsler, Dowdall, Davenport, & Castillo, 1995). Specifically, respondents were asked how many times in the last 30 days they had 4 or more drinks in one sitting, resulting in a continuous variable.

*Drinking and Driving.* Though there were multiple items on the instrument that measured drinking and driving, a dichotomous variable was used as a simple measure of whether or not a respondent drank and drove. On the survey instrument a prompt informed the respondent that "...driving drunk [was] defined as a situation where if you were caught your blood alcohol content would be over the legal limit." The item in question asked, "In the past 6 months have you driven drunk?" with the options yes, no, or n/a.<sup>12</sup>

### **Analytic Strategy**

Preliminary analyses of distributions as well as cross tabulations with the relevant dependent and independent variables assisted in determining which variables would be most appropriate for inclusion in the final models. Diagnostics on the count variable for binge drinking determined that a negative binomial would be the most appropriate tool to measure the outcome.<sup>13</sup> Examination of the dependent variable revealed that it is not normally distributed ( $M=2.32$ , variance=3.93), but skewed with a mode of zero. Using

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<sup>11</sup> The clinical definition of binge drinking is considered 4 or more drinks for females, and 5 or more drinks for males. The question was streamlined to simply "how many times have you had 4 or more drinks in a single occasion" in order to avoid confusing the respondents.

<sup>12</sup> All responses marked "n/a" were considered a no (coded as 0) if the respondent indicated not drinking in the last year.

<sup>13</sup> A dichotomous outcome variable for binge drinking (was the respondent a binge drinker?) was also measured with a logistic regression and demonstrated similar results. It is shown in Appendix B.

STATA, negative binomial models were used to expose significant predictors of binge drinking.

**Table 1. Descriptive Statistics from Drinking and Phoenix Transportation use survey<sup>14</sup> (N=573)**

<i>Variables</i>	<i>%</i>	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
<b><i>Dependent Variable</i></b>					
Binge Drinker (number of occasions)	---	2.32	3.93	0	30
Driven drunk in the last 6 months	14.71	---	---	0	1
<b><i>Independent Variables</i></b>					
Lives within walking distance of the light rail	40.7	---	---	0	1
Frequency of use of the light rail		1.45	1.46	0	4
Self-Control		2.9	.479	1.46	4.0
Frequency of Friends driving drunk		.719	.639	0	2
<b><i>Control Variables</i></b>					
Age		22.15	5.518	18	59
Male	47	---	---	0	1
Non white	47.9	---	---	0	1
Credit hours		2.97	.705	1	5
Time spent with Family		2.92	1.743	0	5
Employed	61	---	---	0	1
Driver	90.4	---	---	0	1
Drinker	85	---	---	0	1

In the instance of drinking and driving a dichotomized outcome variable was used, therefore logistic regression was determined to be the appropriate method to analyze that data.<sup>15</sup> Logistic regression models were used in SPSS to uncover significant predictors of drunk driving. In order to remain consistent in using the relevant theoretical constructs to predict the dependent variables, the same controls and independent variables were used in both the negative binomial and logistic regression models. In order to

<sup>14</sup> A descriptive's table demonstrates that sample population is within the threshold of what would be expected for the current population of study

<sup>15</sup> A negative binomial was used to assess a count variable that measured frequency of drunk driving, but proved to be inconsistent with the logistic regression. The negative binomial found that proximity was associated with a decrease in the frequency of drinking and driving. This is likely due to the relatively small sample size of the current study.

provide context at the outset of the analysis, the author begins with some descriptive analyses in table 1 and histograms in figures 3 and 4 which show ASU students' attitudes and beliefs about light rail use and drunk driving.

### **Limitations**

Because the current study consists of cross-sectional research, a number of threats to validity merit consideration. First, it should be noted that although systematic efforts were made to select a diverse sample of students, this sample was not a random probability sample. Therefore, claims cannot be made that the research findings are truly representative of the entire ASU student body population. Additionally many of the questions on the survey are of a sensitive or personal nature. The stigma associated with drinking and driving may cause some social acceptability bias which could result in underreporting. Finally, while some survey questions were taken from other surveys<sup>16</sup>, and had been validated as reliable measures, many other questions were developed by the author solely for the purpose of this study. These questions, therefore, have not been tested for reliability in earlier research.

## **RESULTS**

Subjective survey items assisted in framing the results of this piece. Two particular questions received a large number of responses due to the fact that the wording did not exclude non-drinkers or people who do not use the light rail. The items in question asked if the respondent agreed or disagreed with a particular statement.<sup>17</sup> Figure 1 illustrates that 83.4% of the respondents agreed that "In general, the light rail reduces

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<sup>16</sup> Self-control and questions regarding drinking behaviors were taken from other reliable surveys.

<sup>17</sup> The items were originally on a likert scale with "strongly agree," "agree," "disagree," and "strongly disagree"

the frequency of drunk driving among ASU students.” Furthermore, Figure 2 establishes that 86% (474/548) believe “expanding the light rail would reduce the frequency of drunk driving.”

Figure 3

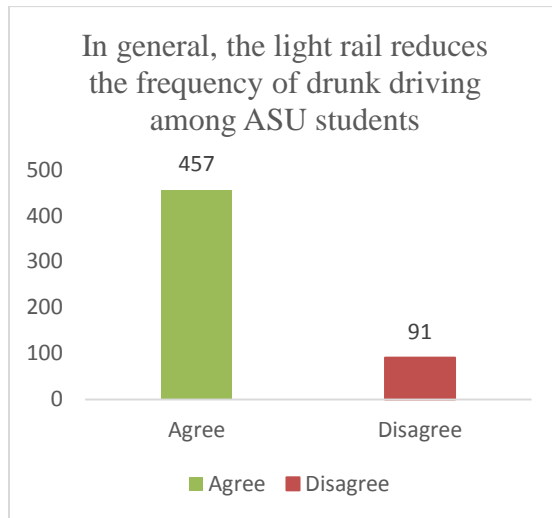
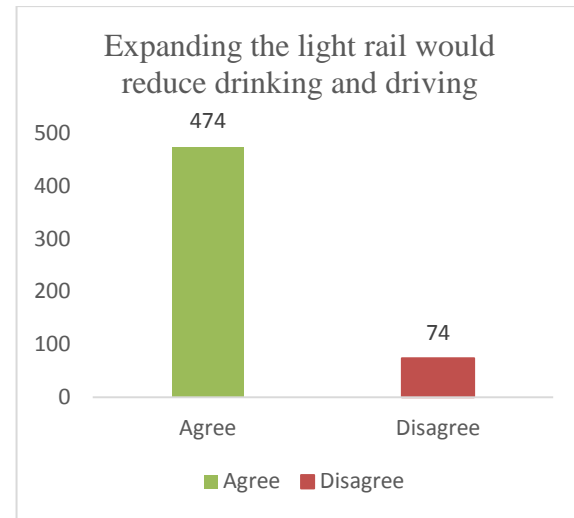


Figure 4



Concerning the key variables, bivariate correlations between the dependent and independent variables were evaluated before the logistic regression models were run. “Time spent with family” and “proximity to the light rail” were the only variables with moderately high correlation (Pearson’s  $r = -.533$ ). All other correlation coefficients remained below .32 (see Appendix A). Collinearity diagnostics demonstrated that multicollinearity was not detrimental to the regression models that followed. Moreover, bivariate regression analyses were run to test for the effects of independent variables on both dependent variables, as well as to ensure that variance inflation factors (VIF) remained below the necessary cutoff of 4.0 (see Fox, 1991).<sup>18</sup>

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<sup>18</sup>All VIF were below 1.6.



**Table 2.**  
**Binge Drinking Negative Binomial Regression Model.**

	<i>b</i>	<i>SE</i>	Exp( <i>b</i> )
Live within walking distance of the LR	.559***	.159	3.52
Frequency of use of the LR	-.080	.044	-1.83
Self-control (mean score)	-.969***	.141	-6.85
Peers drink and drive	.478***	.110	4.34
Age	.002	.014	.11
Male	.242	.127	1.9
Non White	.074	.134	.56
Credit hours	-.448**	.171	-2.61
Time spent with family	-.232***	.042	-5.42
Employed	.242	.135	1.79
Driver	.747**	.239	3.13
Constant	3.295***	.714	4.61
McFadden's R <sup>2</sup> =.072			
Note: Entries are unstandardized coefficients ( <i>b</i> ). * <i>p</i> < .05. ** <i>p</i> < .01. *** <i>p</i> <.001 (two-tailed test)			

Now turning the attention to the first research question, to what extent is binge drinking predicted by proximity to the light rail and frequency of its use? Table 2 presents the negative binomial model predicting binge drinking, which shows significant test of fit and a McFadden's R square value of .072. The model demonstrates that living within a reasonable walking distance is statistically significant in predicting binge drinking ( $b = .559, p < .001$ ). The incident rate ratio in this instance demonstrates that for individuals who live closer to the light rail there exists a 75% increase in the number of occasions an individual reports binge drinking ( $1.75 = 1 - [\exp(-.559)]$ ). However, frequency of use of the light rail was not found to be associated with binge drinking. Additionally, as expected, self-control and peer delinquency also had statistically significant relationships with binge drinking in the expected direction. Specifically, high

self-control was inversely related to self-reported binge drinking. Having delinquent peers increased the likelihood of binge drinking by about 61%. Finally, the routine activities measures time spent with family and amount of credit hours taken, also revealed a significant inverse relationship with binge drinking. It is notable that the inconsistency in the results between the two light rail measures is surprising. Two possible explanations will be elaborated on in the discussion section.

**Table 3.**  
**Drinking and Driving Logistic Regression Model.**

	<i>b</i>	<i>SE</i>	Exp( <i>b</i> )
live within walking distance of LR	-.567	.353	.567
Frequency of LR use	-.252*	.108	.777
Self-control (mean score)	-1.439***	.304	.237
Peers drink and drive	1.248***	.231	3.485
Age	.007	.030	1.007
Gender (1= male)	.703*	.285	2.019
Race (Non White= 1)	.413	.291	1.512
Credit hours	.190	.212	1.210
Time spent with family	-.047	.096	.954
Employed	-.067	.300	.935
Driver	.740	.780	2.096
Constant	-.258	1.542	.772
Nagelkerke's $R^2=.299$			
Note: Entries are unstandardized coefficients ( <i>b</i> ).			
* $p < .05$ . ** $p < .01$ . *** $p < .001$ (two-tailed test)			

Table 3 displays the logistic regression model predicting drunk driving, one of the central investigations in the thesis. The model test of fit is significant with a Nagelkerke's R square value of .29 which is moderate in size. Frequency of use of the light rail is found to be statistically significant and associated with a 23% decline in the odds of drunk driving ( $1/.77=.298$ ). The item measuring residential proximity to the light rail did

not fare as well. Interestingly the self-control and social learning variables remain statistically significant in this model as well. The logistic regression coefficients indicate that higher self-control scores are related to a reduced likelihood of drunk driving. Conversely, having peers that drink and drive triples the odds that a respondent will also report drunk driving. In terms of demographic variables, males are twice as likely as females to report during under the influence of alcohol. No other control variables are significant.

## **DISCUSSION**

With temperatures that routinely exceed 110° Fahrenheit during the summer, the Phoenix metropolitan area is decidedly governed by the heat. While other cities grew in size and population, those cities' civil engineers were able to keep up with evolving transportation concerns (Smith, 1984). As Phoenix's population began to grow outward, however, the heat and sprawl of the city likely caused extensive public transportation systems to take a back seat to the comfort of personally owned vehicles (Arizona Department of Administration, 2011; Kuby, et al, 2004). The trolley car barn fire of 1947 was an additional nail in the coffin for any Phoenician's hopes of an affordable network of buses and railcars (Fleming, 1977). In 2008, when the Valley Metro light rail became operational, the new railcars were entering a more complex city environment compared to what the previous railcar system left behind. Large university campuses now populate the metropolitan landscape, in addition to extensive entertainment venues, and dense clusters of bars and restaurants. Statistically speaking, due to the fact college students are not strangers to drinking or driving under the influence of alcohol (Nagin & Paternoster,

1993; Cohen, 1990), the current study attempted to investigate if their behavioral patterns would be affected by the re-implemented rail system.

Respondents in the current study acknowledged, perhaps in more ways than one, that the Phoenix metro light rail is a factor in their decision making processes relating to binge drinking and driving impaired. Living reasonably close to the light rail was found to be positively associated with binge drinking. Two possible explanations exist for this association. First, it is possible that students who live near the light rail are likely to feel fewer inhibitions with that fact in mind when they go out to socialize and drink alcohol, thereby affecting their amount of alcohol consumption. Second, the light rail runs near two large college campuses. It is possible that students who live within reasonable walking distance of the light rail also live on or near campus. This would mean that a respondent's distance to campus may be associated to their likelihood of participating in college drinking games and activities. It is noteworthy, however, that ASU is a dry campus and alcohol is forbidden in the dormitories (though likely still subsists there). Further research is needed to determine which possibility is more likely, but both suggest interesting findings in terms of student behavior.

If it is the case the students are choosing to drink to excess because they know they have an easily accessible light rail ride home, this may still have positive implications. While binge drinking is not necessarily a positive outcome from a policy standpoint, in this instance it may be the lesser of two evils. A student who decides to drink to excess, but elects not to drive home, is less of a public health risk than a student who has one too many and gets behind the wheel of a car. The net impact of damage

resulting from drunk driver is arguably greater than the public disorder and ordinance violations resulting from students stumbling to the light rail in a drunken state.

Furthermore, an intoxicated individual on the light rail may prove to be a more difficult target to victimize due to the fact that the light rail is well lit and has electronic security and police officers patrolling its cars.

The more promising finding of this study is that those who report riding the light rail more report less drinking and driving. This suggests that a cultural shift in positive views of public transportation as a result of the light rail may pay long term dividends in terms of public health and city planning. This point is more salient with the fact that follow-up models specified with the same predictors estimating use of city buses were not associated with binge drinking or drunk driving. This provides some credibility to the claim that the light rail is more reliable and perhaps easier to use by students while intoxicated than the city bus system. The current findings further demonstrate the need for research on public transportation and its effects on driving under the influence. Further, these findings illustrate a number of policy implications. One implication is that it may be a smart investment for city planners to think about making the light rail system more attractive for the 70,000 students at ASU, removing the obstacles to optimizing its use, and better publicizing its availability. The light rail averages 15 minute wait times between cars, and each car only travels an average of 22 miles an hour (Valley Metro, 2013). Increasing the number of light rail cars and removing additional roadway impediments to rail cars completing travel routes faster might increase ridership among students who might not use the system for lack of patience (incidentally a measure of low

self-control). Also, civil engineers may come to discover that extending the amount of rail service during certain evenings, and for particular rail car routes may have provide additional public health benefits. As evidence, 36.3% of the study sample indicated that if the light rail went to at least one of four entertainment districts they would be less likely to drive drunk. Furthermore, providing an incentive for establishments that serve alcohol to build closer to public transportation lines may also assist in reducing drunk driving and public disorder offenses.

On a broader scale, however, this study highlights the need for more extensive research to be performed with regard to providing safer travel options for university populations especially within the realm of public transportation. The public should be provided public service reminders that alternatives to drinking and driving exist, and perhaps this awareness should be prompted with signage and pamphlets in an around popular socializing venues at ASU. Additionally, if it is the case that there will be an increase in the population of inebriated individuals using public transportation, special security considerations should also be considered –since there will be an increase in individuals who are more easily victimized. Furthermore, additional research is required to determine if individuals are specifically using the light rail to and from their homes and drinking locations in order to avoid driving drunk. Geospatial analyses may be the most definitive method in determining this relationship. Additional analyses should also determine if a significant interaction effect exists between light rail use and self-control. In other words are people with low self-control specifically more likely to use the light rail (especially when inebriated) or are the effects general across the population.

Finally, this research sheds more light on the fact that deterrence through sanctions and increased enforcement does not have to be the only way to prevent people from driving drunk. Altering routine activities through thoughtful city planning and entrepreneurial activities can be effective in restructuring activity patterns and controlling crime. These situational measures should be considered in addition to deterrence based policies if a municipality intends to give its young citizens an opportunity structure that leads to the avoidance of crime.

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APPENDIX A  
CORRELATION MATRIX



Appendix A. Pearson's $r$ Correlation Coefficients														
Variables	Y1	Y2	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Drank and drove	1													
Binge drinker	.260**	1												
Proximity to LR	-.092*	.161**	1											
Frequency of LR use	-.146**	-0.079	0.076	1										
Self-control	-.246**	-.303**	-.114**	0.041	1									
Frequency of friends drunk driving	.316**	.182**	-.098*	-0.081	-.179**	1								
Age	0.027	-0.039	-.210**	0.056	0.044	0.024	1							
Male	0.009	-.271**	0.03	0.012	-0.027	0.016	0.052	1						
Race	0.078	0.016	-.129**	-0.001	.088*	.127**	0.055	-0.071	1					
Credit hours	-0.049	-0.053	.263**	-0.013	0.031	-.084*	-.307**	0.054	-0.066	1				
Employed	0.015	0.052	-.170**	-0.081	0.043	.130**	0.006	0.026	0.048	-0.079	1			
Family time	0.026	-.174**	-.533**	-0.049	.128**	0.043	.155**	-0.003	.173**	-.155**	.093*	1		
Driver	.085*	0.045	-.237**	-.113**	0.024	.163**	0.054	0.043	0.028	-.085*	.131**	.210**	1	
Drinker	-.167**	0.062	0.038	0.035	-0.071	0.067	-.169**	-0.038	-0.045	0.078	0.06	0.039	-0.01	1

## APPENDIX B

### BINGE DRINKING LOGISTIC REGRESSION MODEL

**Binge Drinking Logistic Regression Model.**

	<i>b</i>	<i>SE</i>	Exp( <i>b</i> )
Live within walking distance of the LR	.573*	.240	1.773
Frequency of use of the LR	-.083	.067	.920
Self-control (mean score)	-1.190***	.214	.304
Peers drink and drive	.451**	.157	1.570
Age	-.007	.020	.993
Male	.296	.193	1.345
Non White	.296	.199	1.345
Credit hours	-.200	.147	.819
Time spent with family	-.175**	.067	.839
Employed	.379	.206	1.462
Driver	.509	.347	1.664
Constant	2.752**	.998	15.670

Nagelkerke's  $R^2 = .210$ Note: Entries are unstandardized coefficients (*b*).\* $p < .05$ . \*\*  $p < .01$ . \*\*\* $p < .001$  (two-tailed test)