ABSTRACT

Title of Document: **INTENTION AND WILLINGNESS TO DRIVE WHILE DROWSY IN A POPULATION OF UNIVERSITY STUDENTS IN MARYLAND: APPLICATION OF AN EXTENDED THEORY OF PLANNED BEHAVIOR MODEL**

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This questionnaire-based descriptive study examined the utility of a model based on constructs from the Theory of Planned Behavior and the Prototype Willingness Model to predict intentions and willingness to engage in drowsy driving behavior in a population of university students in Maryland. Overall, students who reported more favorable attitudes and subjective norm and greater perceived control and willingness in relation to drowsy driving behavior were more likely to report stronger intentions to engage in drowsy driving. Furthermore, students who reported more favorable attitudes and subjective norm in relation to drowsy driving behavior were more likely to report greater willingness to engage in drowsy driving. Perceived behavioral control and willingness were the strongest predictors for intention, while

attitudes were a stronger predictor than subjective norm for willingness. Finally, some statistically significant differences in intention and willingness were observed between male and female students, but not between employed and non-employed students.

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INTENTION AND WILLINGNESS TO DRIVE WHILE DROWSY IN A POPULATION OF UNIVERSITY STUDENTS IN MARYLAND: APPLICATION OF AN EXTENDED THEORY OF PLANNED BEHAVIOR MODEL

By

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Advisory Committee:

Professor Kenneth H. Beck, Chair
Professor James Butler III
Professor Min Qi Wang

Dedication

To

My wife Meredith

and

The taxpayers of the State of Maryland,

without whom (for very different reasons) this work would not have been possible.

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Chapter 1: Introduction

1.1 Statement of the Research Problem: Drowsy Driving in Young People

In recent years, researchers in academia, government, and the private sector have built a substantial evidence base indicating that drowsy driving is a significant public safety and health concern in the United States (see **Section 2.1.1**). The National Sleep Foundation (NSF) has cited statistics by the National Highway Traffic Safety Administration (NHTSA) to report that 100,000 police-reported crashes are the direct result of driver fatigue each year in the U.S., resulting in an estimated 1,550 deaths, 71,000 injuries, and $12.5 billion in monetary losses (National Sleep Foundation, 2007). U.S. crash data from 1999 to 2008 reveal that a drowsy driver was involved in 16.5 percent of fatal crashes, 13.1 percent of crashes resulting in hospitalization, and 7 percent of all crashes (Tefft, 2010).

Researchers have been able to identify certain population groups as being particularly at high-risk of experiencing drowsy driving crashes. Among these groups are young persons between the ages of 16 and 29 years, especially males between the ages of 16 and 24 years (Commonwealth of Massachusetts, 2009, p. 14; National Center on Sleep Disorders Research/National Highway Traffic Safety Administration [NCSDR/NHTSA] Expert Panel on Driver Fatigue and Sleepiness, 1998, pp. 16-17, 22; Pack et al., 1995; Tefft, 2010, p. 3). Policy-makers have been advised to develop and implement interventions targeting young people and other identified high-risk groups (Commonwealth of Massachusetts, 2009, pp. 22-24, 28-29; NCSDR/NHTSA,1998, pp. 22-25; National Sleep Foundation, 2007, p. 4; Thiffault, 2011). Some organizations have developed materials and resources to educate young

people and members of the general public on the dangers of drowsy driving (American Academy of Sleep Medicine, 2012; De Dobbeleer, Nathanail, & Adamos, 2009; Driver Reviver, 2008; National Sleep Foundation, 2013). Governmental advisors acknowledge, however, that principles derived from health behavior research should guide the development and implementation of more effective interventions against drowsy driving in the future, and that additional research on sleep and drowsy driving as a health behavior phenomenon is needed (National Center on Sleep Disorders Research [NCSDR], 2011; Thiffault, 2011).

Some governmental advisors have advocated for research on the application of constructs from the Theory of Planned Behavior (TPB) to certain populations known to be especially vulnerable to the dangers of drowsy driving as a first step in developing effective interventions against drowsy driving for these populations (Thiffault, 2011). Over the past 20 years, researchers have applied the TPB and "extended" versions of the TPB successfully to predict intentions and willingness to engage in various driving behaviors in a number of populations around the world (see **Section 2.2.3**). To date, however, such TPB-based models have not been applied to predict intentions, willingness, or behavior related to drowsy driving.

1.2 Research Questions and Hypotheses

The aim of this descriptive study is to examine the utility of an extended TPB model (see **Figure 1.1**) in predicting intentions and willingness to engage in drowsy driving behavior in a population of university (undergraduate and graduate) students in the State of Maryland, U.S.A. Three drowsy driving situations with which many university students in Maryland are familiar were analyzed in this study: driving a

long distance during daylight hours to go home for the summer after staying up late at night for a few weeks to complete final papers, study for final exams, and move out of dormitories or off-campus housing (Situation A); driving down the street to the store in the middle of the night to get a cup of coffee and a snack to stay awake while studying for mid-term examinations during the Fall Term (Situation B); and driving to a friend's apartment in the evening to pick up the friend and go to the airport at the beginning of Spring Break (Situation C). It is hypothesized that in the population to be studied:

1. For all drowsy driving situations analyzed, intention to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, perceived behavioral control, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.
2. For all drowsy driving situations analyzed, willingness to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.
3. After controlling for personal variables, intention to engage in drowsy driving will be predicted by attitudes, subjective norm, perceived behavioral control, and behavioral willingness.
4. After controlling for personal variables, willingness to engage in drowsy driving will be predicted by attitudes and subjective norm.

5. Males will exhibit lower perceived risk, greater invulnerability to danger, and greater intention and willingness to engage in drowsy driving than females for all drowsy driving situations analyzed.
6. For all drowsy driving situations analyzed, individuals who are employed while attending university will exhibit greater intention and willingness to engage in drowsy driving than individuals who are not employed while attending university.

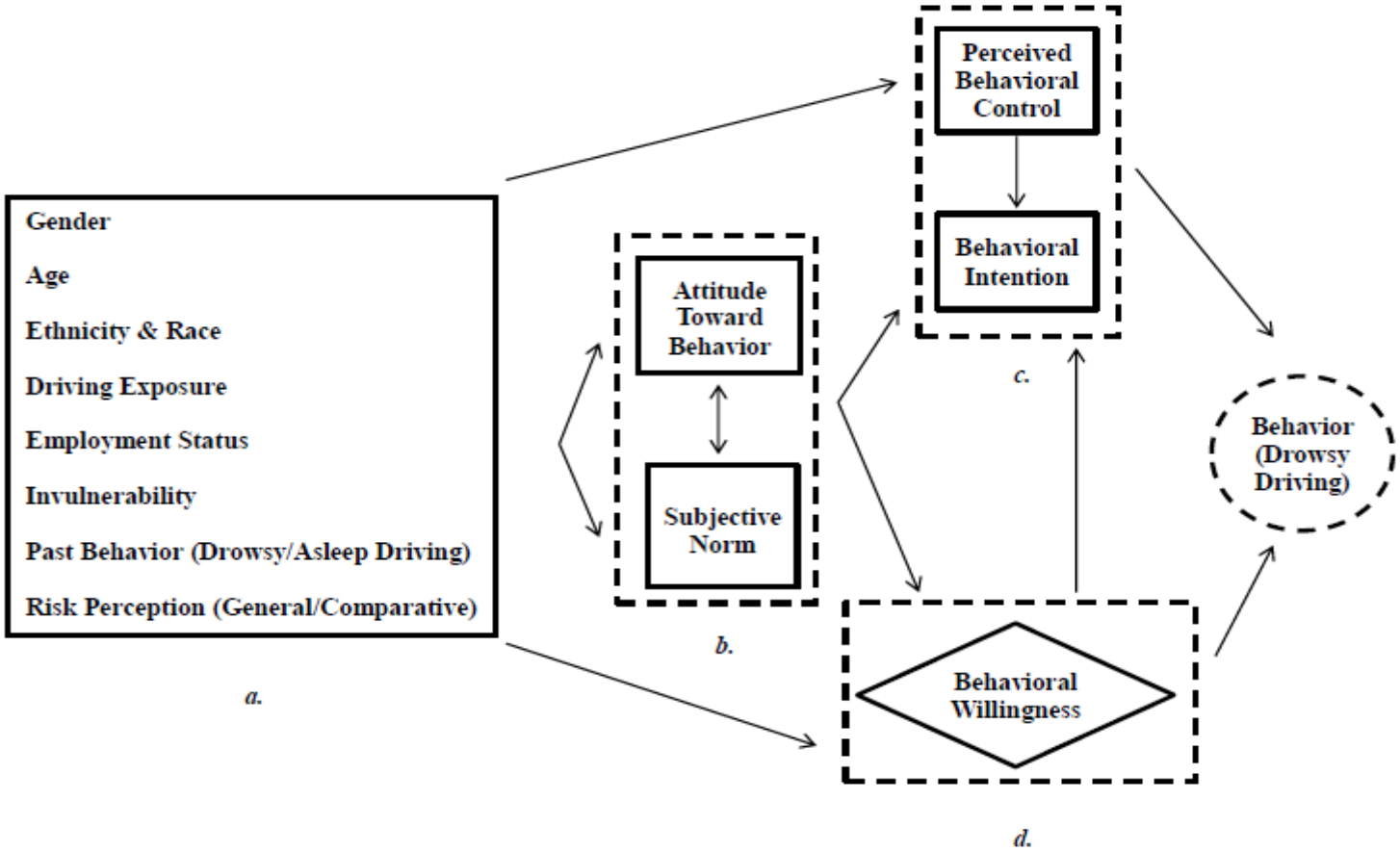

Figure 1.1. Extended Theory of Planned Behavior (TPB) Model for Drowsy Driving. Model components include: (a) personal variables; (b) constructs from the Theory of Reasoned Action (TRA); (c) constructs from the TPB that augment the TRA; and (d) constructs from the Prototype Willingness Model (PWM) that augment the TRA.

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1.3 Definition of Terms

The following definitions apply to the entirety of this report.

"*Asleep driving*" means the act of operating a motor vehicle while asleep.

"*Drowsy driving*" means the act of operating a motor vehicle while drowsy, sleepy, asleep, or fatigued (National Highway Traffic Safety Administration [NHTSA], 2011).[1]

"*Drowsiness*" (adjective: "*drowsy*") means a fluctuating intermediate state between alert wakefulness and sleep which is most often experienced when a person struggles to maintain wakefulness at a time appropriate for sleep, either because of pathologic conditions or sleep deficiency (NCSDR, 2011, p. 24).

"*Fatigue*" means a state of increased discomfort and decreased efficiency resulting from prolonged or excessive exertion. Fatigue is often the consequence of physical labor or a prolonged experience and is characterized by a loss of power or capacity to respond to stimulation, or a disinclination to continue a task at hand ("Dorland's Illustrated Medical Dictionary," 2003; NCSDR/NHTSA,1998, p. 3).

"*Sleep*" (adjective: "*asleep*") means a period of rest for the body and mind, during which volition and consciousness are in partial or complete abeyance and the bodily functions are partially suspended. Sleep is a behavioral state characterized in humans by periods of reduced activity, a particular immobile posture (*e.g.*, lying down with eyes closed), and diminished but readily reversible sensitivity to external stimuli. The ready reversibility of sleep distinguishes it from other states of reduced

[1] The terms drowsiness, sleepiness, and fatigue often are used interchangeably in the drowsy driving literature (NCSDR/NHTSA,1998, p. 3). In the field of sleep research, however, each of these terms has definitions of their own. Some of these definitions are provided in this section.

consciousness such as hibernation and coma ("Dorland's Illustrated Medical Dictionary," 2003; Harvard Medical School Division of Sleep Medicine & WGBH Educational Foundation, 2008; Lockley, 2010).

"*Sleep deficiency*" means a deficit in the quantity or quality of sleep obtained relative to the quantity or quality of sleep needed for optimal health, performance, and well-being. Sleep deficiency may result from prolonged wakefulness leading to sleep deprivation, insufficient sleep duration, and sleep fragmentation or sleep disorders that disrupts sleep and thereby renders sleep non-restorative (Lee, Sanna, & Czeisler, 2013; NCSDR, 2011, p. 25).

"*Sleep health*" means a state of optimal well-being that results from achieving an adequate quantity and quality of sleep on a regular basis (Lee et al., 2013).

"*Sleepiness*" (adjective: "*sleepy*") means the subjective sensation of the desire or need to sleep. Factors that may increase sleepiness include sleep deficiency, misalignment of circadian phase, sleep inertia, some illnesses (including sleep disorders), hypnotic agents, central nervous system depressants (*e.g.*, alcohol), and other pharmacologic agents that induce sleepiness. Factors that may reduce sleepiness include sleep, some illnesses (*e.g.*, hypomania), wake-promoting therapeutics (*e.g.*, caffeine), central nervous system stimulants (*e.g.*, amphetamines), advancing age, and emotional and sympathetic nervous system activation (NCSDR, 2011, p. 26; NCSDR/NHTSA1998, p. 3).

"*Wakefulness*" (adjective: "*awake*") means a condition of alertness or watchfulness. It is also a state marked by indisposition to sleep ("Dorland's Illustrated Medical Dictionary," 2003).

1.4 Public Health Significance

Sleep deficiency and its negative impacts on human performance, health, and safety are well-documented in the scientific literature and have been identified collectively by the Institute of Medicine as an "unmet public health problem" in the United States (Institute of Medicine, 2006). Inadequate or short sleep duration and impaired sleep quality increases the risks for accidents, injuries, and errors, and has been implicated as risk factors for a number of diseases, conditions, and other adverse health outcomes (Elliot & Kuehl, 2007; Geiger-Brown & Trinkoff, 2010; Institute of Medicine, 2006; Lockley, Landrigan, Barger, & Czeisler, 2006; Luyster, Strollo Jr., Zee, & Walsh, 2012; Perry, Patil, & Presley-Cantrell, 2013). Because sleep deficiency (and in particular, sleep restriction and sleep fragmentation) has been identified as the primary cause of drowsy driving in people without sleep disorders (NCSDR/NHTSA, 1998, pp. 5-6), and because of the well-documented prevalence and impacts of drowsy driving in the U.S. (see **Section 2.1.1**), drowsy driving may be characterized as a public health concern in addition to being a public safety concern in the United States (Sleet, Dinh-Zarr, & Dellinger, 2007). The U.S. Government has adopted this view and has included as part of its 10-year *Healthy People 2020* agenda for improving the nation's health an objective to reduce the national rate of vehicular crashes per 100 million road miles traveled due to drowsy driving from the 2008 rate of 2.7 crashes to 2.1 crashes (U.S. Department of Health and Human Services [HHS], 2010).

More recently, researchers have raised awareness about the detrimental health and safety consequences of sleep deficiency and sleepiness in university students,

including the high prevalence rate of drowsy driving behavior in this population of young people (Hershner & Chervin, 2014; Lindsay, Hanks, Hurley, & Dane, 1999; Taylor & Bramoweth, 2010; Taylor, Dolan, Bramoweth, & Rosenthal, 2008). Thus, drowsy driving also may be characterized appropriately as a significant adolescent and college health issue.

Chapter 2: Background

2.1 Literature Review

2.1.1 Drowsy Driving in the United States

In recent years, researchers from advocacy organizations, government, and academia have built a substantial evidence base indicating that drowsy driving is a significant public safety and health concern in the United States. In its first *State of the States Report on Drowsy Driving* report published in November 2007, the National Sleep Foundation (NSF) cited statistics from the National Highway Traffic Safety Administration (NHTSA) of the U.S. Department of Transportation indicating that 100,000 police-reported crashes are the direct result of driver fatigue each year in the United States, resulting in an estimated 1,550 deaths, 71,000 injuries, and $12.5 billion in monetary losses (National Sleep Foundation, 2007). Polling data collected by NSF annually from 1998 through 2005 reveal that the percentage of U.S. adults who reported driving a vehicle while feeling drowsy in the past year ranged from 51 to 62 (National Sleep Foundation, 2005, p. 42). NSF polling data from 2005 and 2009 also reveal that about one-third of U.S. adult drivers reported actually having fallen asleep while driving a vehicle at some point, and that between 1 and 4 percent admitted getting into an accident or near accident in the past year because they dozed off or were too tired to drive (National Sleep Foundation, 2005, pp. 42-43; 2009, p. 42).

These findings are consistent with more recent analyses of data collected by the AAA Foundation for Traffic Safety, which reveal that 41 percent of U.S. drivers surveyed in 2010 reported falling asleep or nodding off while driving at least once in

their lifetime, with 11 percent reporting that they did so within the past year and 4 percent reporting that they did so in the past month (Tefft, 2010); and 32 percent of U.S. drivers surveyed in 2011 admitted that they had driven while they were "so sleepy that [they] had a hard time keeping [their] eyes open" within the past month (AAA Foundation for Traffic Safety, 2011). Moreover, an analysis of actual U.S. crash data from 1999 to 2008 in which at least one passenger vehicle was towed from the scene of the crash revealed that a drowsy driver was involved in 16.5 percent of fatal crashes, 13.1 percent of crashes resulting in hospitalization, and 7 percent of all crashes (Tefft, 2010). The AAA Foundation also found that among drivers surveyed in 2010 who reported falling asleep while driving in the past year, over half did so while driving on a high-speed divided highway or after driving for less than an hour, and more than a quarter did so between the day-time hours of noon and 5:00 p.m. (Tefft, 2010).

Researchers from academia and government have provided additional information illustrating the magnitude of drowsy driving as a societal problem in the United States. In a study that continuously observed drivers of 100 video-instrumented cars for more than 42,000 miles in naturalistic driving conditions, researchers at the Virginia Polytechnic Institute and State University investigating driver performance and behavior in the moments leading up to a motor vehicle crash found that 22 percent of all motor vehicle crashes and 16 percent of near-crashes could be attributed to drowsy driving (Dingus et al., 2006). Furthermore, NHTSA data reveal that drowsy driving was reportedly involved in 2.2 to 2.6 percent of total fatal crashes and in 2.0 to 2.3 percent of total non-fatal injury crashes annually

nationwide between 2005 to 2009 (NHTSA,2011). During this 5-year period, the number of fatalities in crashes on U.S. roadways decreased slightly, while the proportion of such fatalities reported to involve drowsy driving remained relatively consistent at between 2.3 and 2.7 percent (NHTSA, 2011, p. 1, Table 1). NHTSA estimates that in 2009, 2.0 percent of all crashes with non-fatal injuries (approximately 30,000 out of 1.5 million total non-fatal injury crashes) and 1.3 percent of all police-report crashes (72,000 out of 5.5 million total fatal, non-fatal injury, and property-damage-only crashes) on U.S. roadways involved drowsy driving (NHTSA, 2011, p. 2, Table 2).

Federal researchers also have reported stark differences between states in the percentage of fatalities in crashes reported to involve drowsy driving. NHTSA data from 2009 reveal that these state percentages ranged from zero to 9.4 percent, with a median value of 2.4 percent (NHTSA, 2011). In an analysis of data from a set of questions about insufficient sleep administered through the Behavioral Risk Factor Surveillance System (BRFSS) in 19 states and the District of Columbia in 2009 and 2010, researchers from the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services found that state-level self-reported drowsy driving prevalence in these jurisdictions ranged from 2.5 percent, 95% CI [1.8, 3.3] in Oregon to 6.1 percent, 95% CI [4.6, 8.2] in Texas, and that 4.2 percent of the 147,076 respondents from these jurisdictions reported having fallen asleep while driving at least one time during the previous 30 days (Wheaton, Chapman, Presley-Cantrell, Croft, & Roehler, 2013, Table 1).

The CDC study of 2009-2010 BRFSS data also revealed a number of differences in self-reported drowsy driving prevalence between demographic groups (Wheaton et al., 2013, Table 1). Males were more likely to report drowsy driving than females (5.3% versus 3.2%); non-Hispanic whites were less likely to report drowsy driving than other racial or ethnic groups (3.2% versus 6.1% for non-Hispanic blacks, 5.9% for Hispanics, and 6.0% for persons of other race and ethnicity); and retirees (1.0%), students or homemakers (2.1%), and unemployed respondents (3.1%) were less likely to report drowsy driving than those who were employed (5.1%) or unable to work (6.1%). In general, younger adults had higher drowsy driving prevalence rates than older adults (>4.9% among adults aged 18 to 44 years versus 1.7% among adults aged ≥65 years). No associations were observed between educational attainment and drowsy driving. However, respondents who reported frequent insufficient sleep, a daily sleep duration of six hours or less, snoring, or unintentionally falling asleep during the day also reported driving while drowsy more frequently than those who did not report these behaviors (Wheaton et al., 2013, Table 2 & Figure). Similar findings were reported in the CDC's more recent study on the association between drowsy driving and other risk behaviors based on an analysis of BRFSS data from 10 states and Puerto Rico in 2011 and 2012 (Wheaton, Shults, Chapman, Ford, & Croft, 2014).

2.1.2 Populations Vulnerable to Drowsy Driving

Researchers have been able to identify certain population groups as being particularly at high-risk of experiencing drowsy driving crashes (Commonwealth of

Massachusetts, 2009, pp. 14-16; Di Milia et al., 2011; NCSDR/NHTSA,1998, pp. 16-18). Among these groups are:

1. young persons between the ages of 16 and 29 years, especially males between the ages of 16 and 24 years (Commonwealth of Massachusetts, 2009, p. 14; McCartt, Ribner, Pack, & Hammer, 1996, pp. 514-515; NCSDR/NHTSA,1998, pp. 16-17, 22; Pack et al., 1995; Tefft, 2010, p. 3);
2. shift workers, many of whom experience disrupted sleep because of night work or long or irregular hours (NCSDR/NHTSA, 1998, pp. 16-18; Stutts, Wilkins, Osberg, & Vaughn, 2003); and
3. people with untreated sleep apnea syndrome and narcolepsy (NCSDR/NHTSA, 1998, pp. 16-18).

These conclusions are supported by the findings from governmental and non-governmental data sources, which consistently indicate that young and inexperienced drivers (and especially young and inexperienced males) are at higher risk of engaging in drowsy driving behavior than older drivers.

As mentioned in **Section 2.1.1**, the CDC concluded from its analysis of 2009-2010 and 2011-2012 BRFSS data that younger adults had higher drowsy driving prevalence rates than older adults (Wheaton et al., 2013; Wheaton et al., 2014). Interestingly, the CDC's analysis of the 2009-2010 data revealed that drowsy driving prevalence was lower among adults ages 18 to 24 years than among adults ages 25 to 34 years (4.9% versus 6.3%). By contrast, the CDC's analysis of the 2011-2012 data from a different sample of U.S. jurisdictions revealed that drowsy driving prevalence

was higher among adults ages 18 to 24 years than among adults ages 25 to 34 years (5.9% versus 4.8%).

The AAA Foundation reported that among licensed drivers ages 16 to 24 years that it surveyed in 2012, 31 percent reported that they had driven while they were "so sleepy that they had a hard time keeping their eyes open" in the past 30 days, 18 percent reported having done so more than once in this time, and 5.7 percent reported having done so fairly often or regularly. Furthermore, one in seven (14.8%) of these young licensed drivers reported having fallen asleep or nodded off while driving within the past year, and 33 percent reported having done so at least once in their lifetime (AAA Foundation for Traffic Safety, 2012). Data from an earlier AAA Foundation survey revealed that drivers ages 16 to 24 years were nearly twice as likely to be involved in a drowsy driving crash as drivers ages 40 to 59 years (AAA Foundation for Traffic Safety, 2011, 2012).

In a 1994 survey of 1,000 randomly selected New York State licensed drivers, 26.2 percent of respondents in the 25 to 34 years age group (compared to 13.3% in the 16 to 24 age group and <19% in the 35+ age group) and 21 percent of males (compared to 12.2% of females) reportedly drove drowsy "sometimes or often" during the past year (McCartt et al., 1996, p. 515, Table 7). Moreover, in this survey sample, "[h]igher levels of education were associated with increased frequency of drowsy driving," and "[g]reater frequency of drowsy driving was associated with greater reported numbers of hours worked per week, working more than one job, working rotating shifts, and driving as part of work responsibilities" (McCartt et al., 1996, p. 514).

Over the past few decades, drowsy driving has been found to be highly prevalent among students at U.S. universities. For example, in studies of 263 (~74% female, average age = 20.9 years) and 1,039 (72% female, average age = 20.39 years) undergraduate students at the University of North Texas, 17 and 16 percent respectively reported falling asleep while driving (Taylor & Bramoweth, 2010; Taylor et al., 2008). Furthermore, in a study of 300 undergraduate and graduate students at a large religiously-affiliated private university in Utah, 32 percent reported having experienced a "dozing and driving" incident since the beginning of their college career (Lindsay et al., 1999). Among these students, 48 percent also reported experiencing a less severe dozing incident earlier in the same driving trip and 68 percent reported that they continued driving after experiencing the dozing and driving incident. The investigators for this study also estimated the annual incidence rate for fatalities attributable to driver fatigue or dozing and driving in university students to be 1.37 per 10,000, based on their analysis of 86 traffic fatalities involving students at the Utah university that occurred between 1981 and 1996.

Drowsy driving in young people outside of the U.S. also has been investigated extensively. In a study of Norwegian drivers, Sagberg (1999, Table 4) found that the strongest predictors of the probability of falling asleep while driving were annual driving distance ($OR = 1.14$, $p < .0001$) and being a male driver ($OR = 3.49$, $p < .0001$), and that age reduced the odds of having fallen asleep while driving by about 2 percent per year ($OR = 0.98$, $p < .0001$). Furthermore, Sagberg (1999, Table 1) found that years with driver's license appeared to have a protective effect on the odds of sleep involvement as a contributing factor in car crashes ($OR = 0.98$, $p = .01$).

Although age and gender were not found to impact the odds of sleep involvement in car crashes in this study, years with driver's license arguably may be considered a proxy for age of the driver.

In their prospective study of subjective and predicted sleepiness while driving in 47 young Australian drivers (ages between 18 and 25 years) over a four-week period, Smith and colleagues (2005) concluded from their data analysis that young drivers frequently drove at times of day of predicted sleepiness (>7% of the 2,518 driving episodes analyzed) and at times they felt sleepy (>23% of episodes). In a later survey study of 305 drivers in Queensland, Australia, Obst and colleagues (2011) found that males reported more frequently continuing to drive after noticing symptoms of being sleepy compared to females, χ^2 (9, 293) = 20.81, $p < .05$, with 6 percent of males (*cf.* 17% of females) indicating that they never drive after noticing symptoms of being sleepy and 36 percent of males (*cf.* 30% of females) indicating that they drive while sleepy relatively frequently. Males (39%) also were more likely to report having a "close call" on the road due to being sleepy compared to females (25%), χ^2 (1, 302) = 6.65, $p < .01$. Furthermore, drivers in the 25- to 34-years age group were significantly more likely to report driving after noticing symptoms of being sleepy than drivers in the 55- to 64-years age group, $F(5, 287) = 3.53$, $p < .05$, and the 65+ years age group, $F(5, 287) = 3.53$, $p < .01$, with 9 percent of drivers in the 25- to 34-years age group indicating that they never drove after noticing symptoms of being sleepy (*cf.* 20% of drivers in the 55- to 64-years age group and 23% of drivers in the ≥65 years age group) and 45 percent of drivers in the 25- to 34-years age group indicating that they drive while sleepy relatively frequently (*cf.* 22%

of drivers in the 55- to 64-years age group and 18% of drivers in the ≥65 years age group).

More recently, Martiniuk and colleagues (2013) conducted a prospective cohort study of young licensed drivers ages 17 to 24 years in New South Wales, Australia and found that young drivers who reported sleeping six or fewer hours per night had an increased risk for crash compared with those who reported sleeping more than six hours per night (Relative Risk = 1.21, 95% CI [1.04, 1.41]). Furthermore, crashes for young drivers who had reduced average sleep hours per night and reduced sleep hours on weekends were significantly more likely to occur between 8:00 p.m. and 6:00 a.m., with a relative risk of 1.66, 95% CI [1.15, 2.39] for 8:00 p.m. to 11:59 p.m. and a relative risk of 1.86, 95% CI [1.11, 3.13] for 12:00 a.m. to 5:59 a.m. (Martiniuk et al., 2013).

The categorization of younger and inexperienced drivers as a high-risk population for drowsy driving is consistent with findings on risk and hazard perceptions in young and inexperienced drivers from around the world. In studying the relationship between personality factors, risk perceptions, and driving behavior in a survey population of 159 young and inexperienced drivers between the ages of 17 and 20 years drawn from the student body at an Australian university, Machin and Sankey (2008) found that speeding while driving was strongly related to a lower aversion to risk-taking (*i.e.*, perceived danger of certain actions while driving), and that aversion to risk-taking partially mediated the effects of key aspects of personality on speeding behavior (*viz.*, excitement-seeking and altruism).

Smith and colleagues (2009) studied the impact of sleepiness on driving-related hazard perceptions in a sample of 32 "novice" (age range from 17 to 24 years, with a mean driving experience of 1.65 years) and 30 "experienced" (age range from 28 to 36 years, with a mean driving experience of 14.41 years) drivers drawn from the student body at an Australian university and found that the hazard perception skills of novice drivers were significantly slowed by mild increases in sleepiness, whereas the hazard perception skills of the more experienced drivers were relatively unaffected by mild increases in sleepiness. The additional 0.38 seconds in hazard response time observed in novice drivers with high sleepiness levels compared to those with low sleepiness levels was equivalent to 6.33 meters (~21 feet) of travel when driving at a speed of 60 kilometers per hour (~37 miles per hour).

These research findings on sleepiness and driving-related risk and hazard perception in young and inexperienced drivers are consistent with the findings of O'Brien and Mindell (2005) generally supporting the hypothesis that adolescents who reported sleep habits resulting in insufficient sleep also reported engaging in increased risk-taking behaviors compared to adolescents who reported obtaining more adequate sleep.

2.1.3 Attitudes and Perceptions About Drowsy Driving

Despite the high prevalence of drowsy driving reported among U.S. drivers, there appears to be great awareness among U.S. drivers of the dangers of drowsy driving. In the 1994 New York State drowsy driving survey, 54.7 percent of respondents reported that being drowsy (*i.e.*, "so tired you could easily fall asleep") greatly affected their ability to drive safely, and that being drowsy had a greater effect

on their ability to drive safely than either adverse weather or having two drinks of wine, beer, or liquor (McCartt et al., 1996; New York State Task Force on the Impact of Fatigue on Driving, 1994). Nonetheless, 54.6 percent of the survey respondents reportedly experienced driving while drowsy in the last year, with 2.5 percent reportedly driving drowsy "very often" in the last year. Moreover, 24.7 percent of the respondents reportedly fell asleep at the wheel at some point in their driving career, with 2.8 percent reportedly falling asleep at the wheel and crashing in their driving career; and 26.1 percent of the respondents reportedly knew someone who had a crash due to falling asleep at the wheel or drowsiness (McCartt et al., 1996, pp. 513-514, Tables 3 & 5).

Similar findings have been reported among drivers outside of the U.S. In analyzing data from an internet survey of 1,513 Norwegian drivers (55% male, 45% female, average age = 39.6 years) in 2003 to increase understanding of drivers' actions when feeling sleepy, Nordbakke and Sagberg (2007) found that although drivers generally had a good knowledge of the various risk factors for falling asleep while driving and that most drivers were aware of the most effective countermeasures to prevent falling asleep while driving, 73 percent of the drivers surveyed reported that they have continued driving even when they felt too tired to do so. Similarly, Obst and colleagues (2011) reported that although there appeared to be good awareness of the substantial risks associated with driving while sleepy in a survey sample of 305 Australian drivers (114 males, 191 females, average age = 44.67 years, age range 17 to 78 years), 77 percent of these drivers reported having driven while

sleepy, 20 percent reported driving while sleepy relatively frequently, and 30 percent reported having experienced a "close call" on the road due to being sleepy.

Significant social disapproval of drowsy driving behavior also appears to exist within U.S. society. The AAA Foundation found that among U.S. drivers surveyed in 2011, 96 percent viewed it as unacceptable to drive drowsy, 82 percent viewed it as unacceptable for someone to drive when they have trouble keeping their eyes open, and 56 percent rated drowsy drivers as "a very serious safety threat" (AAA Foundation for Traffic Safety, 2011). Furthermore, data from NHTSA's 2002 National Survey of Distracted and Drowsy Driving reveal that "[v]irtually all drivers believe that other drivers who drive while sleepy or drowsy are a threat to their own personal safety and that of their family[,]" with 95 percent perceiving this behavior by others to be a "major threat" and 5 percent perceiving it as a "minor threat" (NHTSA, 2002, pp. 52-53, Figure 18-A). The NHTSA survey did not detect significant differences between gender and age groups in perceived threat from other drowsy drivers: over 90 percent of the males, females, young drivers, and old drivers surveyed all perceived drowsy driving by others to be a major threat to their personal and family's safety. Males were slightly more likely to perceive drowsy driving by others to be a minor (6%), rather than a major (93%), threat to their personal and family's safety compared to female drivers (3% and 96%, respectively); and drivers in their 20s were more likely than other driver age groups to perceive drowsy driving by others as a minor (8%) rather than a major threat (91%) to their personal and family's safety (NHTSA, 2002, pp. 52-53, Figures 18-B & -C).

In their study of Queensland drivers, Obst and colleagues (2011) found that male drivers and younger drivers reported the lowest perceived personal risk in regards to driving while sleepy. Risk perceptions related to driving when sleepy were significantly different between age groups, $F(5, 292) = 4.25$, $p < .001$, with drivers in the 17- to 24-years age group perceiving driving when sleepy to be significantly less risky ($M = 7.61$, $SD = 1.42$) than drivers in the 45- to 54- years age group ($M = 8.57$, $SD = 1.51$), $F(5, 287) = 3.53$, $p < .05$, and drivers in the 55- to 64-years age group ($M = 8.67$, $SD = 1.41$), $F(5, 287) = 3.53$, $p < .001$. Risk perceptions related to driving at 4:00 a.m. (*i.e.*, corresponding approximately to the circadian nadir in humans, which is associated with low alertness) were significantly higher in females ($M = 6.02$, $SD = 2.61$) compared to males ($M = 5.27$, $SD = 2.50$), $\chi 2\ (9, 289) = 12.87$, $p < .05$.

In a study of 695 young (average age of 20.85 years) and relatively inexperienced (*i.e.*, between 6 and 24 months) drivers in Italy who were asked to rate on a 10-point scale (1 = "very low"; 10 = "very high") their likelihood (*i.e.*, perceived risk) of having a night-time car crash due to sleepiness and their level of concern (*i.e.*, worry) about the possibility of having such a crash, Lucidi and colleagues (2006) found that a driver's experience with drowsy driving and frequency of night-time driving in the past six months significantly influenced the driver's risk perception and worries related to night-time car crashes due to sleepiness. Subjects with no experience of night-time driving in the previous six months reported significantly higher perceived risk ($M = 5.1$, $SD = 2.9$) than in subjects who reportedly engaged in night-time driving "once a month" ($M = 4.3$, $SD = 2.5$) and "more than once a month" ($M = 4$, $SD = 2.5$), $F(2,680) = 12.9$, $p = .001$, Partial $\eta^2 = .026$; and significantly

higher worry ($M = 5.6$, $SD = 2.9$) than in subjects who reportedly engaged in night-time driving "once a month" ($M = 5.1$, $SD = 2.9$) and "more than once a month" ($M = 4.3$, $SD = 2.8$), $F(2,680) = 14.5$, $p < .001$, Partial $\eta^2 = .032$. Interestingly, Lucidi and colleagues observed without explanation that subjects with drowsy driving experience reported significantly higher perceived risk but significantly lower worry than subjects with no drowsy driving experience (Perceived Risk: $M = 4.7$, $SD = 2.5$ versus $M = 4.1$, $SD = 2.6$, $F(1,680) = 16.8$, $p = .001$, Partial $\eta^2 = .014$; Worry: $M = 4.5$, $SD = 2.9$ versus $M = 5.3$, $SD = 2.8$, $F(1,680) = 25.2$, $p < .001$, Partial $\eta^2 = .016$). Although no significant differences between gender groups were observed for risk perception or worry in this study, males were significantly more likely than females to report experiencing drowsy driving in the past six months (41.3% versus 27.3%, $\chi^2 = 14.9$, $df = 1$, $p < .001$) and night-time driving ($\chi^2 = 69.6$, $df = 2$, $p < .001$).

Numerous reasons and motivations for drowsy driving have been reported by researchers around the world. About a quarter of the respondents to the 1994 New York State drowsy driving survey reportedly drove drowsy during the past year while on a long trip (29.5%), at night (27.7%), due to lack of sleep (26.6%), or during the day (22.9%), whereas fewer than one in twenty of the respondents reportedly drove drowsy during the past year due to an illness or medical condition (4.6%), taking medications (3.5%), or drinking alcohol (1.8%) (McCartt et al., 1996, p. 513, Table 4). Nordbakke and Sagberg (2007, p. 8, Fig. 4) found that among Norwegian drivers who reported sometimes driving while tired ($n = 1,098$), the most frequently reported reasons for continuing to drive while fatigued or sleepy were short trips (60%),

appointments that had to be kept (39%), short distance remaining to destination (34%), and desire to arrive home from a road trip at a reasonable hour (32%) or from work quickly (23%).

Data from a 2006 public opinion poll of 750 Ontario drivers ranging in age from 16 to 93 years (M = 48; Males = 44% of polling sample) revealed that drivers were less concerned about fatigued or drowsy driving than about other traffic safety issues, with 59.6 percent of the drivers surveyed reporting that they thought fatigued or drowsy driving was a "serious" or "extremely serious" problem, compared with ~65 percent for driving while using cell phones and other forms of distracted driving, 69.2 percent for speeding, 71.9 percent for illicit drug-impaired driving, and 82.2 percent for alcohol-impaired driving (Vanlaar, Simpson, Mayhew, & Robertson, 2008, p. 307, Fig. 2).

2.1.4 Public Policy and Legal Interventions Against Drowsy Driving

The hazards to public health and safety associated with drowsy driving renders this issue a matter of public concern for which governments have a legitimate interest in addressing as a matter of public policy. Governments around the world have attempted to do so by proposing, developing, and implementing various legal, policy, and programmatic interventions to address drowsy driving (Jones, Lee, & Rajaratnam, 2010). These interventions have tended to address drowsy driving as a public safety issue rather than as a public health issue. As discussed later in this section, however, exceptions to this tendency exist.

In 2003, New Jersey became the first U.S. state to pass a law that specifically addresses drowsy driving in both non-commercial and commercial contexts, allowing

the possibility for proof that a person “fell asleep while driving or was driving after having been without sleep for a period in excess of 24 consecutive hours” to give rise to the same legal inference (*i.e.*, driving recklessly) as proof of intoxicated or drunk driving under New Jersey law ("An Act concerning vehicular homicide and amending N.J.S.2C:11-5 [Maggie's Law]," 2003). Although New Jersey remains the only U.S. state to pass a drowsy driving law to date, many states have introduced legislation to address drowsy driving since 2003. These legislative efforts generally have focused on addressing the public safety issues related to drowsy driving and have considered legalistic issues such as how drowsy driving should be defined and penalized (*i.e.*, as a traffic violation, misdemeanor, or felony) under the law (Jones et al., 2010). Since 2005, several bills have been introduced in the Massachusetts legislature that would authorize a number of administrative actions to be taken to address drowsy driving in Massachusetts, including procedural and administrative reforms that place greater importance on sleep issues in the state’s driving licensing processes, the training of law enforcement officers, and even the authority for law enforcement officers to take drowsy drivers into protective custody ("Drowsy Driving Act of 2005," 2005, § 12; "Drowsy Driving Act of 2008," 2008, §12).

Furthermore, Massachusetts lawmakers passed legislation in 2006 that authorized the creation of a special commission of stakeholders from various fields to consider whether the Commonwealth of Massachusetts should introduce legislation to increase penalties for drowsy drivers who cause accidents and to educate the public about drowsy driving ("An Act Further Regulating Driver Education and Junior Operators' Licenses," 2006, § 26). In its final report, the Massachusetts Special

Commission on Drowsy Driving reviewed much of the information presented in **Sections 2.1.1** through **2.1.3**, setting forth the case that drowsy driving is a public health and public safety issue and recommending a number of policy actions that address drowsy driving as such. Among the more public health-oriented recommendations (Commonwealth of Massachusetts, 2009, pp. 25-29) were endorsements for the passage of state legislation that would:

- "put mechanisms in place to educate the motoring public of the dangers of driving while impaired by drowsiness and to have a clear process of enforcement[]";
- require the Governor to proclaim an annual state "Sleep Awareness Week" (to bring attention to problems associated with sleep deprivation and fatigue) and to designate an annual state "Drowsy Driving Prevention Week" (to "bring special attention to the need for public awareness and action relative to the problems associated with drowsy driving and driver fatigue");
- encourage state agencies and private entities "to adopt policies associated with increasing public awareness about sleep, sleep disorders and the consequences related to sleep deprivation[]"; and
- to explore opportunities for the development of public-private partnerships to "promote public education and understanding of the important relationship of adequate sleep and safe driving."

Civil and criminal litigation has functioned as additional interventions against drowsy driving in society. For example, employers have been sued on a number of occasions by victims (or their surviving family members) of car crashes caused by drowsy employees driving home from work (Geiger-Brown, Lee, & Trinkoff, 2013, pp. 314-315, Table 14.2).

Unfortunately, the National Sleep Foundation has identified a number of gaps in state efforts to address drowsy driving as a matter of public policy, including that police officers are not trained on how fatigue affects driving performance; legal or

administrative enforcement mechanisms to handle the worst drowsy driving offenders are lacking; drowsy driving education generally has not been considered a priority in most jurisdictions; and the vast majority of states include information about fatigue or drowsy driving in their driver licensing manuals, but this information is often misleading or minimal (National Sleep Foundation, 2007, p. 2). Furthermore, the NSF articulates some challenges in moving forward that is typical of other public health campaigns:

> Like drugs and alcohol, fatigue needs to be addressed as a public health issue by dealing with the underlying causes of sleep deprivation such as lifestyles, work hours, shift work, or untreated sleep disorders, and as a public safety issue by employing traditional methods of traffic safety: education, enforcement, engineering, and evaluation.
>
> Considering the enforcement aspect, one must recognize that changes in law, whether through changes in prosecution or litigation, often take a great deal of time to establish. Typically, public opinion has to precede the change—there has to be sentiment in the public that something is wrong. As has been seen in the case of drunk driving, and will probably happen with drowsy driving, advocacy groups often need to bring the issue to the forefront of public consciousness.
>
> (National Sleep Foundation, 2007, p. 3)

At the national level in the U.S., most policy action to address drowsy driving has focused on commercial driving contexts. Several U.S. federal agencies have promulgated hours of service regulations for workers in commercial transport (commercial motor carriers) and a number of other industries and professions (Geiger-Brown et al., 2013, p. 310, Table 14.1). There also have been some efforts to address drowsy driving in the general driving public. In 2003, a National Drowsy Driving Act of 2003 was introduced in the U.S. Congress that was intended to provide incentives for U.S. states to develop traffic safety programs to reduce crashes

related to drowsy driving ("Maggie's Law: National Drowsy Driving Act of 2003," 2003). The proposed legislation would have authorized the granting of federal funds to state highway offices and other organizations for various public education purposes related to drowsy driving prevention.

2.1.5 Drowsy Driving and Health Behavior Theory

As mentioned in **Section 1.1**, some advocates have argued that principles derived from the Theory of Planned Behavior and other health behavior research should guide the development and implementation of more effective interventions against drowsy driving in the future, and that additional research on sleep and drowsy driving as a health behavior phenomenon is needed (NCSDR, 2011; Thiffault, 2011). This is consistent with the approach advocated by Robert Foss to incorporate human behavior theory into traffic safety interventions and practice:

> As the fundamental principle of a traffic-safety culture, every program, policy, and law whose goal is to reduce motor vehicle-related injuries and deaths should be derived from, or be demonstrably consistent with, well-documented fundamental principles of human behavior. To implement this principle, we should consciously and conscientiously use existing, well-supported theories in several of the social/behavioral sciences as guides in developing program and policy ideas. In cases where a strategy has been developed in the absence of theoretical guidance, it should be carefully vetted against sound theory before being implemented. (2007, p. 156)

This research study wholly embraces the spirit of Foss' argument.

2.2 Conceptual Framework: Behavior Theories

2.2.1 Theory of Planned Behavior

Originating as an extension of the Theory of Reasoned Action (TRA) to account for behaviors over which individuals have incomplete volitional control (*i.e.*,

the individual can decide at will to perform or not perform the behavior), the Theory of Planned Behavior (TPB) centers on the proposition that the best predictor of a person's behavior is the person's intention to perform a given behavior (Ajzen, 1991). In general, the stronger the person's intention to engage in a behavior, the more likely the person will be to engage in that behavior. This proposition assumes that behavioral intention encapsulates motivational influences on a behavior and are indicative "of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991, p. 181).

Behavioral intention, in turn, is determined by three preceding factors:

1. the person's *attitude toward the behavior*, or "the degree to which the person has a favorable or unfavorable evaluation or appraisal of the behavior in question";
2. the person's *subjective norm*, or "the perceived social pressure to perform or not to perform the behavior"; and
3. the person's *perceived behavioral control*, or "the perceived ease or difficulty of performing the behavior[,]" which is assumed to "reflect past experience as well as anticipated impediments and obstacles".

The relative importance of these three determining factors as predictors of behavioral intention is expected to vary for different behaviors and situations (Ajzen, 1991, p. 188). In general, however, the more favorable a person's attitudes and subjective norm and the greater the person's perceived control, the stronger should be the person's intention to perform the behavior in question (Ajzen, 2013a). Furthermore, the TPB postulates that perceived behavioral control can influence behavior directly,

especially where perceived behavioral control can be used as a substitute for a measure of actual control (Ajzen, 1991, pp. 184-185).

The three principal determinants of behavioral intention postulated by the TPB are influenced by a person's salient beliefs (Ajzen, 1991, pp. 189-198). Attitude toward the behavior is influenced by a person's *behavioral beliefs* or beliefs about the outcomes or consequences of performing a behavior, as well as the person's subjective evaluations of those outcomes or consequences. Subjective norm is influenced by a person's *normative beliefs* or beliefs about the extent to which individuals or groups important to the person ("referents") approve or disapprove of performing a behavior, as well as the person's motivation to comply with the referents' views. Perceived control is influenced by a person's *control beliefs* or perception of factors that inhibit or facilitate performance of the behavior, as well as the person's perceived power of these factors (Ajzen, 1991; Conner & Armitage, 1998; Rivis & Sheeran, 2003). The relationship between the various TPB constructs is illustrated in **Figure 2.1**.

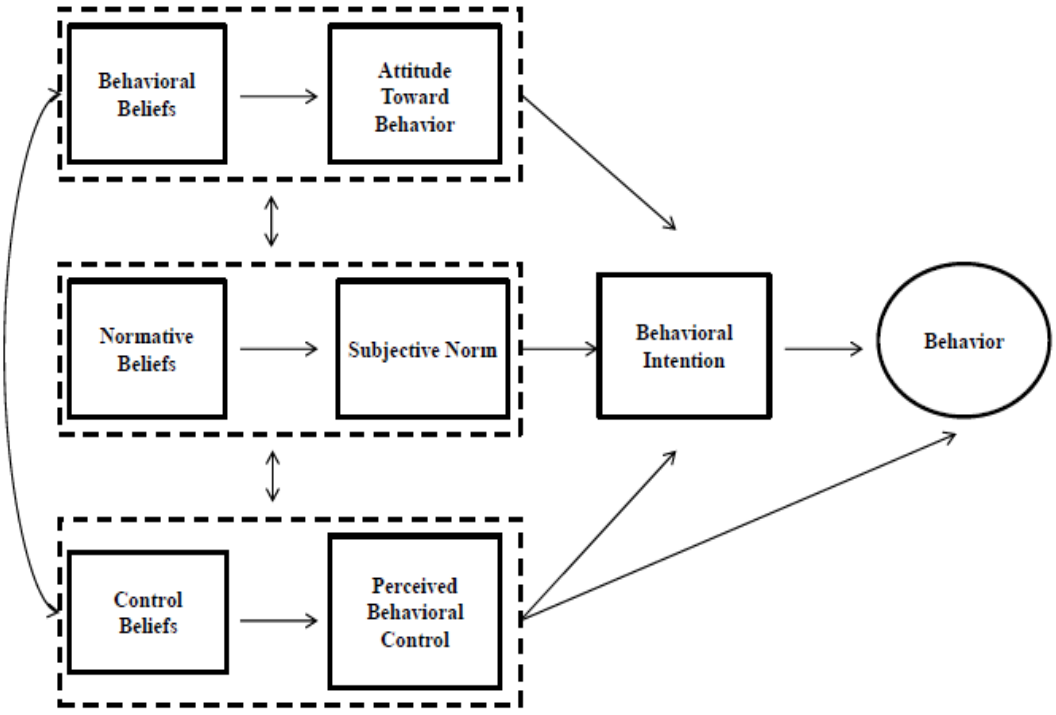

Figure 2.1. The Theory of Planned Behavior (TPB).

Since its proposal, the TPB has been applied to numerous health behaviors (Godin & Kok, 1996). Armitage and Conner (2001) found from their meta-analysis of 185 studies published through the end of 1997 that attitude toward the behavior, subjective norm, and perceived behavioral control together accounted for 39 percent of the variance in behavioral intention and 27 percent of the variance in explaining behavior. Furthermore, the TPB could account for 31 percent of the variance in prospective measures of self-reported behavior and 20 percent of the variance in prospective measures of observed behavior (Armitage & Conner, 2001, p. 482). From their analysis of 56 reported studies of 58 health-related behavioral applications of the TPB, Godin and Kok (1996) found that the TPB performed very well for explaining behavioral intention (averaged R^2 = .41), with attitude toward the behavior

and perceived behavioral control most often the significant variables responsible for this explained variation in intention; and for predicting behavior (averaged $R^2 = .34$), with intention being the most important predictor but perceived behavioral control significantly adding to the prediction in half of the studies analyzed.

2.2.2 Extending the TPB: Additional Variables

Icek Ajzen has noted that the TBP "is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behavior after the theory's current variables have been taken into account" (Ajzen, 1991, p. 199). Numerous researchers have accepted this invitation to extend the TPB, especially to address some of its deficiencies (Conner & Armitage, 1998). For example, to account for unhealthy or unsafe behaviors that are not consequences of rational decision-making (and thus address the TPB assumption that people are logical and rational in their decision-making), researchers have included variables such as *personal norm,* or an individual's perception of how a person such as himself or herself should behave (Godin & Kok, 1996); *moral norms*, or an individual's perception of the moral correctness or incorrectness of performing a behavior (Ajzen, 1991; Conner et al., 2007; Harland, Staats, & Wilke, 1999; Nemme & White, 2010); and *past regret*, or the negative, cognitive-based emotion experienced when an individual realizes or imagines that present circumstances could have been better had the individual acted differently in the past (Conner et al., 2007). Other variables that researchers have used to extend the TPB include *descriptive norm*, or a person's beliefs about the behavior of other people, especially referents (Forward, 2009; Rivis & Sheeran, 2003); *group norm*, which relate to a person's

explicit or implicit expectations regarding one's attitudes and behaviors as a member of a specific reference group within a specific context (Nemme & White, 2010); and *perceived risk*, or a person's subjective evaluation of the possibility that an event may occur and the probability that such an event will have a positive or negative outcome (Rosenbloom, Beigel, & Eldror, 2011; Zhou, Wu, Rau, & Zhang, 2009).

2.2.2.1 Adolescent Risk-Taking, Risk Perception, and Willingness

Several researchers have examined the interaction between constructs related to adolescent egocentrism and risk-taking behavior and those from the TRA and TPB. Some of these researchers have studied the relationship between the TRA constructs (*i.e.*, attitude toward the behavior and subjective norm) and two expressions of adolescent egocentrism in adolescence articulated by David Elkind in the 1960s: (1) *imaginary audience*, or adolescents' "false assumption that others are thinking about [them]" and are "preoccupied with thoughts about [them]"; and (2) *personal fable*, or "the tendency of adolescents to believe they are so unique that no one else can understand their problems or ever have their experiences[,]" which in turn leads to beliefs in their uniqueness and invulnerability (Elkind, 1967; Greene, Krcmar, Walters, Rubin, & Hale, 2000, p. 442; Greene, Rubin, & Hale, 1995, p. 551). In a study of 492 adolescents in junior high school, high school, and college in the southeastern U.S. that examined the effects of AIDS education messages targeted at adolescents, Greene and colleagues found that adolescent imaginary audience predicted greater sensitivity to subjective norm, that adolescent personal fable predicted more negative attitudes toward risk-avoiding behavior, that age was inversely related to both imaginary audience and personal fable, and that females

scored higher on imaginary audience and males scored higher on personal fable (Greene et al., 1995). From this and other studies, personal fable and especially invulnerability have been found to be negatively associated with perceived susceptibility, intention to avoid risk behaviors, and subjective norm in adolescents; and high imaginary audience has been found to be associated with increased inclination to comply with others, which may make adolescents behave more cautiously (Greene et al., 2000). Furthermore, adolescents with the highest level of self-reported risk behavior also were high in sensation-seeking and personal fable, while adolescents with low levels of self-reported risk behavior were low sensation-seeking with either high or low personal fable (Greene et al., 2000).

More recently, Chan and colleagues examined the relationship between a person's *sense of invulnerability to danger* (*i.e.*, a person's over-optimistic perception that he or she is less vulnerable than others to danger) and the TPB variables, theorizing that a person's sense of invulnerability would undermine the person's sense of perceived risk and expectations of negative consequences of a behavior, thereby resulting in less negative attitudes toward the behavior, overestimation of perceived behavioral control, and greater intention to perform the behavior in question (Chan, Wu, & Hung, 2010). In a study of 124 young licensed drivers in Macau, China, these researchers found that sense of invulnerability indirectly influenced a person's intention to drink and drive by promoting favorable attitudes toward and greater perceived behavioral control over drinking and driving.

Some researchers have proposed augmenting the TPB with constructs from the Prototype Willingness Model (PWM) of Adolescent Health Risk Behavior

developed by Gibbons and colleagues to predict behaviors that are considered impulsive (including those that are volitional, but unintended or unplanned) and socially undesirable (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008; Gerrard, Gibbons, Stock, Vande Lune, & Cleveland, 2005; Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons, Gerrard, Ouelette, & Burzette, 1998; Rivis, Abraham, & Snook, 2011). In explaining the development of the PWM, Gibbons and colleagues argued that "[a]lthough many adolescents do not intend to engage in risky behaviors, they do frequently find themselves in situations in which the opportunity to perform these actions is presented to them (*e.g.*, a party where cigarettes are available, an enthusiastic boyfriend or girlfriend who wants to have sex)[,]" so that "[i]n these settings, the issue is more appropriately framed as 'What are you willing to do?', which is not the same as 'What do you plan to do?'" (Gibbons, Gerrard, Blanton, et al., 1998).

The PWM maintains that two types of decision-making are involved in health behavior and that there are therefore two pathways to adolescent risk behavior: (1) a *reasoned path* similar to that described in the TRA and TPB involving more analytic processing to account for intentional or planned risk behaviors which originates with a person's positive attitudes toward performing the behavior and supportive subjective norms and proceeds through behavioral intentions (or "plans" to engage in a behavior) to behavior; and (2) a *social reaction path* involving more heuristic processing to account for unintended or unplanned behavior which originates with *risk prototypes* (*i.e.*, a person's images of the type of individuals who engage in particular risky behaviors) and proceeds through *behavioral willingness* (*i.e.*, a

person's openness to engaging in particular risky behaviors in circumstances that are conducive to that behavior even if the person had not previously intended or contemplated engaging in the behavior) to behavior (Gerrard et al., 2008; Gerrard et al., 2005; Gibbons, Gerrard, Blanton, et al., 1998). Previous behavior also is hypothesized to be an antecedent for both pathways (Gerrard et al., 2008, p. 36, Figure 1; Gibbons, Gerrard, Blanton, et al., 1998, p. 1169, Figure 2). With regard to the social reaction path, the PWM generally predicts that "the more strongly a person identifies with a particular prototype (prototype similarity), and the more favourably the image is viewed (prototype favourability), the more willing the person is to engage in the behaviour defined by the prototype"; and that "prototype favourability is more strongly predictive of willingness when individuals perceive themselves to be similar to the image associated with the behaviour" (Gibbons & Gerrard, 1995; Rivis et al., 2011, p. 447). The relationship between the various PWM constructs is illustrated in **Figure 2.2**.

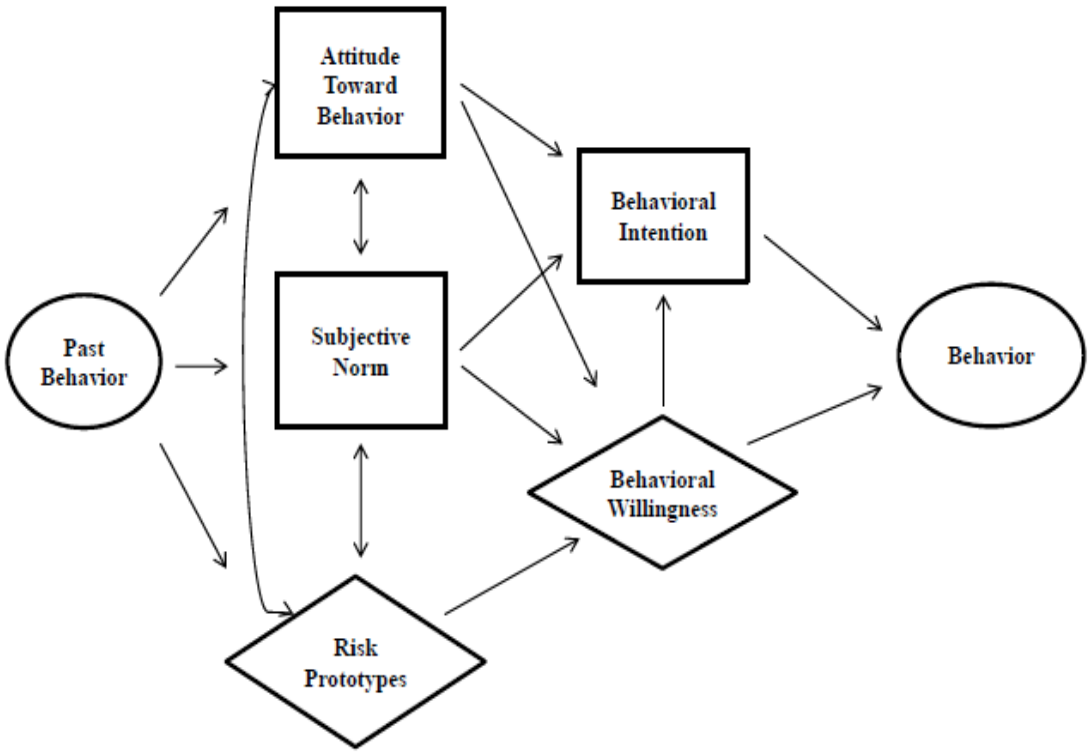

Figure 2.2. The Prototype Willingness Model (PWM). Rectangles represent constructs in the "reasoned path" and diamonds represent constructs in the "social reaction path" of the model.

The PWM maintains that both behavioral willingness and behavioral intention are functions of attitude toward the behavior, subjective norm, and past behavior. However, because of the PWM's focus on risk behavior, measurement of attitudes is more outcome-focused in the PWM than it is in the TRA and TPB, so that "the less danger or the less likelihood of negative outcome an individual associates with a particular risk behavior, the more willing he or she is to engage in that behavior" (Gibbons, Gerrard, Blanton, et al., 1998, p. 1165; Gibbons, Gerrard, Ouelette, et al., 1998).

Gibbons and colleagues have distinguished behavioral willingness from behavioral intention primarily by the reactive nature of the former and the

deliberative nature of the latter, with behavioral willingness characterized by a relative lack of planning or premeditation and self-focus compared to behavioral intention (Gibbons, Gerrard, Blanton, et al., 1998; Gibbons, Gerrard, Ouelette, et al., 1998). Whereas "intentions are plans that have been formulated in order to achieve a particular goal state through certain, instrumental actions" and "involve contemplation of the behavior and, usually, of its consequences[,]" willingness "does not involve goal states, plans, or instrumental actions" and "involves relatively little forethought, which means less consideration of outcomes or consequences" compared to behavioral intentions (Gibbons, Gerrard, Ouelette, et al., 1998, p. 321). Using the example of excessive drinking on college campuses to illustrate this distinction, Gibbons and colleagues explain:

> The student who states that he intends to get drunk this coming Friday night has made some commitment to the behavior and has spent some time considering its requirements and sequelae; the same would be true for the student who says he intends *not* to get drunk. Some students fall into a middle-ground category, however, [and] would be willing to drink, even to excess, *if* the opportunity is afforded, but getting drunk is not a goal for them. They have not given much thought to the prospect and have not specific plans as to how they might get drunk. Unlike the intending (or "willful") student, who creates risk opportunities, the willing student responds to them. (Gibbons, Gerrard, Ouelette, et al., 1998, pp. 321-322)

Furthermore, Gibbons and colleagues (Gibbons, Gerrard, Ouelette, et al., 1998) have hypothesized that compared to individuals who express a commitment (*i.e.*, intention) to engage in a particular risky behavior, individuals who express a willingness to engage in such a behavior are less likely to acknowledge and more likely to deny their personal vulnerability to those risks (*i.e.*, perceived risk, or likelihood that the

individual will experience the negative consequences associated with the risky behavior).

To test these theories and hypothesis, Gibbons and colleagues conducted a series of studies to demonstrate that willingness and intention are related but independent constructs, each of which can be cognitive antecedents to health risk behavior (Gibbons, Gerrard, Blanton, et al., 1998; Gibbons, Gerrard, Ouelette, et al., 1998). Using behavioral expectation (*i.e.*, an individual's assessment of the likelihood that he or she will actually engage in a particular behavior, which includes acknowledgment of relevant past behavior and estimations of opportunity) as a proxy for behavioral intention in these studies (*viz.*, of smoking behavior in adolescents and drunk driving in college students), Gibbons and colleagues found that behavioral expectations and behavioral willingness independently predicted subsequent involvement in risk behavior; and that behavioral expectations were independently associated with personal vulnerability, whereas no such independent association was observed between behavioral willingness and personal vulnerability (Gibbons, Gerrard, Ouelette, et al., 1998). Based on these and other findings, Gibbons and colleagues concluded that behavioral willingness and behavioral expectation (and by extension, behavioral intention) are related constructs that involve different cognitive processes; that individuals who intend to engage in a particular risky behavior acknowledge their personal risk (vulnerability); and that individuals who are only willing to engage in a particular risky behavior do not acknowledge their personal vulnerability and are "more likely to deny the relation between the risk behavior and its personal consequences" (Gibbons, Gerrard, Ouelette, et al., 1998, p. 336).

2.2.2.2 Past Behavior

Several researchers have used past behavior to extend the TPB (Conner & Armitage, 1998; Conner et al., 2007; Elliott, Armitage, & Baughan, 2003; Forward, 2009; Nemme & White, 2010). In fact, Ajzen proposed using measures of past behavior to test the sufficiency of the TPB, arguing that such measures "can be used to test the sufficiency of any model designed to predict future behavior" based on the theory that "past behavior is the best predictor of future behavior" (Ajzen, 1991, p. 202). Conner and Armitage have argued further that although past behavior does not cause subsequent behavior, "frequent performance of a behaviour may bring subsequent behaviour under the control of habitual processes and make subsequent performance more likely" (1998, p. 1436). In reviewing potential variables to add to the TPB, Conner and Armitage found that the addition of past behavior explained on average an additional 7.2 percent of the variance in intentions after taking into account attitude, subjective norm, and perceived behavioral control and 13.0 percent of the variance in behavior after taking into account perceived behavioral control and intentions (1998, pp. 1437-1438). In later years, Conner and colleagues cited such findings to conclude that "[p]ast behaviour is typically the strongest predictor of intention and behaviour, explaining variance over and above that accounted for by the TPB variables" (2007, p. 433).

In a study of 598 licensed drivers in the United Kingdom, Elliott and colleagues (2003) found that past behavior moderated the perceived behavioral control–behavioral intention and perceived behavioral control–future behavior

relationships in the TPB: both of these relationships decreased in strength with increasing frequency of past behavior.

2.2.3 Applications of Extended TPB Models to Driving Behavior

Over the past 20 years, researchers have applied the TPB successfully to predict intentions to engage in various driving behaviors in a number of populations around the world. One of the earliest of these studies was conducted by Parker and colleagues (1992), who found from a sample of 881 English drivers that attitude toward the behavior, subjective norm, and perceived behavioral control together explained significant proportions of the variance in intentions to commit four specific driving violations (42.3% with respect to drinking and driving, 47.2% with respect to speeding, 23.4% with respect to close following, and 31.7% with respect to dangerous overtaking).

Subsequent studies have examined the utility of the TPB in predicting intentions to engage in and subsequent performance (both self-reported and observed) of numerous driving behaviors that may be described as dangerous, impaired, or distracted. For example, Warner and Åberg (2006) used the TPB to predict the everyday speeding behavior of a sample of 112 Swedish drivers, reporting that the TPB variables could account for 39 percent of the variance in self-reported speeding and 28 percent of the variance in logged (observed) speeding. The investigators concluded that attitude toward the behavior, subjective norm, and perceived behavioral control were significant determinants of self-reported speeding; and that self-reported speeding and subjective norm but not perceived behavioral control contributed to the prediction of logged speeding in the drivers studied.

In a study of drivers in the United Kingdom, Conner and colleagues (2007) found that an "extended" TPB that included moral norms, anticipated regret, and past behavior as additional variables explained 82 percent of the variance in intentions to speed when speeding behavior was measured by performance on a driving simulator; and attitudes, moral norms, anticipated regret, and past behavior explained 76 percent of the variance in intentions to speed when speeding behavior was measured by an unobtrusive on-road speed camera assessment. Furthermore, intentions, perceived behavioral control, moral norms, and previous accidents accounted for a total of 35 percent of the variance in speed as assessed on a driving simulator; and intentions and moral norms accounted for a total of 17 percent of the variance in speed as assessed by on-road speed camera. Gender and age did not have an impact on intentions to speed or speeding behavior after controlling for the TPB and the additional variables, and past behavior showed a significant unmediated impact on intentions to speed but no such significant effect on speeding behavior, regardless of whether speeding behavior was measured by performance on a driving simulator or by speed camera assessment (Conner et al., 2007).

In a study of 169 university students in Australia (aged 17 to 24 years), Nemme and White (2010) reported that an extended TPB (with past behavior, group norm, and moral norm as additional variables) could explain significant proportions of the variance in intention to send (50.5%) and read (49.8%) text messages on a mobile phone while driving, as well as the subsequent behavior of sending (38.8%) and reading (49.1%) text messages on a mobile phone while driving. The investigators concluded that attitude predicted intentions to send and read text

messages while driving, that subjective norm and perceived behavioral control determined intentions to send but not read text messages while driving, and that intention but not perceptions of control predicted subsequent text sending and reading behavior.

Chan, Wu, and Hung (2010) found that an extended TPB model that included invulnerability to danger as an additional variable mediated by the principal TPB variables could explain a total of 79 percent of the variances in intention to drink and drive in a sample of 124 young Chinese licensed drivers in Macau (aged 19 to 35 years), that attitude toward the behavior and perceived behavioral control were the strongest predictors of intention, and that subjective norm and invulnerability indirectly influenced intention by promoting favorable attitudes toward and greater perceived behavioral control over driving after alcohol use. The TPB also explained 43 percent of the variance in intention to drive while using a hands-free mobile phone and 48 percent of the variance in intention to drive while using a hand-held mobile phone in a study of 164 students at a driving school in Beijing (aged 17 to 43 years), with perceived behavioral control identified as the strongest predictor of behavioral intention (Zhou et al., 2009).

Rivis and colleagues (2011) have examined the predictive utility of the TPB and PWM variables for young and older male drivers' willingness to drive while intoxicated. In a study of 200 male licensed drivers in a mid-sized English city, half of which were in the 17- to 29-year age group (M = 23.34, SD = 3.19) and the other half in the 30- to 60-year age group (M = 46.3, SD = 8.98), these researchers found that the TPB and PWM variables explained 62 percent of the variance in the

willingness of young male drivers to drive after drinking and 47 percent of the variance in the willingness of older male drivers to drive after drinking. Moreover, the interaction between prototype favorability and similarity contributed seven percent to the variance explained in the willingness of older males to drive after drinking. Rivis and colleagues further assert that their analyses of the study data indicate that: (1) "young male drivers are more willing to drive while intoxicated when they perceive little pressure from significant others to not drink and drive, have a favourable overall evaluation towards driving while intoxicated, believe they are similar to the drink-driver prototype, and find it difficult to never drive when there is any risk that they might be over the [blood alcohol concentration] limit"; and (2) older male drivers are more willing to drink and drive when they perceive little pressure from significant others to not drink and drive, find it difficult to never drive when there is any risk they might be over the limit, and when they have a favourable impression of, and identify with, the type of person who drives after consuming [alcohol]" (2011, pp. 450-451).

2.2.4 Drowsy Driving and an Extended Theory of Planned Behavior

Figure 2.3 illustrates the relationship between the theories reviewed in **Sections 2.2.1** through **2.2.3**. Based on these theories and the research associated with them, it is possible to construct an extended TPB model to predict intentions and willingness to engage in drowsy driving in young people (**Figure 1.1**). This extended TPB is augmented by the PWM construct of behavioral willingness and takes into account personal variables such as age, gender, past experiences and behaviors, risk perception, and sense of invulnerability to danger.

The inclusion of behavioral willingness, risk perception, and sense of invulnerability in the extended TPB model for drowsy driving takes into account the possibility that drowsy driving is a behavior that is not based on rational decision-making, as assumed by the traditional TPB model. As discussed in **Section 2.2.2.1**, the PWM was developed to predict adolescent risk behaviors that are volitional but unintended or unplanned, or that are socially undesirable, and includes both a reasoned path and a social reaction path of decision-making. Because a person may become unexpectedly sleepy or fatigued while driving yet decide to continue driving, drowsy driving may be characterized as a volitional but unintended or unplanned behavior. Furthermore, the driving public's apparent awareness of the health and safety risks associated with drowsy driving (see **Section 2.1.3**) suggests that drowsy driving behavior may be the result of illogical or irrational decision-making. Finally, as discussed in **Section 2.1.3**, U.S. society views drowsy driving with such disapproval that drowsy driving justifiably may be considered a socially undesirable behavior. Together, these considerations justify the inclusion of behavioral willingness (*i.e.*, a person's openness to engaging in particular risky behaviors in circumstances that are conducive to that behavior even if the person had not previously intended or contemplated engaging in the behavior) from the PWM's social reaction path in the extended TPB model for drowsy driving. Moreover, the research on risk perception, sense of invulnerability, and the TPB on dangerous driving behaviors in young and inexperienced drivers (see **Sections 2.1.3** and **2.2.3**) support the inclusion of these variables in the extended TPB model for drowsy driving.

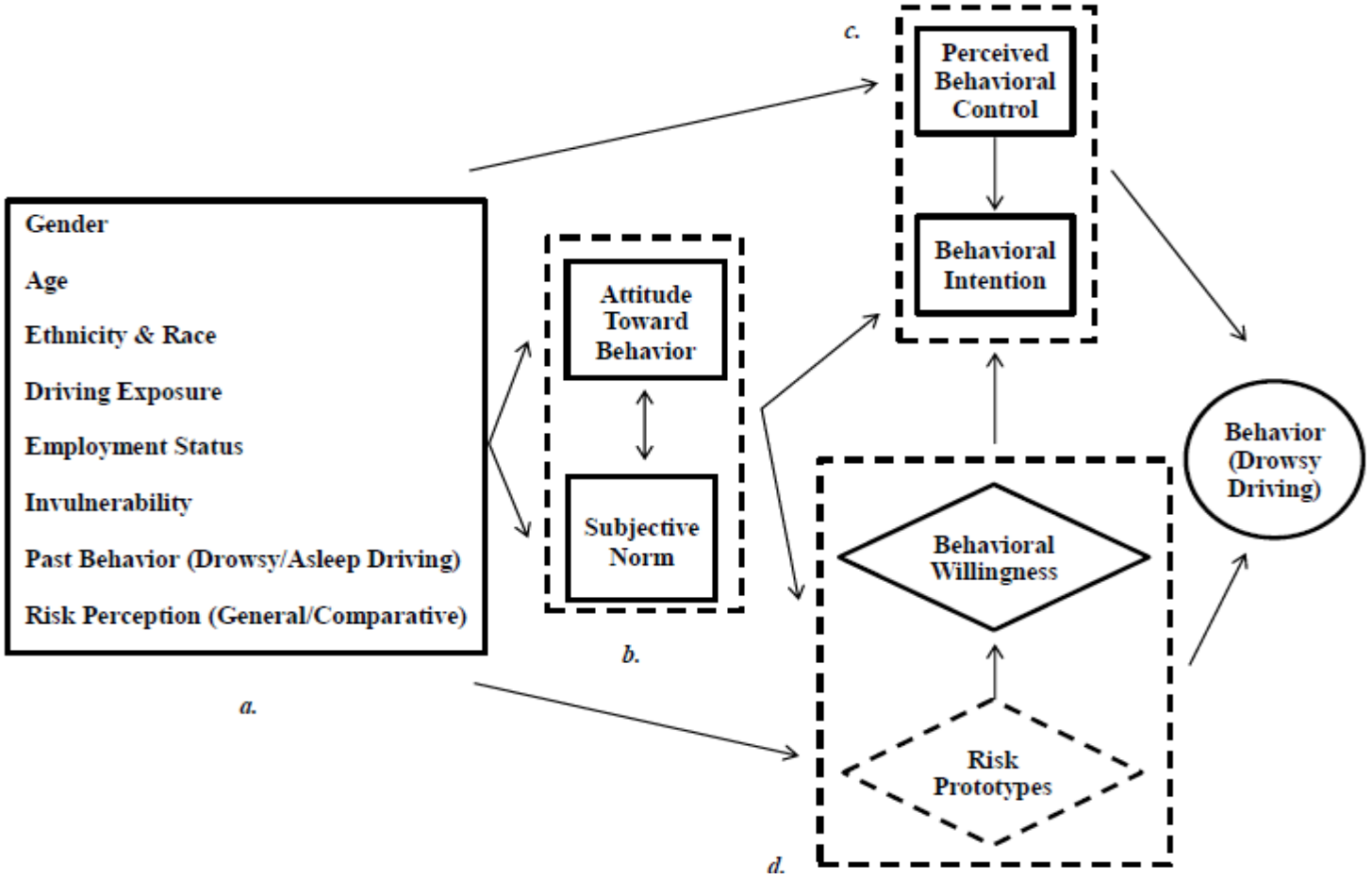

Figure 2.3. Conceptual integration of (*a*) personal variables; (*b*) constructs from the Theory of Reasoned Action (TRA); (*c*) constructs from the TPB that augment the TRA; and (*d*) constructs from the Prototype Willingness Model (PWM) that augment the TRA in the context of drowsy driving behavior.

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This descriptive study aims to examine the utility of the extended TPB model illustrated in **Figure 1.1** in predicting intentions and willingness to engage in drowsy driving in a population of university (undergraduate and graduate) students in the State of Maryland, U.S.A. Three drowsy driving situations with which many university students in Maryland are familiar were analyzed in this study to test the following hypotheses in the population to be studied:

Hypothesis 1: For all drowsy driving situations analyzed, intention to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, perceived behavioral control, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.

Hypothesis 2: For all drowsy driving situations analyzed, willingness to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.

Hypothesis 3: After controlling for personal variables, intention to engage in drowsy driving will be predicted by attitudes, subjective norm, perceived behavioral control, and behavioral willingness.

Hypothesis 4: After controlling for personal variables, willingness to engage in drowsy driving will be predicted by attitudes and subjective norm.

Hypothesis 5: Males will exhibit lower perceived risk, greater invulnerability to danger, and greater intention and willingness to engage in drowsy driving than females for all drowsy driving situations analyzed.

Hypothesis 6: For all drowsy driving situations analyzed, individuals who are employed while attending university will exhibit greater intention and willingness to engage in drowsy driving than individuals who are not employed while attending university.

Hypothesis 1 is derived from the extensive body of research on the applicability of various extended TPB models to dangerous driving behaviors reviewed in **Section 2.2.3**. Hypothesis 2 is derived from the extensive body of research on the applicability of various extended TPB models and the PWM to adolescent risk behavior reviewed in **Section 2.2.2.1** and to dangerous driving behaviors reviewed in **Section 2.2.3**. Hypotheses 3 and 4 are designed to test the predictive utility of the extended TPB model illustrated in **Figure 1.1**.[2] Hypotheses 1(b), 2(b), and 5 are derived from the research on age- and gender-related differences in the predictive utility of the TPB and PWM variables as applied to dangerous driving behaviors

[2] It should be noted that the extended TPB model for drowsy driving examined in this study (and illustrated in **Figure 1.1**) does not represent a complete integration of the TPB and PWM, as risk prototypes are not included in this model. Moreover, future drowsy driving behavior was not examined in this study.

reviewed in **Section 2.2.3** (*e.g.*, Chan et al., 2010; Rivis et al., 2011), as well as from the age- and gender-related differences observed in the data from survey studies and polls on drowsy driving prevalence rates, attitudes, and perceptions reviewed in **Sections 2.1.2** and **2.1.3**. Hypothesis 6 is derived from employment status-related differences observed in the data from survey studies and polls on drowsy driving prevalence rates reviewed in **Sections 2.1.1** and **2.1.2** (*e.g.*, McCartt et al., 1996; Wheaton et al., 2013).

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Chapter 3: Methods

3.1 Study Sample and Design

3.1.1 Population to be Studied

Undergraduate and graduate students of the University of Maryland, College Park (UMCP) were recruited for this descriptive study, with an initial target sample size of at least 300 questionnaire respondents (ideally 150 males and 150 females, evenly split between undergraduates and graduates). With this sample size, a correlation of

$r = .16$ could be detected with 80 percent power and a probability level of .05 using a two-tailed test. Furthermore, for comparisons of means between two independent groups within the population studied (*e.g.*, male versus female; undergraduates versus graduates; employed versus unemployed), a Cohen's *d* of 0.46 could be detected with 80 percent power and a probability level of .05 using a two-tailed test if 75 respondents per group could be recruited for the study. If 150 respondents per group could be recruited for the study, a Cohen's *d* of 0.32 could be detected with 80 percent power and a probability level of .05 using a two-tailed test.

Such a target sample size is consistent with recently reported studies that have applied the TPB to impaired or distracted driving behaviors in young drivers (Chan et al., 2010; Nemme & White, 2010; Zhou et al., 2009).

3.1.2 Sampling Procedure

Recruitment efforts consisted of announcements disseminated through UMCP-affiliated websites and social media sites, UMCP campus e-mail lists, flyers posted around the UMCP campus, direct e-mails to UMCP students, and other means

of communicating with UMCP's undergraduate and graduate student bodies pursuant to UMCP policies.

Students interested in participating in the study as respondents were directed to a website through which the questionnaire described in **Section 3.2.1** and reproduced in **Appendix 1** was administered. As an incentive to participate in this study, students who completed the questionnaire became eligible to enter into a raffle to win one of ten $25 electronic Gift Cards from their choice of Amazon.com, iTunes®, or Starbucks®. Assuming that the target sample size of 300 respondents could be achieved, the odds of winning a gift card would be one in thirty.

3.2 Measurement

3.2.1 Questionnaire

Respondents were asked to complete an online questionnaire that was developed and administered using Qualtrics™ (see **Appendix 1**). The questionnaire was designed to collect background information about the respondent and his or her past driving behavior; to measure the respondent's attitudes, subjective norm, perceived behavioral control, behavioral intention, behavioral willingness, and risk perceptions for the three drowsy driving situations described below; and to assess the respondent's sense of invulnerability to danger. The TPB-related items in the questionnaire (**Sections 3.2.1.2** to **3.2.1.5**) were modeled after those used by Elliott and colleagues (2003), Zhou and colleagues (2009), Nemme and White (2010), and Chan and colleagues (2010) to assess the applicability of extended TPB models to a number of risky driving behaviors (*viz.*, driver compliance with speed limits, mobile phone use while driving, and drunk driving). Additional modifications to the design

of the questionnaire were informed by guidance published by Icek Ajzen (2013a) and Montaño and Kasprzyk (2008). An overview of the scale-based items on the questionnaire is presented in **Table 3.1**.

Three drowsy driving situations were presented on the questionnaire to the respondents using the following texts:

> ***Situation A*:** You are driving home from campus for the summer on a Sunday morning. You've spent the past 2 weeks writing term papers and studying for final exams, the last of which took place the previous Thursday. You spend Thursday night and much of Friday celebrating the end of the school year. On Saturday morning, you finally start to pack and move out of your dormitory/off-campus housing. The packing and moving out process continues late into Saturday night and the very early morning hours of Sunday morning. You grab a few hours of sleep before starting on your 500 mile trip home at 10:00 AM on Sunday. As you drive on the Capital Beltway out of College Park, you find yourself having a hard time keeping your eyes open.
>
> ***Situation B*:** You are studying for Fall mid-term exams, which are scheduled to take place from Wednesday afternoon through Friday morning. At 2:00 AM on the Wednesday of your first mid-term exam, you find yourself dozing off repeatedly at your desk as you try to read through your textbook one last time. You decide to drive down to the 24-hour convenience store 1.5 miles away to get some coffee and a snack to help you stay alert. As you drive down Route 1 in College Park, you find yourself having a hard time keeping your eyes open.
>
> ***Situation C:*** It's the Friday evening at the start of Spring Break, and you have a flight to catch. One of your friends also has a flight to catch that evening, and you've already agreed to pick him/her up at his/her apartment so that you can ride to the airport together. For the past week, you have been studying for mid-term exams and have gotten less than 4 hours of sleep a night. As you drive to your friend's apartment, you find yourself having a hard time keeping your eyes open.

These texts were developed in consultation with five individuals (three males and two females, ranging in ages from 19 to 25 years) who had completed at least one year of post-secondary education at a two- or four-year institution in the U.S. and who were

licensed drivers. Five drowsy driving situations were drafted based on the input of these five individuals regarding their opinions about drowsy driving (*e.g.*, "What do you think of drowsy driving? How would you define drowsy driving?"), their past experiences with drowsy driving (*e.g.*, "If you have driven while drowsy in the past, why did you do so?") or circumstances in which they might engage in drowsy driving (*e.g.*, "Even if you have not driven while drowsy in the past, in what sort of circumstances might/would you drive while drowsy?"), and their perceptions of how people important to them view drowsy driving (*e.g.*, "Who do you look up to when it comes to modeling your driving behavior, and how do you think these individuals feel about drowsy driving?"). These individuals subsequently were asked to review the five drowsy driving scenarios and to rate each for their *plausibility* (*i.e.*, "Is the scenario believable?"), *probability* (*i.e.*, "How likely is it for a University-aged person to experience this scenario?"), and *clarity* (*i.e.*, "Is the scenario easy to understand?") on a 5-point scale (1 = Low; 5 = High). Rating scores for plausibility, probability, and clarity were added up to calculate a composite score for each situation. The situations with the three highest composite scores were selected for use in this study as Situations A, B, and C.

Table 3.1

Overview of Scale-Based Measurements of Extended TPB Model Variables: Questionnaire Items, Scoring, and Ranges

Construct/Variable	Questionnaire Items			Scoring	Possible Score Range
	Situation A	Situation B	Situation C		
Attitude Toward the Behavior	Q18(a)(1) *to* Q18(a)(5)	Q18(b)(1) *to* Q18(b)(5)	Q18(c)(1) *to* Q18(c)(5)	7-point unipolar semantic differential scales.	
	[5 items]	[5 items]	[5 items]	Mean score for the 5 items represent a composite score for attitude measure for each situation.	1 *to* 7
Subjective Norm	Q19(a) *to* Q21(a)	Q19(b) *to* Q21(b)	Q19(c) *to* Q21(c)	7-point unipolar scale.	
	[3 items]	[3 items]	[3 items]	After reversing the scores for Q19(a), (b), and (c), mean scores for the 3 items are calculated to produce a composite score for subjective norm for each situation.	1 *to* 7
Perceived Behavioral Control	Q22(a) *and* Q23(a)	Q22(b) *and* Q23(b)	Q22(c) *and* Q23(c)	7-point unipolar scale.	
	[2 items]	[2 items]	[2 items]	Mean score for the 2 items represent a composite score for perceived behavioral control for each situation.	1 *to* 7

Construct/Variable	Questionnaire Items: Situation A	Situation B	Situation C	Scoring	Possible Score Range
Behavioral Intention	Q24(a) *to* Q27(a) [4 items]	Q24(b) *to* Q27(b) [4 items]	Q24(c) *to* Q27(c) [4 items]	7-point unipolar scale. After reversing the scores for Q26(a), (b), and (c), mean scores for the 3 items are calculated to produce a composite score for behavioral intention for each situation.	1 *to* 7
Behavioral Willingness	Q28(a)(1) *to* Q28(a)(3) [3 items]	Q28(b)(1) *to* Q28(b)(3) [3 items]	Q28(c)(1) *to* Q28(c)(3) [3 items]	7-point unipolar scale. After reversing the scores for Q28(a), (b), and (c), mean scores for the 3 items are calculated to produce a composite score for behavioral willingness for each situation.	1 *to* 7
Risk Perception (General)	Q29(a)(1) *to* Q29(a)(3) *and* Q31(a)(1) [4 items]	Q29(b)(1) *to* Q29(b)(3) *and* Q31(b)(1) [4 items]	Q29(c)(1) *to* Q29(c)(3) *and* Q31(c)(1) [4 items]	7-point unipolar scale. For each situation, the mean score for the three Q29 items will be calculated and multiplied by the score for the first Q31 item to produce a composite score for general risk perception.	1 *to* 7 (Individual Items) 1 *to* 49 (Composite Score)
Risk Perception (Comparative)	Q30(a)(1) *to* Q30(a)(3) *and* Q31(a)(2) [4 items]	Q30(b)(1) *to* Q30(b)(3) *and* Q31(b)(2) [4 items]	Q30(c)(1) *to* Q30(c)(3) *and* Q31(c)(2) [4 items]	7-point unipolar scale. For each situation, the mean score for the three Q30 items will be calculated and multiplied by the score for the second Q31 item to produce a composite score for comparative risk perception.	1 *to* 7 (Individual Items) 1 *to* 49 (Composite Score)

Construct/Variable	Questionnaire Items			Scoring	Possible Score Range
	Situation A	Situation B	Situation C		
Invulnerability to Danger	Q32(1) to Q32(12) [12 items]			7-point unipolar scale. These scores will be added together to calculate a composite score for danger invulnerability.	1 *to* 7 (Individual Items) 12 to 84 (Composite Score)

Note: TPB = Theory of Planned Behavior

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3.2.1.1 Demographic and Health Information

Background information collected from respondents included gender, age, education level, ethnicity and race, citizenship status, the participant's state of residence as indicated by his or her permanent mailing address, driver's license status, driving exposure (*i.e.*, years of driving experience, years with a driver's license, access to motor vehicles, frequency of driving, and average miles driven per year), and employment status and conditions (Q1 to Q10). Respondents also were asked whether they had any conditions or took any hypnotic agents, central nervous system depressants (*e.g.*, alcohol), or other pharmacologic agents that induce sleepiness (Q11 to Q13); and whether they had any sleep-reducing conditions or took any wake-promoting therapeutics (*e.g.*, caffeine), central nervous system stimulants (*e.g.*, amphetamines), or other pharmacologic agents (Q14 to Q17).

3.2.1.2 Attitude Toward the Behavior

Attitude toward the behavior was measured directly by asking respondents to complete the following statement for the three situations presented by rating five pairs of adjectives on 7-point unipolar semantic differential scales: "For me, driving while feeling drowsy or sleepy in this situation would be ____." The five pairs of adjectives were: bad – good, dangerous – safe, unpleasant – pleasant, unnecessary – necessary, foolish – wise (Question 18). Each item was scored from 1 to 7, and mean scores for each item were calculated to produce a composite score for attitude for each situation. These adjective pairs were based on the recommendations of Ajzen (1991, 2013a, 2013b) and have been used in other studies of the TPB variables as

applied to various dangerous driving behaviors (Chan et al., 2010; Nemme & White, 2010; Zhou et al., 2009).

3.2.1.3 Subjective Norm

Subjective norm was measured for the three situations presented by calculating the mean score of three items, each rated on a 7-point unipolar scale ranging from 1 to 7. The three items were:

> [Q19] ‘‘People who are important to me would hope that I would *not* drive while feeling drowsy or sleepy in this situation” (*strongly disagree to strongly agree*).
>
> [Q20] ‘‘People who are important to me would (*disapprove–approve*) of my driving while feeling drowsy or sleepy in this situation.”
>
> [Q21] ‘‘People who are important to me would think that I (*should not–should*) drive while feeling drowsy or sleepy in this situation.”

These items were adapted from those used by several groups of researchers who have investigated the TPB variables for numerous dangerous driving behaviors (Chan et al., 2010; Elliott et al., 2003; Nemme & White, 2010; Zhou et al., 2009). Scores for the first subjective norm item (Q19) were reversed before calculating the mean score of all three items.

3.2.1.4 Perceived Behavioral Control

Perceived behavioral control was measured for the three situations presented by calculating the mean score of two items, each rated on a 7-point unipolar scale ranging from 1 to 7. The two items were:

[Q22] “In this situation, I believe that I have the ability to drive while feeling drowsy or sleepy” (*strongly disagree to strongly agree*).

[Q23] “For me, driving while feeling drowsy or sleepy in this situation would be ____.” (*extremely difficult to extremely easy*).

These items were adapted from those used by several groups of researchers who have investigated the TPB variables for numerous dangerous driving behaviors (Chan et al., 2010; Elliott et al., 2003; Zhou et al., 2009).

3.2.1.5 Behavioral Intention

Behavioral intention was assessed for the three situations presented by calculating the mean score of four items, each rated on a 7-point unipolar scale ranging from 1 to 7. The four items were:

[Q24] “In such a situation, how likely is it that you will drive while feeling drowsy or sleepy?” (*extremely unlikely to extremely likely*).

[Q25] “In a similar situation in the future, do you intend to drive while feeling drowsy or sleepy?” (*definitely do not to definitely do*).

[Q26] “In a similar situation in the future, what is the degree that you will avoid driving while feeling drowsy or sleepy?” (*very little to very great*).

[Q27] “In a similar situation in the future, how likely or unlikely is it that you will drive while feeling drowsy or sleepy?” (*extremely unlikely to extremely likely*).

These items were adapted from those used by Zhou and colleagues in their investigation of cell phone use while driving (2009). Scores for the third behavioral

intention item (Q26) were reversed before calculating the mean score of all four items.

3.2.1.6 Behavioral Willingness

Behavioral willingness was measured for the three situations presented by asking the participant to rate on a 7-point unipolar scale ranging from 1 to 7 (*not at all willing to very willing*) their willingness to do the following if they were the driver in each of the drowsy driving situations provided: stop driving immediately to get some rest; drive a little further before stopping to get some rest; or continue driving until reaching their destination (Q28[1] to [3]). The scale for the first item (Question 28[1]) was reversed and a mean score for the three items was determined to calculate a composite score for behavioral willingness. This method is consistent with that developed by Gibbons and colleagues to measure behavioral willingness in adolescents (Gerrard et al., 2008; Gibbons, Gerrard, Blanton, et al., 1998).

3.2.1.7 Risk Perception

Two types of risk perception were measured for the three situations presented: "general" risk perception (*i.e.*, perceived risk in general) and "comparative" risk perception (*i.e.*, perceived risk compared to other people of the same age as the participant). For both types of risk perception, a composite score was calculated by multiplying the numerical scores from two sets of items:

1. the mean score of three items designed to measure the participant's perceived magnitude of the risk associated with each of the three drowsy driving situations presented (hereinafter "[Risk] Magnitude Items"); and

2. the score from a single item designed to measure the probability that the participant believes that he or she would be in each of the three drowsy driving situations presented (hereinafter "[Risk] Probability Item").

In mathematical terms, the composite score for risk perception is expressed as:

***Risk Perception Score* = (*Mean of Magnitude Items*) x (*Probability Item*)**

The three Magnitude Items for general risk perception were:

> [Q29(1)] "If you were the driver in this situation, how likely or unlikely is it that you will crash the car into something?"
>
> [Q29(2)] "If you were the driver in this situation, how likely or unlikely is it that you will drive in an unsafe manner?"
>
> [Q29(3)] "If you were the driver in this situation, how likely or unlikely is it that you will injure yourself or others?"

These items were adapted from those used by researchers who have investigated young peoples' risk perceptions of numerous dangerous driving behaviors (Lucidi et al., 2006; Zhou et al., 2009). The Probability Item for general risk perception was: "Thinking about yourself generally as a driver, how likely is it that you would find yourself in this drowsy driving situation?" (Q31[1]).

Similar Magnitude (Q30[1] to [3]) and Probability (Q31[2]) Items were used to measure comparative risk perception, except that each statement was modified with the phrase "compared to others your age." Thus, for example, the Probability Item for comparative risk perception was: "Thinking about yourself generally as a driver, compared to others your age, how likely is it that you would find yourself in this drowsy driving situation?"

All Magnitude and Probability Items were rated on a 7-point unipolar scale ranging from 1 to 7 (*extremely unlikely* to *extremely likely* for items related to general risk perception; *extremely less likely than others* to *extremely more likely than others* for items related to comparative risk perception). Consequently, the composite score for both types of risk perception measured could range from 1 to 49.

3.2.1.8 Invulnerability to Danger

Invulnerability was measured using the 12 items pertaining to danger invulnerability from the Adolescent Invulnerability Scale (Duggan, Lapsley, & Norman, 2000; Lapsley & Hill, 2010), which has demonstrated strong reliability (Duggan et al., 2000 [Cronbach's alpha = .85]; Lapsley & Hill, 2010 [Cronbach's alpha = .76]) and significant correlations with risk behaviors in young people (Duggan et al., 2000 [$r = .43$, $p < 0.00$]). The 12 danger invulnerability items (Q32[1] to [12]) were:

1. I'm unlikely to be injured in an accident.
2. Nothing bad will happen to me when I go to a place by myself.
3. There are times when I think I am indestructible.
4. I could probably drink and drive without getting into an accident.
5. I'm unlikely to get hurt if I did a dangerous thing.
6. Special problems, like getting an illness or disease, are not likely to happen to me.
7. Nothing can harm me.
8. The problems that happen to people my age are unlikely to happen to me.

9. Driving very fast wouldn't be dangerous if I were driving.
10. Taking safety precautions is far more important for other people than it is for me.
11. Safety rules do not apply to me.
12. It is not necessary for me to worry about being injured or harmed.

All of these items were scored on a 7-point unipolar scale ranging from 1 to 7 (*strongly disagree* to *strongly agree*) and added together to calculate a composite score for danger invulnerability.

3.2.1.9 Previous Driving Behavior

Previous driving behavior relevant to the study was measured by having respondents identify the number of times they had engaged in various driving behaviors in the past 30 days, in the past 12 months (or since starting their studies at UMCP), and in their lifetime. The driving behaviors were:

[Q33] Driving a motor vehicle while being so drowsy or sleepy that the driver had a hard time keeping his or her eyes open.

[Q34] Falling asleep or nodding off while driving a motor vehicle, even just for a second or two.

[Q36] Driving a motor vehicle to run a personal errand at night.

[Q37] Driving a motor vehicle to run a personal errand at night while feeling drowsy or sleepy.

[Q38] Driving a motor vehicle to an off-campus location at the end of an academic year (*i.e.*, for the summer) since starting at university.

[Q39] Driving a motor vehicle to an off-campus location at the end of an academic year (*i.e.*, for the summer) while feeling drowsy or sleepy since starting at university.

[Q40] Driving a motor vehicle to a social or professional engagement that the driver was obligated to attend.

[Q41] Driving a motor vehicle to a social or professional engagement that the driver was obligated to attend while feeling drowsy or sleepy.

Q33 and Q34 relate to the participant's general experience engaging in drowsy driving behaviors (*viz.*, drowsy driving in Q33 and asleep driving in Q34); Q36 through 41 relate to the participant's experience engaging in the activities described in the three drowsy driving situations analyzed in this study. The responses to Q33 and Q34 were used to group the respondents into four categories of "past drowsy driving experience" and "past asleep driving experience": "Never" (*i.e.*, never in the past 30 days, 12 months, lifetime); "Ever" (*i.e.*, never in the past 30 days, but at least once in the past 12 months or lifetime); "Recent" (*i.e.*, once in the past 30 days; and "Frequent" (*i.e.*, more than once in the past 30 days).

3.2.2 Validity and Reliability

As indicated throughout **Section 3.2.1**, the various self-report scales included in the study questionnaire (**Appendix 1**) were adapted from similar scales that have been used widely and validated in previous studies of the TPB and PWM variables vis-à-vis dangerous driving behaviors. Consequently, there is reason to have confidence in the construct validity of the scales used in this study, even though validity was not assessed directly in this study. Furthermore, Cronbach's alpha

coefficients were calculated to assess the internal consistency of the scales in the study questionnaire.

These methods have been used to assess validity and reliability in numerous TPB studies involving road safety-related behaviors (Elliott et al., 2003; Elliott, Armitage, & Baughan, 2007; Holland & Hill, 2007; Zhou et al., 2009).

3.3 Study Timeline

Table 3.2 presents the timeline for this research study as it actually unfolded during Calendar Year 2014.

Table 3.2

Timeline for the Drowsy Driving Study at the University of Maryland, College Park

Date	**Event**
February 28, 2014	Thesis proposal defense and approval.
March 31 *to* April 16, 2014	Institutional Review Board review and approval.
April 16 *to* June 17, 2014	Data collection.
July *and* August 2014	Data analysis and final report.
September 18, 2014	Thesis Defense Meeting.

3.4 Analysis Plan

Zero-order correlations were calculated between the variables measured by the questionnaire for the three drowsy driving situations analyzed to assess Hypotheses 1 and 2. In addition, hierarchical multiple linear regression analyses were conducted to assess the contribution of the personal variables, TPB variables (augmenting the TRA variables), and PWF variables illustrated in **Figure 1.1** to the prediction of behavioral intention (*i.e.*, Hypothesis 3) and behavioral willingness (*i.e.*, Hypothesis 4) for the three drowsy driving situations analyzed. Two-tailed *t*-tests were used to assess differences between demographic groups based on gender (*i.e.*, Hypothesis 5), and employment status (*i.e.*, Hypothesis 6).

All statistical tests employed in this study were performed using the IBM® SPSS® Statistics Version 21.0 software for students. This study used the .05 level to define statistical significance.

3.5 Ethical Issues

The complete protocol for this study was submitted for review by the Institutional Review Board (IRB) for the University of Maryland, College Park on March 31, 2014 (IRB # 585643-1). The Student Investigator cooperated fully with IRB members to address the issues that arose from the IRB's review of the study protocol.

An approval letter from the IRB to begin this study with an initial maximum enrollment of 300 respondents was received on the morning of April 16, 2014 (IRB # 585643-2). In response to high rates of participation during the first week of the

study (*viz.*, 225 respondents by the morning of April 25), an amendment to increase maximum enrollment in the study to 700 respondents was submitted to the IRB on April 25 and approved on April 28 (IRB # 585643-3). Images of both IRB approval letters are provided in **Appendix 2**.

3.5.1 Informed Consent

All recruiting materials developed for this study informed the prospective participant of the purpose of the study, the procedures involved, steps taken to ensure the participant's confidentiality, potential risks and benefits of participating in the study, eligibility information for the gift card drawing, the contact information of the Student Investigator, and the participant's absolute right to withdraw from the study at any time for any reason without any detrimental consequences. Some of the messages and materials that were used to recruit respondents into this study are provided in **Appendix 3**.

Respondents gave their implied consent to participate in the study by completing the online questionnaire. A waiver of documented consent was requested from and approved by the IRB.

3.5.2 Confidentiality Procedures

No records linking specific questionnaires to the identities of individual respondents have been maintained. No personal identifiers were used to analyze and interpret the data collected in this study, and all results from this study have been reported in aggregate form. All raw data and information collected as part of this study have been stored on a password-protected computer and external hard drives owned by the Student Investigator. Both the password-protected computer and

external hard drives have been kept in a secure location at all times. At the conclusion of the study, any personal data collected from respondents for purposes of the gift card drawing will be destroyed. These measures have been designed to ensure that the identities and personal information of the respondents remain confidential throughout and after completion of the study.

Chapter 4: Results

4.1 Data Collection and Analysis

The online questionnaire was formally launched on the afternoon of April 16, 2014 and remained open for data collection until June 10. Additional data collection using the online questionnaire took place from June 11 until June 17. In all, 677 respondents started the questionnaire between April 16 and June 17, with 511 reaching the end of the questionnaire and deciding whether or not to enter the raffle. Data for all 677 of these questionnaire respondents were recorded for subsequent analysis. Because over 98% of these respondents (n = 668) took the questionnaire before the Spring 2014 UMCP Commencement Ceremonies on May 22 and 23, it can be deduced that the vast majority of respondents were enrolled as UMCP students during the Spring 2014 Term (January 27 to May 23).

The raffle drawing was conducted on June 18, with ten winners randomly drawn from a pool of 492 raffle entrants. All winners were notified via e-mail and given instructions on how to claim their electronic Gift Card prize.

4.2 Sample of Questionnaire Respondents Analyzed

4.2.1 Overview of the Sample

Of the 677 questionnaire respondents whose data were recorded, 24 did not respond to any of the questionnaire items and therefore were excluded from all of the data analyses conducted in this study. Of the remaining 653 respondents, another six were excluded from the data analyses because they identified themselves as being either UMCP faculty or alumni during the Spring 2014 Term. Finally, the oldest

respondent in the dataset (82 years) was excluded from the data analysis as an extreme outlier because the next oldest respondent was 62 years old and there were a total of four respondents who were over 60 years old and 20 respondents who were over 40 years old. As a result of all of these exclusions, a total of 646 respondents were used for data analysis (hereinafter "[questionnaire] respondents analyzed") in this study.

Some additional data cleaning was required for the set of 646 questionnaire respondents analyzed in this study. Two respondents who indicated that they were both undergraduate and graduate students at UMCP were recoded as being an "Other" type of UMCP student. The age for one respondent was changed from 1986 to 28 based on the assumption that the respondent had entered her birth year instead of her age in years in the questionnaire (2014 – 1986 = 28).

4.2.2 Demographic Characteristics

Summary demographic characteristics for the sample of questionnaire respondents analyzed in this study are presented in **Table 4.1**. The four respondents who did not indicate the level of education they were pursuing at UMCP are excluded from this summary table of demographic data. For purposes of comparison, summary demographic characteristics for students who enrolled at UMCP during the Spring 2014 Term as reported by the UMCP Office of Institutional Research, Planning, and Assessment (IRPA) also are presented in **Table 4.1**.

Among the undergraduate respondents, the following demographic characteristics were over-represented by at least 10 percentage points relative to the Spring 2014 UMCP undergraduate student body: females (68.2% versus 46.7%),

Maryland residents (86.8% versus 76.8%), and School of Public Health students (22.4% versus 7.6%). Conversely, males and out-of-state (non-Maryland resident) students were under-represented by at least 10 percentage points among the undergraduate respondents relative to the Spring 2014 UMCP undergraduate student body (31.8% versus 53.3% and 12.1% versus 23.2%, respectively). The undergraduate respondents also were under-represented by over 10 percentage points in the category of students enrolled in the Office of Undergraduate Studies, which includes undergraduate students who have not declared a major (1.6%, compared to 14.0% among Spring 2014 UMCP undergraduate students).

Among the graduate student respondents, the following demographic characteristics were over-represented by at least 10 percentage points relative to the Spring 2014 UMCP graduate student body: females (77.4% versus 47.7%), Maryland residents (74.2% versus 33.9%), U.S. citizens (85.5% versus 70.0%), whites (64.0% versus 45.3%), College of Education students (22.6% versus 9.1%), College of Information Studies students (23.1% versus 4.2%), and School of Public Health students (21.5% versus 2.6%). By contrast, the following demographic characteristics were under-represented by at least 10 percentage points among the graduate student respondents relative to the Spring 2014 UMCP graduate student body: males (22.6% versus 52.3%), out-of-state students (24.7 % versus 66.1%), foreign students (14.5% versus 30.0%), Robert H. Smith School of Business students (2.7% versus 16.6%), and A. James Clark School of Engineering students (3.8% versus 18.9%).

For all other demographic characteristics observed in this study, the frequencies observed among the undergraduate and graduate student respondents were within 10 percentage points of the frequencies reported by IRPA for the Spring 2014 UMCP undergraduate and graduate student bodies.

Table 4.1

Demographic Characteristics of Questionnaire Respondents Analyzed (N=642) and Students Enrolled at the University of Maryland, College Park (UMPC) during the Spring 2014 Term (N=36,102)

Characteristic	Questionnaire Respondents Analyzed[a]			UMCP Enrolled Students (Spring 2014)[b]	
	Undergraduate Students (*n* = 447)	Graduate Students (*n* = 186)	Other Students (*n* = 9)	Undergraduate Students (*n* = 26,474)	Graduate Students (*n* = 9,628)
Gender [*n* (%)]					
Male	142 (31.8)	42 (22.6)	2 (22.2)	14,100 (53.3)	5,038 (52.3)
Female	305 (68.2)	144 (77.4)	7 (77.8)	12,374 (46.7)	4,590 (47.7)
Residency [*n* (%)]					
In-State (Maryland)	388 (86.8)	138 (74.2)	8 (88.9)	20,332 (76.8)	3,262 (33.9)
Out-of-State	54 (12.1)	46 (24.7)	1 (11.1)	6,142 (23.2)	6,366 (66.1)
Other or Unknown	5 (1.1)	2 (1.1)	-	-	-
Citizenship [*n* (%)]					
U.S. (Domestic Students)	421 (94.2)	159 (85.5)	8 (88.9)	25,629 (96.8)	6,741 (70.0)
Foreign	18 (4.0)	27 (14.5)	1 (11.1)	845 (3.2)	2,887 (30.0)
Unknown	8 (1.8)	-	-	-	-
Race (Domestic Students) [*n* (%)][c,d]					
White	229[e] (51.2)	119 (64.0)	3 (33.3)	14,140 (53.4)	4,366 (45.3)
Black or African-American	33 (7.4)	13 (7.0)	1 (11.1)	3,295 (12.4)	681 (7.1)
Asian	92 (20.6)	14 (7.5)	3 (33.3)	4,131 (15.6)	661 (6.9)
American Indian or Alaska Native	1 (0.2)	0 (0.0)	0 (0.0)	35 (0.1)	11 (0.1)
Native Hawaiian or Other Pacific Islander	3 (0.7)	0 (0.0)	0 (0.0)	21 (0.1)	5 (0.1)
Two or More	18 (4.0)	5 (2.7)	0 (0.0)	939 (3.5)	163 (1.7)
Other or Unknown	6 (1.3)	2 (1.1)	0 (0.0)	707 (2.7)	494 (5.1)
Ethnicity (Domestic Students) [*n* (%)][c]					
Hispanic or Latino	39 (8.7)	6 (3.2)	1 (11.1)	2,361 (8.9)	360 (3.7)
Unknown	2[e] (0.5)	-	-	-	-

Characteristic	Questionnaire Respondents Analyzed[a]			UMCP Enrolled Students (Spring 2014)[b]	
	Undergraduate Students (n = 447)	Graduate Students (n = 186)	Other Students (n = 9)	Undergraduate Students (n = 26,474)	Graduate Students (n = 9,628)
College or School [*n* (%)][f]					
College of Agriculture and Natural Resources	30 (6.7)	3 (1.6)	0 (0.0)	1,176 (4.4)	383 (4.0)
School of Architecture, Planning, and Preservation	8 (1.8)	2 (1.1)	0 (0.0)	168 (0.6)	244 (2.5)
College of Arts and Humanities	68 (15.2)	6 (3.2)	1 (11.1)	2,772 (10.5)	867 (9.0)
College of Behavioral and Social Sciences	80 (17.9)	8 (4.3)	0 (0.0)	4,590 (17.3)	878 (9.1)
Robert H. Smith School of Business	40 (8.9)	5 (2.7)	0 (0.0)	2,639 (10.0)	1,596 (16.6)
College of Computer, Mathematical and Natural Sciences	74 (16.6)	29 (15.6)	2 (22.2)	4,363 (16.5)	1,343 (13.9)
College of Education	24 (5.4)	42 (22.6)	3 (33.3)	670 (2.5)	880 (9.1)
A. James Clark School of Engineering	53 (11.9)	7 (3.8)	0 (0.0)	3,799 (14.3)	1,824 (18.9)
Philip Merrill College of Journalism	17 (3.8)	0 (0.0)	0 (0.0)	517 (2.0)	57 (0.6)
College of Information Studies	1 (0.2)	43 (23.1)	0 (0.0)	0 (0.0)	409 (4.2)
School of Public Health	100 (22.4)	40 (21.5)	2 (22.2)	2,006 (7.6)	249 (2.6)
School of Public Policy	3 (0.7)	4 (2.2)	0 (0.0)	0 (0.0)	340 (3.5)
Office of Undergraduate Studies	7 (1.6)	0 (0.0)	0 (0.0)	3,700 (14.0)	0 (0.0)
Other	10 (2.2)	2 (1.1)	3 (33.3)	74 (0.3)	14 (0.1)

Note: Percentages may not add up to 100% because of rounding errors. UMCP = University of Maryland, College Park.

[a] Excludes 31 respondents from the total sample of questionnaire respondents (N = 677) as described in **Section 4.2.1** (*i.e.*, age outlier, faculty, alumni, and those who did not answer any questions once providing their consent). Also excludes four respondents who did not indicate their education level at UMCP. [b] Data reported by the UMCP Office of Institutional Research, Planning, and Assessment (IRPA). [c] Data on race and ethnicity are reported in the manner prescribed by IRPA and U.S. Government reporting requirements as described in: https://www.irpa.umd.edu/WhatsNew/new_ethnicity_explain.cfm. [d] Excludes eight (1.8%) undergraduate respondents whose citizenship status was unknown. [e] Includes two respondents who did not indicate whether they were of Hispanic or Latino origin, but who identified themselves as White. [f] Includes data from respondents who selected more than one UMCP College or School.

Summary statistics for the age distribution of the questionnaire respondents analyzed and the enrolled student body at UMCP during the Spring 2014 Term are presented in **Tables 4.2** and **4.3**, respectively. The age-related statistics for the questionnaire respondents exclude one respondent whose gender was unknown and include three respondents who identified their gender but who did not indicate their education level at UMCP. Visual representations of these age-related statistics are presented in **Figures 4.1** and **4.2** to facilitate comparisons between the respondents and the Spring 2014 UMCP student body.

In general, undergraduate respondents were younger than graduate respondents ($M = 21.27$ versus $M = 28.64$). Males were slightly older than females among the undergraduate respondents ($M = 21.64$ versus $M = 21.10$) and younger than females among the graduate student respondents ($M = 27.55$ versus $M = 28.96$). Furthermore, undergraduate respondents were slightly older than the Spring 2014 UMCP undergraduate student body ($M = 21.27$ versus $M = 20.97$), whereas graduate student respondents were slightly younger than the Spring 2014 UMCP graduate student body ($M = 28.64$ versus $M = 29.37$).

The observed age range for respondents was substantially smaller than the age range reported by IRPA for the Spring 2014 UMCP student body. It should be noted, however, that the age range for respondents becomes comparable to that of the Spring 2014 UMCP student body if the 82-year old respondent excluded from the data analysis as an extreme outlier is included when calculating the age-related statistics for the respondents.

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Table 4.2

Summary Statistics for Age Distribution of Questionnaire Respondents Analyzed

Summary Statistic	All Questionnaire Respondents Analyzed			Undergraduate Students			Graduate Students			Other Students
	Male (n = 187)	Female (n = 458)	All (n = 645[a])	Male (n = 142)	Female (n = 305)	All (n = 447)	Male (n = 42)	Female (n = 144)	All (n = 186)	All (n = 9)
M (*SD*)	22.97 (4.88)	23.71 (6.36)	23.49 (5.97)	21.64 (2.53)	21.10 (3.06)	21.27 (2.91)	27.55 (7.63)	28.96 (7.60)	28.64 (7.61)	28.11 (11.91)
Median	22	22	22	21	21	21	25.5	27	26	23
Mode	21	20	20	21	20	20	23	23[b]	23	18[b]
Range (Min., Max.)	42 (18, 60)	43 (18, 61)	43 (18, 61)	14 (18, 32)	34 (18, 52)	34 (18, 52)	38 (22, 60)	40 (21, 61)	40 (21, 61)	32 (18, 50)
IQR (Q1, Q3)	4 (20, 24)	5 (20, 25)	5 (20, 25)	2 (20, 22)	2 (20, 22)	2 (20, 22)	5.25 (23, 28.25)	7 (24, 31)	6 (24, 30)	17.5 (20.5, 37.5)

Note: Unit for all data displayed is in years. The age for one respondent was changed from 1986 to 28 based on the assumption that the respondent had entered her birth year instead of her age in years in the questionnaire (2014 – 1986 = 28). *M* = Mean; *SD* = Standard Deviation; Max. = Maximum Value; Min. = Minimum Value; *IQR* = Interquartile Range; Q1 = 25th Percentile; Q3 = 75th Percentile.

[a] Excludes one respondent whose gender was unknown. Includes three respondents who identified their gender but who did not indicate their education level at the University of Maryland, College Park. [b] Multiple modes exist. The smallest value is shown.

Table 4.3

Summary Statistics for Age Distribution of UMCP Students Enrolled during the Spring 2014 Term

Summary Statistic	Undergraduate Students			Graduate Students		
	Male (n = 14,100)	Female (n = 12,374)	All (n = 26,474)	Male (n = 5,038)	Female (n = 4,590)	All (n = 9,628)
M (*SD*)	21.07 (3.89)	20.86 (3.78)	20.97 (3.84)	29.46 (7.40)	29.26 (7.87)	29.37 (7.62)
Median	20	20	20	28	27	27
Mode	21	21	21	24	23	23
Range (Min., Max.)	71 (16, 87)	60 (15, 75)	72 (15, 87)	63 (20, 83)	69 (19, 88)	69(19, 88)
IQR (Q1, Q3)	3 (19, 22)	2 (19, 21)	2 (19, 21)	7 (25, 32)	7 (24, 31)	8 (24, 32)

Note: Unit for all data displayed is in years. *M* = Mean; *SD* = Standard Deviation; Max. = Maximum Value; Min. = Minimum Value; *IQR* = Interquartile Range; Q1 = 25th Percentile; Q3 = 75th Percentile. Data reported by the Office of Institutional Research, Planning, and Assessment (IRPA) for the University of Maryland, College Park (UMCP).

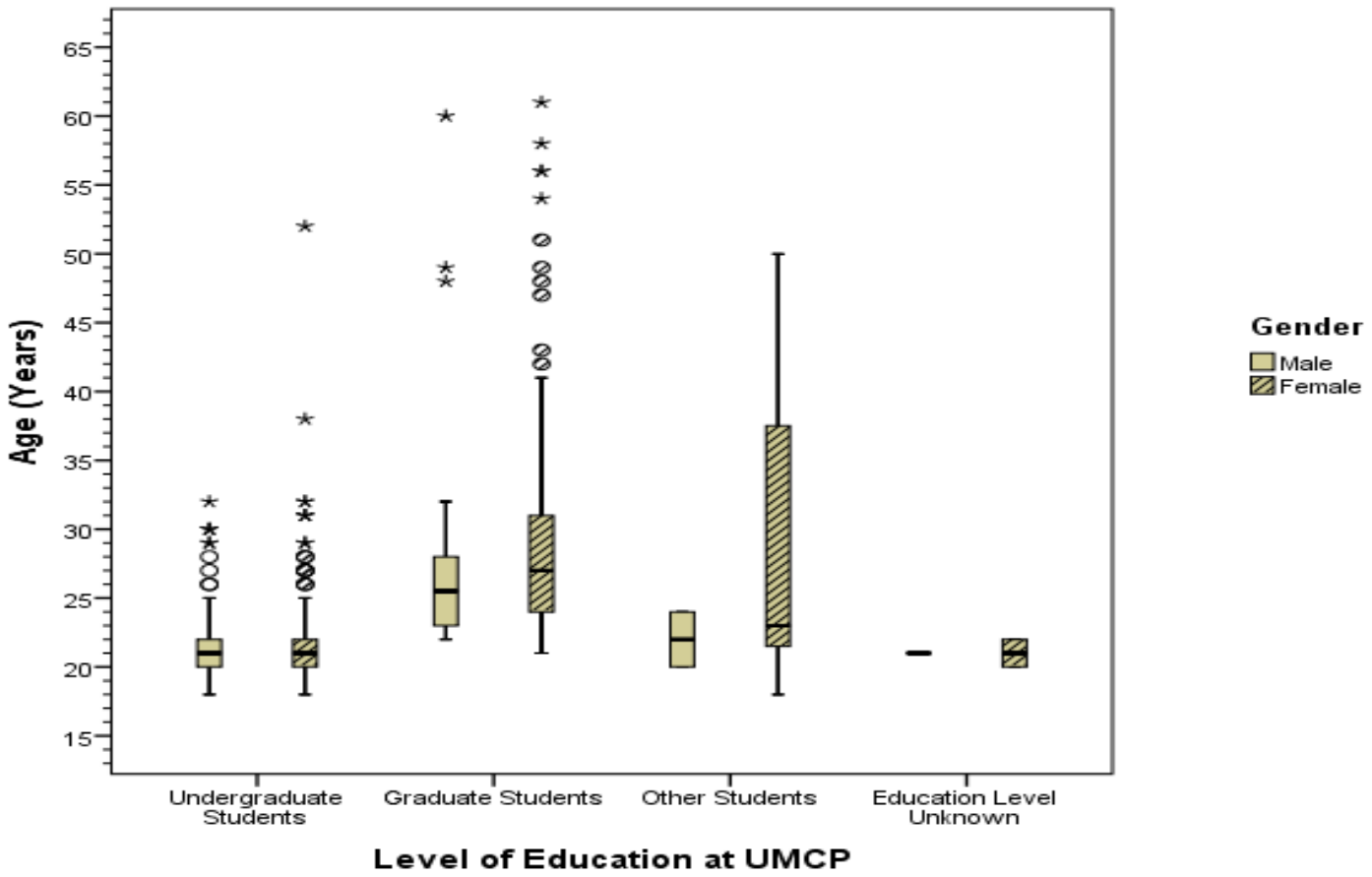
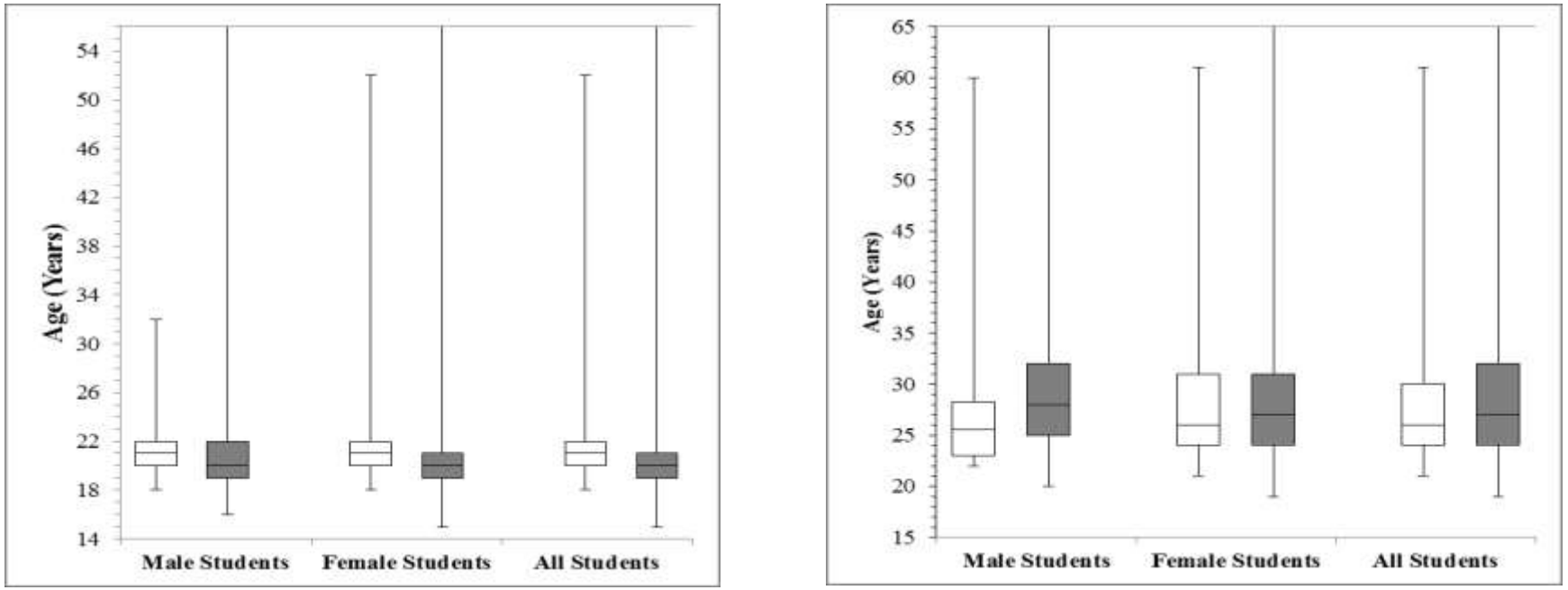


Figure 4.1. Tukey box plots of the age distribution of questionnaire respondents analyzed, grouped by level of education at UMCP and gender. Boxes represent the interquartile range and are intersected by the median line for the demographic category. Whiskers (T-bars) extend to 1.5 times the height of the box or (if no age values fall within this range) to the minimum or maximum age value for the demographic category. Rounded dots represent outliers, which are defined as values that fall outside of the whiskers. Asterisks represent extreme outliers, which are defined as values that are more than three times the height of the boxes.
UMCP = University of Maryland, College Park.



a. Undergraduate Students ***b. Graduate Students***

Figure 4.2. Box-and-whisker plots of the age distribution grouped by gender for (a) undergraduate respondents and the Spring 2014 enrolled undergraduate student body at the University of Maryland, College Park (UMCP); and (b) graduate student respondents and the Spring 2014 enrolled graduate student body at UMCP. Boxes represent the interquartile range and are intersected by the median line for the demographic category. Whiskers (T-bars) extend to the minimum and maximum age values for the demographic category. To enhance the readability of the plots, the y-axes are cut off at points well below the maximum age values reported by the UMCP Office of Institutional Research, Planning, and Assessment (IRPA) for the Spring 2014 UMCP undergraduate and graduate student bodies.

4.2.3 Employment Status and Past Driving Behavior

Employment status, past drowsy driving experience (*i.e.*, driving a motor vehicle while being so drowsy or sleepy that the driver had a hard time keeping his or her eyes open), and past asleep driving experience (*i.e.*, falling asleep or nodding off while driving a motor vehicle, even just for a second or two) for the sample of questionnaire respondents analyzed in this study are presented in **Table 4.4**. The four respondents who did not indicate the level of education they were pursuing at UMCP are excluded from this summary table of employment and past driving behavior data.

Table 4.5 presents data relating to past drowsy driving experience and past asleep driving experience among the questionnaire respondents analyzed grouped by level of education at UMCP and employment status. In addition to the four respondents who did not indicate their level of education at UMCP, this table excludes 20 respondents who did not indicate their employment status.

Among undergraduate respondents of both genders, approximately 60 percent reported being employed, fewer than 10 percent reported having no past drowsy driving experience, and approximately 70 percent reported having some past drowsy driving experience. Nearly 40 percent of undergraduate respondents reported having no past asleep driving experience, with a higher percentage of females (43.3%) than males (31.7%) reporting this behavior. By contrast, over 40 percent of undergraduate respondents reported having some past asleep driving experience, with a higher percentage of males (50.7%) than females (35.4%) reporting this behavior. Similar percentages in past drowsy driving experience and past asleep driving experience were observed for both employed and unemployed undergraduate respondents.

Among graduate student respondents of both genders, over 80 percent reported being employed. The graduate student respondents shared many similarities with the undergraduate respondents in the frequencies with which they reported their past drowsy driving experience and past asleep driving experience: fewer than 10 percent of the graduate student respondents of both genders reported having no past drowsy driving experience; over 70 percent of both genders reported having some past drowsy driving experience; nearly 40 percent reported having no past asleep driving experience, with a higher percentage of females (38.2%) than males (28.6%) reporting this behavior; and approximately 40 percent reported having some past asleep driving experience, with a higher percentage of males (50.0%) than females (39.6%) reporting this behavior.

Similar percentages in past drowsy driving experience and past asleep driving experience were observed for employed graduate student respondents. Among graduate student respondents who were not employed, nearly two-thirds reported having some past drowsy driving experience, nearly 30 percent reported having no past asleep driving experience, and over 35 percent reported having some past asleep driving experience.

Figure 4.3 presents a graphical depiction of the frequency distribution of average miles driven per year among the questionnaire respondents analyzed, grouped by level of education at UMCP. Most of the respondents analyzed drove an average of 15,000 miles or less per year.

Table 4.4

Employment Status, Past Drowsy Driving and Past Asleep Driving Experience of Questionnaire Respondents Analyzed (N=642)

Characteristic	Undergraduate Students			Graduate Students			Other Students		
	Male (*n* = 142)	Female (*n* = 305)	All (*n* = 447)	Male (*n* = 42)	Female (*n* = 144)	All (*n* = 186)	Male (*n* = 2)	Female (*n* = 7)	All (*n* = 9)
Employment Status [*n* (%)]									
Yes	84 (59.2)	189 (62.0)	273 (61.1)	37 (88.1)	118 (81.9)	155 (83.3)	2 (100)	4 (57.1)	6 (66.7)
No	54 (38.0)	104 (34.1)	158 (35.3)	5 (11.9)	23 (16.0)	28 (15.1)	0 (0.0)	2 (28.6)	2 (22.2)
Unknown	4 (2.8)	12 (3.9)	16 (3.6)	0 (0.0)	3 (2.1)	3 (1.6)	0 (0.0)	1 (14.3)	1 (11.1)
Past Drowsy Driving Experience [*n* (%)]									
Never	9 (6.3)	30 (9.8)	39 (8.7)	3 (7.1)	6 (4.2)	9 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)
Ever	50 (35.2)	124 (40.7)	174 (38.9)	17 (40.5)	72 (50.0)	89 (47.8)	0 (0.0)	3 (42.9)	3 (33.3)
Recent	25 (17.6)	48 (15.7)	73 (16.3)	6 (14.3)	21 (14.6)	27 (14.5)	1 (50.0)	1 (14.3)	2 (22.2)
Frequent	33 (23.2)	38 (12.5)	71 (15.9)	7 (16.7)	13 (9.0)	20 (10.8)	1 (50.0)	1 (14.3)	2 (22.2)
Unknown	25 (17.6)	65 (21.3)	90 (20.1)	9 (21.4)	32 (22.2)	41 (22.0)	0 (0.0)	2 (28.6)	2 (22.2)
Past Asleep Driving Experience [*n* (%)]									
Never	45 (31.7)	132 (43.3)	177 (39.6)	12 (28.6)	55 (38.2)	67 (36.0)	1 (50.0)	1 (14.3)	2 (22.2)
Ever	46 (32.4)	79 (25.9)	125 (28.0)	16 (38.1)	51 (35.4)	67 (36.0)	1 (50.0)	3 (42.9)	4 (44.4)
Recent	17 (12.0)	13 (4.3)	30 (6.7)	1 (2.4)	4 (2.8)	5 (2.7)	0 (0.0)	1 (14.3)	1 (11.1)
Frequent	9 (6.3)	16 (5.2)	25 (5.6)	4 (9.5)	2 (1.4)	6 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)
Unknown	25 (17.6)	65 (21.3)	90 (20.1)	9 (21.4)	32 (22.2)	41 (22.0)	0 (0.0)	2 (28.6)	2 (22.2)

Note: Excludes four respondents who did not indicate their education level at the University of Maryland, College Park. Never = Never in the past 30days, 12 months, lifetime; Ever = Never in the past 30 days, but at least once in the past 12 months or lifetime; Recent = Once in the past 30 days; Frequent = More than once in the past 30 days.

Table 4.5

Past Drowsy Driving Experience and Past Asleep Driving Experience of Questionnaire Respondents Analyzed Grouped by Level of Education and Employment Status (N=622)

Characteristic	Undergraduate Students		Graduate Students		Other Students	
	Employed (*n* = 273)	Not Employed (*n* = 158)	Employed (*n* = 155)	Not Employed (*n* = 28)	Employed (*n* = 6)	Not Employed (*n* = 2)
Past Drowsy Driving Experience [*n* (%)]						
Never	25 (9.2)	14 (8.9)	9 (5.8)	0 (0.0)	0 (0.0)	0 (0.0)
Ever	103 (37.7)	71 (44.9)	78 (50.3)	11 (39.3)	1 (16.7)	2 (100)
Recent	55 (20.1)	18 (11.4)	24 (15.5)	3 (10.7)	2 (33.3)	0 (0.0)
Frequent	48 (17.6)	23 (14.6)	16 (10.3)	4 (14.3)	2 (33.3)	0 (0.0)
Unknown	42 (15.4)	32 (20.3)	28 (18.1)	10 (35.7)	1 (16.7)	0 (0.0)
Past Asleep Driving Experience [*n* (%)]						
Never	113 (41.4)	64 (40.5)	59 (38.1)	8 (28.6)	2 (33.3)	0 (0.0)
Ever	80 (29.3)	45 (28.5)	57 (36.8)	10 (35.7)	2 (33.3)	2 (100)
Recent	23 (8.4)	7 (4.4)	5 (3.2)	0 (0.0)	1 (16.7)	0 (0.0)
Frequent	15 (5.5)	10 (6.3)	6 (3.9)	0 (0.0)	0 (0.0)	0 (0.0)
Unknown	42 (15.4)	32 (20.3)	28 (18.1)	10 (35.7)	1 (16.7)	0 (0.0)

Note: Excludes four respondents who did not indicate their education level at the University of Maryland, College Park. Also excludes 20 respondents who did not indicate their employment status. Never = Never in the past 30days, 12 months, lifetime; Ever = Never in the past 30 days, but at least once in the past 12 months or lifetime; Recent = Once in the past 30 days; Frequent = More than once in the past 30 days.

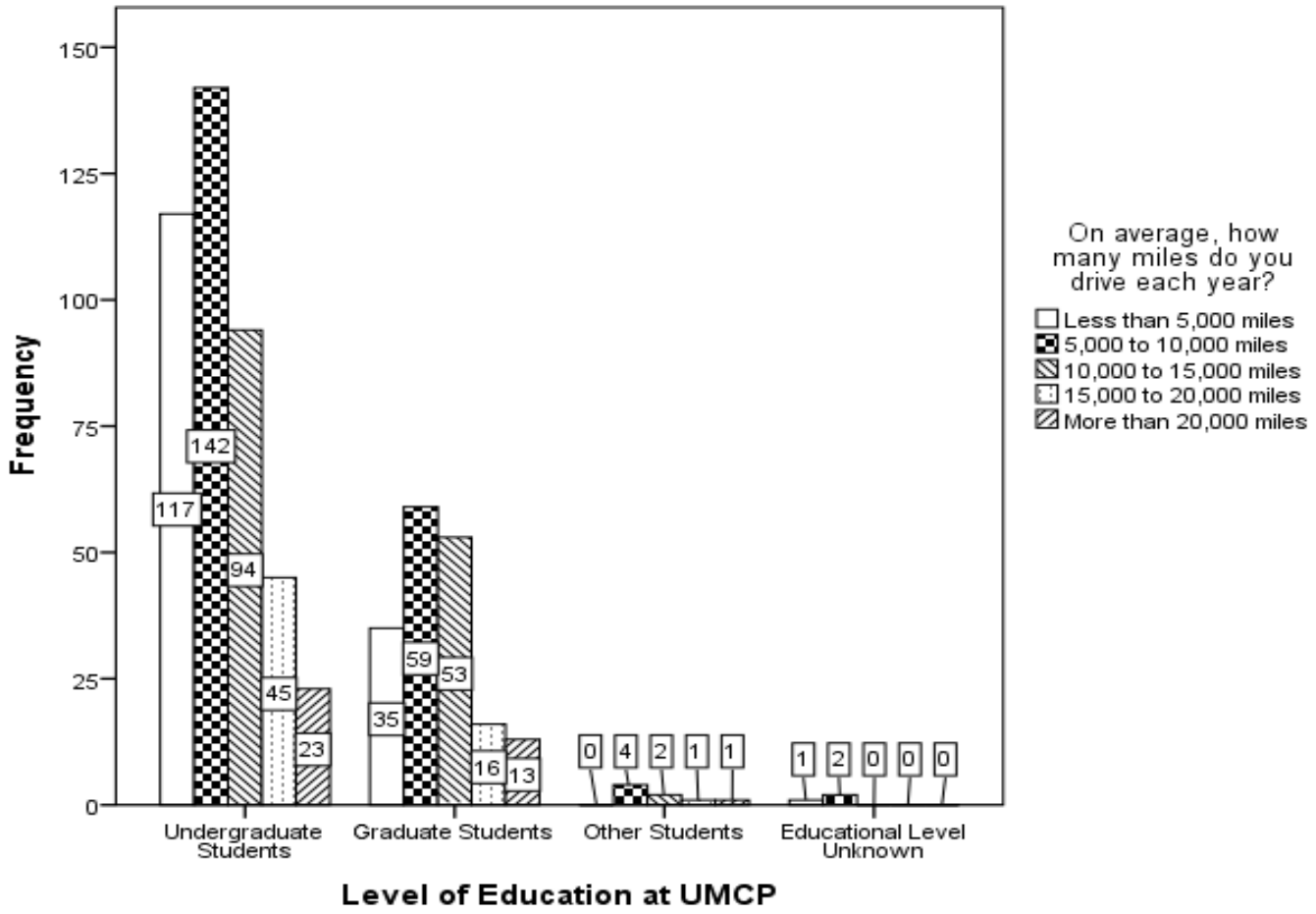


Figure 4.3. Frequency distribution of average miles driven per year among questionnaire respondents analyzed ($N = 608$), grouped by level of education at the University of Maryland, College Park (UMCP). The boxed numbers represent the frequency counts for the corresponding category.

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4.3 Overview of Extended TPB Model Variable Measurements

4.3.1 Reliability Analysis of Scale-Based Questionnaire Items

Cronbach's alpha coefficients for the scale-based items on the questionnaire designed to measure the behavioral and neurocognitive variables from the extended TPB model for drowsy driving are presented in **Table 4.6**. Overall, most of the scale-based questionnaire items demonstrated good internal consistency for all three drowsy driving situations analyzed, with Cronbach's alpha coefficients greater than .700.

As indicated in **Section 3.2.1.6**, the mean score of three questionnaire items (Q28[1] to [3]) was originally intended to measure behavioral willingness. Because these three items demonstrated unacceptably poor internal consistency across all drowsy driving situations analyzed (Cronbach's alpha < .300), and because the Cronbach's alpha rose to acceptable levels (> .700) when the second behavioral willingness item (Q28[2]) was discarded, it was ultimately decided to calculate the composite score for behavioral willingness using the remaining two items (Q28[1] and [3]) for all drowsy driving situations analyzed.

Furthermore, as described in **Section 3.2.1.7**, general and comparative risk perception were originally intended to be measured via the product of the mean score of three items intended to measure the magnitude of general (Q29[1] to [3]) or comparative (Q30[1] to [3]) perceived risk and the probability of the general (Q31[1]) or comparative (Q31[2]) risk. The three Magnitude Items demonstrated excellent internal consistency for both general and comparative perceived risk across all drowsy driving situations analyzed (Cronbach's alpha >.900). Furthermore, the three

Magnitude Items and the single Probability Item generally demonstrated good internal consistency for both general and comparative perceived risk across all drowsy driving situations analyzed (Cronbach's alpha ≥.668, with most >.700). These reliability results support the method chosen to measure general and comparative risk perception in this study.

4.3.2 Descriptive Statistics for Extended TPB Model Variable Measurements

Descriptive statistics for the composite scores calculated from the scale-based questionnaire items designed to measure the behavioral and neurocognitive variables from the extended TPB model for drowsy driving are presented in **Table 4.7**. For all three drowsy driving situations analyzed, the composite scores for the variables from the TPB and PWM (*i.e.*, attitudes, subjective norm, perceived behavioral control, behavioral intention, and behavioral willingness) generally did not exhibit profound skewness (with values between -1 and 1 in all cases) or kurtosis (with values between -1.21 and 1.35 and most values between -1 and 1 in all cases). The composite scores for general and comparative risk perception and invulnerability to danger generally exhibited greater skewness (with values between 1 and 2 in all cases) and kurtosis (with values between .48 and 7.82 in all cases) than the composite scores for the variables from the TPB and PWM.

Table 4.6

Cronbach's Alpha Coefficients of Scale-Based Items Measuring Extended TPB Model Variables in the UMCP Drowsy Driving Questionnaire

Construct/Variable	Number of Items	Situation A		Situation B		Situation C	
		Cronbach's Alpha	Responses Included	Cronbach's Alpha	Responses Included	Cronbach's Alpha	Responses Included
Attitude Toward the Behavior	5	**.847**	577	**.905**	535	**.885**	511
Subjective Norm	3	**.442**[a]	587	**.716**	539	**.790**	514
Perceived Behavioral Control	2	**.791**	572	**.835**	531	**.823**	512
Behavioral Intention	4	**.887**	571	**.904**	530	**.894**	511
Behavioral Willingness							
Q28(1) *to* Q28(3)	3	**.298**	553	**.110**	523	**-.112**[b]	510
Q28(1) *and* Q28(3)	2	**.780**	553	**.806**	523	**.742**	510
Risk Perception (General)							
Magnitude Items: Q29(1) *to* Q29(3)	3	**.933**	552	**.947**	524	**.949**	510
Magnitude & Probability Items: Q29(1) *to* Q29(3) *and* Q31(1)	4	**.743**	552	**.668**	524	**.723**	510
Risk Perception (Comparative)							
Magnitude Items: Q30(1) *to* Q30(3)	3	**.959**	552	**.976**	524	**.973**	510
Magnitude & Probability Items: Q30(1) *to* Q30(3) *and* Q31(2)	4	**.785**	552	**.794**	523	**.809**	510
Invulnerability to Danger	12			Cronbach's alpha = **.865** Responses Included = 509			

Note: Cronbach's alpha coefficients presented in boldface font. Only questionnaire responses ($N = 646$) that included responses to every item used to measure a variable were used to calculate the Cronbach's alpha coefficient for that variable (*i.e.*, listwise deletion was used to identify responses excluded from the Cronbach's alpha coefficient calculations). TPB = Theory of Planned Behavior; UMCP = University of Maryland, College Park.

[a] Low Cronbach's alpha may be related to low covariance and correlations between the items used to measure this variable for this drowsy driving situation.
[b] Negative average covariance among items observed.

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Table 4.7

Descriptive Statistics for Composite Scores of Extended TPB Model Variables in the UMCP Drowsy Driving Questionnaire

Construct/Variable	*n*	*M* (*SD*)	Median	Mode	Range (Min., Max.)	IQR (Q1, Q3)
Attitudes						
Situation A	588	2.237 (0.958)	2.1	1	6 (1, 7)	1.4 (1.4, 2.8)
Situation B	539	2.517 (1.144)	2.4	1	6 (1, 7)	1.6 (1.6, 3.2)
Situation C	514	2.642 (1.123)	2.8	1	6 (1, 7)	1.6 (1.8, 3.4)
Subjective Norm						
Situation A	587	2.145 (1.059)	2.00	1	5 (1, 6)	2 (1, 3)
Situation B	539	2.446 (1.231)	2.33	1	6 (1, 7)	2.33 (1, 3.33)
Situation C	514	2.634 (1.333)	2.67	1	6 (1, 7)	2.42 (1.25, 3.67)
Perceived Behavioral Control						
Situation A	572	3.186 (1.358)	3.0	4	6 (1, 7)	2 (2, 4)
Situation B	531	3.624 (1.568)	4.0	4	6 (1, 7)	2.5 (2.5, 5)
Situation C	512	3.614 (1.444)	4.0	4	6 (1, 7)	2 (2.5, 4.5)
Behavioral Intention						
Situation A	572	3.453 (1.533)	3.50	2	6 (1, 7)	2.75 (2, 4.75)
Situation B	531	3.317 (1.608)	3.25	1	6 (1, 7)	2.75 (2. 4.75)
Situation C	512	3.974 (1.586)	4.25	5	6 (1, 7)	2.5 (2.75, 5.25)
Behavioral Willingness						
Situation A	553	3.953 (1.787)	4.0	6	6 (1, 7)	3 (2.5, 5.5)
Situation B	524	4.889 (1.936)	5.5	7	6 (1, 7)	2.88 (3.63, 6.5)
Situation C	510	5.067 (1.700)	5.5	7	6 (1, 7)	2.5 (4, 6.5)
Risk Perception (General)						
Situation A	553	12.687 (9.235)	10.00	6	48 (1, 49)	12 (6, 18)
Situation B	524	9.317 (7.796)	6.67	6	48 (1, 49)	7.92 (4.08, 12)
Situation C	510	11.131 (7.983)	10.00	6	48 (1, 49)	9.67 (5.33, 15)
Risk Perception (Comparative)						
Situation A	553	10.465 (7.616)	8.67	6	48 (1, 49)	10 (5, 15)
Situation B	523	8.750 (6.722)	7.44	4	48 (1, 49)	8 (4, 12)
Situation C	510	9.855 (6.703)	9.00	16	48 (1, 49)	10.8 (4, 14.8)
Invulnerability	509	29.778 (11.195)	29.00	30	72 (12, 84)	14 (22, 36)

Note: *n* = Responses included in calculations of descriptive statistics; *M* = Mean; *SD* = Standard Deviation; Max. = Maximum Value; Min. = Minimum Value; *IQR* = Interquartile Range; Q1 = 25th Percentile; Q3 = 75th Percentile. TPB = Theory of Planned Behavior; UMCP = University of Maryland, College Park.

4.4 Analysis of Hypotheses

4.4.1 HYPOTHESIS 1: Associations with Intention to Drive While Drowsy

> *For all drowsy driving situations analyzed, intention to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, perceived behavioral control, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.*

Zero-order correlation coefficients (Pearson's *r*) for the variables from the extended TPB model for drowsy driving are presented in **Tables 4.8** (for Situation A), **4.9** (for Situation B), and **4.10** (for Situation C). For all three drowsy driving situations analyzed, positive correlations were observed between behavioral intention and attitudes ($.569 \leq r \leq .582$), subjective norm ($.411 \leq r \leq .558$), perceived behavioral control ($.685 \leq r \leq .704$), past drowsy driving ($.269 \leq r \leq .384$) and asleep driving experience ($.157 \leq r \leq .237$), invulnerability to danger ($.180 \leq r \leq .264$), general ($.096 \leq r \leq .153$) and comparative ($.102 \leq r \leq .159$) risk perception, and behavioral willingness ($.649 \leq r \leq .679$). All of these positive correlations were significant at the .05 level, of which nearly all were significant at the .01 level.

Negative correlations were observed between behavioral intention and age for all three drowsy driving situations analyzed ($-.153 \leq r \leq -.049$). Only the negative correlation for Situation B was statistically significant, although the negative correlation for Situation C approached statistical significance ($p = .051$).

4.4.2 HYPOTHESIS 2: Associations with Willingness to Drive While Drowsy

> *For all drowsy driving situations analyzed, willingness to drive while drowsy will be: (a) positively associated with positive attitudes, subjective norm, past experience driving while drowsy, and sense of invulnerability to danger; and (b) negatively associated with age and perceived risk.*

As mentioned in **Section 4.4.1**, zero-order correlation coefficients for the variables from the extended TPB model for drowsy driving are presented in **Tables 4.8** through **4.10**. For all three drowsy driving situations analyzed, positive correlations were observed between behavioral willingness and attitudes ($.437 \leq r \leq .467$), subjective norm ($.345 \leq r \leq .414$), perceived behavioral control ($.553 \leq r \leq .643$), past drowsy driving ($.150 \leq r \leq .208$) and asleep driving ($.056 \leq r \leq .116$) experience, and invulnerability to danger ($.064 \leq r \leq .184$). Nearly all of these positive correlations were significant at the .01 level. The positive correlation between behavioral willingness and past asleep driving experience was significant at the .01 level for Situation A, but not significant for Situations B and C. Furthermore, the positive correlation between behavioral willingness and invulnerability to danger was significant at the .01 level for Situation A, significant at the .05 level for Situation B, and not significant for Situation C.

Positive correlations also were observed between behavioral willingness and comparative risk perception for Situations A ($r = .010$) and B ($r = .015$), although neither of these correlations were significant. A non-significant ($p = .430$) negative correlation was observed between behavioral willingness and comparative risk perception for Situation C ($r = -.035$).

Negative correlations were observed between behavioral willingness and age for all three drowsy driving situations analyzed ($-.207 \leq r \leq -.083$). These negative

correlations were significant at the .01 level for Situations A and B and approached significance for Situation C ($p = .060$). Non-significant negative correlations were observed between behavioral willingness and general risk perception for Situations A ($p = .508$) and C ($p = .438$), and no correlation ($p = .000$) was observed between these two variables for Situation B.

Table 4.8

Zero-Order Correlation Coefficients for Extended TPB Model Variables in Situation A (N=509)

Construct/Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*M*	*SD*
1. Behavioral Intention	1											3.46	1.50
2. Attitude Toward the Behavior	.575**	1										2.22	0.95
3. Subjective Norm	.411**	.501**	1									2.13	1.06
4. Perceived Behavioral Control	.685**	.553**	.394**	1								3.20	1.34
5. Past Drowsy Driving Experience	.384**	.188**	.140**	.231**	1							1.47[a]	0.90
6. Past Asleep Driving Experience	.237**	.107*	-.014	.107*	.530**	1						0.71[a]	0.85
7. Invulnerability to Danger	.264**	.204**	.124**	.251**	.164**	.141**	1					29.8	11.2
8. Age in Years	-.049	-.019	-.039	-.066	-.023	.004	-.085	1				23.2	5.54
9. Risk Perception (General)	.096*	-.141**	-.075	-.156**	.206**	.202**	.003	.001	1			12.6	9.21
10. Risk Perception (Comparative)	.102*	-.014	-.013	-.088*	.223**	.269**	.069	.108*	.671**	1		10.4	7.61
11. Behavioral Willingness	.679**	.437**	.345**	.553**	.208**	.116**	.184**	-.149**	-.029	.010	1	3.95	1.78

Note: Correlation coefficients calculated after listwise deletion of missing values. *M* = Mean; *SD* = Standard Deviation; TPB = Theory of Planned Behavior.

[a] Scoring was as follows: 0 = Never (Never in the past 30days, 12 months, lifetime); 1 = Ever (Never in the past 30 days, but at least once in the past 12 months or lifetime); 2 = Recent (Once in the past 30 days); 3 = Frequent (More than once in the past 30 days).

* $p < .05$ level, two-tailed. ** $p < .01$, two-tailed.

Table 4.9

Zero-Order Correlation Coefficients for Extended TPB Model Variables in Situation B (N=509)

Construct/Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*M*	*SD*
1. Behavioral Intention	1											3.31	1.61
2. Attitude Toward the Behavior	.569**	1										2.51	1.15
3. Subjective Norm	.547**	.617**	1									2.43	1.23
4. Perceived Behavioral Control	.704**	.603**	.568**	1								3.62	1.58
5. Past Drowsy Driving Experience	.269**	.162**	.136**	.164**	1							1.47[a]	0.90
6. Past Asleep Driving Experience	.197**	.175**	.122**	.098*	.530**	1						0.71[a]	0.85
7. Invulnerability to Danger	.180**	.195**	.183**	.215**	.164**	.141**	1					29.8	11.2
8. Age in Years	-.153**	-.115**	-.084	-.151**	-.023	.004	-.085	1				23.2	5.54
9. Risk Perception (General)	.153**	-.004	-.033	-.106*	.099*	.136**	.074	-.030	1			9.31	7.85
10. Risk Perception (Comparative)	.159**	.099*	.079	-.044	.139**	.163**	.082	.030	.704**	1		8.74	6.74
11. Behavioral Willingness	.649**	.467**	.385**	.643**	.150**	.056	.096*	-.207**	.000	.015	1	4.87	1.94

Note: Correlation coefficients calculated after listwise deletion of missing values. *M* = Mean; *SD* = Standard Deviation; TPB = Theory of Planned Behavior.

[a] Scoring was as follows: 0 = Never (Never in the past 30days, 12 months, lifetime); 1 = Ever (Never in the past 30 days, but at least once in the past 12 months or lifetime); 2 = Recent (Once in the past 30 days); 3 = Frequent (More than once in the past 30 days).

* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

Table 4.10

Zero-Order Correlation Coefficients for Extended TPB Model Variables in Situation C (N=508)

Construct/Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*M*	*SD*
1. Behavioral Intention	1											3.97	1.59
2. Attitude Toward the Behavior	.582**	1										2.64	1.13
3. Subjective Norm	.558**	.654**	1									2.62	1.32
4. Perceived Behavioral Control	.694**	.631**	.526**	1								3.61	1.45
5. Past Drowsy Driving Experience	.285**	.199**	.175**	.203**	1							1.47[a]	0.90
6. Past Asleep Driving Experience	.157**	.094*	.103*	.083	.530**	1						0.71[a]	0.85
7. Invulnerability to Danger	.197**	.264**	.214**	.159**	.163**	.139**	1					29.8	11.2
8. Age in Years	-.087	-.032	-.057	-.075	-.024	.003	-.086	1				23.2	5.55
9. Risk Perception (General)	.134**	-.048	-.021	-.107*	.184**	.224**	.026	.027	1			11.2	7.99
10. Risk Perception (Comparative)	.102*	.030	.056	-.057	.170**	.240**	.077	.090*	.687**	1		9.88	6.70
11. Behavioral Willingness	.657**	.445**	.414**	.555**	.176**	.076	.064	-.083	-.034	-.035	1	5.06	1.70

Note: Correlation coefficients calculated after listwise deletion of missing values. *M* = Mean; *SD* = Standard Deviation; TPB = Theory of Planned Behavior.

[a] Scoring was as follows: 0 = Never (Never in the past 30days, 12 months, lifetime); 1 = Ever (Never in the past 30 days, but at least once in the past 12 months or lifetime); 2 = Recent (Once in the past 30 days); 3 = Frequent (More than once in the past 30 days).

* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

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4.4.3 HYPOTHESIS 3: Predictors of Intention to Drive While Drowsy

After controlling for personal variables, intention to engage in drowsy driving will be predicted by attitudes, subjective norm, perceived behavioral control, and behavioral willingness.

Hierarchical (sequential) multiple regression was used to assess the predictive utility of attitudes, subjective norm, perceived behavioral control, and behavioral willingness (*i.e.*, the predictor variables) vis-à-vis intention to engage in drowsy driving behavior. For all three drowsy driving situations analyzed, the composite scores for intention were regressed on to the composite scores for the predictor variables after controlling for numerous personal variables from the extended TPB model for drowsy driving (*i.e.*, gender, age, ethnicity, race, annual driving exposure, employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception). These personal variables were entered into the regression model as a single block of control variables in Step 1.[3] Intention was then regressed on to the predictor variables in two ways: together as a single block in Step 2 (*i.e.*, a two-step regression model), and individually as separate blocks in Steps 2 through 5 (*i.e.*, a five-step regression model). No imputations were used to replace missing values, and because the composite scores for the predictor variables were not profoundly skewed or kurtotic

[3] Among these personal variables, the following nominal categorical variables were dummy coded as indicated before being entered into the regression model as control variables: gender (1 = Male; 2 = Female), ethnicity (1 = Hispanic; 2 = Not Hispanic), race (for each race category presented in **Table 4.1**: 0 = No; 1 = Yes), and employment status (1 = Employed; 2 = Not Employed). Furthermore, among these personal variables, the following ordinal categorical variables were rank ordered as indicated before being entered into the regression model as control variables: annual driving exposure (1 = "Less than 5,000 miles"; 2 = "5,000 to 10,000 miles"; 3 = "10,000 to 15,000 miles"; 4 = "15,000 to 20,000 miles"; 5 = "More than 20,000 miles") and past drowsy driving and asleep driving experience (0 = Never, 1 = Ever, 2 = Recent, 3 = Frequent).

(see **Section 4.3.2**), no transformations were made to correct non-normal distributions.

The results from the two- and five-step regression models are presented in **Tables 4.11** and **4.12**, respectively, and include the unstandardized regression coefficients (*B*), the standardized regression coefficients (β), the multiple correlation coefficient (*R*) and its square (R^2), and changes in R^2 between steps (ΔR^2). Both regression models were significant at the .001 level for all three drowsy driving situations analyzed, with $R^2 = .704$, $F(21, 475) = 53.74$, $p = .000$ for Situation A; $R^2 = .657$, $F(21, 475) = 43.37$, $p = .000$ for Situation B; and $R^2 = .665$, $F(21, 474) = 44.88$, $p = .000$ for Situation C. Thus, the personal variables and the predictor variables accounted for 65.7 to 70.4 percent of the variance in behavioral intention in all three drowsy driving situations analyzed. The personal variables entered in Step 1 accounted for approximately 15 to 24 percent of this variance, with $R^2 = .241$, $F(17, 479) = 8.94$, $p = .000$ for Situation A; $R^2 = .153$, $F(17, 479) = 5.10$, $p = .000$ for Situation B; and $R^2 = .170$, $F(17, 478) = 5.76$, $p = .000$ for Situation C. Together, the predictor variables (when entered together in Step 2 of the two-step regression model) significantly accounted for an additional ~46 to ~50 percent of the variance, with $\Delta R^2 = .463$, $\Delta F = 185.60$, $p = .000$ for Situation A; $\Delta R^2 = .504$, $\Delta F = 174.60$, $p = .000$ for Situation B; and $\Delta R^2 = .495$, $\Delta F = 175.43$, $p = .000$ for Situation C. Furthermore, the results from the five-step regression model reveal that:

1. attitudes accounted for approximately 25 percent of this additional variance, with $\Delta R^2 = .235$, $\Delta F = 214.60$, $p = .000$ for Situation A; $\Delta R^2 = .245$, $\Delta F = 194.98$, $p = .000$ for Situation B; and $\Delta R^2 = .257$, ΔF

= 213.51, $p = .000$ for Situation C;

2. perceived behavioral control accounted for approximately 13 to 15 percent of this additional variance, with $\Delta R^2 = .144$, $\Delta F = 186.90$, $p = .000$ for Situation A; $\Delta R^2 = .152$, $\Delta F = 186.07$, $p = .000$ for Situation B; and $\Delta R^2 = .127$, $\Delta F = 149.18$, $p = .000$ for Situation C; and
3. subjective norm and behavioral willingness each accounted for less than 10 percent of this additional variance ($p = .000$ for all cases).

For both the complete two- and five-step regression models, analysis of the regression coefficients (*i.e.*, *B* and β) indicate that the predictor variables each contributed significantly ($p < .05$) to the variance in willingness for all three drowsy driving situations analyzed at nearly every step. The only exception was subjective norm for Situation A in the last step of both regression models, $\beta = 0.036$, $t(475) = 1.20$, $p = .232$.

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Table 4.11

Hierarchical Multiple Regression Analyses Predicting Intention to Engage in Drowsy Driving from Attitude, Subjective Norm, Perceived Behavioral Control, and Willingness (Entered Together)

	Situation A			Situation B			Situation C		
Predictor	ΔR^2	*B*	β	ΔR^2	*B*	β	ΔR^2	*B*	β
Step 1	.241***			.153***			.170***		
Control Variables[a]									
Step 2	.463***			.504***			.495***		
Attitude Toward the Behavior		0.304***	0.193		0.117*	0.084		0.133*	0.095
Subjective Norm		0.051	0.036		0.216***	0.165		0.176***	0.147
Perceived Behavioral Control		0.401***	0.359		0.382***	0.373		0.391***	0.357
Behavioral Willingness		0.290***	0.341		0.245***	0.292		0.320***	0.339
Total R^2	.704***			.657***			.665***		
Adjusted R^2	.691			.642			.651		
n		497			497			496	

Note: Hierarchical (sequential) multiple regression performed after listwise deletion of missing values.

[a] Control variables include gender, age, ethnicity, race, driving exposure (average miles driven per year), employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.12

Hierarchical Multiple Regression Analyses Predicting Intention to Engage in Drowsy Driving from Attitude, Subjective Norm, Perceived Behavioral Control, and Willingness (Entered Separately)

	Situation A					Situation B					Situation C				
		β (Step Number)[a]					β (Step Number)[a]					β (Step Number)[a]			
Predictor	ΔR^2	2	3	4	5	ΔR^2	2	3	4	5	ΔR^2	2	3	4	5
Step 1 Control Variables[b]	.241***					.153***					.170***				
Step 2 Attitudes	.235***	0.516	0.449	0.250	0.193	.245***	0.527	0.338	0.128	0.084	.257***	0.542	0.367	0.132	0.095
Step 3 Subjective Norm	.014***		0.140	0.065	0.036[c]	.061***		0.320	0.160	0.165	.044***		0.280	0.193	0.147
Step 4 Perceived Behavioral Control	.144***			0.490	0.359	.152***			0.537	0.373	.127***			0.484	0.357
Step 5 Willingness	.070***				0.341	.046***				0.292	.068***				0.339
Total R^2	.704***					.657***					.665***				

Note: Regression performed after listwise deletion of missing values. Discrepancies between Total R^2 and summation of ΔR^2 values are due to rounding errors.
[a] All β coefficients presented were significant at the .05 level, except where noted. [b] Control variables include gender, age, ethnicity, race, driving exposure (average miles driven per year), employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception. [c] Not statistically significant ($p = .232$).
* $p < .05$. ** $p < .01$. *** $p < .001$.

4.4.4 HYPOTHESIS 4: Predictors of Willingness to Drive While Drowsy

After controlling for personal variables, willingness to engage in drowsy driving will be predicted by attitudes and subjective norm.

Hierarchical (sequential) multiple regression was used to assess the predictive utility of attitudes and subjective norm vis-à-vis willingness to engage in drowsy driving behavior. For all three drowsy driving situations analyzed, the composite scores for willingness were regressed on to the composite scores for attitudes and subjective norm after controlling for numerous personal variables from the extended TPB model for drowsy driving (*i.e.*, gender, age, ethnicity, race, annual driving exposure, employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception). These personal variables were entered into the regression model as a single block of control variables in Step 1.[4] Willingness was then regressed on to attitudes and subjective norm in two ways: together as a single block in Step 2 (*i.e.*, a two-step regression model), and individually as separate blocks in Steps 2 and 3 (*i.e.*, a three-step regression model). No imputations were used to replace missing values, and because the composite scores for attitudes and subjective norm were not profoundly skewed or kurtotic (see **Section 4.3.2**), no transformations were made to correct non-normal distributions.

The results from the two- and three-step regression models are presented in **Tables 4.13** and **4.14**. Both regression models were significant at the .001 level for all three drowsy driving situations analyzed, with $R^2 = .313$, $F(19, 477) = 11.42$,

[4] Among these personal variables, nominal categorical variables were dummy coded and ordinal categorical variables were rank ordered as described in **Footnote 3** before being entered into the regression model as control variables.

p = .000 for Situation A; R^2 = .294, F(19, 477) = 10.47, p = .000 for Situation B; and R^2 = .333, F(19, 476) = 12.48, p = .000 for Situation C. Thus, personal variables, attitudes, and subjective norm accounted for 29.4 to 33.3 percent of the variance in behavioral willingness in the three drowsy driving situations analyzed. The personal variables entered in Step 1 accounted for approximately 9 to 16 percent of this variance, R^2 = .160, F(17, 479) = 5.36, p = .000 for Situation A; R^2 = .092, F(17, 479) = 2.87, p = .000 for Situation B; and R^2 = .157, F(17, 478) = 5.23, p = .000 for Situation C. Attitudes and subjective norm together (when entered in Step 2 of the two-step regression model) significantly accounted for an additional ~15 to ~20 percent of the variance, with ΔR^2 = .153, ΔF = 53.06, p = .000 for Situation A; ΔR^2 = .202, ΔF = 68.27, p = .000 for Situation B; and ΔR^2 = .176, ΔF = 62.61, p = .000 for Situation C. Furthermore, the results from the three-step regression model reveal that attitudes accounted for 13 to 19 percent of this additional variance, with ΔR^2 = .138, ΔF = 93.60, p = .000 for Situation A; ΔR^2 = .188, ΔF = 125.20, p = .000 for Situation B; and ΔR^2 = .152, ΔF = 105.32, p = .000 for Situation C. The three-step regression model results also reveal that subjective norm accounted for less than 3 percent of this additional variance ($p < .01$ for all cases).

For both the two- and three-step regression models, analysis of the regression coefficients (*i.e.*, B and β) indicate that attitudes and subjective norm each contributed significantly to the variance in willingness for all three drowsy driving situations analyzed ($p < .01$ in all cases).

Table 4.13

Hierarchical Multiple Regression Analyses Predicting Willingness to Engage in Drowsy Driving from Attitudes and Subjective Norm (Entered Together)

	Situation A			Situation B			Situation C		
Predictor	ΔR^2	*B*	β	ΔR^2	*B*	β	ΔR^2	*B*	β
Step 1	.160***			.092***			.157***		
Control Variables[a]									
Step 2	.153***			.202***			.176***		
Attitude Toward the Behavior		0.602***	0.325		0.620***	0.373		0.436***	0.291
Subjective Norm		0.243**	0.145		0.236**	0.151		0.259***	0.203
Total R^2	.313***			.294***			.333***		
Adjusted R^2	.285			.266			.306		
n		497				497		496	

Note: Hierarchical (sequential) multiple regression performed after listwise deletion of missing values.

[a] Control variables include gender, age, ethnicity, race, driving exposure (average miles driven per year), employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception.

** $p < .01$. *** $p < .001$.

Table 4.14

Hierarchical Multiple Regression Analyses Predicting Willingness to Engage in Drowsy Driving from Attitudes and Subjective Norm (Entered Separately)

Predictor	Situation A			Situation B			Situation C		
	ΔR^2	β (Step 2)	β (Step 3)	ΔR^2	β (Step 2)	β (Step 3)	ΔR^2	β (Step 2)	β (Step 3)
Step 1 Control Variables[a]	.160***			.092***			.157***		
Step 2 Attitude Toward the Behavior	.138***	0.395***	0.325***	.188***	0.462***	0.373***	.152***	0.418***	0.291***
Step 3 Subjective Norm	.015**		0.145**	.014**		0.151**	.023***		0.203***
Total R^2	.313***			.294***			.333***		

Note: Hierarchical (sequential) multiple regression performed after listwise deletion of missing values. Discrepancies between the Total R^2 value and the summation of the ΔR^2 values are due to rounding errors.

[a] Control variables include gender, age, ethnicity, race, driving exposure (average miles driven per year), employment status, sense of invulnerability to danger, past drowsy driving and asleep driving experience, and general and comparative risk perception.

** $p < .01$. *** $p < .001$.

4.4.5 HYPOTHESIS 5: Differences Between Male and Female Respondents

Males will exhibit lower perceived risk, greater invulnerability to danger, and greater intention and willingness to engage in drowsy driving than females for all drowsy driving situations analyzed.

Differences observed in composite scores of variables from the extended TPB model for drowsy driving between male and female respondents are presented in **Table 4.15**. In absolute terms, compared to the female respondents, the male respondents generally had higher composite scores for invulnerability to danger, behavioral intention, and behavioral willingness for all three drowsy driving situations analyzed. Conversely, compared to female respondents, the male respondents generally had lower composite scores for general and composite risk perception in all three drowsy driving situations analyzed.

The difference observed in invulnerability to danger between males and females was highly significant ($p < .01$). General risk perception ($p = .041$) and behavioral willingness ($p = .013$) were significantly different ($p < .05$) between the gender groups only for Situation B. The difference observed in behavioral intention between males and females was highly significant ($p < .01$) for Situation B and significant for Situation C ($p < .05$).

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Table 4.15

Differences Observed in Composite Scores of Extended TPB Model Variables Between Male and Female Respondents

Construct/Variable	Male		Female					95% CI	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*	*LL*	*UL*
Invulnerability to Danger	152	33.8 (13.2)	357	28.1 (9.76)	4.806**	224.414	.000	3.36859	8.05154
Risk Perception (General)									
Situation A	167	11.6 (8.76)	386	13.2 (9.41)	-1.848	336.712	.066	-3.16612	0.09913
Situation B	159	8.34 (6.74)	365	9.74 (8.18)	-2.048*	361.177	.041	-2.75144	-0.05607
Situation C	152	10.5 (7.51)	358	11.4 (8.17)	-1.220	307.980	.223	-2.38037	0.55836
Risk Perception (Comparative)									
Situation A	167	10.3 (8.15)	386	10.5 (7.38)	-0.282	289.130	.778	-1.65207	1.23752
Situation B	159	8.52 (6.53)	364	8.85 (6.81)	-0.526	313.197	.599	-1.56809	0.90645
Situation C	152	9.23 (6.67)	358	10.1 (6.71)	-1.366	286.073	.173	-2.15710	0.38990
Behavioral Intention									
Situation A	171	3.52 (1.56)	401	3.42 (1.52)	0.669	315.296	.504	-0.18340	0.37228
Situation B	162	3.78 (1.60)	369	3.12 (1.57)	4.407**	302.330	.000	0.36587	0.95625
Situation C	152	4.22 (1.55)	360	3.87 (1.59)	2.347*	291.767	.020	0.05724	0.65154
Behavioral Willingness									
Situation A	167	4.03 (1.75)	386	3.92 (1.80)	0.648	323.974	.518	-0.21593	0.42785
Situation B	159	5.20 (1.85)	365	4.75 (1.96)	2.504*	317.625	.013	0.09589	0.79977
Situation C	152	5.16 (1.64)	358	5.03 (1.72)	0.863	297.597	.389	-0.17845	0.45712

Note: Statistical calculations for each analysis (all two-tailed tests conducted at the .05 significance level) are based on the cases with no missing or out-of-range data for any variable in the analysis. Equal variances are not assumed. *n* = Number of cases; *M* = Mean; *SD* = Standard Deviation; *df* = Degrees of Freedom; CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit; TPB = Theory of Planned Behavior.

* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

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4.4.6 HYPOTHESIS 6: Differences Between Employed and Non-Employed Respondents

> *For all drowsy driving situations analyzed, individuals who are employed while attending university will exhibit greater intention and willingness to engage in drowsy driving than individuals who are not employed while attending university.*

Differences observed in composite scores for intention and willingness to engage in drowsy driving behavior between employed and non-employed respondents are presented in **Table 4.16**. No significant differences ($p > .05$) were observed between the two groups of respondents for all three drowsy driving situations presented in the questionnaire.

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Table 4.16

Differences Observed in Composite Scores for Behavioral Intention and Behavioral Willingness Between Employed and Non-Employed Respondents

	Employed		Not Employed					95% CI	
Construct/Variable	*n*	*M* (*SD*)	*n*	*M* (*SD*)	*t*	*df*	*p*	*LL*	*UL*
Behavioral Intention									
Situation A	399	3.47 (1.53)	173	3.42 (1.54)	0.316	325.413	.752	-0.23109	0.31949
Situation B	373	3.28 (1.63)	158	3.40 (1.56)	-0.762	307.923	.447	-0.40944	0.18082
Situation C	363	3.98 (1.62)	149	3.97 (1.50)	0.039	295.428	.969	-0.28872	0.30045
Behavioral Willingness									
Situation A	386	3.96 (1.81)	167	3.94 (1.74)	0.087	325.763	.931	-0.30710	0.33538
Situation B	370	4.86 (1.96)	154	4.95 (1.88)	-0.456	297.436	.649	-0.44257	0.27619
Situation C	363	5.10 (1.70)	147	4.98 (1.71)	0.761	267.581	.447	-0.20183	0.45606

Note: Statistical calculations for each analysis (all two-tailed tests conducted at the .05 significance level) are based on the cases with no missing or out-of-range data for any variable in the analysis. Equal variances are not assumed. *n* = Number of cases; *M* = Mean; *SD* = Standard Deviation; *df* = Degrees of Freedom; CI = Confidence Interval; *LL* = Lower Limit; *UL* = Upper Limit.

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Chapter 5: Discussion

5.1 Summary of Central Findings

5.1.1 Associations Between the Extended TPB Model Variables

The results reported in **Sections 4.4.1** and **4.4.2** and **Tables 4.8** through **4.10** indicate that among the respondents analyzed in this study, both intention and willingness to drive while drowsy were:

1. positively associated with positive attitudes, subjective norm, perceived behavioral control, past experience driving while drowsy, and sense of invulnerability to danger for all drowsy driving situations presented; and
2. negatively associated with age for some of the drowsy driving situations presented.

These study results provide substantial support for most components of Hypotheses 1 and 2 and are generally consistent with the literature reviewed in **Section 2.2.3** on the utility of the TPB in predicting intentions to engage in various risky driving behaviors.

The correlations observed in this study between behavioral intention and attitudes ($.569 \leq r \leq .582$), subjective norm ($.411 \leq r \leq .558$), and perceived behavioral control ($.685 \leq r \leq .704$) generally were stronger than those reported by Godin and Kok (1996) in their comprehensive review of several dozen health-related applications of the TPB (overall average correlations of .46 for attitudes, .34 for subjective norm, and .46 for perceived behavioral control), which included four driving-related applications of the TPB (average correlations of .26 for attitudes, .48 for subjective norm, and .44 for perceived behavioral control). However, as was

observed in this study, Godin and Kok reported a stronger correlation between intention and perceived control than between intention and attitudes for risky driving behaviors. Furthermore, the strength of correlation observed in this study between behavioral willingness and attitudes ($.437 \leq r \leq .467$), subjective norm ($.345 \leq r \leq .414$), and perceived behavioral control ($.553 \leq r \leq .643$) compared favorably with those reported by Rivis and colleagues (2011) in their investigation of willingness of younger and older male drivers to drive while intoxicated (significant correlations of $.27 \leq r \leq .52$ for attitudes, $.24 \leq |r| \leq .34$ for subjective norm, and $.26 \leq |r| \leq .70$ for perceived behavioral control).

By contrast, the results from this study do not support the component of Hypotheses 1 and 2 predicting negative associations between risk perception and both behavioral intention and behavioral willingness. In fact, the significant positive associations observed between behavioral intention and risk perception in all three drowsy driving situations analyzed directly contradict this component of Hypothesis 1. This contradiction, along with the lack of association observed between behavioral willingness and risk perception, appears to be consistent with the findings of Gibbons and colleagues that individuals who intend to engage in a particular risky behavior acknowledge their personal risk vis-à-vis the behavior, whereas individuals who are only willing to engage in the behavior do not acknowledge such risks (Gibbons, Gerrard, Ouelette, et al., 1998). The results relating to Hypotheses 1 and 2 support the theory put forth by Gibbons and colleagues that behavioral intention is deliberative in nature and includes contemplation of the behavior and its

consequences, whereas behavioral willingness is reactive in nature and involves less consideration of outcomes and consequences of the behavior (see **Section 2.2.2.1**).

It is worth noting that strong and highly significant ($p < .01$) positive correlations were observed between behavioral intention and behavioral willingness for all three drowsy driving situations analyzed in this study, with $r = .679$ for Situation A, $r = .649$ for Situation B, and $r = .657$ for Situation C. These observed correlations between behavioral intention and behavioral willingness are consistent with those observed between behavioral expectation (which was used as a proxy for behavioral intention) and behavioral willingness by Gibbons and colleagues (Gibbons, Gerrard, Blanton, et al., 1998; Gibbons, Gerrard, Ouelette, et al., 1998).

5.1.2 Predictive Utility of the Extended TPB Model for Drowsy Driving

The results reported in **Section 4.4.3** and **Tables 4.11** and **4.12** provide significant support for Hypothesis 3 and are largely consistent with the literature reviewed in **Sections 2.2.1** and **2.2.3** on the predictive utility of the TPB constructs in numerous health-related and risky driving behaviors. In general, the respondents who reported more favorable attitudes and subjective norm and greater perceived control and willingness in relation to drowsy driving behavior were more likely to report stronger intentions to engage in drowsy driving behavior. Together, these variables significantly explained an additional ~50 percent of the variance in intention to engage in drowsy driving behavior after taking into account the personal variables included in the extended TPB model for drowsy driving illustrated in **Figure 1.1**. This figure compares favorably with the finding of Godin and Kok (1996) that

attitudes, subjective norm, and perceived behavioral control explained an average of 41 percent of the variation in intention to engage in 58 health-related behaviors.

For all three drowsy driving situations analyzed, perceived behavioral control ($0.357 \leq \beta \leq 0.373$) and behavioral willingness ($0.292 \leq \beta \leq 0.341$) were the strongest predictors of behavioral intention, whereas attitude toward the behavior ($0.084 \leq \beta \leq 0.193$) and subjective norm ($0.036 \leq \beta \leq 0.165$) were the weakest predictors. These findings reflect those of Godin and Kok (1996), who reported in their review of health-related applications of the TPB that perceived behavioral control was a stronger predictor of intention than attitudes for automobile-related behaviors.

Similarly, the results reported in **Section 4.4.4** and **Tables 4.13** and **4.14** provide significant support for Hypothesis 4. In general, the respondents who reported more favorable attitudes and subjective norm in relation to drowsy driving behavior were more likely to report greater willingness to engage in drowsy driving behavior. Together, these variables significantly explained nearly an additional 20 percent of the variance in willingness to engage in drowsy driving behavior after taking into account the personal variables included in the extended TPB model for drowsy driving. Between the two variables, attitude toward the behavior was the stronger predictor ($0.291 \leq \beta \leq 0.373$) of behavioral willingness and subjective norm was the weaker predictor ($0.145 \leq \beta \leq 0.203$) for all three drowsy driving situations analyzed. These findings are generally consistent with those reported by Rivis and colleagues (2011) from their investigation of the predictive utility of the TPB and PWM variables on the willingness of younger and older male drivers to drive while

intoxicated (see **Section 2.2.3**). As was observed in this study, Rivis and colleagues found that attitude toward the behavior was a stronger predictor of willingness than subjective norm in younger male drivers aged 17 to 29 years ($\beta = 0.20$, $p < .01$ for attitudes and $|\beta| = 0.14$, $p < .05$ for subjective norm) but not in older male drivers aged 30 to 60 years ($\beta = 0.01$, $p > .05$ for attitudes and $|\beta| = 0.16$, $p < .05$ for subjective norm). The findings for the younger population are most relevant for comparative purposes because most respondents analyzed in this study were under 30 years of age (see **Table 4.2**). Because Rivis and colleagues included variables measuring perceived behavioral control and risk prototypes in their regression analyses, it is not possible to make direct comparisons between their results and those of this study regarding the contribution of variables from the TPB and PWM to the variation in behavioral willingness.

5.1.3 Differences Observed between Demographic Groups

The results reported in **Section 4.4.5** and **Table 4.15** indicate that males in the study sample generally exhibited lower perceived risk and greater invulnerability to danger, intention to engage in drowsy driving behavior, and willingness to engage in drowsy driving behavior than the females in the study sample. These differences between the gender groups were significant for some of these variables in some of the drowsy driving situations analyzed. Differences in general risk perception attained or approached statistical significance in two of the three situations analyzed, whereas differences in comparative risk perception did not attain statistical significance in any of the situations analyzed. These results generally are consistent with the literature reviewed in **Section 2.1.3** on differences in risk perception between gender groups.

Furthermore, differences in behavioral intention attained statistical significance in two of the three situations analyzed, whereas differences in behavioral willingness attained statistical significance in only one of the three situations analyzed. Overall, these mixed results provide modest support for Hypothesis 5.

By contrast, the results reported in **Section 4.4.6** and **Table 4.16** do not provide any support for Hypothesis 6. No statistically significant differences in intention or willingness to engage in drowsy driving behavior were observed between employed and non-employed respondents for any of the drowsy driving situations analyzed. Even raw comparisons between the descriptive statistics for the data revealed no consistent pattern in the mean differences in behavioral intention and willingness between the two employment-status groups.

5.2 Implication of the Findings

5.2.1 Theoretical Implications

Overall, the central findings of this study indicate that the extended TPB model for drowsy driving illustrated in **Figure 1.1** may be highly useful for predicting intentions and willingness to engage in drowsy driving behavior among university students and similar populations. Some of the theoretical implications of this conclusion are discussed in this section, and some practical implications are discussed in **Section 5.2.2**.

5.2.1.1 Perceived Behavioral Control and Perceived Risk

In this study, perceived behavioral control was identified consistently as the strongest predictor of intention to engage in drowsy driving behavior. Also in this study, perceived risk concerning drowsy driving behavior appeared to be positively

associated with intention to engage in drowsy driving behavior. One possible explanation for this surprising observation may be that elevated perceived behavioral control negates or attenuates perceived risk regarding drowsy driving behavior. Alternatively, elevated perceived behavioral control may negate or attenuate the impact of perceived risk on intention to engage in drowsy driving behavior. The data from this study provide some support for both of these propositions: as reported in **Tables 4.8** through **4.10**, significant small negative correlations were observed between perceived behavioral control and general risk perception ($-.156 \leq r \leq -.106$) for all drowsy driving situations analyzed in this study. Moreover, small negative correlations were also observed between perceived behavioral control and comparative risk perception ($-.088 \leq r \leq -.044$), although only the correlation for Situation A was significant ($r = -.088$, $p < .05$).

Additional support for these propositions can be found in research from the field of business management and administration indicating that an increase in perceived self-efficacy decreases perceived risk, which in turn increases risk-taking behavior (Krueger & Dickson, 1994). Such research findings are relevant because perceived behavioral control is closely associated with the concept of perceived self-efficacy (Ajzen, 1991, 2002), which refers to "people's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives" (Bandura, 1991, p. 257). In general, self-efficacy relates in part to convictions about the ease or difficulty of performing a behavior required to produce an outcome (Bandura, 1977).

5.2.1.2 Behavioral Willingness and the Extended TPB Model

After perceived behavioral control, behavioral willingness was identified consistently as the second strongest predictor of intention to engage in drowsy driving behavior in this study. As indicated in **Table 4.12**, the inclusion of willingness significantly explained an additional 4.6 to 7 percent of the variation in intention to engage in drowsy driving behavior on top of the variation explained by personal variables and the traditional TPB antecedents to intention. This finding suggests that the inclusion of behavioral willingness may significantly improve the performance of the TPB in explaining variation in intentions to drive while drowsy among university students.

Attitude toward the behavior was identified consistently as a stronger predictor of willingness to engage in drowsy driving behavior than subjective norm in this study. One possible explanation for this finding could be that attitudes have a stronger influence on the formation of risk prototypes related to drowsy driving in university students than subjective norm, which in turn influences behavioral willingness. Although this study cannot provide empirical support for this proposition because the impact of risk prototypes was not included in any of the hypotheses investigated, the work of Rivis and colleagues provides some such empirical support. More specifically, Rivis and colleagues found that the associations between attitudes and variables intended to measure prototype similarity ($r = .33$, $p < .001$) and prototype favorability ($r = .42$, $p < .001$) were stronger than the associations between subjective norm and these prototype-related variables ($|r| = .26$,

$p < .01$ for prototype similarity and $|r| = .22$, $p < .05$ for prototype favorability) in young male drivers (2011, p. 450, Table 1).

It is worth noting that Rivis and colleagues also found that perceived behavioral control was the strongest predictor of willingness in young male drivers, and that this variable was a stronger predictor of willingness among younger male drivers ($|\beta| = 0.47$) than among older male drivers ($|\beta| = 0.24$). Although perceived behavioral control was not assessed as a predictor of behavioral willingness in this study, highly significant ($p < .01$) correlations were observed between perceived behavioral control and behavioral willingness in all three drowsy driving situations analyzed, with $r = .553$ for Situation A, $r = .643$ for Situation B, and $r = .555$ for Situation C (see Tables **4.8** through **4.10**). These correlations were stronger than those observed between willingness and attitudes (with $r = .437$ for Situation A, $r = .467$ for Situation B, and $r = .445$ for Situation C). Thus, it is possible that perceived behavioral control actually may be a stronger predictor of willingness to engage in drowsy driving behavior than attitudes. Further investigation is necessary to explore this possibility (see **Section 5.4**).

5.2.1.3 Gender and Employment Status

Significant differences in risk perception, intentions, and willingness were observed between males and females for some but not all of the drowsy driving situations analyzed in this study. One explanation for this finding would be that males and females reacted differently to each of the three drowsy driving situations, so that the magnitude of gender-based differences in risk perceptions, intentions, and willingness fluctuated between the situations analyzed.

The failure to detect any statistically significant differences between employment-status groups in this study may suggest that a person's employment status has little bearing on the cognitive formation of intentions and willingness to engage in drowsy driving behavior. Alternatively, this finding may reflect a potential self-selection bias among respondents that resulted in a study sample consisting of employed and non-employed individuals with similar experiences, attitudes, or opinions pertaining to drowsy driving (see discussion in **Section 5.3.2**). Another possible explanation for this finding is that the student body from which the study sample was drawn may consist of employed and non-employed individuals with similar experiences, attitudes, or opinions pertaining to drowsy driving. Such similarities in experiences, attitudes, or opinions may lead to similar propensities to develop intentions and willingness to engage in drowsy driving behavior.

This study continues a pattern of conflicting observations in recent drowsy driving-related studies regarding differences between employed and non-employed individuals. For example, an analysis of BRFSS data from 2011 to 2012 (Wheaton et al., 2014) found no statistically significant difference in drowsy driving prevalence rates between employed (4.5 percent, 95% CI [4.0, 5.1]) and unemployed individuals (3.7 percent, 95% CI [2.6, 5.1]), whereas an analysis of BRFSS data from 2009 to 2010 from a different sample of the U.S. population from a different set of U.S. states and territories (Wheaton et al., 2013) found a statistically significant difference in drowsy driving prevalence rates between employed (5.1 percent, 95% CI [4.7, 5.6] and unemployed individuals (3.1 percent, 95% CI [2.4, 4.0]). These inconsistent

observations suggest that employment status may not be a particularly reliable predictor of drowsy driving behavior.

5.2.2 Practical Implications

The extended TPB model for drowsy driving illustrated in **Figure 1.1** presents a promising theoretical framework for improving the effectiveness of existing drowsy driving prevention efforts targeted at young people and for designing more effective educational campaigns and interventions against drowsy driving in young people in the future. Given the substantial evidence from the TPB and PWM literature that behavioral intention generally is the best predictor of actual future behavior and that behavioral willingness is a critical predictor of actual future behavior that is impulsive or socially undesirable in nature, the findings from this study on intentions and willingness to engage in drowsy driving behavior are relevant to such campaigns and interventions.

Directly influencing behavioral intention and behavioral willingness through educational campaigns or interventions against drowsy driving is a challenging undertaking, however, as direct measurement of variables related to these constructs relies heavily on self-reporting and are therefore prone to social desirability bias. Furthermore, as the extended TPB model examined in this study and the existing literature on the TPB and the PWM all make clear, numerous interacting neurocognitive processes contribute to both of these constructs. Indirectly influencing willingness and intentions (and thus, in accordance with the extended TPB model, future behavior) through campaigns and interventions that address the

cognitive antecedents of intention and willingness is therefore a more feasible strategy.

Because perceived behavioral control and willingness were found to be the strongest predictors of intention to engage in drowsy driving behavior among university students in this study, educational campaigns and interventions intended to prevent drowsy driving among young people should put greater emphasis on addressing these constructs. Most existing drowsy driving prevention campaigns and educational materials focus on providing factual information about the dangers of and risk factors for drowsy driving, recognizing signs of sleepiness while driving, and effective countermeasures against drowsiness while driving. Fear appeals regarding the health and safety consequences of drowsy driving accidents also feature prominently in these campaigns and materials. By contrast, relatively little information is provided in these campaigns and materials about how people's perceptions about their ability to drive while drowsy differ from their actual ability to drive while drowsy. Furthermore, the messages delivered through these campaigns and materials generally are not intended to influence people's perceptions about their ability to drive while drowsy (*i.e.*, perceived behavioral control) or their perception of factors that inhibit or facilitate their ability to drive while drowsy (*i.e.*, control beliefs). Re-packaging existing campaign messages or developing new campaign messages to focus more on influencing these perceptions and beliefs regarding behavioral control may enhance the effectiveness of these drowsy driving prevention efforts, particularly in young people.

Although some messages delivered through current drowsy driving campaigns and materials are aimed at influencing people's general attitudes toward drowsy driving, it is unclear whether these messages influence people's attitudes toward risk prototypes of drowsy drivers. Re-packaging existing campaign messages or developing new campaign messages intended to influence attitudes toward drowsy driver prototypes (*i.e.*, prototype favorability and prototype similarity) may indirectly influence the willingness level of young people to engage in drowsy driving in the future. As postulated by the extended TPB model for drowsy driving, the change in willingness level would have an effect on young people's intentions to engage in drowsy driving behavior and on their likelihood to actually engage in drowsy driving behavior in the future.

5.3 Limitations

Several potential threats to the validity of the findings from this research study were introduced during questionnaire development, participant recruitment, and data analysis.

5.3.1 Shortcomings in Questionnaire Development and Design

The three drowsy driving situations analyzed in this study were developed from the input of five young U.S. citizens who were currently enrolled in or had recently graduated from Associate's or Bachelor's degree programs at post-secondary educational institutions in the U.S. (see **Section 3.2.1**). Consequently, the drowsy driving situations that were ultimately developed focused on situations that younger respondents in college were more likely to experience and relate to than older respondents with full-time jobs and families. Older respondents who had difficulty

relating to the drowsy driving situations presented also may have had difficulty answering the questionnaire items used to measure the variables from the extended TPB model, thereby compromising the quality of the data yielded by these respondents.

Furthermore, the questionnaire items used to measure the TPB and PWM variables in this study were not reviewed by experts in these behavioral theories to assess the face and content validity of these items. The distinction made between general and comparative risk perception and the method used to measure these variables described in **Section 3.2.1.7** also were not reviewed and validated by experts in risk perception theory.

Finally, the excessive length of the questionnaire (with a total of over 100 distinct items) may have resulted in increased respondent fatigue and burden within the study sample. More rigorous pilot testing of the questionnaire items in conjunction with principal components or factor analysis could have resulted in fewer questionnaire items and thus reduced respondent fatigue and burden in the study sample.

5.3.2 Representativeness of the Study Sample

As discussed in **Sections 4.2.2**, raw comparisons between the percentage of various demographic groups in the sample of UMCP students analyzed as respondents in this study and the enrolled student body at UMCP during the Spring 2014 Term indicated that certain demographic categories were over-represented in the study sample. Females, Maryland residents, and School of Public Health students were especially over-represented among undergraduate and graduate students in the

study sample. U.S. citizens, whites, College of Education students, and College of Information Studies students also were especially over-represented among the graduate students in the study sample. These and the other demographic differences observed between the study sample and the enrolled student body reported in **Table 4.1** were not analyzed for statistical significance in this study. Consequently, no determination was made as to the statistical representativeness (or non-representativeness) of the study sample in relation to the Spring 2014 enrolled student body at UMCP. Furthermore, data weighting was not employed in response to suspected oversampling of certain demographic groups in this sample. These analytical omissions potentially threaten the validity and weaken the generalizability of the central findings from this study.

The results of this study also may have been influenced by self-selection bias within the study sample, as UMCP students with past experience driving while drowsy or for whom the issue of drowsy driving is particularly important may have been more likely to participate in this study. Prevalence data on the past drowsy driving or asleep driving behavior of the enrolled student body at UMCP during the Spring 2014 Term was not available, so it was not possible to compare the percentage of respondents with past drowsy driving or past asleep driving experience in this study with that of the Spring 2014 enrolled student body at UMCP. The 40.3 percent of undergraduate respondents in this study (142 males, 305 females, average age = 21.27 years) who reported having past asleep driving experience (180 "Ever," "Recent," and "Frequent" cases out of 447 undergraduate respondents analyzed; see **Table 4.4**), however, is substantially higher than the 16 percent of respondents in a

sample of 1,039 (72% females, average age = 20.39 years) undergraduate students at the University of North Texas who reported falling asleep while driving (Taylor & Bramoweth, 2010). Moreover, the 40.8 percent of undergraduate and graduate student respondents in this study (184 males, 449 females) who reported having past asleep driving experience (258 "Ever," "Recent," and "Frequent" cases out of 633 undergraduate and graduate student respondents analyzed; see **Table 4.4**) is higher than the 32 percent of respondents in a stratified random sample of 300 (47% male, 52% female, median age = 22 years) undergraduate and graduate students at a large and extremely "dry" (*i.e.*, low prevalence of alcohol consumption) religiously-affiliated private university in Utah who reported experiencing a "dozing and driving" incident since the beginning of their college career (Lindsay et al., 1999). These comparisons between different study samples suggest that self-selection bias indeed may have occurred within the UMCP study sample, and that due care therefore must be exercised before generalizing the conclusions drawn from this study to populations beyond the study sample.

5.3.3 Shortcomings in the Data Analysis

The results reported in **Section 4.3.2** and **Table 4.7** suggest that some of the questionnaire data used to measure the behavioral and neurocognitive variables from the extended TPB model for drowsy driving may not have been normally distributed. Because the statistical tests used to analyze the data collected in this study assume a normal distribution of the data analyzed, the use of these tests to analyze the potentially non-normally distributed data without transformation may threaten the validity of the results reported in **Section 4.4**. This threat is mitigated by the fact that

the data used to measure attitudes, subjective norm, perceived behavioral control, behavioral intention, and behavioral willingness were not profoundly skewed or kurtotic (see discussion in **Section 4.3.2**), and by the fact that the size of the study sample was relatively large ($N \approx 500$ for all statistical analyses performed in this study). These mitigating factors also justify the decision to leave the questionnaire data untransformed before using them for statistical analysis in this study. Nonetheless, the apparent non-normal distribution of some of the questionnaire data influenced the decision in this study to not assume equal variances when statistically comparing differences between demographic groups in the study sample (see notes for **Tables 4.15** and **4.16**).

Finally, with regard to the hierarchical multiple regression analyses used to assess Hypotheses 3 and 4, the methods used to enter predictors sequentially into the regression models reported in **Sections 4.4.3** and **4.4.4** and **Tables 4.11** through **4.14** did not allow for assessment of the unique contribution of each predictor to the variation in the dependent variables analyzed (*i.e.*, behavioral intention and behavioral willingness). Only the unique contribution of the variable(s) entered into the last step for each regression analysis could be determined in this study. Furthermore, with regard to the hierarchical multiple regression analyses reported in **Tables 4.12** and **4.14** in which a single predictor was entered into each step of the regression model, the decision to add attitudes before subjective norm (when testing Hypotheses 3 and 4) and to add subjective norm before perceived behavioral control (when testing Hypothesis 3) was arbitrary and not based on any theoretical foundation. The addition of attitudes in the second step of these models means that

most of the shared variance with the predictors entered in later steps was credited to attitudes, thereby potentially inflating the relative importance of attitudes in explaining variation in behavioral intention and willingness.

5.4 Directions for Future Research

The findings from this study present a number of research questions for future investigation. First, the relationship between perceived behavioral control, perceived risk, and perceived self-efficacy in relation to drowsy driving warrants further study in light of the surprising results discussed in **Section 5.2.1.1**. Furthermore, as mentioned in **Section 5.2.1.2**, the relationship between perceived behavioral control and behavioral willingness (which was not investigated in this study) needs further exploration in light of the findings of Rivis and colleagues (2011). Future investigations also should explore how the inclusion of risk prototypes in the extended TPB model for drowsy driving would impact the predictive utility of the model.

Several research questions also may be addressed by additional analyses of the data collected for this study. For example, the unique contribution of each variable from the extended TPB model to the variation in behavioral intention and willingness can be assessed using appropriate statistical analyses of the study data. In addition, the statistical analyses performed in this study may be repeated after transforming the data to correct non-normal distributions or weighting the data to correct oversampling in the data, and the results of these analyses should be compared with those reported in **Chapter 4**.

The predictive validity of the extended TPB model also might be assessed if this study were reproduced in a more representative sample of UMCP students, in samples of students from other educational institutions, or in a sample of young licensed drivers drawn from the general population. Results from these future studies could then be compared with those of this study. If the findings of these future studies are consistent with the findings of this study, the predictive validity of the extended TPB model and the external validity of the findings of this study would be affirmed.

Before the questionnaire developed for this study can be used in future studies of drowsy driving behavior, the construct validity of the questionnaire items should be formally assessed so that appropriate revisions can be made. Additional pilot testing of the questionnaire items (*e.g.*, through focus groups), in conjunction with principal components or factor analysis, also should be employed to help reduce the length of and fine-tune the content of the questionnaire before it is used again for research purposes.

Finally, a logical sequel to this study would involve an examination of the utility of the extended TPB model in predicting actual drowsy driving behavior. Such a study would be difficult to realize, however, given the significant methodological and logistical challenges of measuring drowsy driving incidence in study participants.

5.5 Conclusions

This study is believed to be the first in which the predictive utility of the Theory of Planned Behavior was scientifically assessed in the context of drowsy driving behavior. The extended TPB model examined in this study may be highly

useful for predicting intentions and willingness to engage in drowsy driving behavior among university students and similar populations. This model also presents a promising theoretical framework for improving the effectiveness of existing drowsy driving prevention efforts targeted at young people and for designing more effective interventions against drowsy driving in young people in the future. Additional research on the predictive validity of this model and research to improve the quality of the questionnaire used to measure the model's behavioral and neurocognitive variables are needed to bolster the validity of these conclusions.

Appendices

Appendix 1: Questionnaire on Drowsy Driving | University of Maryland

INFORMED CONSENT

Project Title	Intention and Willingness to Drive While Drowsy in a Population of University Students in Maryland: An Application of an Extended Theory of Planned Behavior Model
Purpose of the Study	This research is being conducted by Clark J. Lee (Student Investigator) under the supervision of Prof. Kenneth H. Beck (Faculty Advisor) of the Department of Behavioral and Community Health in the School of Public Health at the University of Maryland, College Park. **You are being invited to participate in this research project because you are a student at the University of Maryland, College Park who is at least 18 years old and who likely has a driver's license.** The purpose of this research project is **to better understand the personal and cognitive factors that contribute to drowsy driving behavior in young people.** The results of this study may inform the development of more effective interventions against drowsy driving in young people, who are particularly vulnerable to the health and safety hazards associated with drowsy driving behavior. As used in this study, "drowsy driving" means the act of operating a motor vehicle while drowsy, sleepy, asleep, or fatigued.
Procedures	The procedures for this study involve your participation in a brief **online questionnaire**. It should require about **20 to 25 minutes** of your time to complete. The questionnaire will ask you about your attitudes, perceptions, intentions, willingness, and previous experiences related to drowsy driving. One example of a questionnaire item is: "How many times have you driven a motor vehicle while being so drowsy or sleepy that you had a hard time keeping your eyes open during the past year?"

	Upon completing the questionnaire, you will be asked whether you want to participate in a raffle to win **one of ten $25 electronic Gift Cards** from your choice of **Amazon, iTunes, or Starbucks**. If you would like to be entered into the E-Gift Card raffle, you will be directed to a site where you will be asked to provide your name and e-mail address. Your name and e-mail address will be held in confidence and will not be connected to your responses in the questionnaire in any way.
Potential Risks and Discomforts	The risks associated with completing this questionnaire are minimal, as all of your responses are anonymous to the greatest extent possible. However, should you feel uncomfortable answering any of the questions, you may choose to ignore them.
Potential Benefits	Although you will not benefit directly from participating in this study, your participation may help enhance general understanding of the personal and cognitive factors that contribute to drowsy driving behavior in young people. This knowledge could be used in the future to develop more effective interventions against drowsy driving in young people, who are particularly vulnerable to the health and safety hazards associated with drowsy driving behavior.
Confidentiality	You will not be required to provide any information that may link your identity to your questionnaire responses. To enter the E-Gift Card raffle upon completing the questionnaire, you will be directed to a new landing page where you can provide your name and an e-mail address separately from your questionnaire responses. The Student Investigator will do his best to minimize any potential loss of confidentiality. The data for this study will be collected via an online survey provider (Qualtrics) and stored in the survey provider's database, which is only accessible with a password. Information submitted to the online survey provider will be backed up daily on its secure servers, and the online survey provider will not use any of the information it receives. All data and information collected as part of this study will be downloaded from the online survey provider and saved on to a password-protected computer and an external hard drive. Both the password-protected computer and external hard drive will be kept in a secure location at all times. Only the Student Investigator, his Faculty Advisor, and members of his Thesis Committee

	will have access to the study data and information stored on the computer and external hard drive. **Any personal identifying information collected from participants for purposes of the E-Gift Card raffle will be destroyed at the conclusion of this study.** All other data and files pertinent to the research will be retained for a period of no less than 7 years after the completion of the research in accordance with the University of Maryland, College Park policy on records retention and disposal. No personal identifying information will be used to analyze and interpret the data collected in this study, and all results from this study will be reported in aggregate form (*e.g.*, group averages). **Individual questionnaire responses will never be reported.**
Medical Treatment	The University of Maryland, College Park does not provide any medical, hospitalization or other insurance for participants in this research study, nor will the University of Maryland, College Park provide any medical treatment or compensation for any injury sustained as a result of participation in this research study, except as required by law.
Compensation	Upon completing the questionnaire, you will become eligible to participate in a raffle to win **one of ten $25 electronic Gift Cards** from your choice of **Amazon, iTunes, or Starbucks**. If you are a raffle winner, you will be responsible for any taxes assessed on the compensation.
Right to Withdraw and Questions	**Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify. Choosing to participate in the study will have no effect on your grades or standing at the University of Maryland, College Park.** Please contact the following individuals if you have questions, concerns, or complaints; or if you need to report an injury related to the research:

	Clark J. Lee, JD [Student Investigator] ***Master of Public Health Candidate*** Phone: (240) 777-4569 E-Mail: cjlee@umd.edu **Kenneth H. Beck, PhD, FAAHB** [Faculty Advisor] ***Professor*** Phone: (301) 405-2527 E-Mail: kbeck1@umd.edu **2387 School of Public Health Building** **Department of Behavioral and Community Health** **University of Maryland** **College Park, Maryland 20742**
Participant Rights	If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: **University of Maryland, College Park** **Institutional Review Board Office** **1204 Marie Mount Hall** **College Park, Maryland 20742** Phone: (301) 405-0678 E-Mail: irb@umd.edu This research has been reviewed according to the University of Maryland, College Park Institutional Review Board procedures for research involving human subjects.
Statement of Consent	By selecting your choice below, you are indicating your right to consent or not consent electronically. **By selecting "YES,** I Consent**" and clicking on the "Continue" button below, you affirm that:** 1. **YOU are at least 18 years old;** 2. **YOU are enrolled as a student at the University of Maryland, College Park;** 3. **YOU have read and understand the terms of this study; and** 4. **YOU are agreeing voluntarily to participate in this study.**

	If you DO NOT wish to participate in this study, please select "**NO,** I DO NOT Consent" and click "Continue" to decline participation. You will not be eligible to enter into the E-Gift Card raffle if you decline participation.

Q0 Do you consent to participate in this study?

- ❍ YES, I Consent (1)
- ❍ NO, I DO NOT Consent (2)

Note: Participant must answer this question to proceed to the next page of the questionnaire

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If* No *Is Selected, Then Skip To the following end-of-questionnaire message:

Thank you for your interest in this study.

This page is left blank intentionally.

PART 1: Demographic and Health Information

Please answer the following questions about yourself.

Q1 What is your gender?

- ❍ Male (1)
- ❍ Female (2)

Q2 What is your age, in years?

Q3 What level of education are you currently pursuing at the University of Maryland, College Park?

- ❑ Undergraduate (1)
- ❑ Graduate (2)
- ❑ Other (3) _____

Q4 Which college(s) or school(s) are you enrolled in at the University of Maryland, College Park? Select all that apply.

- ❑ College of Agriculture and Natural Resources (1)
- ❑ School of Architecture, Planning, and Preservation (2)
- ❑ College of Arts and Humanities (3)
- ❑ College of Behavioral and Social Sciences (4)
- ❑ Robert H. Smith School of Business (5)
- ❑ College of Computer, Mathematical and Natural Sciences (6)
- ❑ College of Education (7)
- ❑ A. James Clark School of Engineering (8)
- ❑ Philip Merrill College of Journalism (9)
- ❑ College of Information Studies (10)
- ❑ School of Public Health (11)
- ❑ School of Public Policy (12)
- ❑ Office of Undergraduate Studies (13)
- ❑ Other (14) _____

Q5 Are you of Hispanic or Latino origin?

- ❍ Yes (1)
- ❍ No (2)

Q6 What is your race? Please select all that you identify with.

- ❑ American Indian or Alaska Native (1)
- ❑ Asian (2)
- ❑ Black or African-American (3)
- ❑ Native Hawaiian or other Pacific Islander (4)
- ❑ White (5)
- ❑ Other (6) _____

Q7 Are you a United States citizen?

- ❍ Yes (1)
- ❍ No (2)

Q8(a) In what state is your permanent mailing address?

- ❍ Alabama (51)
- ❍ Alaska (52)
- ❍ American Samoa (53)
- ❍ Arizona (54)
- ❍ Arkansas (55)
- ❍ California (56)
- ❍ Colorado (57)
- ❍ Connecticut (58)
- ❍ Delaware (59)
- ❍ District of Columbia (60)
- ❍ Florida (61)
- ❍ Georgia (62)
- ❍ Guam (63)
- ❍ Hawaii (64)
- ❍ Idaho (65)
- ❍ Illinois (66)
- ❍ Indiana (67)
- ❍ Iowa (68)
- ❍ Kansas (69)
- ❍ Kentucky (70)
- ❍ Louisiana (71)
- ❍ Maine (72)
- ❍ Maryland (73)
- ❍ Massachusetts (74)

- ❍ Michigan (75)
- ❍ Minnesota (76)
- ❍ Mississippi (77)
- ❍ Missouri (78)
- ❍ Montana (79)
- ❍ Nebraska (80)
- ❍ Nevada (81)
- ❍ New Hampshire (82)
- ❍ New Jersey (83)
- ❍ New Mexico (84)
- ❍ New York (85)
- ❍ North Carolina (86)
- ❍ North Dakota (87)
- ❍ Northern Mariana Islands (88)
- ❍ Ohio (89)
- ❍ Oklahoma (90)
- ❍ Oregon (91)
- ❍ Pennsylvania (92)
- ❍ Puerto Rico (93)
- ❍ Rhode Island (94)
- ❍ South Carolina (95)
- ❍ South Dakota (96)
- ❍ Tennessee (97)
- ❍ Texas (98)
- ❍ Utah (99)
- ❍ Vermont (100)

- ❍ Virgin Islands (U.S.) (101)
- ❍ Virginia (102)
- ❍ Washington (103)
- ❍ West Virginia (104)
- ❍ Wisconsin (105)
- ❍ Wyoming (106)

Q8(b) If address is not in the U.S., please indicate the country in the space below.

Q9 Do you have a driver's license?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q10**

Q9(a) How many years have you been driving?

Q9(b) How many years have you had your driver's license?

Q9(c) Do you have access to a motor vehicle during the school year?

- ❍ Yes (1)
- ❍ No (2)

Q9(d) How often do you drive?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Every Day (4)

Q9(e) On average, how many miles do you drive each year?

- ❍ Less than 5,000 miles (1)
- ❍ 5,000 to 10,000 miles (2)
- ❍ 10,000 to 15,000 miles (3)
- ❍ 15,000 to 20,000 miles (4)
- ❍ More than 20,000 miles (5)

Q9(f) What time of the day do you usually drive? Select all that apply.

- ❑ 7 AM to 11 AM (1)
- ❑ 11 AM to 3 PM (2)
- ❑ 3 PM to 7 PM (3)
- ❑ 7 PM to 11 PM (4)
- ❑ 11 PM to 3 AM (5)
- ❑ 3 AM to 7 AM (6)

Q10 Are you employed?
- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q11.**

Q10(a) On average, how many hours per week do you work?

Q10(b) For your current job(s), do you work rotating shifts?

- ❍ Yes (1)
- ❍ No (2)

Q10(c) For your current job(s), do you have to work during the daytime?

- ❍ Yes (1)
- ❍ No (2)

Q10(d) For your current job(s), do you have to work in the evening?

- ❍ Yes (1)
- ❍ No (2)

Q10(e) For your current job(s), do you have to work at night after 11 PM?

- ❍ Yes (1)
- ❍ No (2)

Q10(f) Does your current job(s) involve physical exertion for extended periods of time?

- ❍ Yes (1)
- ❍ No (2)

Q11 Do you have any physical, medical, or mental condition(s) that induces sleepiness or causes you to struggle to stay awake at times when you are expected to be awake? If Yes, please list the condition(s) in the space provided.

- ❍ Yes (1) _____
- ❍ No (2)

Q12 Do you consume alcoholic beverages (Examples: beer, wine, liquor)?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q13**

Q12(a) How many days per week do you consume alcoholic beverages?

- ❍ 1 day (1)
- ❍ 2 days (2)
- ❍ 3 days or more (3)
- ❍ Do Not Consume Every Week (4)

Q12(b) How many alcoholic beverages do you typically have when you drink alcohol?

- ❍ 1 to 2 (1)
- ❍ 3 to 4 (2)
- ❍ 5 or more (3)

Q12(c) What time of the day do you usually consume alcoholic beverages? Select all that apply.

- ❑ Morning (6 AM to 12 PM) (1)
- ❑ Afternoon (12 PM to 6 PM) (2)
- ❑ Night-time (6 PM to 12 AM) (3)
- ❑ Late Night (12 AM to 6 AM) (4)

Q12(d) Do you combine alcohol with other beverages, including caffeinated beverages (Examples: coffee, tea, caffeinated soft drinks) and/or energy drinks (Examples: Red Bull, Monster, Rockstar, 5-hour Energy)?

- ❍ Yes (1)
- ❍ No (2)

Q13 Other than alcohol, do you take any hypnotic agents, central nervous system depressants, or other pharmacologic agents (drugs) that induce sleepiness?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q14**

Q13(a) Please list the sleepiness-inducing agent(s) in the space below.

Q13(b) On average, how many days each month during the past year have you taken any of these agent(s)?

- ❍ 1 to 4 days (1)
- ❍ 5 to 9 days (2)
- ❍ 10 to 14 days (3)
- ❍ 15 days or more (4)

Q13(c) What time of the day do you usually take these agent(s)? Select all that apply.

- ❑ Morning (6 AM to 12 PM) (1)
- ❑ Afternoon (12 PM to 6 PM) (2)
- ❑ Night-time (6 PM to 12 AM) (3)
- ❑ Late Night (12 AM to 6 AM) (4)

Q14 Do you have any physical, medical, or mental condition(s) that induces wakefulness or reduces sleepiness? If Yes, please list the condition(s) in the space provided.

- ❍ Yes (1) _____
- ❍ No (2)

Q15 Do you consume caffeinated beverages (Examples: coffee, tea, caffeinated soft drinks)?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q16**

Q15(a) How many days per week do you consume caffeinated beverages?

- ❍ 1 day (1)
- ❍ 2 days (2)
- ❍ 3 days or more (3)
- ❍ Do Not Consume Every Week (4)

Q15(b) How many caffeinated beverages do you typically have each day?

- ❍ 1 to 2 (1)
- ❍ 3 to 4 (2)
- ❍ 5 or more (3)

Q15(c) What time of the day do you usually consume caffeinated beverages? Select all that apply.

- ❑ Morning (6 AM to 12 PM) (1)
- ❑ Afternoon (12 PM to 6 PM) (2)
- ❑ Night-time (6 PM to 12 AM) (3)
- ❑ Late Night (12 AM to 6 AM) (4)

Q16 Do you consume energy drinks (Examples: Red Bull, Monster, Rockstar, 5-hour Energy)?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Q17**

Q16(a) How many days per week do you consume energy drinks?

- ❍ 1 day (1)
- ❍ 2 days (2)
- ❍ 3 days or more (3)
- ❍ Do Not Consume Every Week (4)

Q16(b) How many energy drinks do you typically have each day?

- ❍ 1 to 2 (1)
- ❍ 3 to 4 (2)
- ❍ 5 or more (3)

Q16c What time of the day do you usually consume energy drinks? Select all that apply.

- ❑ Morning (6 AM to 12 PM) (1)
- ❑ Afternoon (12 PM to 6 PM) (2)
- ❑ Night-time (6 PM to 12 AM) (3)
- ❑ Late Night (12 AM to 6 AM) (4)

Q17 Other than caffeine or energy drinks, do you take any wake-promoting therapeutics, central nervous system stimulants (Example: amphetamines), or other wake-promoting pharmacologic agents (drugs)?

- ❍ Yes (1)
- ❍ No (2)

***If* No *Is Selected, Then Skip To* Part 2**

Q17(a) Please list the wake-promoting agent(s) in the space below.

Q17(b) On average, how many days each month during the past year have you taken any of these agent(s)?

- ❍ 1 to 4 days (1)
- ❍ 5 to 9 days (2)
- ❍ 10 to 14 days (3)
- ❍ 15 days or more (4)

Q17(c) What time of the day do you usually take these agent(s)? Select all that apply.

- ❑ Morning (6 AM to 12 PM) (1)
- ❑ Afternoon (12 PM to 6 PM) (2)
- ❑ Night-time (6 PM to 12 AM) (3)
- ❑ Late Night (12 AM to 6 AM) (4)

PART 2: Behavioral and Psychometric Measurements

For each of the three drowsy driving situations presented, please respond to each of the following questions by selecting the answer that best describes your opinion. Some of the questions may appear to be similar, but they do address somewhat different issues. Please read each question carefully.

****As used in this study, "drowsy driving" means the act of operating a motor vehicle while drowsy, sleepy, asleep, or fatigued****

Situation A

You are driving home from campus for the summer on a Sunday morning. You've spent the past 2 weeks writing term papers and studying for final exams, the last of which took place the previous Thursday. You spend Thursday night and much of Friday celebrating the end of the school year. On Saturday morning, you finally start to pack and move out of your dormitory/off-campus housing. The packing and moving out process continues late into Saturday night and the very early morning hours of Sunday morning. You grab a few hours of sleep before starting on your 500 mile trip home at 10:00 AM on Sunday. As you drive on the Capital Beltway out of College Park, you find yourself having a hard time keeping your eyes open.

Q18(a) For me, driving while feeling drowsy or sleepy in this situation would be:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Bad:Good (1)	❍	❍	❍	❍	❍	❍	❍
Dangerous:Safe (2)	❍	❍	❍	❍	❍	❍	❍
Unpleasant:Pleasant (3)	❍	❍	❍	❍	❍	❍	❍
Unnecessary:Necessary (4)	❍	❍	❍	❍	❍	❍	❍
Foolish:Wise (5)	❍	❍	❍	❍	❍	❍	❍

Q19(a) People who are important to me would hope that I would not drive while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disagree (7)
- ❍ Quite Disagree (6)
- ❍ Slightly Disagree (5)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (3)
- ❍ Quite Agree (2)
- ❍ Strongly Agree (1)

Q20(a) People who are important to me would (disapprove–approve) of my driving while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disapprove (1)
- ❍ Quite Disapprove (2)
- ❍ Slightly Disapprove (3)
- ❍ Neither Approve nor Disapprove (4)
- ❍ Slightly Approve (5)
- ❍ Quite Approve (6)
- ❍ Strongly Approve (7)

Q21(a) People who are important to me would think that I (should not–should) drive while feeling drowsy or sleepy in this situation.

- ❍ Definitely Should Not (1)
- ❍ Probably Should Not (2)
- ❍ Maybe Should Not (3)
- ❍ Neither Should nor Should Not (4)
- ❍ Maybe Should (5)
- ❍ Probably Should (6)
- ❍ Definitely Should (7)

Q22(a) In this situation, I believe that I have the ability to drive while feeling drowsy or sleepy.

- ❍ Strongly Disagree (1)
- ❍ Quite Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Quite Agree (6)
- ❍ Strongly Agree (7)

Q23(a) For me, driving while feeling drowsy or sleepy in this situation would be:

- ❍ Extremely Difficult (1)
- ❍ Quite Difficult (2)
- ❍ Slightly Difficult (3)
- ❍ Neither Easy nor Difficult (4)
- ❍ Slightly Easy (5)
- ❍ Quite Easy (6)
- ❍ Extremely Easy (7)

Q24(a) In this situation, how likely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q25(a) In a similar situation in the future, do you intend to drive while feeling drowsy or sleepy?

- ❍ Definitely Do Not (1)
- ❍ Probably Do Not (2)
- ❍ Maybe Do Not (3)
- ❍ Neither Do nor Do Not (4)
- ❍ Maybe Do (5)
- ❍ Probably Do (6)
- ❍ Definitely Do (7)

Q26(a) In a similar situation in the future, what is the degree that you will avoid driving while feeling drowsy or sleepy?

- ❍ Very Little (7)
- ❍ Quite Little (6)
- ❍ Slightly Little (5)
- ❍ Neither Great nor Little (4)
- ❍ Slightly Great (3)
- ❍ Quite Great (2)
- ❍ Very Great (1)

Q27(a) In a similar situation in the future, how likely or unlikely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q28(a) If you were the driver in this situation, how willing would you be to do the following:

	Very Unwilling (1)	Quite Unwilling (2)	Slightly Unwilling (3)	Neither Willing nor Unwilling (4)	Slightly Willing (5)	Quite Willing (6)	Very Willing (7)
Stop driving immediately to get some rest. (1)	❍	❍	❍	❍	❍	❍	❍
Drive a little further before stopping to get some rest. (2)	❍	❍	❍	❍	❍	❍	❍
Continue driving until you reached your destination. (3)	❍	❍	❍	❍	❍	❍	❍

Q29(a) If you were the driver in this situation, how likely is it:

	Extremely Unlikely (1)	Quite Unlikely (2)	Slightly Unlikely (3)	Neither (4)	Slightly Likely (5)	Quite Likely (6)	Extremely Likely (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q30(a) If you were the driver in this situation, compared to others your age, how likely is it:

	Extremely Less Likely Than Others (1)	Quite Less Likely Than Others (2)	Slightly Less Likely Than Others (3)	Neither (4)	Slightly More Likely Than Others (5)	Quite More Likely Than Others (6)	Extremely More Likely Than Others (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q31(a) Thinking about yourself generally as a driver:

How likely is it that you would find yourself in this drowsy driving situation? (1)	❍ Extremely Unlikely (1)	❍ Quite Unlikely (2)	❍ Slightly Unlikely (3)	❍ Neither (4)	❍ Slightly Likely (5)	❍ Quite Likely (6)	❍ Extremely Likely (7)
Compared to others your age, how likely is it that you would find yourself in this drowsy driving situation? (2)	❍ Extremely Less Likely Than Others (1)	❍ Quite Less Likely Than Others (2)	❍ Slightly Less Likely Than Others (3)	❍ Neither (4)	❍ Slightly More Likely Than Others (5)	❍ Quite More Likely Than Others (6)	❍ Extremely More Likely Than Others (7)

Situation B

You are studying for Fall mid-term exams, which are scheduled to take place from Wednesday afternoon through Friday morning. At 2:00 AM on the Wednesday of your first mid-term exam, you find yourself dozing off repeatedly at your desk as you try to read through your textbook one last time. You decide to drive down to the 24-hour convenience store 1.5 miles away to get some coffee and a snack to help you stay alert. As you drive down Route 1 in College Park, you find yourself having a hard time keeping your eyes open.

Q18(b) For me, driving while feeling drowsy or sleepy in this situation would be:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Bad:Good (1)	❍	❍	❍	❍	❍	❍	❍
Dangerous:Safe (2)	❍	❍	❍	❍	❍	❍	❍
Unpleasant:Pleasant (3)	❍	❍	❍	❍	❍	❍	❍
Unnecessary:Necessary (4)	❍	❍	❍	❍	❍	❍	❍
Foolish:Wise (5)	❍	❍	❍	❍	❍	❍	❍

Q19(b) People who are important to me would hope that I would not drive while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disagree (7)
- ❍ Quite Disagree (6)
- ❍ Slightly Disagree (5)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (3)
- ❍ Quite Agree (2)
- ❍ Strongly Agree (1)

Q20(b) People who are important to me would (disapprove–approve) of my driving while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disapprove (1)
- ❍ Quite Disapprove (2)
- ❍ Slightly Disapprove (3)
- ❍ Neither Approve nor Disapprove (4)
- ❍ Slightly Approve (5)
- ❍ Quite Approve (6)
- ❍ Strongly Approve (7)

Q21(b) People who are important to me would think that I (should not–should) drive while feeling drowsy or sleepy in this situation.

- ❍ Definitely Should Not (1)
- ❍ Probably Should Not (2)
- ❍ Maybe Should Not (3)
- ❍ Neither Should nor Should Not (4)
- ❍ Maybe Should (5)
- ❍ Probably Should (6)
- ❍ Definitely Should (7)

Q22(b) In this situation, I believe that I have the ability to drive while feeling drowsy or sleepy.

- ❍ Strongly Disagree (1)
- ❍ Quite Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Quite Agree (6)
- ❍ Strongly Agree (7)

Q23(b) For me, driving while feeling drowsy or sleepy in this situation would be:

- ❍ Extremely Difficult (1)
- ❍ Quite Difficult (2)
- ❍ Slightly Difficult (3)
- ❍ Neither Easy nor Difficult (4)
- ❍ Slightly Easy (5)
- ❍ Quite Easy (6)
- ❍ Extremely Easy (7)

Q24(b) In this situation, how likely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q25(b) In a similar situation in the future, do you intend to drive while feeling drowsy or sleepy?

- ❍ Definitely Do Not (1)
- ❍ Probably Do Not (2)
- ❍ Maybe Do Not (3)
- ❍ Neither Do nor Do Not (4)
- ❍ Maybe Do (5)
- ❍ Probably Do (6)
- ❍ Definitely Do (7)

Q26(b) In a similar situation in the future, what is the degree that you will avoid driving while feeling drowsy or sleepy?

- ❍ Very Little (7)
- ❍ Quite Little (6)
- ❍ Slightly Little (5)
- ❍ Neither Great nor Little (4)
- ❍ Slightly Great (3)
- ❍ Quite Great (2)
- ❍ Very Great (1)

Q27(b) In a similar situation in the future, how likely or unlikely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q28(b) If you were the driver in this situation, how willing would you be to do the following:

	Very Unwilling (1)	Quite Unwilling (2)	Slightly Unwilling (3)	Neither Willing nor Unwilling (4)	Slightly Willing (5)	Quite Willing (6)	Very Willing (7)
Stop driving immediately to get some rest. (1)	❍	❍	❍	❍	❍	❍	❍
Drive a little further before stopping to get some rest. (2)	❍	❍	❍	❍	❍	❍	❍
Continue driving until you reached your destination. (3)	❍	❍	❍	❍	❍	❍	❍

Q29(b) If you were the driver in this situation, how likely is it:

	Extremely Unlikely (1)	Quite Unlikely (2)	Slightly Unlikely (3)	Neither (4)	Slightly Likely (5)	Quite Likely (6)	Extremely Likely (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q30(b) If you were the driver in this situation, compared to others your age, how likely is it:

	Extremely Less Likely Than Others (1)	Quite Less Likely Than Others (2)	Slightly Less Likely Than Others (3)	Neither (4)	Slightly More Likely Than Others (5)	Quite More Likely Than Others (6)	Extremely More Likely Than Others (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q31(b) Thinking about yourself generally as a driver:

How likely is it that you would find yourself in this drowsy driving situation? (1)	❍ Extremely Unlikely (1)	❍ Quite Unlikely (2)	❍ Slightly Unlikely (3)	❍ Neither (4)	❍ Slightly Likely (5)	❍ Quite Likely (6)	❍ Extremely Likely (7)
Compared to others your age, how likely is it that you would find yourself in this drowsy driving situation? (2)	❍ Extremely Less Likely Than Others (1)	❍ Quite Less Likely Than Others (2)	❍ Slightly Less Likely Than Others (3)	❍ Neither (4)	❍ Slightly More Likely Than Others (5)	❍ Quite More Likely Than Others (6)	❍ Extremely More Likely Than Others (7)

Situation C

It's the Friday evening at the start of Spring Break, and you have a flight to catch. One of your friends also has a flight to catch that evening, and you've already agreed to pick him/her up at his/her apartment so that you can ride to the airport together. For the past week, you have been studying for mid-term exams and have gotten less than 4 hours of sleep a night. As you drive to your friend's apartment, you find yourself having a hard time keeping your eyes open.

Q18(c) For me, driving while feeling drowsy or sleepy in this situation would be:

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Bad:Good (1)	❍	❍	❍	❍	❍	❍	❍
Dangerous:Safe (2)	❍	❍	❍	❍	❍	❍	❍
Unpleasant:Pleasant (3)	❍	❍	❍	❍	❍	❍	❍
Unnecessary:Necessary (4)	❍	❍	❍	❍	❍	❍	❍
Foolish:Wise (5)	❍	❍	❍	❍	❍	❍	❍

Q19(c) People who are important to me would hope that I would not drive while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disagree (7)
- ❍ Quite Disagree (6)
- ❍ Slightly Disagree (5)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (3)
- ❍ Quite Agree (2)
- ❍ Strongly Agree (1)

Q20(c) People who are important to me would (disapprove–approve) of my driving while feeling drowsy or sleepy in this situation.

- ❍ Strongly Disapprove (1)
- ❍ Quite Disapprove (2)
- ❍ Slightly Disapprove (3)
- ❍ Neither Approve nor Disapprove (4)
- ❍ Slightly Approve (5)
- ❍ Quite Approve (6)
- ❍ Strongly Approve (7)

Q21(c) People who are important to me would think that I (should not–should) drive while feeling drowsy or sleepy in this situation.

- ❍ Definitely Should Not (1)
- ❍ Probably Should Not (2)
- ❍ Maybe Should Not (3)
- ❍ Neither Should nor Should Not (4)
- ❍ Maybe Should (5)
- ❍ Probably Should (6)
- ❍ Definitely Should (7)

Q22(c) In this situation, I believe that I have the ability to drive while feeling drowsy or sleepy.

- ❍ Strongly Disagree (1)
- ❍ Quite Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Quite Agree (6)
- ❍ Strongly Agree (7)

Q23(c) For me, driving while feeling drowsy or sleepy in this situation would be:

- ❍ Extremely Difficult (1)
- ❍ Quite Difficult (2)
- ❍ Slightly Difficult (3)
- ❍ Neither Easy nor Difficult (4)
- ❍ Slightly Easy (5)
- ❍ Quite Easy (6)
- ❍ Extremely Easy (7)

Q24(c) In this situation, how likely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q25(c) In a similar situation in the future, do you intend to drive while feeling drowsy or sleepy?

- ❍ Definitely Do Not (1)
- ❍ Probably Do Not (2)
- ❍ Maybe Do Not (3)
- ❍ Neither Do nor Do Not (4)
- ❍ Maybe Do (5)
- ❍ Probably Do (6)
- ❍ Definitely Do (7)

Q26(c) In a similar situation in the future, what is the degree that you will avoid driving while feeling drowsy or sleepy?

- ❍ Very Little (7)
- ❍ Quite Little (6)
- ❍ Slightly Little (5)
- ❍ Neither Great nor Little (4)
- ❍ Slightly Great (3)
- ❍ Quite Great (2)
- ❍ Very Great (1)

Q27(c) In a similar situation in the future, how likely or unlikely is it that you will drive while feeling drowsy or sleepy?

- ❍ Extremely Unlikely (1)
- ❍ Quite Unlikely (2)
- ❍ Slightly Unlikely (3)
- ❍ Neither Likely nor Unlikely (4)
- ❍ Slightly Likely (5)
- ❍ Quite Likely (6)
- ❍ Extremely Likely (7)

Q28(c) If you were the driver in this situation, how willing would you be to do the following:

	Very Unwilling (1)	Quite Unwilling (2)	Slightly Unwilling (3)	Neither Willing nor Unwilling (4)	Slightly Willing (5)	Quite Willing (6)	Very Willing (7)
Stop driving immediately to get some rest. (1)	❍	❍	❍	❍	❍	❍	❍
Drive a little further before stopping to get some rest. (2)	❍	❍	❍	❍	❍	❍	❍
Continue driving until you reached your destination. (3)	❍	❍	❍	❍	❍	❍	❍

Q29(c) If you were the driver in this situation, how likely is it:

	Extremely Unlikely (1)	Quite Unlikely (2)	Slightly Unlikely (3)	Neither (4)	Slightly Likely (5)	Quite Likely (6)	Extremely Likely (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q30(c) If you were the driver in this situation, compared to others your age, how likely is it:

	Extremely Less Likely Than Others (1)	Quite Less Likely Than Others (2)	Slightly Less Likely Than Others (3)	Neither (4)	Slightly More Likely Than Others (5)	Quite More Likely Than Others (6)	Extremely More Likely Than Others (7)
That you will crash the car into something? (1)	❍	❍	❍	❍	❍	❍	❍
That you will drive in an unsafe manner? (2)	❍	❍	❍	❍	❍	❍	❍
That you will injure yourself or others? (3)	❍	❍	❍	❍	❍	❍	❍

Q31(c) Thinking about yourself generally as a driver:

How likely is it that you would find yourself in this drowsy driving situation? (1)	❍ Extremely Unlikely (1)	❍ Quite Unlikely (2)	❍ Slightly Unlikely (3)	❍ Neither (4)	❍ Slightly Likely (5)	❍ Quite Likely (6)	❍ Extremely Likely (7)
Compared to others your age, how likely is it that you would find yourself in this drowsy driving situation? (2)	❍ Extremely Less Likely Than Others (1)	❍ Quite Less Likely Than Others (2)	❍ Slightly Less Likely Than Others (3)	❍ Neither (4)	❍ Slightly More Likely Than Others (5)	❍ Quite More Likely Than Others (6)	❍ Extremely More Likely Than Others (7)

PART 3: Adolescent Invulnerability Scale

Q32 Please read each of the following statements and select the response that best describes you. Some of the statements may appear to be similar, but they do address somewhat different issues. Please read each statement carefully.

	Strongly Disagree (1)	Quite Disagree (2)	Slightly Disagree (3)	Neither Agree nor Disagree (4)	Slightly Agree (5)	Quite Agree (6)	Strongly Agree (7)
I'm unlikely to be injured in an accident. (1)	❍	❍	❍	❍	❍	❍	❍
Nothing bad will happen to me when I go to a place by myself. (2)	❍	❍	❍	❍	❍	❍	❍
There are times when I think I am indestructible. (3)	❍	❍	❍	❍	❍	❍	❍
I could probably drink and drive without getting into an accident. (4)	❍	❍	❍	❍	❍	❍	❍

I'm unlikely to get hurt if I did a dangerous thing. (5)	❍	❍	❍	❍	❍	❍	❍
Special problems, like getting an illness or disease, are not likely to happen to me. (6)	❍	❍	❍	❍	❍	❍	❍
Nothing can harm me. (7)	❍	❍	❍	❍	❍	❍	❍
The problems that happen to people my age are unlikely to happen to me. (8)	❍	❍	❍	❍	❍	❍	❍
Driving very fast wouldn't be dangerous if I were driving. (9)	❍	❍	❍	❍	❍	❍	❍
Taking safety precautions is far more	❍	❍	❍	❍	❍	❍	❍

important for other people than it is for me. (10)							
Safety rules do not apply to me. (11)	❍	❍	❍	❍	❍	❍	❍
It is not necessary for me to worry about being injured or harmed. (12)	❍	❍	❍	❍	❍	❍	❍

PART 4: Driving Behavior

Please answer the following questions about your previous driving behavior. Some of the questions may appear to be similar, but they do address somewhat different issues. Please read each question carefully.

Q33 How many times have you driven a motor vehicle while being so drowsy or sleepy that you had a hard time keeping your eyes open:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

***If* Never *is NOT Selected for "In your lifetime", Then Skip To* Q36**

Q34 How many times have you fallen asleep or nodded off while driving a motor vehicle, even just for a second or two:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

***If* Never *is NOT Selected for "In your lifetime", Then Skip To* Q36**

Q35 Thinking about the last time you drove while being so drowsy or sleepy that you had a hard time keeping your eyes open, fell asleep, or nodded off while driving a motor vehicle:

- ❑ Less than 1 hour (1)
- ❑ 1 to 2 hours (2)
- ❑ 2 to 4 hours (3)
- ❑ 4 to 6 hours (4)
- ❑ More than 6 hours (5)
- ❑ Do Not Remember (6)
- ❑ Less than 1 hour (7)
- ❑ 1 to 2 hours (8)
- ❑ 2 to 4 hours (9)
- ❑ 4 to 8 hours (10)
- ❑ 8 to 12 hours (11)
- ❑ 12 to 16 hours (12)
- ❑ More than 16 hours (13)
- ❑ Do Not Remember (14)
- ❑ Less than 4 hours (15)
- ❑ 4 to 5 hours (16)
- ❑ 5 to 6 hours (17)
- ❑ 6 to 7 hours (18)
- ❑ 7 to 8 hours (19)
- ❑ More than 8 hours (20)
- ❑ Do Not Remember (21)
- ❑ 7 AM to 11 AM (22)
- ❑ 11 AM to 3 PM (23)

- ❑ 3 PM to 7 PM (24)
- ❑ 7 PM to 11 PM (25)
- ❑ 11 PM to 3 AM (26)
- ❑ 3 AM to 7 AM (27)
- ❑ Do Not Remember (28)
- ❑ Multi-lane interstate-type highways with posted speed limits of 55 mph or above (29)
- ❑ Non-interstate, multi-lane roads with posted speed limits of 40-55 mph (30)
- ❑ Two-lane roads with one lane of traffic traveling in each direction, with posted speed limits of 45 mph or higher (31)
- ❑ City, town, or neighborhood streets with posted speed limits of 35 mph or less (32)
- ❑ Do Not Remember (33)
- ❑ Yes (34)
- ❑ No (35)
- ❑ Do Not Remember (36)
- ❑ Yes (37)
- ❑ No (38)
- ❑ Do Not Remember (39)

Q36 How many times have you driven a motor vehicle to run a personal errand at night:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

Q37 How many times have you driven a motor vehicle to run a personal errand at night while feeling drowsy or sleepy:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

Q38 How many times have you driven a motor vehicle to an off-campus location at the end of an academic year (i.e., for the summer):

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
Since starting your studies at the University of Maryland, College Park? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

Q39 How many times have you driven a motor vehicle to an off-campus location at the end of an academic year (i.e., for the summer) while feeling drowsy or sleepy:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
Since starting your studies at the University of Maryland, College Park? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

Q40 How many times have you driven a motor vehicle to a social or professional engagement that you were obligated to attend:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

Q41 How many times have you driven a motor vehicle to a social or professional engagement that you were obligated to attend while feeling drowsy or sleepy:

	Never (0)	1 Time (1)	2 to 4 Times (2)	5 Times or More (3)
During the past 30 days? (1)	❍	❍	❍	❍
During the past year? (2)	❍	❍	❍	❍
In your lifetime? (3)	❍	❍	❍	❍

PART 5: Comments

Please feel free to comment on your experience with this survey.

Q42 This questionnaire was easy to understand.

- ❍ Strongly Disagree (1)
- ❍ Quite Disagree (2)
- ❍ Slightly Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Slightly Agree (5)
- ❍ Quite Agree (6)
- ❍ Strongly Agree (7)

Q43 Completing this questionnaire was:

- ❍ Extremely Difficult (1)
- ❍ Quite Difficult (2)
- ❍ Slightly Difficult (3)
- ❍ Neutral (4)
- ❍ Slightly Easy (5)
- ❍ Quite Easy (6)
- ❍ Extremely Easy (7)

Q44 How did you find out about this study? Select all that apply.

- ❑ Direct E-Mail (1)
- ❑ E-Newsletter Announcement (2)
- ❑ Facebook Announcement (3)
- ❑ Announcement on a Course ELMS (Canvas) Site (4)
- ❑ Paper Flyer (5)
- ❑ Word-of-Mouth (6)
- ❑ Other (Please specify) (7) _____

Q45 Please use the space below to provide any additional comments:

Thank you for taking time to complete this questionnaire.

You are eligible to enter into a raffle to win one of ten $25 E-Gift Cards from your choice of Amazon, iTunes, or Starbucks. If you are interested in entering the E-Gift Card raffle, please select the RAFFLE button below to be directed to a site where you can provide your name and e-mail address. As a reminder, your name and e-mail address will not be connected to your responses in the questionnaire, and all files with your name and e-mail address created for your raffle entry will be deleted at the conclusion of this study.

If you are not interested in entering the raffle, please select the FINISH button below.

******If you are selected as a raffle winner, you will be responsible for reporting this information to the relevant tax authorities (including the U.S. Internal Revenue Service) and for paying any taxes assessed on this compensation.******

If you have any questions, please contact Clark Lee at cjlee@umd.edu.

- ❍ **RAFFLE**
- ❍ **FINISH**

***If* RAFFLE *Is Selected, Then Redirect To* Raffle Entry**

If* FINISH *Is Selected, Then Skip To the following end-of-questionnaire message:

Thank you for your interest in this study. Your responses have been recorded.

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Appendix 2: Institutional Review Board Approval Letters

UNIVERSITY OF MARYLAND
INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE:	April 16, 2014
TO:	Clark Lee, JD
FROM:	University of Maryland College Park (UMCP) IRB
PROJECT TITLE:	[585643-2] Intention and Willingness to Drive While Drowsy in a Population of University Students in Maryland: An Application of an Extended Theory of Planned Behavior Model
REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	April 16, 2014
EXPIRATION DATE:	April 15, 2015
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # 7

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure which are found on the IRBNet Forms and Templates Page.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of April 15, 2015.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

UNIVERSITY OF MARYLAND
INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE:	April 28, 2014
TO:	Clark Lee, JD
FROM:	University of Maryland College Park (UMCP) IRB
PROJECT TITLE:	[585643-3] Intention and Willingness to Drive While Drowsy in a Population of University Students in Maryland: An Application of an Extended Theory of Planned Behavior Model
REFERENCE #:	
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	April 28, 2014
EXPIRATION DATE:	April 15, 2015
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # 7

Thank you for your submission of Amendment/Modification materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure which are found on the IRBNet Forms and Templates Page.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of April 15, 2015.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

Appendix 3: Recruitment Materials

Announcement Disseminated via E-Mail and Canvas Sites

TO: UMD Students

SUBJECT: *UMD Students Wanted for Drowsy Driving Survey (With Chance to Win $25 E-Gift Card!)*

Dear UMD Student:

I would like to invite you to participate in a **research study on drowsy driving** that I am conducting as a Master of Public Health student at the University of Maryland, College Park.

Your participation in this study would involve about **20 to 25 minutes** of your time to complete an **online questionnaire** about your attitudes, perceptions, intentions, willingness, and previous experiences related to drowsy driving.

By completing the questionnaire, you will become eligible to participate in a raffle to win **one of ten $25 electronic Gift Cards** from your choice of **Amazon, iTunes, or Starbucks**.

If interested, please click the secure link below to get started.

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsae1ngViI17

Although you will not benefit directly from participating in this study, your participation may help enhance general understanding of the personal and cognitive factors that contribute to drowsy driving behavior in young people. This knowledge could be used in the future to develop more effective interventions against drowsy driving in young people, who are particularly vulnerable to the health and safety hazards associated with drowsy driving behavior.

Thank you for your attention. Please feel free to contact me if you have any questions about this study.

Sincerely,

Clark J. Lee, JD
Master of Public Health Candidate
Department of Behavioral and Community Health
School of Public Health
University of Maryland, College Park
E-Mail: cjlee@umd.edu

******This research has been fully approved by the Institutional Review Board (IRB) for the University of Maryland, College Park* (IRB # 585643-2)*****

Announcement Disseminated via Facebook and Electronic Newsletters

TO: UMD Students

SUBJECT: *UMD Students Wanted for Drowsy Driving Survey (With Chance to Win $25 E-Gift Card!)*

All students enrolled at the University of Maryland, College Park and at least 18 years of age are invited to participate in a **research study on drowsy driving**.

Participating in this study involves taking about **20 to 25 minutes** of your time to complete an **online questionnaire** about your attitudes, perceptions, intentions and willingness, and previous experiences related to drowsy driving.

By completing the questionnaire, you will become eligible to participate in a raffle to win **one of ten $25 electronic Gift Cards** from your choice of **Amazon, iTunes, or Starbucks**.

Although you will not benefit directly from participating in this study, your participation may help enhance general understanding of the personal and cognitive factors that contribute to drowsy driving behavior in young people.

Interested? Just click the secure link below to get started!

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsae1ngViI17

******This research has been fully approved by the Institutional Review Board (IRB) for the University of Maryland, College Park* (IRB # 585643-2)*****

Second Recruiting Announcement

TO: UMD Students

SUBJECT: *UMD Students Wanted for Drowsy Driving Survey (With Chance to Win $25 E-Gift Card!)*

All students enrolled at the University of Maryland, College Park and at least 18 years of age are invited to participate in a **research study on drowsy driving**.

Participating in this study involves taking about **20 to 25 minutes** of your time to complete an **online questionnaire** about your attitudes, perceptions, intentions and willingness, and previous experiences related to drowsy driving.

If you start this questionnaire but do not complete it in one sitting, you can continue the questionnaire where you left off at a later time (up to 1 month from the start date) by using the same device on which you started it

By completing the questionnaire, you will become eligible to participate in a raffle to win **one of ten $25 electronic Gift Cards** from your choice of **Amazon, iTunes, or Starbucks**.

Although you will not benefit directly from participating in this study, your participation may help enhance general understanding of the personal and cognitive factors that contribute to drowsy driving behavior in young people.

Interested? Just click the secure link below to get started!

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsae1ngViI17

******This research has been fully approved by the Institutional Review Board (IRB) for the University of Maryland, College Park* (IRB # 585643-2 & -3)*****

Questions? Contact ***Clark Lee*** (cjlee@umd.edu)

UMD Students Needed *for* Drowsy Driving Survey

Complete a 20-25 minute online survey about your attitudes, perceptions, intentions, willingness, and previous experiences related to drowsy driving.

Photo Source: Zero Fatalities

This research will help enhance general understanding of the personal and cognitive factors that contribute to drowsy driving behavior in young people.

To get involved, take a tab below or write to cjlee@umd.edu

Includes opportunity to enter into a raffle to win one of ten $25 E-Gift Cards from Amazon, iTunes, or Starbucks!

Participation in this study is completely voluntary.

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsaeIngViI17 (or e-mail cjlee@umd.edu)

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsaeIngViI17 (or e-mail cjlee@umd.edu)

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsaeIngViI17 (or e-mail cjlee@umd.edu)

https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsaeIngViI17 (or e-mail cjlee@umd.edu)

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https://umd.az1.qualtrics.com/SE/?SID=SV_b2sAsaeIngViI17 (or e-mail cjlee@umd.edu)

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