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Factors That Influence The Perceived Risk Of Driving Under The Influence Of Small Amounts Of Marijuana And Alcohol (DUI-SAMA)

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FACTORS THAT INFLUENCE THE PERCEIVED RISK OF DRIVING UNDER THE
INFLUENCE OF SMALL AMOUNTS OF MARIJUANA AND
ALCOHOL (DUI-SAMA)

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Dedication

To my mother and father for being there for me whenever I have ever needed your help with anything and for teaching me the importance of keeping God in my life. To my brother for teaching me the importance of being well-rounded and pursuing knowledge from a wide variety of sources. To my sister for reminding me that dreams can be achieved with dedication and hard work. To my wife for being the most understanding, thoughtful, and supportive person I have ever encountered. And to my daughter for motivating me to reach for the stars.

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ALCOHOL (DUI-SAMA)

by

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DISSERTATION

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Abstract

The national trend toward the legalization of recreational marijuana use will likely increase the number of opportunities for young adults to legally drive under the combined influence of small amounts of marijuana and alcohol (DUI-SAMA). Research suggests that driving performance is moderately impaired when small amounts of marijuana and alcohol are consumed independently; however, driving performance is dramatically impaired when both substances are consumed in combination. The present study investigated the perceived risk of DUI-SAMA under two levels of stress (no stress, stress) and three levels of urgency (non-urgent, semi-urgent, urgent). One-hundred and sixty-five marijuana users ($M_{\text{age}} = 20.3$) were randomly exposed to a stressful or non-stressful manipulation. Stress did not influence the perceived risk of DUI-SAMA, the perceived dangerousness of DUI-SAMA, or willingness to DUI-SAMA. Level of urgency emerged as a key factor explaining self-reported willingness to DUI-SAMA. Specifically, participants were significantly more willing to DUI-SAMA in urgent conditions than in non-urgent conditions. These findings are favorable from a public health perspective, suggesting that marijuana users evaluate the urgency of situations when making decisions about their willingness to DUI-SAMA. However, participants were significantly more willing to DUI-SAMA than to drive a motor vehicle after consuming enough alcohol to reach a BAC of 0.08. Ironically, research suggest that the driving impairments observed in DUI-SAMA mimic the driving impairments observed when individuals are at or have exceeded the legal BAC of 0.08. Thus findings in the current study suggest that marijuana users underestimate the risks associated with DUI-SAMA.

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Chapter 1: Introduction

The national trend toward the legalization of recreational marijuana use will likely increase the number of opportunities for young adults to legally Drive Under the Influence of Small Amounts of Marijuana and Alcohol (DUI-SAMA). Research suggests that driving performance is only moderately impaired when small amounts of marijuana and alcohol are consumed independently; however, driving performance is dramatically impaired when small amounts of marijuana and alcohol are consumed simultaneously (Ramaekers, Robbe, & O'Hanlon, 2000; Hartman, & Huestis, 2013; Sewell, Poling, & Sofuoglu, 2009). Yet few studies have investigated the perceived risk of DUI-SAMA, despite its public health threat. The current study investigated several factors that influence the perceived risk of DUI-SAMA, including emotional and situational factors. Specifically, the current study examined the perceived risk of DUI-SAMA after participants were exposed to two levels of stress (no stress, stress) and three levels of urgency (non-urgent, semi-urgent, urgent) in a high risk population: marijuana users ages 18- 25.

1.1 MARIJUANA LEGISLATION

The first medical marijuana law was passed in 1996. Two decades later, more than half of the states in the U.S. have legalized medical marijuana use and eight states (*Colorado, Washington, Oregon, Alaska, California, Nevada, Massachusetts, and Maine*) and the District of Columbia have legalized recreational marijuana use for individuals who are 21 years of age or older (see Table 1). Approximately five million people reported using marijuana daily in 2007 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014). Approximately eight million people reported using marijuana daily in 2013 (SAMHSA, 2014). The 2015 National Survey on Drug Use and Health estimated that 6.9 million young adults ages

18-25 reported using marijuana the month preceding the survey (HSDUH, 2016). In addition, 13.6 million adults ages 26 or over reported using marijuana the month preceding the survey (HSDUH, 2016). The ease of access afforded by the legalization of marijuana may lead to increased rates of marijuana use in drivers, the consequences of which are discussed below.

Table 1: 29 U.S. jurisdictions with medical marijuana laws as of June 26, 2017

Jurisdiction	Medical Marijuana Year Passed	Recreational Marijuana Year Passed	Legal Possession
1.Alaska*	1998	2014	1 oz usable; 6 plants (3 mature, 3 immature)
2.Arizona	2010		2.5 oz usable; 12 plants
3.Arkansas	2016		3 oz usable per 14-day period
4.California*	1996	2016	8 oz usable; 6 mature or 12 immature plants
5.Colorado*	2000	2012	2 oz usable; 6 plants (3 mature, 3 immature)
6.Connecticut	2012		2.5 oz usable
7.Delaware	2011		6 oz usable
8.Florida	2016		Amount to be determined
9.Hawaii	2000		4 oz usable; 7 plants
10.Illinois	2013		2.5 ounces of usable cannabis during a period of 14 days
11.Maine*	1999	2016	2.5 oz usable; 6 plants
12.Maryland	2014		30-day supply, amount to be determined
13.Massachusetts*	2012	2016	60-day supply for personal medical use (10 oz)
14.Michigan	2008		2.5 oz usable; 12 plants

15.Minnesota	2014		30-day supply of non-smokeable marijuana
16.Montana	2004		1 oz usable; 4 plants (mature); 12 seedlings
17.Nevada*	2000	2016	2.5 oz usable; 12 plants
18.New Hampshire	2013		Two ounces of usable cannabis during a 10-day period
19.New Jersey	2010		2 oz usable
20.New Mexico	2007		6 oz usable; 16 plants (4 mature, 12 immature)
21.New York	2014		30-day supply non-smokeable marijuana
22.North Dakota	2016		3 oz per 14-day period
23.Ohio	2016		Maximum of a 90-day supply, amount to be determined
24.Oregon*	1998	2015	24 oz usable; 24 plants (6 mature, 18 immature)
25.Pennsylvania	2016		30-day supply
26.Rhode Island	2006		2.5 oz usable; 12 plants
27.Vermont	2004		2 oz usable; 9 plants (2 mature, 7 immature)
28.Washington*	1998	2012	8 oz usable; 6 plants
Washington, DC*	2010	2014	2 oz dried
29.West Virginia	2017		30-day supply (amount to be determined)

Note: The information presented was compiled from ProCon.org (2017). Asterisk indicates that the state has legalized recreational marijuana use.

1.2 MARIJUANA, ALCOHOL, AND DRUGGED DRIVING

Motor vehicle crashes are the leading cause of death each year among young people ages 16- 25 years in the United States (Azofeifa, Mattson, & Lyerla, 2015). Alcohol is the most

frequently detected substance in fatal car crashes in the U.S. (National Highway Traffic Safety Administration [NHTSA], 2013) and marijuana is the second most frequently detected drug in fatal car accidents (Brady & Li, 2012). According to the National Highway Transportation Safety Administration (NHTSA), 25% of all motor vehicle crash fatalities involve drivers who had a blood alcohol concentration (BAC) of 0.01 g/dl or greater (Subramanian, 2005). Furthermore, when examining only individuals who were 21 years of age who had a blood alcohol concentration (BAC) of 0.01 g/dl or greater, the number of fatal motor vehicle crash fatalities increased from 25% to 39%. Marijuana use may also increase the risk of motor vehicle crashes. Research suggests that marijuana use within a month of driving a motor vehicle is associated with 2 to 6 times higher risk of crashing while driving a motor vehicle compared to unimpaired drivers (Asbridge, Hayden, & Cartwright, 2012; Baldock, 2008; Bates & Blakely, 1999; Beirness, Simpson, & Williams 2006; Li et al., 2012; Ramaekers, Berhaus, van Laar, & Drummer, 2004). The problems associated with driving under the influence of alcohol, marijuana, and the combination of both are well-documented.

1.3 ALCOHOL AND DRIVING PERFORMANCE

Driving under the influence of alcohol decreases brake reaction times and hazard perception, and increases mean driving speed, lateral movement within driving lanes and attempts to 'pass' or overtake other vehicles. Observable impairments in driving performance after consuming alcohol are documented at levels below 0.05% BAC (Moskowitz & Robinson, 1988; Robbe, 1994; Moskowitz & Fiorentino, 2000). Statistically significant increases in crash risk after consuming alcohol have been reported for levels as low as 0.04% BAC (Compton et al., 2002) and serious driving impairment is commonly observed at 0.08% BAC (Moskowitz &

Fiorentino, 2000). The legal BAC for driving in the U.S. is a maximum of 0.08% and the legal BAC for driving in Europe is a maximum of 0.05%.

Research suggests that driving under the influence of alcohol in young adults is declining; however, driving under the influence of marijuana may be increasing (Azofeifa, Mattson, & Lyerla, 2015). Between 1991- 2011, drinking and driving among high school students decreased from 22.3% to 10.3% (Azofeifa et al., 2015). Similarly, between 2007- 2014, marijuana use and driving increased from 8.6% to 12.6% (Azofeifa et al., 2015). The increase in the prevalence of marijuana use and driving may contribute to an increase in the amount of motor vehicle injuries and fatalities. Drugged driving results in several types of driving impairments that are discussed below.

1.4 MARIJUANA AND DRIVING PERFORMANCE

Driving under the influence of marijuana decreases mean driving speeds and increases lane weaving and mean distance headway to preceding vehicles (Hartman et al., 2015; Downey et al, 2013; Bondallaz et al., 2016; Anderson et al 2010). Importantly, a review by Sewell, Poling, and Sofuoglu (2009) concluded that experienced marijuana users demonstrated “*almost no functional impairment*” under the influence of marijuana “*except when it is combined with alcohol* (pg 3).” A common explanation for the latter effects is that drivers under the influence of alcohol tend to underestimate their degree of impairment; thus, they drive faster, increase attempts to overtake vehicles, and decrease distances headway to the preceding vehicle (Hartman et al., 2016; Neavyn, Blohn, & Babu, 2014; Robbe & O’Hanlon, 1993; Smiley, 1999; Sewell et al., 2009;). Conversely, drivers under the influence of marijuana tend to overestimate their degree of impairment and thus they driver slower, make fewer attempts to overtake vehicles, and

increase distances headway to preceding vehicles (Hartman et al., 2016; Neavyn et al., 2014; Robbe & O'Hanlon, 1993; Sewell et al., 2009; Smiley, 1999).

Smiley (1999) suggested that individuals impaired by marijuana tend to realize that they are impaired and thus they try to compensate by driving cautious and slower. More specifically, individuals who consume marijuana may make deliberate efforts to compensate for their impairment by allocating their full attention toward driving as safe as possible. A literature review by Sewell et al., (2009) supports this assumption and revealed that seven out of ten studies reported that marijuana was associated with decreased driving speeds even when participants were provided with explicit instructions to maintain a particular speed, whereas alcohol was consistently associated with increased driving speeds in all ten studies. The differential effects of alcohol and marijuana on driving ability may also be due to their differential effects on *automatic* and *complex* cognitive functions.

1.5 DRIVING PERFORMANCE, DRUGS, AND AUTOMATIC AND COMPLEX FUNCTIONS

Automatic functions. Automatic functions can be described as cognitive processes that do not require conscious control/effort (Raemakers et al., 2009). Automatic functions related to driving include speed adjustment and tracking (Raemakers et al., 2009; Sewell et al., 2009). Speed adjustment refers to one's ability to maintain consistent speeds. Tracking refers to the percentage of time deviated from the lane and the amount of swerving movements observed. Tracking is the most reported driving skill that is impaired after consuming marijuana (Raemakers et al., 2000; Smiley, 1999).

Complex functions. Complex functions can be described as cognitive processes that require conscious control/effort. Complex functions related to driving include headway

maintenance, brake latency, and understanding traffic (Raemakers et al., 2009; Sewell et al., 2009). Headway maintenance refers to the ability to control mean distance headway to the preceding vehicle. Brake latency or brake reaction time, refers to the ability to apply the brakes promptly in traffic situations that require immediate decreases in speed. Understanding traffic refers to the ability to predict traffic patterns and to be aware of hazards.

Effects of Drugs on Automatic and Complex Functions. Substances (e.g., tobacco, alcohol, and marijuana) effect automatic and complex functioning in unique fashions. Spilich (1992) found that smoking tobacco impaired performance on complex information processing tasks (e.g., reading comprehension tasks or avoiding obstacles in the road using a driving simulator) but did not impair performance on simple (automatic) perceptual tasks (e.g., searching for a target letter embedded in an array of letters). Researchers suggest that the driving-related impairments associated with marijuana are more pronounced in *automatic functions* than *complex functions* (Raemakers et al., 2009; Sewell et al., 2009). Conversely, driving-related impairments associated with alcohol at comparable doses are more pronounced in *complex functions* than *automatic functions* (Sewell et al., 2009). Driving-related impairments in automatic functions have been observed in doses of marijuana as low as 6.25mg, which is quantified in the literature as a third of a joint (Sewell et al., 2009). Observable impairments in complex functions after consuming alcohol are documented at levels below 0.05% BAC (Moskowitz & Fiorentino, 2000). Notably, driving impairments increase as doses of marijuana or alcohol increase.

1.6 DRIVING PERFORMANCE AND DRUG DOSAGE (LOW VS. HIGH)

Defining Drug Dosage (Alcohol and Marijuana). Blood alcohol concentration (BAC) is indexed by the number of grams of alcohol detected per 100 milliliters of blood. BAC is the

most common metric for assessing the concentration of alcohol in an individual's body. A dose of alcohol that is designed to reach a BAC equal to or less than 0.04% is typically referred to as a "low" dose of alcohol and a dose that is designed to reach a BAC ranging from 0.05% to 0.08% is typically referred to as a "high" dose of alcohol (Robbe, 1998; Raemakers et al., 2000; Downey et al., 2013; Hartman et al., 2015). Quantifying doses of marijuana is more complex than quantifying doses of alcohol because the potency of marijuana varies in strength and quantity.

Delta-9 Tetrahydrocannabinol (THC) is the psychoactive chemical compound (active ingredient) in marijuana that is used to determine the potency of marijuana. THC is also the active ingredient in marijuana that produces the euphoric feeling that is commonly referred to as feeling "high." Research examining driving impairments after consuming marijuana has aimed to identify doses of marijuana that result in unsafe driving behaviors. The latter line of research also aims to identify doses of marijuana that result in driving impairments severe enough to warrant the establishment of a legal limit of marijuana consumption prior to driving; similar to the established legal limit of alcohol consumption prior to driving in the U.S. (BAC of 0.08). Another aim of the latter line of research is to investigate the combined effects of varying doses of marijuana and alcohol on driving performance. Doses of marijuana have been quantified in a number of ways: 1) micrograms per kilogram ($\mu\text{g/kg}$), 2) milligrams (mg), and 3) percentage of THC.

Ramaekers et al. (2000) and Robbe (1998) referred to a low dose marijuana cigarette as a cigarette that contains 100 $\mu\text{g/kg}$ of THC and a high dose marijuana cigarette as a cigarette that contains 200 $\mu\text{g/kg}$ of THC (see Table 3 for conversions). Liguori, Gatto, and Jarrett (2002) referred to a low dose marijuana cigarette as a cigarette that contains 1.75% THC (equal to 16mg

of marijuana) and a high dose marijuana cigarette as a cigarette that contains 3.33% THC (equal to 30mg of marijuana) (see Table 4 for conversions). Similarly, Downey et al., (2013) referred to low doses of marijuana as cigarettes that contain 1.8% THC and high doses of marijuana as cigarettes that contain approximately 3% THC.

1.7 ALCOHOL, MARIJUANA, AND DRIVING IMPAIRMENTS: DOSE DEPENDENT EFFECTS

Two conclusions have emerged from studies of drugged driving impairment (e.g., alcohol and marijuana). First, the effects of alcohol and marijuana on driving performance are dose-dependent. More specifically, driving impairments increase as doses of marijuana increase. Similarly, driving impairment increase as doses of alcohol increase. Second, driving impairments are greatest when both alcohol and marijuana are used in combination prior to driving a motor vehicle.

Dose Level and Driving Performance. Hartman et al., (2015) investigated the impact of varying amounts of marijuana and alcohol on driving performance. Dose-dependent effects were investigated by administering various doses of marijuana and alcohol to eighteen participants and subsequently assessing their driving performance in a driving simulator. The authors did not report a test of significance but did report that THC concentrations of 2 µg were associated with mean speed decreases of 0.2-0.3 km per hour relative to placebo conditions. THC concentrations of 5 or 7 µg, were associated with mean speed decreases of 0.9 or 1.2 km per hour. Furthermore, THC concentrations of 10 or 20 µg were associated with mean speed decreases of 2.4 or 4.1 km per hour. These results demonstrate that incremental increases in marijuana were associated with incremental decreases in mean driving speed. Moreover, an examination of ‘headway maintenance’ revealed a similar pattern such that 2, 5, 6, and 10 µg of THC concentrations were

associated with 1.8%, 4.5%, 6.3%, and 9.0% increases in mean headway distance. The latter results support the assumption that marijuana users may attempt to compensate for their impairment by driving slower and increasing the space between the vehicles they were following as they became increasingly impaired. Conversely, alcohol consumption demonstrated the opposite effects. Speed increased by 3.3%, 8.2%, and 13.2% as BAC increased by 0.02%, 0.05%, and 0.08%, respectively.

Driving Under the Influence of Small Amount of Marijuana and Alcohol (DUI-SAMA).

Research suggests that alcohol and marijuana consumed independently at low doses do not yield sufficient driving impairments to merit legislation; however, driving performance is dramatically impaired when low doses of the two substances are consumed simultaneously (Ramaekers et al., 2000; Hartman & Huestis, 2013; Sewell et al., 2009). In a study by Ramaekers et al. (2000) eighteen participants consumed either an alcohol placebo or a dose of alcohol designed to reach a peak BAC of 0.06-0.07 g/dl. Simultaneously, participants consumed either a low dose of marijuana (100 µg/kg dose of marijuana), a high dose of marijuana (200 µg/kg), or a marijuana placebo. Driving instructors accompanied the participants while driving on the highway after consuming either the placebo or the marijuana and alcohol combinations. Vehicles were equipped with driving controls so that the driving instructor could control the vehicle and ensure safety in an emergency. Driving tests assessed lane stability and the number of times that the driver swerved between lanes. Performance deficits were moderate in conditions in which alcohol or marijuana were administered independently; however, driving performance was impaired “dramatically” when both substances were simultaneously consumed. Furthermore, driving impairment increased as doses of marijuana increased.

Downey et al., (2013) recruited 80 recreational marijuana users to participate in six double-blind counter-balanced experimental sessions that involved consuming varying doses of marijuana and alcohol, and subsequently driving in a simulator that mimics a natural driving environment. Participants in the study smoked marijuana cigarettes that contained 0% THC (placebo), 1.8% THC, or 3% THC. The authors did not specify whether the participants smoked the entire cigarette. Participants also consumed sufficient alcohol to achieve 0% BAC (placebo), 0.03% BAC, or 0.05% BAC. Driving impairments (e.g., lane weaving) were observed more often when alcohol and marijuana were consumed simultaneously than when alcohol and marijuana were consumed independently. Similar results were reported using a driving simulator in a sample of 12 healthy individuals (Liguori et al., 2002). Marijuana was administered by having participants smoke a marijuana cigarette averaging about 85 mm in length and 25 mm in circumference that contained either 0% THC, 1.75% THC (equal to 16mg of marijuana) or 3.33% THC (equal to 30mg of marijuana). Low levels of marijuana (1.75% THC) consumed alone did not impair brake latency, but low levels of marijuana administered in combination with low levels of alcohol did impair brake latency.

Ronen et al. (2010) studied driving impairments in twelve recreational marijuana users, defined as users who smoke marijuana at least 1-4 times a month. Participants were given one of the following: (1) a dose of alcohol to reach the level of 0.05 BAC, (2) a 12 mg dose of marijuana (approximately two-thirds of a joint), or (3) the combination of both alcohol and marijuana. Driving impairments were greatest when alcohol and marijuana were consumed in combination; that is, the simultaneous use of both drugs results in greater lane weaving and failure to keep the steering wheel straight.

Drivers in the U.S. are legally allowed to drive after consuming alcohol, given that their BAC is less than 0.08%. A public health threat may arise if drivers mistakenly assume that driving under the combined influence of small amounts of marijuana and alcohol (DUI-SAMA) will not severely impair their driving. This potential misunderstanding is likely to become a major public health concern as more states legalize the recreational use of marijuana. For this reason, it seems imperative to identify situational and emotional factors that impact the perceived risk of driving under the combined influence of small amounts of marijuana and alcohol (DUI-SAMA; Frietze, 2016).

1.8 DUI-SAMA: SITUATIONAL INFLUENCES

A limited number of studies have explored individuals' willingness to drive after consuming marijuana, alcohol, and the combination of both in situations of varying urgency (Fritze, 2016; Porath-Waller, 2008; Robbe, 1994; Ronen et al., 2010). Ronen et al., (2010) recruited 13 recreational users of alcohol and marijuana to complete a series of experimental sessions in which they were administered a placebo, alcohol (BAC of 0.05%), marijuana (13mg; see Table 3 for conversions), and combinations of each. After consuming each drug, participants reported their willingness to drive a motor vehicle. Willingness to drive after consuming the substances was assessed in three different situations ranging from not urgent to very urgent: 1) *"I would be willing to drive for 16 Km when the reason is unimportant but gratifying, such as driving to a friend or to a party."* 2) *"I would be willing to drive for 16 Km when the reason is important but there is another option such as when taking a sick friend home when he would otherwise call a taxi."* 3) *"I would be willing to drive for 16 Km when the reason is urgent like driving a sick baby to a hospital."* Participants who consumed alcohol, marijuana, or both substances simultaneously did not report differences to drive a designated distance in all three

conditions of urgency (i.e., not urgent, semi-urgent, very urgent). More specifically, individuals who were impaired by alcohol, marijuana, or the both substances simultaneously reported no significant differences in the average distance they would drive, regardless of the substance that they had consumed. However, participants were willing to drive an average distance of 5.85 – 7.08 km in the non-urgent situation, 7.54 – 10.36 km in the semi-urgent situation, and 19.4 – 25.05 km in the very urgent situation. The latter trend in results may indicate that participants were more willing to drive in a very urgent situation compared to a non-urgent situation; although the authors did not include a test of statistical significance. Similarly, Robbe (1994) found that the majority of individuals who were under the influence of marijuana (100 µg/kg) or alcohol (0.04% BAC) were willing to drive in urgent conditions and less willing to drive in non-urgent conditions.

Frietze (2016) investigated the impact of stress on willingness to drive in situations of varying levels of urgency after hypothetically consuming small amounts of marijuana and alcohol. Frietze (2016) extended earlier research in three important ways by: 1) examining the influence of social stress on a participants willingness to DUI-SAMA in situations of varying levels of urgency; 2) examining the influence of social stress on the perceived risk of DUI-SAMA; and 3) examining the influence of social stress on risky behaviors in a non-driving context (i.e., performance on the Balloon Analogue Risk Task; BART). One hundred and sixty participants were randomly assigned to a stress or no stress condition. In urgent situations (i.e., driving a sick friend to the hospital) participants exposed to a stressful manipulation reported less willingness to DUI-SAMA ($M = 2.38$, $SD = 1.36$; on a 5-point scale ranging from not at all willing to extremely willing) than participants exposed to a neutral (non-stressful) manipulation ($M = 2.89$, $SD = 1.48$, $t(158) = -2.28$, $p = .024$, two-tailed). However, stress level did not

influence reported willingness to DUI-SAMA in semi-urgent and non-urgent conditions. Notably, Fritze (2016) reported that stress decreased willingness to DUI-SAMA in semi-urgent ($\beta = -0.374, p = 0.035$) and urgent situations ($\beta = -0.539, p = 0.013$) after controlling for frequency of marijuana and alcohol use in a regression model. Similarly, stress increased the perceived risk of DUI-SAMA after controlling for frequency of marijuana use in a regression model. Marijuana experience was also positively associated with reported willingness to DUI-SAMA in urgent, semi-urgent, and non-urgent conditions ($r = 0.25, r = 0.40, r = 0.45$, respectively). Finally, marijuana experience was negatively associated with the perceived risk of DUI-SAMA ($r = -0.25$) and the perceived dangerousness of DUI-SAMA ($r = -0.44$). The current research extends the above focus by studying individuals who are at increased risk for DUI-SAMA: young adults using marijuana in the past 12 months.

1.9 MARIJUANA USE: AFFECTIVE INFLUENCES

Research suggests that marijuana use is prompted by a variety of factors including *stress* (O'Hare & Sherrer, 2000; Labouvie, 1986), *social anxiety* (Marmorstein, White, Loeber, & Stouthamer-Loeber, 2010; Buckner, Bonn-Miller, Zvolensky, & Schmidt, 2007) and *depression* (Tu, Ratner, & Johnson, 2008). Findings from a systematic review examining the impact of stress on initiating marijuana use suggests that marijuana is commonly used as a stress-coping strategy (Hyman, & Sinha, 2009). The use of marijuana has also been linked to the presence of stress-related symptoms in both clinical and non-clinical samples (O'Hare & Sherrer, 2000). In a study examining attitudes toward substance use in a sample of 169 college students, 23% of the students advocated the use of alcohol for dealing with stressful situations and 12% advocated the use marijuana for dealing with stressful situations (McCormack, Laybold, Dickerman-Nelson, & Budd, 1993).

Marijuana use and social anxiety co-occur at high rates. Researchers propose that socially anxious individuals may use marijuana in order to cope with elevated anxiety (Buckner, Heimberg, Matthews, & Silgado, 2012). More specifically, in comparison to all anxiety disorders (i.e., panic disorder, social anxiety disorder, generalized anxiety disorder, and specific phobias) individuals with social anxiety disorder have the highest rate of cannabis dependence (Agosti, Nunes, & Levin, 2002). Approximately one third of individuals with social anxiety disorder are also cannabis dependent (Agosti et al., 2002). In addition, social anxiety is associated with increases in marijuana abuse in college students (Buckner et al., 2007), and high rates of social anxiety are associated with marijuana dependence (Buckner et al., 2008). The current study examined the impact one type of social anxiety – social stress, on the perceived risk of driving a motor vehicle after using marijuana.

1.10 DUI-SAMA: AFFECTIVE INFLUENCES

Emotions and Risk Perceptions. Traditional models of decision-making assume that individuals rationally analyze the potential outcomes of their decisions to maximize benefits and minimize costs. As research on decision-making progressed, this assumption was challenged by incorporating emotional states into the decision making process. Emotions are typically categorized as either positive (e.g., happy, excited, interested) or negative (e.g., afraid, angry, sad) when examined in decision-making studies. Negative emotions are associated with increased risk perceptions (Johnson & Tversky, 1983; Hu, Xie, & Li, 2013), whereas positive emotions are associated with decreased risk perceptions (Lin, 2008).

Researchers face several challenges when assessing emotional states in participants. Seemingly similar emotional states (e.g., sadness, depression) are often described using the same verbal labels (e.g., unhappy, gloomy, melancholy) (Bower, 1981). Thus researchers lack unique

descriptive words for a number of emotional states. From this perspective, emotions have been compared to colors, such that prominent emotions can be mixed in order to create other emotions (Plutchik, 1980). Given the complexity of emotions, researchers have moved away from the study of broad classes of emotions (such as “positive emotions” or “negative emotions”) to the study of specific emotions (e.g., fear or anger) and their specific impact on decision making. For example, in a study investigating the impact of fear and anger on risk perceptions, ninety-seven participants were exposed to a brief questionnaire that assessed their level of fear in threatening situations, such as encountering a snake or being trapped in enclosed places (Lerner & Keltner, 2000). An additional questionnaire assessed the participants’ tendency to react with anger in irritated situations, such as being criticized in front of others. Risk perceptions were assessed using Johnson and Tversky’s (1983) *Perception of Risk Questionnaire*. Within the questionnaire participants are informed that 50,000 people in the U.S. die in car accidents each year. Participants are then asked to consider the latter numbers when estimating the number of deaths that occur due to 12 events (e.g., brain cancer, floods). Risk perceptions were positively related to fear ($r = .24, p < .05$) and negatively related to anger ($r = -.20, p < .05$). More specifically, risk perceptions increased as levels of fear increased and risk perceptions decreased as levels of anger increased. Similar results were reported in a study assessing the impact of fear and anger on the perceived risk of driving related accidents (Lu, Xie, & Zhang, 2013). Ninety-seven drivers were randomized into a fear inducing condition, an anger inducing condition, or an emotionally neutral condition by reading one of the following: 1) a brief vignette designed to elicit a non-emotional response regarding a library opening, 2) a brief vignette designed to elicit fear about a driving related accident (e.g., being involved in a traffic accident), 3) a brief vignette designed to elicit anger regarding a driving related incident (e.g., a conflict between another driver). The

perceived risk of being involved in an accident-related outcome after being exposed to one of the three vignettes was assessed using an 11-point scale ranging from *extremely unlikely* to *extremely likely*. Fear inducing stimuli increased the perceived risk of accident-related outcomes compared to emotionally neutral stimuli ($M = 5.67$, $SD = 1.61$ & $M = 4.42$, $SD = 1.4$, $d = .83$, $p < .001$, respectively). In contrast, anger inducing stimuli decreased the perceived risk of accident-related outcomes compared to emotionally neutral stimuli ($M = 3.03$, $SD = 1.15$ & $M = 4.42$, $SD = 1.4$, $d = 1.08$, $p < .001$, respectively).

In the above studies, fear resulted in increased risk perceptions and anger resulted in decreased risk perceptions. Such findings suggest how emotional states contribute to risk perceptions. Arguably, the most common emotional state accompanying daily problems is stress. The *Stress in America Survey* commissioned by the American Psychological Association reported that three out of four adults experience at least one stress symptom per month (Anderson et al., 2015). Despite the frequent experience of stress, only a few studies have examined the impact of stress on risk perceptions and risk taking. The present study sought to address this gap in knowledge by examining the impact of social stress on the perceived risk of DUI-SAMA and willingness to DUI-SAMA in a sample of marijuana users.

Stress, Risk Perceptions, and Risk Taking. Investigators have proposed several definitions of stress, including “a response that occurs when people perceived that the demands from external situations were beyond their coping capacity” (Lazarus & Folkman, 1984), and “the process of interaction from resolution requests from the environment” (Suzuki & Ito, 2013). The above definitions of stress are vague and do not include words that are descriptive of a particular emotion. Describing stress is often challenging for researchers because the relevant adjectives (e.g., nervous, worried) can also be used to describe other emotional states (e.g., fear).

That is, the adjectives used to describe one emotional state are often interchangeable with another emotional state. For example, the *Stress in America Survey* asked participants to report stress symptoms they had previously experienced. The most commonly reported symptoms included feeling irritable or angry (37%), feeling nervous or anxious (35%), lacking interest or motivation (34%), feeling fatigued (32%), feeling overwhelmed (32%), and feeling depressed or sad (32%) (Anderson et al., 2015). Notably, each of the latter stress symptoms could also be described as unique emotional states (e.g., anger, sadness), yet each symptom was categorized as an expression of stress, introducing a lack of uniformity in assessment. The heterogeneity of terminology and constructs presents challenges to researchers investigating the impact of stress. Similar challenges emerge in laboratory studies designed to induce stress.

Investigators have employed several laboratory based strategies for *studying* or *inducing* stress in the laboratory, each possibly assessing different aspects of this broad construct. López-Vazquez and Marván (2003) for example, studied stress by recruiting participants who had experienced a stressful catastrophic event in their lives. Lange, Fleming, and Toussaint (2004) studied stress by recruiting residents from a community that had experienced psychological stress following a natural disaster. Galván and McGlennen (2012) studied stress by recruiting participants when they felt low and high levels of stress. Notably, the above studies used correlational designs and did not employ a manipulation to induce stress. Lighthall, Mather, and Gorlick (2009) induced stress by asking participants to submerge their hands in ice water for a few minutes. The most common method for inducing stress involves asking participants to deliver a speech in front of an audience (Johnson, Dariotis, & Wang, 2012; Reynolds et al., 2013; Frietze, 2016). Several key findings have emerged from the latter research, as illustrated in the studies described below.

López-Vazquez and Marván (2003) recruited 191 adults who had experienced a catastrophic (stressful) event in their lives, and were still threatened by the catastrophe reoccurring (e.g., living in a location that was impacted by an earthquake). Levels of stress were assessed prior to assessing participant's perceptions of the catastrophe reoccurring. Stress levels were positively associated with risk perceptions related to the catastrophe reoccurring ($r = .295$; $p < .001$).

Lange et al. (2004) examined stress responses of community residents who were evacuated following the derailment of a train that contained hazardous materials. The stress responses of community members who were evacuated ($N = 40$) were compared to the stress responses of community members from a non-affected community ($N = 50$). Participants completed a scale assessing the perceived risk of chemical waste. Higher psychological stress was associated with higher perceived risks of chemical waste in the community that was evacuated compared to the community that was not affected ($M = 2.67$, $SD = 1.19$ & $M = 2.09$, $SD = 1.21$, $p < 0.05$, $d = 0.48$, respectively on a 5-point scale). However, no causal conclusions can be drawn regarding the impact of stress on risk perceptions in the latter two studies because each study was based on correlational rather than experimental designs.

Galván and McGlennen (2012) examined the association between self-reported stress and risk taking behavior in a sample of 34 adolescents. Participants visited the lab twice: 1) when they were experiencing low levels of stress, and 2) when they were experiencing high levels of stress. The Computerized Cups Task (Levin & Hart, 2003) was used to assess risk taking behavior. The task requires participants to choose between one of two cups: 1) the first cup contains a guaranteed prize of \$2, and 2) the second cup either contains more than \$2 or less than \$2. Participants who visited the lab when they were experiencing high levels of stress displayed

significantly greater risk taking behavior than when they were experiencing low levels of stress. Specifically, ‘high stress’ participants made a significantly greater *percentage* of risky choices by choosing cups that contained an unknown amount of money (more than \$2 or less than \$2) compared to “low stress” participants ($M = 65\%$, $SD = 17.18$ & $M = 58\%$, $SD = 21.23$, $d = .36$, $p < 0.05$, respectively).

Lighthall et al. (2009) investigated the impact of stress on *risk-taking behavior* as indexed by performance on the Balloon Analogue Risk Task (BART) in a sample of 45 participants (Lejuez et al., 2002). The BART challenges participants to pump as much air as possible into a computer simulated balloon without causing an explosion. The number of pumps and explosions served as the dependent variables. Stress was induced by asking participants to submerge their hand in a pitcher of ice water for three consecutive minutes. Cortisol levels (the primary hormone associated with stress) were subsequently obtained to assess level of stress. Participants who were exposed to the stressor (i.e., hand submerged in ice water) had higher cortisol levels than the participants in the control group. Men who were exposed to the stressor displayed significantly greater risk taking behaviors as indexed by performance on the BART than men who were not exposed to the stressor ($M = 48.15$, $SD = 5.14$ & $M = 42.78$, $SD = 5.14$, $d = 1.04$, $p < .001$, respectively). In contrast, women who were exposed to the stressor displayed significantly less risk taking behaviors as indexed by performance on the BART compared to women who were not exposed to the stressor ($M = 32.45$, $SD = 5.14$ & $M = 39.34$, $SD = 4.92$, $d = 1.37$, $p < .001$, respectively).

Johnson et al. (2012) investigated the impact of stress on risk-taking behavior as indexed by performance on the Balloon Analogue Risk Task (BART). Eighty-nine adolescents (ages 18-21) were exposed to either a stressful or non-stressful manipulation. Participants who were

exposed to the stressful manipulation gave a speech in front of an audience, a task referred to as the Trier Social Stress Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993). Risk behaviors as indexed by performance on the BART were not significantly influenced by the stressful manipulation ($d = .12$).

Notably, the emotional stress that is elicited by experiencing a catastrophic life event may be different than the physical stress elicited by submerging one's hand in ice water, or the social stress elicited from giving a speech in front of an audience. Each of the above procedures for studying or inducing stress includes strengths and weaknesses. Recruiting participants who have experienced catastrophic (stressful) life events excludes the use of an experimental design, the use of submerging one's hand in ice water lacks ecological validity, and the induction of social stress is laborious and time consuming. However, a recent review suggests that the induction of social stress using the TSST is the most valid method for inducing stress (see below).

Stress Induction: Trier Social Stress Task (TSST). Social stress is defined as a feeling of anxiety that is experienced within a social situation (Wadman, Durkin, & Conti-Ramsden, 2011). The Trier Social Stress Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) induces social stress by asking participants to give a speech in front of a live audience. Notably, the TSST induces stress using an approach that simulates the psychological and social stress that many people encounter daily, rather than asking participants to dip their hands in ice water to induce stress. The TSST is the only manipulation for inducing stress in a laboratory setting that includes a naturalistic context simulating the stress that people often experience (Birkett, 2011). Moreover, Dickerson and Kemeny (2004) conducted a meta-analysis of 208 studies and concluded that the TSST was the most effective standardized protocol for increasing the primary

hormone (cortisol) associated with stress. The TSST was employed in the current study to investigate the impact of stress on risk perceptions and risk taking behavior.

1.11 STRESS, RISK PERCEPTIONS, AND RISK TAKING: THEORETICAL PREDICTIONS

Researchers have proposed a number of frameworks to explain how social stress and other emotional states influence decision-making. Three of the leading theoretical frameworks include: 1) the *valence-based framework* (Johnson & Tversky, 1983), 2) the *appraisal tendency framework* (ATF; Han, Lerner, & Keltner, 2007) and 3) the *limited cognitive resource framework* (Eysenck, Derakshan, Santos, & Calvo, 2007). A brief description of each framework is provided below.

Valence-Based Framework. The Valence-Based Framework proposes that emotions can be categorized as either positive (e.g., happy or joy) or negative (e.g., stress or anxiety) and each type of emotion has unique effects on decision-making. Positive emotions have been described as emotions that are intrinsically attractive or good, whereas negative emotions have been described as emotions that are intrinsically aversive or bad (Frijda, 1986. p. 207). Studies guided by the Valence-Based Framework suggest that positive emotions are associated with decreased risk perceptions and negative emotions are associated with increased risk perceptions (Hu, Xie, & Li, 2013; Johnson & Tversky, 1983). Thus, from the theoretical perspective of the Valence-Based Framework, all emotions categorized as positive should decrease risk perceptions and all emotions categorized as negative should increase risk perceptions. For example, within the Valence-Based Framework, *fear* and *anger* are both categorized as negative emotions and therefore should elicit similar effects on risk perceptions. Similarly, stress would be categorized as a negative emotion and should also impact risk perceptions in the same direction as anger and

fear. However, the Valence-Based Framework fails to recognize that emotions cannot simply be dichotomized as positive or negative because each emotion (fear, anger, and stress) may elicit unique responses to risky situations. For example, research suggests that fear is associated with an increase in risk perceptions and anger is associated with a decrease in risk perceptions (Lerner & Keltner, 2000). These unique effects cannot be explained by the Valence-Based Framework. A theoretical framework that has emerged to explain the differential effects of fear and anger on risk behaviors.

The Appraisal Tendency Framework. The Appraisal Tendency Framework (ATF; Han, Lerner, & Keltner, 2007) proposes that people cognitively evaluate their emotional experiences and these evaluations (appraisals) influence decision-making. The ATF distinguishes between the impact of specific emotions (e.g., fear, anger, happiness, sadness) on the decision making process and proposes that people tend to make cognitive appraisals to describe their emotional experiences. For example, Smith and Ellsworth (1985) identified six cognitive appraisals that can be used to explain emotional experiences: 1) pleasantness, 2) responsibility, 3) anticipated effort, 4) attentional activity, 5) certainty, and 6) control. These six cognitive appraisals can explain the unique impacts of fear and anger on decision-making. The ATF assumes that fear and anger operate distinctively on the cognitive appraisals of certainty and control. Certainty refers to the degree that an individual perceives a situation as having a predictable outcome (Smith & Ellsworth, 1985). Control refers to the degree that an individual perceives that they can control the outcome of the situation they are encountering (Smith & Ellsworth, 1985). The ATF assumes that there are two types of control: 1) self-control, which refers to the extent to which one feels like they had the ability to control the situation, and 2) situational-control, which refers to the extent to which one feels like circumstances beyond anyone's control contributed to

the situation. Appraisals of uncertainty and situational-control are associated with fear (Lerner & Keltner, 2000). In contrast, appraisals of certainty and self-control are associated with anger (Lerner & Keltner, 2000). The ATF represents an important advance beyond traditional valence-based frameworks for understanding decision making processes; however, “cognitive load” is a key factor that is omitted from the ATF and omnipresent in decision making.

Cognitive Load (CL) and Limited Cognitive Resource (LCR) Frameworks. The CL and LCR frameworks propose that people have limited cognitive resources. These resources can be drained or depleted by emotional experiences, leaving fewer resources available to guide decision making and other cognitive processes. Cognitive load is defined as the total amount of mental effort used by working memory (the system associated with comprehension and reasoning). The LCR framework proposes that cognitive performance is dependent on cognitive resources and individuals have a finite amount of cognitive resources. Cho, Altarriba, and Popiel (2015) investigated the impact of high levels of cognitive load (e.g., multitasking) on cognitive performance. Thirty participants read a brief passage and were assigned to one of two conditions: 1) a “cognitive load” condition in which participants read the brief passage and were also asked to solve math problems, 2) a “no-load” condition in which participants only read the brief passage. Participants in the “cognitive load” condition subsequently scored lower on a reading comprehension test in comparison to participants in the “no-load condition” (M_s/SD , 48/16 & 61/18, respectively on a 100 point scale). These findings suggest that cognitive abilities are taxed when cognitive resources are distributed among several tasks rather than devoted to a single task.

Emotional states such as stress are thought to impair cognitive performance in the same manner that multitasking impairs cognitive performance. Presumably stress impairs cognitive

performance because cognitive resources are diverted away from the decision-making process and recruited to regulate the stress (Eysenck, Derakshan, Santos, & Calvo, 2007). Thus, attention is directed toward controlling the stress elicited from the stressor rather than focusing on making an optimal decision.

Research guided by the LCR framework suggests that stress increases risk taking behavior because stress impairs an individuals' decision making process. The studies discussed above support this general proposition. However, additional studies also suggest that stress increases risk *perceptions* (a finding not predicted by the CLF framework) (Friedze, 2016; Lange et al., 2004; López-Vazquez & Marván, 2003). Two factors may account for these seemingly conflicting findings. First, the impact of stress on risk taking and risk perception may depend upon the experimental method used to elicit stress (e.g., physical pain, psychological distress). Second, the impact of stress on risk taking and risk perception may depend upon the type of risk behavior or risk perception assessed: health threatening (e.g., drunk driving) versus non-health threatening (e.g., gambling).

Risk Avoidance Framework. The Risk-Avoidance Framework proposes that people seek to reduce the “emotional experience” that accompanies anxiety by avoiding risky decisions. Studies addressing this issue have yielded conflicting results. Some research suggests that social anxiety increases risk-taking as indexed by performance on the Balloon Analogue Risk Task (BART) (Reynolds et al., 2013), whereas other research suggests that social anxiety decreases risk taking as indexed by performance on the BART (Maner et al., 2007).

The LCR framework predicts that social anxiety increases risk-taking behaviors (Reynolds et al., 2013). In contrast, two explanations have been proposed for predicting that social anxiety would be associated with risk-avoidant decisions (Maner et al., 2007). First,

anxiety may signal that a threat is present and thus facilitate psychological responses aimed at reducing vulnerability to the threat (Butler & Mathews, 1987). That is, individuals attempt to reduce their vulnerability to the threat by avoiding the threat. Second, existing research suggests that individuals who report high trait anxiety also expect higher perceptions to experience negative outcomes in the future (Lerner & Keltner, 2000); thus, anxiety is thought to increase the perceived risk of a negative outcome occurring and causes individuals to engage in less behaviors that could result in negative outcomes (e.g., driving under the influence of a controlled substance). The present study tested the risk-avoidant framework by assessing health-related decisions about DUI-SAMA.

Limited Cognitive Resource Framework Versus Risk-Avoidant Framework. Several findings suggest that the Risk-Avoidance Framework explains decision-making when individuals experiencing stress are confronted with health-threatening decisions. In contrast, findings suggest that the LCR framework may explain decision-making when individuals experiencing stress are faced with non-health threatening decisions. For example, Fritze (2016) reported that stress decreased reported willingness to DUI-SAMA (a health-threatening decision). More specifically, participants' who experienced stress reported lower willingness to DUI-SAMA in an urgent situation ($M = 2.38$, $SD = 1.36$, on a 5-point scale ranging from *not at all willing* to *extremely willing*) in comparison to participants who did not experience stress, [$M = 2.89$, $SD = 1.48$; $t(158) = -2.28$, $d = .36$, $p = .024$, two-tailed]. The latter results suggest that the stress elicited by the TSST may produce risk-avoidant responses associated with a health-threatening outcome (e.g., DUI-SAMA). Notably, this prediction is consistent with research reporting increases in risk perceptions when participants evaluate threats involving consequences harmful to one's health, such as the perceived risk of experiencing a natural disaster (Lange et al., 2004)

or the perceived risk of a catastrophe reoccurring in one's life (López-Vazquez & Marván, 2003). Conversely, when an individual is making non-health threatening decisions (e.g., performance on the BART), it is predicted that the *limited cognitive resources framework* will explain decision-making (i.e., taking more risks because attention is allocated toward mitigating the stress rather than making optimal decisions). Research demonstrates that risk behaviors increase when tasks did not involve threats to one's health, such as the computerized cup task (Galván & McGlennen, 2012) or the BART (Johnson et al., 2012; Lighthall et al., 2009). In a study by Fritze (2016), differences between the stress and no stress group were not detected when examining performance on the BART, however, the BART was not administered using conventional protocol (e.g., administering the BART immediately after the TSST) and was administered after a 10-15 minute delay.

1.12 GAPS IN KNOWLEDGE

The present study addresses several gaps in knowledge. First, little is known about the perceived risk of DUI-SAMA; the present study addresses this gap in knowledge by assessing the perceived risk of DUI-SAMA in a sample of students who are “at risk” for engaging in DUI-SAMA behaviors (i.e., marijuana users). Second, little is known about the factors associated with the perceived risk of DUI-SAMA; the present study addresses this gap in knowledge by investigating factors that may influence the perceived risk of DUI-SAMA, such as the emotional state of the individual (e.g., stress) and situations that may encourage risky driving (e.g., urgent situations). Third, no studies have investigated why the Limited Cognitive Resource (LCR) framework accurately predicts risk taking behaviors in some situations, whereas the Risk-Avoidant Framework accurately predicts risk taking behaviors in other situations. The present study sought to address this gap in knowledge by investigating the impact of stress in two

distinct contexts that may explain the findings from the LCR and Risk-Avoidant frameworks: a health related context (i.e., the perceived risk of DUI-SAMA) and a non-health related context (i.e., risk behavior as indexed by performance on the BART).

1.13 SPECIFIC AIMS AND HYPOTHESES

The aim of the present study was to identify factors that influence the perceived risk of DUI-SAMA. The present study investigated the perceived risk of DUI-SAMA under two levels of stress (no stress, stress) and three levels of urgency (non-urgent, semi-urgent, urgent) in a high risk population (young adults ages 18-25). The present study tested six hypotheses: H₁) stress will decrease a participant's willingness to DUI-SAMA under urgent and non-urgent conditions, H₂) stress will increase the perceived risk of DUI-SAMA under urgent and non-urgent conditions, H₃) stress will increase the perceived dangerousness of DUI-SAMA under urgent and non-urgent conditions, H₄) stress will increase risk-taking behavior on the Balloon Analogue Risk Task (BART), H₅) willingness to DUI-SAMA will increase as level of urgency increases, and H₆) willingness to DUI-SAMA will be higher than willingness to driving a motor vehicle after consuming enough alcohol to reach a BAC of 0.08 in urgent and non-urgent conditions. Specifically, the present study investigated the perceived risk of DUI-SAMA when participants are exposed to two levels of stress (no stress, stress) and three levels of urgency (non-urgent, semi-urgent, urgent).

Chapter 2: Methods

2.1 PARTICIPANTS

One-hundred and seventy five students from the University of Texas at El Paso (UTEP) were recruited to participate in the study and offered the option to be paid seventeen dollars or receive one hour of course credit for their Introduction to Psychology course. The mean age was 20.30 ($SD = 2.00$); 59% of the sample was female. Approximately 78.3% of the sample was Hispanic, 7.2% was Caucasian, 2.4% was African American, 1.8% was Asian, and the remainder were classified as “other.” Eligible participants were UTEP students, ages 18 to 25, who reported using marijuana at least once in the 12 months preceding the survey.

A power analysis using *G-power* indicated that 158 participants were needed to provide an 80% chance of detecting a moderate effect ($d = .45$) of stress level (stress vs. no stress) on risk taking behaviors as indexed by performance on the Balloon Analogue Risk Task (2-tail t-test, $\alpha=.05$) (Büchner, Erdfelder, Faul, & Lang, 2010). The latter effect size was derived from computing the weighted average effect size reported in two studies assessing the impact of stress on performance on the BART (Reynolds et al., 2013; Schepis, McFetridge, Chaplin, Sinha, & Krishnan-Sarin, 2011).

The current sample size also provides an 80% chance of detecting a moderate effect ($d = .45$) of stress level (no stress vs. stress) on *risk perceptions* (2-tail t-test, $\alpha=.05$). The latter power analysis is derived from computing the weighted average effect size reported in two studies that assessed the impact of stress on *risk perceptions* (Lange, Fleming, & Toussaint, 2004; López-Vázquez & Marván, 2003).

Two samples of participants were recruited: 1) one-hundred and sixty five participants who reported using marijuana in the 12 months preceding the survey, and 2) ten students who

had not used marijuana. The latter subjects were recruited in the study solely for purposes of maintaining the anonymity of marijuana users. That is, participating in the study did not indicate if a participant was a marijuana user. The data from the ten non-marijuana users was not analyzed.

2.2 DESIGN

A between subjects design (stress/no stress) was used with four dependent variables: 1) risk taking behavior as indexed by performance on the BART, 2) perceived risk of DUI-SAMA, 3) perceived dangerousness of DUI-SAMA, and 4) self-reported willingness to DUI-SAMA.

2.3 MEASURES

Pre-Screening Survey (Appendix A). The following two items were used to assess participant eligibility: 1) “*During the last 12 months, how often did you use marijuana?*” 2) “*Age*”. Individuals who were ages 18 -25 who reported any marijuana use in the past 12 months were eligible to participate in the study. The latter two eligibility items were embedded with 7 additional background items to help mask eligibility criteria.

Sociodemographic and Background Questionnaire (Appendix B). An 8-item demographic questionnaire assessed basic characteristics such as gender, age, and ethnicity.

Marijuana and Alcohol Questionnaire (Appendix C). A 14-item questionnaire adapted from Porath-Waller (2008) assessed prior marijuana and alcohol use. The questionnaire assesses lifetime marijuana use, lifetime alcohol use, and frequency of using each substance in the past year. Sample item: “*During the last 12 months, how often did you use marijuana?*” Response options included: (1) “*Don’t know what marijuana is*”, (2) “*Have never used marijuana in my lifetime*,” (3) “*Didn’t use marijuana in the last 12 months*,” (4) “*1 time*,” (5) “*2 times*,” (6) “*3 or 4 times*,” (7) “*5 to 8 times*,” (8) “*9-12 times (about once a month)*,” (9) “*13-26 times (about*

twice a month),” (10) “27 or more times (more than twice a month). Sample item: “If you had to categorize yourself as a marijuana user, which of the three categories best describes your use?”

Response options were coded as: (1) *“Experimental user (e.g., I have tried marijuana a 1-3 times),”* (2) *“Occasional user (e.g., I use marijuana once a month or less),”* (3) *“Regular user (e.g., I use marijuana weekly or daily).”*

Physiological Measure of Stress. An electronic pulse apparatus (NoninConnect Wireless Pulse Oximeter) was placed on the participant’s fingertip and used as a physiological measure of stress. The apparatus provides a digital measurement of the participant’s pulse and transmits the data wirelessly to the researcher via Bluetooth. Pulse measurements were assessed at six time points: 1) baseline, prior to the stress manipulation, 2) after reading the instructions for the stress manipulation, 3) after watching the stress induction video, 4) after the BART, 5) after completing the STAI, and 6) after completing the dependent measures. Pulse measurements were assessed at the same six time points in the non-stress condition. The average of the pulse rates across all six time points was computed for the stress and no stress groups. Computing the average across all six time points was a conservative approach compared to excluding the baseline because including the baseline attenuates the average in the stress group. Prior research suggests that heart rate can increase by 10-11 BPM on average when stress is induced by asking participants to deliver a speech in front of an audience (Friedze, 2016; Kudielka, Schommer, Hellhammer, & Kirschbaum, 2004).

State-Trait Anxiety Inventory (STAI; Appendix F). A 6-item subscale from the STAI assessed the participant’s level of stress. Participants indicated how they felt at the moment. Sample items: *“I feel calm,” “I feel tense,”* and *“I feel worried.”* Response options ranged from: (1) *“Not at all,”* (2) *“Somewhat,”* (3) *“Moderately,”* (4) *“Very much.”* Scores can range

from 6 to 24. Internal reliability of the scale is moderately high (Cronbach's $\alpha = 0.82$; Marteau & Bekker, 1992). The 6-item version was reduced from the original 20-item STAI (Spielberger & Gorsuch, 1983) that has demonstrated a 0.91 Cronbach's α (Marteau & Bekker, 1992). In a previous study using a similar protocol, the Cronbach alpha coefficient was 0.79 (Frietze, 2016).

Balloon Analogue Risk Task (BART). The Balloon Analogue Risk Task (BART; Lejuez et al., 2002) is a computerized program that assesses risk taking behavior. Participants are challenged to pump as much air as possible into a computer simulated balloon without causing an explosion. The likelihood of the balloon exploding increases as the number of pumps increases. Notably, participants are able to witness the balloon increase in size with each pump that does not result in an explosion. Standard instructions for the BART include paying participants with cash whereas in the current study instructions were slightly modified to reward participants with raffle tickets instead of cash. More specifically, participants were instructed that three random winners would be selected to win one of three UTEP bookstore gift cards (\$150, \$100, or \$75) at completion of the study. Participants were instructed: *"Now you're going to see 10 balloons, one after another, on the screen. For each balloon, you can click the button that will pump up the balloon. Each time you click the pump button, the balloon pumps up a little more. BUT remember, balloons pop if you pump them up too much. It is up to you to decide how much to pump up each balloon. Some of these balloons might pop after just one pump. Others might not pop until they fill the whole screen. You get 1 raffle ticket for every dollar you earn. Each pump earns 0.01 cent. But if a balloon pops, you lose the money you earned on that balloon. To keep the money from a balloon, stop pumping before it pops and click the button labeled 'Collect \$\$\$'. After each time you collect \$\$\$ or pop a balloon, a new balloon will appear. At the end of the experiment, you will be given raffle tickets for the amount*

earned on the game.” Risk behavior was assessed in two ways: 1) average number of explosions, 2) average number of balloon pumps that did not result in explosions. In a previous study using a similar protocol, the average number of explosions across ten trials was less than four (Frietze, 2016). In addition, the average amount of balloon pumps across ten trials that did not result in explosions was approximately 250 pumps (Frietze, 2016).

Perceived Risk of DUI-SAMA (Appendix G). A single item assessed the participant’s perceived risk of DUI-SAMA. The item was adapted from Porath-Waller (2008): *“In your opinion, how would you rate your driving ability within one hour after drinking a small amount of alcohol (e.g., one and a half beers) and using a small amount of marijuana?”* Response options ranged from: (1) *“Not at all impaired,”* to (7) *“Very much impaired.”*

Perceived Willingness to DUI-SAMA (Appendix G). Three items adapted from Porath-Waller (2008) assessed the participants willingness to DUI-SAMA under three levels of urgency: 1) non-urgent, such as driving a friend to a fast-food restaurant, 2) semi-urgent, such as driving a mildly sick friend home, and 3) urgent reason, such as driving a severely injured friend to the hospital. Sample item: *“Imagine that you want to drive to a severely injured friend to a hospital. How willing would you be to drive your friend to the hospital within one hour of using a small amount of marijuana in combination with a small amount of alcohol (e.g., one and a half beers) to drive a severely injured friend to the hospital?”* Response options ranged from: (1) *“Not at all willing,”* to (7) *“Very much willing.”*

Perceived Dangerousness (Appendix G). A single item assessed the participant’s perceived dangerousness of DUI-SAMA: *“How dangerous do you think it is to drive within one hour of drinking a small amount of alcohol (e.g., one and a half beers) and using a small amount*

of marijuana?” Response options ranged from: (1) “*Not at all dangerous,*” to (7) “*Extremely dangerous.*”

Perceived Willingness to Knowingly DUI (Appendix G). A 3-item scale adapted from Porath-Waller (2008) assessed the participants willingness to knowingly DUI under three levels of urgency: 1) non-urgent, such as driving a friend to a fast-food restaurant, 2) semi-urgent, such as driving a mildly sick friend home, and 3) urgent reason, such as driving a severely injured friend to the hospital. Sample item: “*Imagine that you want to drive a severely injured friend to a hospital. How willing you would be to drive your friend to the hospital within one hour of drinking enough alcohol that you would get into trouble with the police if you were stopped while driving (that is, your blood alcohol content reached the legal limit of 0.08)?*” Response options ranged from: (1) “*Not at all willing,*” to (7) “*Very much willing.*”

Driving Under the Influence in Past 12 Months (Appendix G). Two items adapted from Caetano, Ramisetty-Mikler, and Rodriguez (2009) assessed if participants have driven under the influence of alcohol or marijuana in the past 12 months. Sample item: “*During the last 12 months, have you driven a motor vehicle after you had drunk enough alcohol to be in trouble if the police had stopped you?*” Sample item: “*During the last 12 months, have you driven a motor vehicle after you had consumed enough marijuana to be in trouble if the police had stopped you?*” Responses were coded using a two-point scale (yes=1, no=0).

2.4 MANIPULATIONS

Subjects in the stress condition were exposed to two manipulations designed to induce stress: a modified version of the Trier Social Stress Task (TSST) and a stress induction video, described below.

Trier Social Stress Task (TSST; Appendix E). A modified version of the Trier Social Stress Task (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) was used to induce stress. The TSST induces stress by asking participants to deliver a five minute speech in front of a live audience of at least three confederates (Hawn, Paul, Thomas, Miller, & Amstadter, 2015). The TSST was modified in the present study by informing participants that they would be delivering the speech in front of a live audience in another room. Participants were informed that they would have time to draft the speech during a 10 minute preparation period.

The following instructions were provided to participants to create a link between the topic of their speech and the topic of the questionnaires:

“We are trying to learn more about how students and community members make decisions, especially health related decisions. Such decisions often arise out of national debates addressing important topics.

*Below is a list of 4 topics that have recently been in the national news. You will be randomly assigned to discuss the pros and cons of **ONE** of the following topics: 1) removing vending machines from elementary schools, 2) allowing tobacco use on college campuses, 3) legalizing the recreational use of marijuana, and 4) requiring vaccinations for students enrolled in public school.*

You will be provided with a brief fact sheet that includes information that may help you prepare your speech. You can use this information when preparing your speech, but the fact sheet will be removed prior to delivering the speech. We’ve asked you to wear this small apparatus on your finger to help us learn more about how people respond both verbally and non-verbally to conversations involving some of these national debates. In order to provide

audience members enough time to arrive at the room that we've reserved down the hall, we will ask you to spend a few minutes completing some additional health related surveys and tasks."

The latter instructions were designed to convince participants that a live audience was present to hear their speech. The above approach has been used in a previous research (Frietze, 2016).

Stress Induction Video. Participants were shown a six-minute video that was designed to induce stress among viewers. The video was developed by Reynolds et al. (2013) and depicts a student delivering a speech to an audience comprised of professors who subsequently pose questions to the student. The student exhibits stressful reactions (e.g., stumbling over words). The present study administered the TSST and the stress induction video as the experimental manipulation. The video was shown to participants immediately after they were introduced to the TSST.

Non-Stressful Video. A six-minute video with neutral stimuli was presented to the non-stress condition. The video depicted a live debate regarding the removal of vending machines from public schools.

2.5 PROCEDURE

Approximately 60 minutes were required to complete the protocol. Participants initially completed the pre-screening survey to determine their eligibility. Ten participants with no history of marijuana use were also included in the study to maintain the anonymity of marijuana users.

Eligible participants began by reading and signing the IRB approved consent form. After signing the consent form, participants chose a random number from a box and were verbally informed that they would learn more about the number that they obtained later in the study.

Next, participants completed the *demographic survey* and the *marijuana and alcohol questionnaire*. Participants were then randomly assigned to the stress or no stress condition. Participants were informed that the study sought to learn about the types of verbal and non-verbal cues that influence an audience's reaction to presentations on various topics. Next, the electronic pulse reader was placed on the participant's fingertip and the initial BPM measurement were recorded. Participants in the stress condition were provided with the TSST instructions and their next BPM measurement was recorded. Next, the participants viewed the stress and anxiety induction video and their BPM measurement was recorded again. Participants then completed the BART and subsequently had their BPM measurement recorded. Next, participants completed the STAI and had their next BPM measurement recorded. Participants in the non-stress condition read neutral instructions (see Appendix D), viewed the neutral stimuli video, completed the BART, and STAI, and had their BPM measurements recorded at similar time points. Next, willingness to DUI-SAMA in urgent, semi-urgent, and non-urgent situations was assessed (see Appendix G). The perceived risk of DUI-SAMA and perceived dangerousness of DUI-SAMA was subsequently assessed (see Appendix G). The final BPM measurement was then taken. Finally, participants were given the marijuana fact sheet (see Appendix H) and a blank sheet of paper to take notes. Participants were informed that they had ten minutes to prepare their speech. After ten minutes, participants were informed that there was a twist in the study and they had a 50% chance of giving a speech themselves or leaving their notes for the next participant that will have to give the speech. Participants were informed that the number that they obtained in the beginning of the study determined they wouldn't deliver the speech and their notes would be passed on to the next participant. Participants were then debriefed regarding this deception at the conclusion of the experiment (see Appendix I).

2.6 APPROACH TO ANALYSES

Basic descriptive statistics were conducted for all key demographic variables for each subsample of participants (experimental vs. control) as well as the combined sample.

Descriptive statistics were calculated for the perceived risk of DUI-SAMA, willingness to DUI-SAMA, and risk taking behavior (indexed by performance on the BART).

As a manipulation check to determine if stress was higher in the stress condition, an independent-samples t-test was conducted to compare State Trait Anxiety Index (STAI) scores and the physiological measure for the stress and no stress groups.

Correlation and regression analyses assessed the relationship between the participant's stress levels, perceived risk of DUI-SAMA and risk taking behavior. To test the hypothesis that stress decreases willingness to DUI-SAMA under urgent and non-urgent conditions, t-tests and linear regression were conducted using willingness to DUI-SAMA as the dependent variable and experimental condition (stress/no stress) as the independent variable. To test the hypothesis that stress increases the perceived risk of DUI-SAMA, t-tests and linear regression were conducted entering risk-perceptions of DUI-SAMA as the dependent variable and experimental condition (stress/no stress) as the independent variable. To test the hypothesis that stress increases the perceived dangerousness of DUI-SAMA, t-tests and linear regression were conducted entering perceived dangerousness as the dependent variable and experimental condition (stress/no stress) as the independent variable. To test the hypothesis that stress increases risk behaviors, t-tests and linear regression were conducted using performance scores on the BART as the dependent variable and experimental condition (stress/no stress) as the independent variable. To test the hypothesis that willingness to DUI-SAMA will increase as levels of urgency increase, repeated measures tests assessed differences in reported willingness to DUI-SAMA in urgent conditions

and non-urgent conditions. To test the hypotheses that willingness to DUI-SAMA will be higher than willingness to DUI, a series of repeated measure tests were assessed differences under urgent and non-urgent situations.

Chapter 3: Results

3.1 PARTICIPANT CHARACTERISTICS

Approximately 37.3% of the sample categorized themselves as “experimental marijuana users”, having only used marijuana 1-3 times; 38% of the sample categorized themselves as occasional marijuana users, having used marijuana once a month or less; and 24.1% of the sample categorized themselves as regular marijuana users, using marijuana weekly or daily. Approximately 26.5% of the sample reported using marijuana 27 or more times over the past 12 months. Approximately 32.5% of the sample reported that they could consume an entire joint within a one hour period without their driving skills being seriously impaired. Moreover, 75.8% of the sample reported that they could consume more than 1/3 of a joint within a one hour period without their driving skills being seriously impaired. Ninety-seven percent of the sample reported drinking alcohol in their lifetime, 80.7% reported drinking alcohol at least once a month, and 89.2% reported having at least 2 drinks on the days in which they do drink. Approximately, 69.9% of the sample reported smoking marijuana and drinking alcohol within one hour of each other in the past 12 months.

Approximately 93.4% of the sample reported driving a motor vehicle in the past year. Approximately 49.4% of the sample reported driving a motor vehicle within one hour of using marijuana, 45.8% of the sample reported driving a motor vehicle within one hour of drinking alcohol, and 20.5% reported driving a motor vehicle within one hour of drinking alcohol and using marijuana in combination at least one time.

Correlational analyses revealed that frequency of marijuana use in the past 12 months was associated with the following variables: frequency of alcohol use in the past 12 months ($r = .22, p = .005$), frequency of the combined use of marijuana and alcohol in the past 12 months ($r =$

.55, $p < .001$), frequency of driving under the influence of marijuana ($r = .68$, $p < .001$), and frequency of driving under the combined influence of marijuana and alcohol ($r = .28$, $p < .001$; see Table 2). Additionally, frequency of marijuana use in the past 12 months was associated with willingness to DUI-SAMA in urgent ($r = .28$, $p < .001$), semi-urgent ($r = .30$, $p < .001$), and non-urgent conditions ($r = .30$, $p < .001$). Similar associations were found when examining the frequency of alcohol use in the past 12 months (see Table 2).

Correlational analyses also revealed that the perceived risk of DUI-SAMA was negatively associated with frequency of driving under the influence of alcohol, marijuana, or the combination of alcohol and marijuana ($r_s \geq -.28$, $p_s < .001$; see Table 2). Similarly, the perceived dangerousness of DUI-SAMA was also negatively associated with frequency of driving under the influence of alcohol, marijuana, or the combination of alcohol and marijuana ($r_s \geq -.24$, $p_s < .001$; see Table 2).

Manipulation Check. An independent-samples t-test was conducted to compare State Trait Anxiety Index (STAI) scores ($\alpha = 0.78$) and the physiological measure for the stress and no stress groups. STAI scores were higher in the stress group ($M = 11.83$, $SD = 2.89$) than in the no stress group, $M = 10.63$, $SD = 3.49$; $t(163) = 2.41$, $d = .37$, $p = .017$. In addition, Beats Per Minute (BPM) assessed using the pulse oximeter were higher in the stress group ($M = 85.07$, $SD = 12.82$) than in the no stress group, $M = 81.20$, $SD = 10.87$; $t(160) = 2.08$, $d = .33$, $p = .04$. Scores on the STAI correlated with BPM ($r = .16$, $p = .042$), these findings suggest that the stress induction manipulation was successful.

Pulse measurements at the six time points also suggest that stress manipulation was successful (see Figure 1, p. 50). As expected, at time 1 (prior to the stress manipulation), no differences between the stress ($M = 80.60$, $SD = 13.99$) and no stress group were detected, $M =$

82.43, $SD = 13.03$; $t(163) = .872$, $d = .14$, $p = .384$. At time 2, participants exposed to the TSST instructions had significantly higher BPM rates ($M = 87.59$, $SD = 14.55$) than participants not exposed to the TSST instructions, $M = 80.87$, $SD = 12.23$; $t(163) = 3.21$, $d = .50$, $p = .002$. At time 3, participants exposed to the stress induction video had significantly higher BPM rates ($M = 88.56$, $SD = 15.74$) than participants not exposed to the stress induction video, $M = 80.08$, $SD = 12.36$; $t(163) = 3.84$, $d = .60$, $p < .001$. At time 4 (after completing the BART) participants in the stress condition had significantly higher BPM rates ($M = 86.35$, $SD = 13.58$) than participants not in the stress condition, $M = 82.10$, $SD = 11.85$; $t(163) = 2.15$, $d = .33$, $p = .033$. At time 5 (after completing the STAI) participants in the stress condition had significantly higher BPM rates ($M = 83.21$, $SD = 13.82$) than participants not in the stress condition, $M = 78.79$, $SD = 11.00$; $t(162) = 2.26$, $d = .35$, $p = .025$. At time 6 (after completing the DUI-SAMA items) BPM rates no longer differed in the stress ($M = 84.81$, $SD = 13.07$) than and no stress condition, $M = 81.52$, $SD = 11.70$; $t(160) = 1.69$, $d = .27$, $p = .093$.

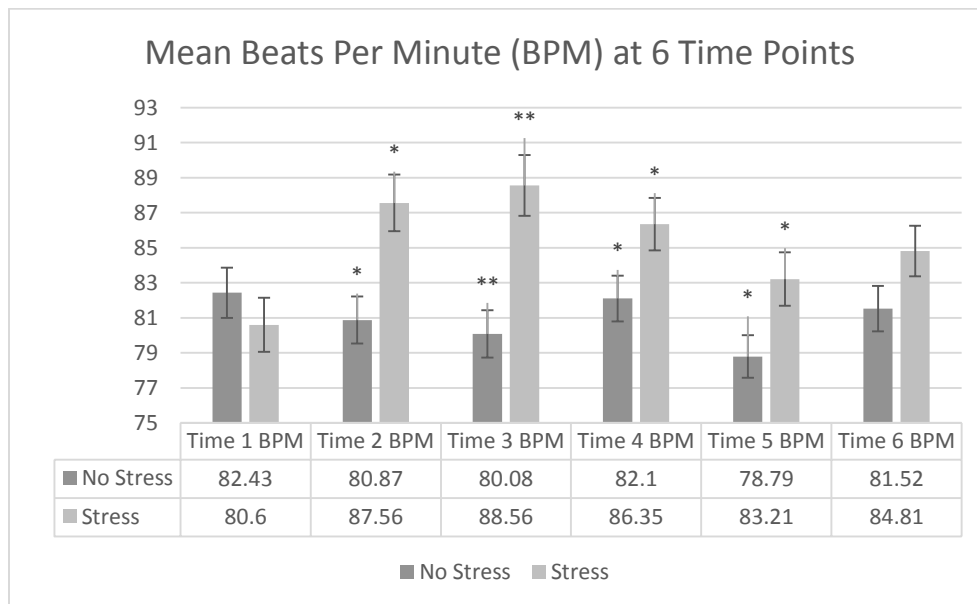


Figure 1. Physiological Differences Between Stress and No Stress Group ($N = 165$)

Note: $*p < .05$

$**p < .001$

3.2 STRESS AND DUI-SAMA

Stress and Perceived Willingness to DUI-SAMA. Independent-samples t-tests were conducted to compare willingness to DUI-SAMA under urgent and non-urgent conditions for the stress and no stress groups (see Tables 5, 6, & 7, respectively). Participants in the stress induced group were not significantly more willing to DUI-SAMA in urgent situations ($M = 4.73$, $SD = 2.14$) than participants in the non-stress group, $M = 4.72$, $SD = 1.90$; $t(163) = 0.03$, $p = .978$ (two-tailed). In addition, participants in the stress induced group were not significantly more willing to DUI-SAMA in semi-urgent situations ($M = 3.69$, $SD = 1.97$) than participants in the non-stress group, $M = 3.80$, $SD = 1.78$; $t(163) = -.343$, $p = .73$ (two-tailed). Furthermore, participants in the stress induced group were not significantly more willing to DUI-SAMA in non-urgent situations ($M = 3.82$, $SD = 2.05$) than participants in the non-stress group, $M = 3.65$, $SD = 1.80$; $t(163) = .56$, $p = .58$ (two-tailed).

Stress and Perceived Risk of DUI-SAMA. An independent-samples t-test was conducted to compare participants' perceived risk of DUI-SAMA in the stress and control groups. There was not a significant difference in the perceived risk of DUI-SAMA in the stress ($M = 3.32$, $SD = 1.71$) and no stress groups, $M = 3.48$, $SD = 1.67$; $t(163) = -.626$, $p = .532$ (two-tailed). Regression analyses using the STAI and BPM as predictors did not reveal significant effects when examining the perceived risk of DUI-SAMA ($\beta = .051$, $p = .206$; $\beta = .01$, $p = .376$, respectively).

Stress and Perceived Dangerousness of DUI-SAMA. An independent-samples t-test was conducted to compare participant's perceived dangerousness of DUI-SAMA in the stress and control groups. There was not a significant difference in the perceived dangerousness of DUI-SAMA in the stress ($M = 3.94$, $SD = 1.50$) and the no stress groups, $M = 3.88$, $SD = 1.25$; $t(163)$

= .276, $p = .783$ (two-tailed). A linear regression revealed that BPM significantly predicted perceived dangerousness of DUI-SAMA, $\beta = 0.024$, $t(161) = 2.76$, $p = .006$. A linear regression inputting the STAI as a predictor of perceived dangerousness of DUI-SAMA did not reveal significant effects ($\beta = .031$, $p = .36$).

Stress and Perceived Willingness to Knowingly DUI. An independent-samples t-test was conducted to compare willingness to knowingly DUI (i.e., willingness to driving a motor vehicle after consuming enough alcohol to reach a BAC of 0.08) under urgent and non-urgent conditions for the stress and no stress groups (see Tables 8, 9, & 10, respectively). There was not a statistical difference in participants' reported willingness to knowingly DUI under urgent conditions in the stress ($M = 3.71$, $SD = 2.21$) and the no stress groups, $M = 3.39$, $SD = 2.02$; $t(163) = .975$, $p = .331$ (two-tailed). There was not a significant difference in participants' reported willingness to knowingly DUI under semi-urgent conditions for participants in the stress ($M = 2.18$, $SD = 1.54$) and the no stress groups, $M = 2.13$, $SD = 1.43$; $t(163) = .22$, $p = .83$ (two-tailed). In addition, there was not a significant difference in participants' reported willingness to knowingly DUI under non-urgent conditions for participants in the stress ($M = 2.11$, $SD = 1.52$) and the no stress groups, $M = 2.06$, $SD = 1.47$; $t(163) = .21$, $p = .832$ (two-tailed).

Stress and Balloon Analogue Risk Task (BART). An independent-samples t-test was conducted to compare scores on the BART in the stress and control groups. As hypothesized, there was a significant difference in the total number of explosions across ten trials in the stress ($M = 3.18$, $SD = 1.75$) and the no stress groups, $M = 2.55$, $SD = 1.46$; $t(162) = 2.52$, $p = .013$ (two-tailed). There was not a significant difference in the total number of balloon pumps in the stress ($M = 184.41$, $SD = 84.85$) and the no stress groups, $M = 195.57$, $SD = 81.90$; $t(162) = -0.86$, $p = .393$ (two-tailed). A linear regression revealed that BPM significantly predicted total

number of balloon explosions, $\beta = -0.023$, $t(160) = -2.18$, $p = .031$. A linear regression inputting the STAI as a predictor of performance on the BART did not reveal significant effects in total number of balloon pumps or total number of balloon explosions ($\beta = -1.94$, $p = .341$; $\beta = -.046$, $p = .254$)

3.3 LEVEL OF URGENCY AND DUI-SAMA

Repeated measure tests were used to assess differences in reported willingness to DUI-SAMA in urgent conditions than in non-urgent conditions. As hypothesized, the results of the paired samples t-tests suggest that willingness to DUI-SAMA in urgent conditions ($M = 4.73$, $SD = 2.01$) was significantly higher than willingness to DUI-SAMA in semi-urgent conditions ($M = 3.75$, $SD = 1.84$; $t(164) = -9.31$, $d = 0.51$, $p < .001$, two-tailed). In addition, willingness to DUI-SAMA in urgent conditions ($M = 4.73$, $SD = 2.01$) was significantly higher than willingness to DUI-SAMA in non-urgent conditions ($M = 3.73$, $SD = 1.92$; $t(164) = -8.63$, $d = 0.51$, $p < .001$, two-tailed). Willingness to DUI-SAMA in semi-urgent conditions ($M = 3.75$, $SD = 1.84$) was not significantly higher than willingness to DUI-SAMA in non-urgent conditions ($M = 3.73$, $SD = 1.92$; $t(164) = -.20$, $d = 0.01$, $p = .841$, two-tailed).

Level of Urgency, DUI-SAMA, and DUI. A series of repeated measure tests were used to assess if participants were more willing to DUI-SAMA than to drive a motor vehicle after consuming enough alcohol to reach a BAC of 0.08 (see Figure 2, p. 53). These analyses were intended to assess if participants regarded DUI-SAMA (see Appendix G, items 13-15) as dangerous as DUI (see Appendix G, items 22-24). The results of the paired samples t-tests suggest that willingness to DUI-SAMA in urgent conditions ($M = 4.72$, $SD = 2.01$) was significantly higher than willingness to knowingly DUI in urgent conditions ($M = 3.55$, $SD = 2.12$; $t(164) = 7.58$, $d = .57$, $p < .001$, two-tailed). In addition, willingness to DUI-SAMA in

semi-urgent conditions ($M = 3.75$, $SD = 1.87$) was significantly higher than willingness to knowingly DUI in semi-urgent conditions ($M = 2.16$, $SD = 1.48$; $t(164) = 12.02$, $d = .94$, $p < .001$, two-tailed). Lastly, willingness to DUI-SAMA in non-urgent conditions ($M = 3.73$, $SD = 1.92$) was significantly higher than willingness to knowingly DUI in non-urgent conditions ($M = 2.08$, $SD = 1.49$; $t(164) = 11.34$, $d = .96$, $p < .001$, two-tailed).

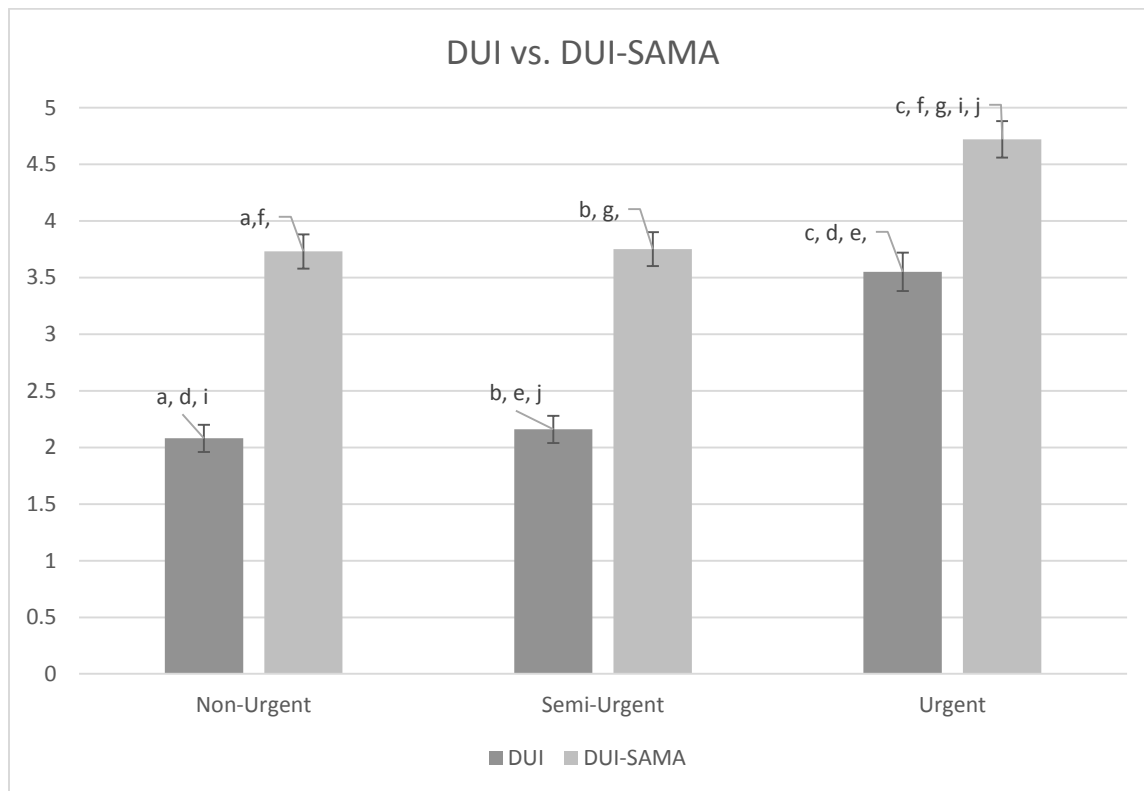


Figure 2. Willingness to DUI vs. DUI-SAMA

Note: DUI refers to willingness to drive a motor vehicle after consuming enough alcohol to reach a BAC of 0.08. DUI-SAMA refers to willingness to drive after consuming small amounts of marijuana and alcohol. Higher scores indicate higher willingness. Significant group differences are indicated by identical subscripts ($ts > 7.58$ and $ps < .001$).

3.4 MARIJUANA USE AND DUI-SAMA

Frequency of Marijuana Use and DUI-SAMA. Linear regression analyses were conducted to examine the impact of self-reported frequency of marijuana use (12 months

preceding the survey) on willingness to DUI-SAMA in urgent and non-urgent conditions.

Preliminary analyses were conducted to ensure that there were not violations of assumptions such as normality, linearity, multicollinearity, and homoscedasticity. Frequency of marijuana use significantly predicted willingness to DUI-SAMA in the non-urgent condition, $\beta = 0.29$, $t(164) = 4.01$, $p < .001$. More specifically, for every one unit change in frequency of marijuana use, there was a 0.29 unit increase in willingness to DUI-SAMA in the non-urgent condition. Frequency of marijuana use also explained a significant proportion of variance in the willingness to DUI-SAMA in the non-urgent condition, $R^2 = 0.09$, $F(1, 164) = 16.08$, $p < .001$. In addition, frequency of marijuana use significantly predicted willingness to DUI-SAMA in the semi-urgent condition, $\beta = 0.28$, $t(158) = 4.07$, $p < .001$. More specifically, for every one unit change in frequency of marijuana use, there was a 0.28 unit increase in willingness to DUI-SAMA in the semi-urgent condition. Frequency of marijuana use also explained a significant proportion of variance in the willingness to DUI-SAMA in the semi-urgent condition, $R^2 = 0.09$, $F(1, 164) = 16.60$, $p < .001$. Frequency of marijuana use also significantly predicted willingness to DUI-SAMA in the urgent condition, $\beta = 0.28$, $t(164) = 3.71$, $p < .001$. More specifically, for every one unit change in frequency of marijuana use, there was a 0.28 unit increase in willingness to DUI-SAMA in the urgent condition. Frequency of marijuana use also explained a significant proportion of variance in the willingness to DUI-SAMA in the urgent condition, $R^2 = 0.08$, $F(1, 164) = 13.78$, $p < .001$.

Frequency of marijuana use was not a significant predictor of the perceived risk of DUI-SAMA ($\beta = -0.99$, $p = .128$). In addition, marijuana experience was not a significant predictor of perceptions of dangerousness associated with DUI-SAMA ($\beta = -0.09$, $p = .085$).

In addition, frequency of marijuana use did not predict willingness to knowingly DUI in non-urgent situations ($\beta = 0.037, p = .522$), semi-urgent situations ($\beta = 0.044, p = .447$), or urgent situations ($\beta = 0.121, p = .139$).

Lastly, frequency of marijuana use did not influence the mean number of balloon pumps ($\beta = 4.46, p = .169$) or balloon explosions ($\beta = 0.029, p = .651$) on the BART.

3.5 ALCOHOL USE AND DUI-SAMA

Frequency of Alcohol Use and DUI-SAMA. Linear regression analyses were calculated to examine the influence of the self-reported frequency of alcohol use (12 months preceding the survey) on willingness to DUI-SAMA in urgent and non-urgent conditions. Frequency of alcohol use significantly predicted willingness to DUI-SAMA in the non-urgent condition, $\beta = 0.33, t(163) = 2.99, p = .003$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.33 unit increase in willingness to DUI-SAMA in the non-urgent condition. Frequency of alcohol use also explained a significant proportion of variance in the willingness to DUI-SAMA in the non-urgent condition, $R^2 = 0.05, F(1, 163) = 8.93, p = .003$. In addition, frequency of alcohol use significantly predicted willingness to DUI-SAMA in the semi-urgent condition, $\beta = 0.35, t(163) = 3.24, p = .001$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.35 unit increase in willingness to DUI-SAMA in the semi-urgent condition. Frequency of alcohol use also explained a significant proportion of variance in the willingness to DUI-SAMA in the semi-urgent condition, $R^2 = 0.06, F(1, 163) = 10.48, p = .001$. Frequency of alcohol use significantly predicted willingness to DUI-SAMA in the urgent condition, $\beta = 0.28, t(163) = 2.37, p = .019$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.28 unit increase in willingness to DUI-SAMA in the urgent condition. Frequency of alcohol use also explained a significant proportion of

variance in the willingness to DUI-SAMA in the urgent condition, $R^2 = 0.03$, $F(1, 163) = 5.60$, $p = .019$.

Frequency of alcohol use also predicted perceptions of dangerousness associated with DUI-SAMA, $\beta = -0.17$, $t(163) = -2.13$, $p = .035$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.17 unit decrease the perceived dangerousness of DUI-SAMA. Frequency of alcohol use also explained a significant proportion of variance in the perceived dangerousness of DUI-SAMA, $R^2 = 0.03$, $F(1, 163) = 4.54$, $p = .035$.

Frequency of alcohol use predicted willingness to knowingly DUI in non-urgent situations, $\beta = 0.44$, $t(163) = 5.38$, $p < .001$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.44 unit increase willingness to knowingly DUI in non-urgent situations. Frequency of alcohol use also explained a significant proportion of variance in willingness to knowingly DUI in non-urgent situations, $R^2 = 0.15$, $F(1, 163) = 28.96$, $p < .001$.

Frequency of alcohol use predicted willingness to knowingly DUI in semi-urgent situations $\beta = 0.37$, $t(163) = 4.39$, $p < .001$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.37 unit increase willingness to knowingly DUI in semi-urgent situations. Frequency of alcohol use also explained a significant proportion of variance in willingness to knowingly DUI in semi-urgent situations, $R^2 = 0.11$, $F(1, 163) = 19.77$, $p < .001$.

Frequency of alcohol use predicted willingness to knowingly DUI in urgent situations, $\beta = 0.44$, $t(163) = 3.57$, $p < .001$. More specifically, for every one unit change in frequency of alcohol use, there was a 0.44 unit increase willingness to knowingly DUI in urgent situations. Frequency of alcohol use also explained a significant proportion of variance in willingness to knowingly DUI in urgent situations, $R^2 = 0.07$, $F(1, 163) = 12.76$, $p < .001$.

Frequency of alcohol use did not influence the perceived risk of DUI-SAMA ($\beta = -0.178$, $p = .08$). Lastly, frequency of alcohol use did not influence the mean number of balloon pumps ($\beta = -6.47$, $p = .19$) or balloon explosions ($\beta = -0.162$, $p = .10$) on the BART.

3.6 MARIJUANA, ALCOHOL, AND DUI-SAMA

Controlling for Marijuana and Alcohol Use. A series of hierarchical regression models were conducted to control for the effects of self-reported frequency of marijuana use (12 months preceding the survey) and self-reported frequency of alcohol use (12 months preceding the survey). More specifically, models assessed if stress could predict a significant amount of variance in willingness to DUI-SAMA in urgent and non-urgent conditions after controlling for the effects of frequency of marijuana use and frequency of alcohol use. In addition, hierarchical regression models examined the perceived dangerousness of DUI-SAMA and the perceived risk of DUI-SAMA, after controlling for the effects of frequency of marijuana use and frequency of alcohol use. Notably, although the overall models were significant, significant group differences (stress, no stress) did not emerge in willingness to DUI-SAMA for urgent ($\beta = -0.043$, $p = 0.886$), semi-urgent conditions ($\beta = -0.184$, $p = 0.51$), and non-urgent condition ($\beta = 0.073$, $p = 0.80$). Similarly, significant group differences (stress, no stress) did not emerge in the perceived dangerousness associated with DUI-SAMA ($\beta = 0.10$, $p = 0.63$) or the perceived risk of DUI-SAMA ($\beta = -0.12$, $p = 0.66$). In addition, significant group (stress vs. no stress) differences did not emerge in willingness to knowingly DUI in urgent ($\beta = 0.278$, $p = 0.39$), semi-urgent ($\beta = 0.01$, $p = 0.99$), and non-urgent conditions ($\beta = -0.002$, $p = 0.99$), after controlling for marijuana and alcohol experience.

Frequency of Driving Under the Combined Influence of Marijuana and Alcohol.

Hierarchical regression analyses were conducted to control for the effects of self-reported

frequency of driving under the combined influence of marijuana and alcohol (12 months preceding the survey). More specifically, models assessed if stress could predict a significant amount of variance in the willingness to DUI-SAMA in urgent, semi-urgent, and non-urgent conditions (see Tables 11, 12, & 13, respectively). In addition, hierarchical regression models examined the perceived dangerousness of DUI-SAMA and the perceived risk of DUI-SAMA. After controlling for the effects of self-reported frequency of driving under the combined influence of marijuana and alcohol, group differences (stress, no stress) did not emerge in willingness to DUI-SAMA for the urgent condition ($\beta = -0.126, p = 0.681$; see Table 11), semi urgent ($\beta = -.304, p = 0.25$; see Table 12), or non-urgent condition ($\beta = -.032, p = 0.91$ see Table 13). In addition, group differences did not emerge when examining perceived dangerousness associated with DUI-SAMA ($\beta = 0.18, p = 0.37$) or the perceived risk of DUI-SAMA ($\beta = -.039, p = 0.88$). Lastly, significant group (stress vs. no stress) differences did not emerge in willingness to knowingly DUI for both the urgent ($\beta = 0.211, p = 0.52$), semi-urgent conditions ($\beta = -0.08, p = 0.72$), and non-urgent condition ($\beta = -0.096, p = 0.66$), after controlling for frequency of driving under the combined influence of marijuana and alcohol.

3.7 EXPLORATORY ANALYSIS

Gender. Independent-samples t-tests were conducted to examine gender differences associated with the perceived willingness to DUI-SAMA in urgent on non-urgent conditions, perceived risk of DUI-SAMA, perceived dangerousness of DUI-SAMA, perceived willingness to knowingly DUI, and risk behaviors as indexed by the BART. Statistically significant gender differences emerged in willingness to DUI-SAMA in urgent conditions in men ($M = 5.12, SD = 1.94$) and women, $M = 4.46, SD = 2.03$; $t(163) = -2.09, d = .33, p = .038$ (two-tailed). Statistically significant gender differences emerged in willingness to DUI-SAMA in semi-urgent

conditions in men ($M = 4.13$, $SD = 1.92$) and women, $M = 3.48$, $SD = 1.79$; $t(163) = -2.34$, $d = .35$, $p = .027$ (two-tailed). Statistically significant gender differences emerged in willingness to DUI-SAMA in non-urgent conditions in men ($M = 4.16$, $SD = 1.94$) and women, $M = 3.44$, $SD = 1.86$; $t(163) = -2.42$, $d = .38$, $p = .017$ (two-tailed). Additionally, statistically significant gender differences emerged in willingness to knowingly DUI in urgent conditions in men ($M = 4.03$, $SD = 2.30$) and women, $M = 3.21$, $SD = 1.93$; $t(163) = -2.46$, $d = .39$, $p = .015$ (two-tailed). Statistically significant gender differences emerged in willingness to knowingly DUI in semi-urgent conditions in men ($M = 2.54$, $SD = 1.73$) and women, $M = 1.90$, $SD = 1.22$; $t(163) = -2.78$, $d = .43$, $p = .006$ (two-tailed). Statistically significant gender differences emerged in willingness to knowingly DUI in non-urgent conditions in men ($M = 2.51$, $SD = 1.78$) and women, $M = 1.80$, $SD = 1.18$; $t(163) = -3.09$, $d = .47$, $p = .002$ (two-tailed). There was not significant gender differences in the perceived dangerousness of DUI-SAMA, the perceived risk of DUI-SAMA, the mean number of balloon pumps that did not result in explosions, and the total amount of explosions in the BART ($ps = .09$, $.051$, $.871$, $.146$, respectively).

Chapter 4: Discussion

Findings from the current study suggest that several factors may impact the perceived risk of DUI-SAMA, perceived dangerousness of DUI-SAMA, and self-reported willingness to DUI-SAMA. Level of urgency emerged as a key factor explaining self-reported willingness to DUI-SAMA. Specifically, participants were significantly more willing to DUI-SAMA in an urgent condition (e.g., *driving a severely injured friend to the hospital*) than in a non-urgent condition (e.g., *driving a friend to a fast food restaurant*). These findings are favorable from a public health perspective, suggesting that marijuana users evaluate the urgency of situations when making decisions about their willingness to DUI-SAMA. However, participants were significantly more willing to DUI-SAMA than to drive a motor vehicle after consuming enough alcohol to reach a BAC of 0.08. Ironically, a number of studies suggest that the driving impairments observed in DUI-SAMA mimic the driving impairments observed when individuals are at or have exceeded the legal BAC of 0.08 (Ramaekers, Robbe, & O'Hanlon, 2000; Hartman, & Huestis, 2013; Sewell et al., 2009). Thus findings in the current study suggest that marijuana users failed to recognize that DUI-SAMA is equally or potentially more dangerous than driving a motor vehicle after consuming enough alcohol to reach a BAC of 0.08. This potential misunderstanding is likely to become a major public health concern as more states legalize marijuana use. Specifically, legalizing marijuana use will likely increase the number of drivers who will consume marijuana in combination with a legal amount alcohol (BAC less than 0.08) and mistakenly assume that their driving performance will not be severely impaired.

4.1 STRESS, DUI-SAMA, AND THE BART

The current findings support that the Trier Social Stress Task (TSST) is an effective manipulation for inducing stress. Specifically, participants exposed to the TSST reported

significantly higher levels of stress on the State Trait Anxiety Index (STAI) than participants not exposed to the TSST. In addition, participants exposed to the TSST had significantly higher physiological measurements (increase of 4 BPM) compared to the participants not exposed to the TSST. These findings are consistent with previous studies that have measured stress following the TSST. For example, Fritze (2016) reported significant increases in STAI scores following the TSST in 160 university students ($d = 1.03, p < .001$). Kudielka et al., (2004) reported an increase of 10 BPM following the TSST in 180 participants. Similarly, Fritze (2016) reported an increase of 11 BPM following the TSST in 160 participants. The present findings suggest that the stress induced from the TSST can successfully be assessed using self-reported measures of stress and physiological measures of stress.

The current findings suggest that stress did not influence the perceived risk or perceived dangerousness of DUI-SAMA. Additionally, stress did not influence willingness to DUI-SAMA in urgent and non-urgent conditions. In contrast, Fritze (2016) found that stress decreased willingness to DUI-SAMA in urgent conditions ($d = .36, p = .024$). This inconsistency in findings between Fritze (2016) and the current study may be related to the differences in the procedures of administering the items assessing the perceived risk of DUI-SAMA, perceived dangerousness of DUI-SAMA, and willingness to DUI-SAMA. Specifically, in the present study participants completed the Balloon Analogue Risk Task (BART) immediately after being exposed to the TSST. In contrast, Fritze (2016) assessed the perceived risk of DUI-SAMA, perceived dangerousness of DUI-SAMA, and willingness to DUI-SAMA immediately after being exposed to the TSST. The delay of approximately five to eight minutes between administering the TSST and the DUI-SAMA items may have contributed to a reduction in stress levels, subsequently diminishing the impact of stress on the DUI-SAMA items. Conversely, if

the stress induced from the TSST does diminish after a short delay (5-8 minutes), then the delay should have equally impacted BART scores in Fretze (2016) who administered the BART after the DUI-SAMA items (approximately 10-15 minute delay). Indeed, Fretze (2016) did not detect group differences (stress, no stress) on the BART, suggesting that the delay diminished the impact of the stress induced from the TSST. Furthermore, findings from the current study suggest that during the time in which participants were completing the DUI-SAMA items, stress diminished to a level in which significant group differences (stress, no stress) were no longer detectable (see Figure 1, p. 50). More specifically, group differences on the physiological measure (assessing BPM) were detected immediately after exposing participants to the TSST ($d = .50, p = .002$) and immediately after exposing participants to the stress induction video ($d = .60, p < .001$). Higher BPM were still detected in the stress group following the BART ($d = .33, p = .033$) and the STAI ($d = .35, p = .025$). However, group differences (stress, no stress) were no longer detected following the DUI-SAMA items ($d = .27, p = .093$; see Figure 1, p. 50); suggesting that stress diminished while participants were completing the DUI-SAMA items. The latter findings may indicate that the stress induced from the TSST diminishes shortly after exposure (approximately 5-8 minutes); thus researchers should consider the latter time frame when planning the amount of dependent measures to include after TSST exposure.

The current study administered the BART immediately after being exposed to the TSST (thus no delay present to attenuate the stress induced from the TSST) and findings suggest that stress increased risk-taking behavior as indexed by performance on the BART. Specifically, participants exposed to the TSST had significantly more balloon explosions on the BART than participants not exposed to the TSST. These findings are consistent with research demonstrating that stress increased risk taking behaviors on the BART (Lighthall et al., 2009; Johnson et al.,

2012). In addition, these findings are consistent with the *limited cognitive resources framework* (i.e., taking more risks because attention is allocated toward mitigating the stress rather than making optimal decisions). In the current study, stress did not influence the average amount of balloon pumps on the BART. However, it is important to note that the instructions for the BART in the current study slightly differed from standard instructions of the BART. In the previous studies that have used the BART, participants are typically paid the total amount earned (e.g., one cent for each balloon pump). In the current study, participants were awarded a raffle ticket for every 100 balloon pumps. Therefore, the variability in responses from the participant may have been limited by the instructions in the present study. More specifically, as participants were pumping up their final balloon on the BART, rather than choosing to stop at a time point in which they anticipated the balloon exploding (as they would using the traditional BART instructions in order to maximize their payout), participants tended to continue pumping up the last balloon with the aim of reaching the next hundredth pumps (e.g., 100, 200, 300) needed to obtain the maximum payout from the task (e.g., 1 raffle ticket for 100 pumps, 2 raffle tickets for 200 pumps, etc.).

4.2 FREQUENCY OF MARIJUANA USE AND DRIVING

Several findings in the current study suggest that marijuana users dramatically underestimate the risks associated with driving under the influence of marijuana. One third of the sample reported that they could consume an entire joint within a one hour period before their driving skills would be impaired. In addition, more than three quarters of the sample believed they could consume more than a third of a joint within a one hour period before their driving skills would be impaired. Research suggests that driving-related impairments (i.e., lane weaving and speed adjustments) have been observed in doses of marijuana as low as 6.25mg, which is

quantified as a third of a joint (Sewell et al., 2009). Findings from the current study suggest that the sample (young adult marijuana users) is at “high risk” of driving under the influence of large enough quantities of marijuana to produce observable driving impairments.

Additionally, the sample in the current study may be an “at risk” sample for engaging in DUI-SAMA. Approximately half of the sample reported driving a motor vehicle within one hour of using marijuana. Forty-five percent of the sample reported driving a motor vehicle within one hour of using alcohol. One-fifth of the sample reported driving a motor vehicle within one hour of using both marijuana and alcohol. The latter rates of driving a motor vehicle within one hour of using both marijuana and alcohol have implications for public health. For example, the 2017 Monitoring the Future Survey (MFC) reported that the rates of marijuana use among college students in the U.S. was at the highest observed in three decades (Miech et al., 2017). Specifically, thirty-nine percent of college students (ages 19- 22) indicated that they have used marijuana 12 months preceding the survey (Miech et al., 2017). Considering that the U.S. Department of Education reported that 20.4 million students were expected to attend American colleges in 2017 and approximately 40% (or 8,160,000) are between the ages of 18 to 24, then findings from Monitoring the Future Survey (MFC) would suggest that approximately 39% (or 3,182,400) of college students in the U.S. used marijuana in the prior 12 months. Given the latter numbers, the current study suggests that in the past 12 months, approximately 636,480 (20% of 3,182,400) college students in the U.S. (ages 18 – 24) have driven a motor vehicle within one hour of using both marijuana and alcohol. The estimated prevalence of young adults driving a motor vehicle after consuming both marijuana and alcohol will likely increase as more states in the U.S. legalize marijuana use.

4.3 GENDER DIFFERENCES

The current findings suggest that males may be more likely to engage in DUI-SAMA than females. For example, males were significantly more willing than females to DUI-SAMA in urgent, semi-urgent, and non-urgent conditions. Additionally, males were significantly more willing than females to knowingly DUI (i.e., drive after consuming enough alcohol to reach a BAC of 0.08) in urgent, semi-urgent, and non-urgent conditions. These findings are consistent with research suggesting that males under the age of 26 engage in riskier driving behaviors (e.g., DUI) than females (Begg & Langley, 2001). Additionally, research suggests that males use marijuana and alcohol at higher rates than females (SAMHSA, 2014); presumably increasing the likelihood of engaging in DUI-SAMA. Future researchers should consider the role of gender when planning studies that assess willingness to DUI-SAMA (e.g., recruiting an equal number of males and females).

4.4 STRENGTHS

Few studies have examined factors associated with willingness to DUI-SAMA; the present study addressed this gap in knowledge by investigating the impact of two factors: 1) the emotional state of the individual (stress, no stress), and 2) situations that may encourage risky driving (e.g., level of urgency). Frietze (2016) concluded that marijuana users may be a “high risk” sample because marijuana users reported increased willingness to DUI-SAMA in urgent and non-urgent conditions. In addition, marijuana users reported lower perceived risks associated with DUI-SAMA and lower perceptions of dangerousness associated with DUI-SAMA. The current study extended upon the findings from Frietze (2016) by recruiting a sample of students who are “at risk” for engaging in DUI-SAMA behaviors (i.e., young adult marijuana users).

Additionally, no studies have compared willingness to DUI-SAMA with willingness to drive a motor vehicle after consuming enough alcohol to reach a BAC of 0.08. As mentioned, driving impairments observed in DUI-SAMA mimic the driving impairments observed when individuals are at or have exceeded the legal BAC of 0.08 (Ramaekers et al., 2000; Hartman & Huestis, 2013; Sewell et al., 2009). Therefore, this study addresses an important issue that is likely to become a major public health concern as more states legalize the recreational use of marijuana; that is, marijuana users may fail to recognize that DUI-SAMA is equally or potentially more dangerous than driving a motor vehicle after consuming enough alcohol to reach a BAC of 0.08.

4.5 LIMITATIONS

There are several limitations to this study. First, the manipulation used in the current study, the TSST, lacks generalizability outside of a laboratory. Furthermore, the stress that is induced from the TSST may be different from other types of stress that people experience on a daily basis (e.g., having a flat tire). Future studies should assess the generalizability of the TSST to the stress that is experienced in daily life. Second, three important variables were not assessed immediately following the TSST: the perceived risk of DUI-SAMA, the perceived dangerousness of DUI-SAMA, and willingness to DUI-SAMA in urgent on non-urgent conditions. The latter variables were assessed after the BART was administered, thus the delay between tasks could have attenuated the effect from the TSST. Third, the current study did not include the standard BART instructions, potentially limiting the variability in responses.

4.6 FUTURE DIRECTIONS

Future research should investigate the length of time that stress is detectable following the TSST manipulation. Specifically, researchers should investigate the length in time in which

the effects of the TSST dissipate to a level that is no longer detectable. The latter line of research is particularly useful for researchers who intend to use the TSST to induce stress. That is, researchers need to know the length of time that stress is induced following the TSST so that they can plan their study accordingly to include their dependent measures within this timeframe.

Future research should also assess the level of agreement between participant's views of what represents an urgent condition, a semi-urgent condition, or a non-urgent condition. Specifically, researchers should assess if participants agree that "driving a friend to a fast food restaurant," represents a non-urgent condition. Researchers should also assess if participants agree that "driving a friend home from a party to help them avoid getting punished for violating a parental curfew," represents a semi-urgent condition. Additionally, researchers should assess if participants agree that "driving a friend to the hospital," represents an urgent condition. Future research should build upon the present study by identifying additional situations that are described as urgent, semi-urgent, and non-urgent. Such research could result in the development of a scale with reliable psychometric properties for assessing willingness to DUI-SAMA in conditions of varying levels of urgency.

Additionally, future research should extend upon the current findings by investigating reasons people report to try marijuana for the first time or report using marijuana on a regular basis. Epidemiological research suggests that the most frequently reported reason for using marijuana is to mitigate stress and anxiety (Cheng et al., 2010). Future studies should examine the link between marijuana use, stress, and anxiety in order to identify methods for mitigating risky behaviors associated with marijuana use (e.g., DUI-SAMA). The latter line of research could identify factors associated with experimental and regular marijuana use.

4.7 CONCLUDING REMARKS

The rates of simultaneous marijuana and alcohol consumption prior to driving are likely to rise as more states begin legalizing marijuana use in the United States. Marijuana users may underestimate the risks associated with driving under the influence of marijuana and DUI-SAMA. Health communicators should focus on increasing the awareness of the actual risks associated with DUI-SAMA (e.g., DUI-SAMA is as risky as or potentially riskier than driving after consuming enough alcohol to reach a BAC of 0.08) with aims of reducing motor vehicle accidents.

References

- Anderson, N.B., Belar, C.D., Breckler, S.H., Nordal, K.C., Ballard, W.D., Bufka, L.F., Bossolo, L., Bethune, S., Brownawell, A., & Wiggins, K., Stress in American: Paying with our health. (2015). Retrieved June 14, 2015, from <http://www.apa.org/news/press/releases/stress/2014/stress-report.pdf>
- Agosti, V., Nunes, E., & Levin, F. (2002). Rates of psychiatric comorbidity among US residents with lifetime cannabis dependence. *The American journal of drug and alcohol abuse*, 28(4), 643-652.
- Asbridge, M., Hayden, J. A., & Cartwright, J. L. (2012). Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis. *Bmj*, 344, e536.
- Azofeifa, A., Mattson, M. E., & Lyster, R. (2015). Driving Under the Influence of Alcohol, Marijuana, and Alcohol and Marijuana Combined Among Persons Aged 16–25 Years—United States, 2002–2014. *MMWR*, 64(48), 1325-9.
- Baldock, M. (2008). Cannabis and the risk of crash involvement.
- Bates, M. N., & Blakely, T. A. (1999). Role of cannabis in motor vehicle crashes. *Epidemiologic Reviews*, 21(2), 222-232.
- Begg, D., & Langley, J. (2001). Changes in risky driving behavior from age 21 to 26 years. *Journal of Safety Research*, 32(4), 491-499.
- Beirness, D., Simpson, H. M., & Williams, A. F. (2006). Role of cannabis and benzodiazepines in motor vehicle crashes. *Transportation research circular*, 12-21.
- Bondallaz, P., Favrat, B., Chtioui, H., Fornari, E., Maeder, P., & Giroud, C. (2016). Cannabis and its effects on driving skills. *Forensic science international*, 268, 92-102.

- Bower, G. H. (1981). Mood and memory. *American psychologist*, 36(2), 129.
- Brady J.E., & Li, G. (2012). Prevalence of alcohol and other drugs in fatally injured drivers. *Addiction*, 108, 104-114.
- Birkett, M. A. (2011). The Trier Social Stress Test protocol for inducing psychological stress. *Journal of visualized experiments: JoVE*, (56).
- Buchner, A., Erdfelder, E., Faul, F., & Lang, A. (2010) G*Power Version 3.1.3
- Buckner, J. D., Bonn-Miller, M. O., Zvolensky, M. J., & Schmidt, N. B. (2007). Marijuana use motives and social anxiety among marijuana-using young adults. *Addictive Behaviors*, 32(10), 2238-2252. doi:10.1016/j.addbeh.2007.04.004
- Buckner, J. D., Heimberg, R. G., Matthews, R. A., & Silgado, J. (2012). Marijuana-related problems and social anxiety: The role of marijuana behaviors in social situations. *Psychology Of Addictive Behaviors*, 26(1), 151-156. doi:10.1037/a0025822
- Buckner, J. D., Schmidt, N. B., Bobadilla, L., & Taylor, J. (2006). Social anxiety and problematic cannabis use: evaluating the moderating role of stress reactivity and perceived coping. *Behaviour Research and Therapy*, 44(7), 1007-1015.
- Buckner, J. D., Schmidt, N. B., Lang, A. R., Small, J. W., Schlauch, R. C., & Lewinsohn, P. M. (2008). Specificity of social anxiety disorder as a risk factor for alcohol and cannabis dependence. *Journal Of Psychiatric Research*, 42(3), 230-239. doi:10.1016/j.jpsychires.2007.01.002
- Butler, G., & Mathews, A. (1987). Anticipatory anxiety and risk perception. *Cognitive Therapy and Research*, 11(5), 551-565.
- Caetano, R., Ramisetty-Mikler, S., & Rodriguez, L. A. (2009). The Hispanic Americans Baseline Alcohol Survey (HABLAS): the association between birthplace, acculturation and

- alcohol abuse and dependence across Hispanic national groups. *Drug and alcohol dependence*, 99(1), 215-221.
- Center for Behavioral Health Statistics and Quality. (2016). Key substance use and mental health indicators in the United States: Results from the 2015 National Survey on Drug Use and Health (HHS Publication No. SMA 16-4984, NSDUH Series H-51). Retrieved from <http://www.samhsa.gov/data/>
- Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS) [online] (2007) [cited 2015 June 14]. Available from URL: <http://www.cdc.gov/injury/wisqars>.
- Cheung, J. T., Mann, R. E., Ialomiteanu, A., Stoduto, G., Chan, V., Ala-Leppilampi, K., & Rehm, J. (2010). Anxiety and mood disorders and cannabis use. *The American journal of drug and alcohol abuse*, 36(2), 118-122.
- Cho, K. W., Altarriba, J., & Popiel, M. (2015). Mental juggling: when does multitasking impair reading comprehension?. *The Journal of general psychology*, 142(2), 90-105.
- Compton, R. P., & Berning, A. (2015). *Drug and Alcohol Crash Risk* (No. DOT HS 812 117).
- Csémy, L., Sovinová, H., & Procházka, B. (2012). Alcohol Consumption and Marijuana Use in Young Adult Czechs. *Central European Journal Of Public Health*, 20(4), 244-247.
- Dept of Transportation (US), National Highway Traffic Safety Administration (NHTSA). Traffic Safety Facts 2013 Data: Alcohol-Impaired Driving. Washington (DC): NHTSA; 2014 [cited 2015 June 14]. Available at URL: <http://www-nrd.nhtsa.dot.gov/Pubs/812102.pdf>
- Dickerson, S. S., & Kemeny, M. E. (2004). Acute Stressors and Cortisol Responses: A Theoretical Integration and Synthesis of Laboratory Research. *Psychological Bulletin*, 130(3), 355-391. doi:10.1037/0033-2909.130.3.355

- Downey, L. A., King, R., Papafotiou, K., Swann, P., Ogden, E., Boorman, M., & Stough, C. (2013). The effects of cannabis and alcohol on simulated driving: Influences of dose and experience. *Accident Analysis & Prevention*, 50, 879-886.
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, 7(2), 336-353. doi:10.1037/1528-3542.7.2.336
- Fabre, L. F., & McLendon, D. (1981). The efficacy and safety of nabilone (a synthetic cannabinoid) in the treatment of anxiety. *The Journal of Clinical Pharmacology*, 21(S1), 377S-382S.
- Frietze, G. A. (2016). *The impact of stress on risk perceptions and risk behaviors* (Thesis, The University of Texas at El Paso).
- Frijda, N.H., (1986) *The Emotions*. Cambridge(UK): Cambridge University Press, 1986. p. 207
- Galván, A., & McGlennen, K. M. (2012). Daily stress increases risky decision-making in adolescents: A preliminary study. *Developmental Psychobiology*, 54(4), 433-440. doi:10.1002/dev.20602
- Graves, K., Fernandez, M., Shelton, T., Frabutt, J., & Williford, A. (2005). Risk and Protective Factors Associated with Alcohol, Cigarette, and Marijuana Use During Adolescence. *Journal Of Youth & Adolescence*, 34(4), 379-387. doi:10.1007/s10964-005-5766-1
- Han, S., Lerner, J. S., & Keltner, D. (2007). Feelings and consumer decision making: The appraisal-tendency framework. *Journal Of Consumer Psychology*, 17(3), 158-168. doi:10.1016/S1057-7408(07)70023-2
- Hartman, R. L., & Huestis, M. A. (2013). Cannabis effects on driving skills. *Clinical chemistry*, 59(3), 478-492.

- Hawn, S. E., Paul, L., Thomas, S., Miller, S., & Amstadter, A. (2015). Stress Reactivity to an Electronic Version of the Trier Social Stress Test: A Pilot Study. *Frontiers in Psychology*, 6, 724.
- Huestis, M. A., & Cone, E. J. (1998). Differentiating new marijuana use from residual drug excretion in occasional marijuana users. *Journal of analytical toxicology*, 22(6), 445-454.
- Hu, T., Xie, X., & Li, J. (2013). Negative or positive? The effect of emotion and mood on risky driving. *Transportation Research Part F: Traffic Psychology And Behaviour*, 1629-40.
doi:10.1016/j.trf.2012.08.009
- Hyman, S. M., & Sinha, R. (2009). Stress-related factors in cannabis use and misuse: implications for prevention and treatment. *Journal of substance abuse treatment*, 36(4), 400-413.
- Iversen, L. (2005). Long-term effects of exposure to cannabis. *Current opinion in Pharmacology*, 5(1), 69-72.
- Johnson, S. B., Dariotis, J. K., & Wang, C. (2012). Adolescent risk taking under stressed and nonstressed conditions: conservative, calculating, and impulsive types. *The Journal Of Adolescent Health: Official Publication Of The Society For Adolescent Medicine*, 51(2 Suppl), S34-S40. doi:10.1016/j.jadohealth.2012.04.021
- Johnson, E. J., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal Of Personality And Social Psychology*, 45(1), 20-31. doi:10.1037/0022-3514.45.1.20
- Johnston, L. D., O'Malley, P. M., Miech, R. A., Bachman, J. G., & Schulenberg, J. E. (2014). *Monitoring the Future national results on drug use: 1975-2013: Overview, Key Findings on Adolescent Drug Use*. Ann Arbor: Institute for Social Research, The University of Michigan.

- Kirschbaum, C., Pirke, K., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test': A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, 28(1-2), 76-81. doi:10.1159/000119004
- Kilmer, J. R., Hunt, S. B., Lee, C. M., & Neighbors, C. (2007). Marijuana use, risk perception, and consequences: Is perceived risk congruent with reality?. *Addictive Behaviors*, 32(12), 3026-3033. doi:10.1016/j.addbeh.2007.07.009
- Kudielka, B. M., Schommer, N. C., Hellhammer, D. H., & Kirschbaum, C. (2004). Acute HPA axis responses, heart rate, and mood changes to psychosocial stress (TSST) in humans at different times of day. *Psychoneuroendocrinology*, 29(8), 983-992.
- Laberge, J. C., & Ward, N. J. (2004). Research note: Cannabis and driving—research needs and issues for transportation policy. *Journal of Drug Issues*, 34(4), 971-990
- Labouvie, E. W. (1986). Alcohol and marijuana use in relation to adolescent stress. *International Journal Of The Addictions*, 21(3), 333-345.
- Lange, L. J., Fleming, R., & Toussaint, L. L. (2004). Risk perceptions and stress during the threat of explosion from a railroad accident. *Social Behavior And Personality*, 32(2), 117-128. doi:10.2224/sbp.2004.32.2.117
- Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & Emotion*, 14(4), 473-493
- Levin, I. P., & Hart, S. S. (2003). Risk preferences in young children: Early evidence of individual differences in reaction to potential gains and losses. *Journal Of Behavioral Decision Making*, 16(5), 397-413. doi:10.1002/bdm.453
- Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., Strong, D.R., & Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The

- Balloon Analogue Risk Task (BART). *Journal Of Experimental Psychology: Applied*, 8(2), 75-84. doi:10.1037/1076-898X.8.2.75
- Lighthall, N.R. Mather, M. Gorlick, M.A. (2009). Acute stress increases sex differences in risk seeking in the balloon analogue risk task PLoS ONE, 4, p. e6002
- Li, M. C., Brady, J. E., DiMaggio, C. J., Lusardi, A. R., Tzong, K. Y., & Li, G. (2011). Marijuana use and motor vehicle crashes. *Epidemiologic reviews*, 34(1), 65-72.
- Liguori, A. B. (2002). Separate and combined effects of marijuana and alcohol on mood, equilibrium and simulated driving. *Psychopharmacology*, 163(3/4), 399.
- Lin, W. B. (2008). Investigation on the model of consumers' perceived risk—integrated viewpoint. *Expert Systems with Applications*, 34(2), 977-988.
- López-Vaquez, E., & Marván, M. L. (2003). Risk perception, stress and coping strategies in two catastrophe risk situations. *Social Behavior And Personality*, 31(1), 61-70.
doi:10.2224/sbp.2003.31.1.61
- Lu, J., Xie, X., & Zhang, R. (2013). Focusing on appraisals: How and why anger and fear influence driving risk perception. *Journal Of Safety Research*, 4565-73.
doi:10.1016/j.jsr.2013.01.009
- Maner, J. K., Richey, J. A., Cromer, K., Mallott, M., Lejuez, C. W., Joiner, T. E., & Schmidt, N. B. (2007). Dispositional anxiety and risk-avoidant decision-making. *Personality and Individual Differences*, 42(4), 665-675.
- Marteau, T. M., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). *Br J Clin Psychol*, 31(Pt 3), 301-306.
- Marmorstein, N. R., White, H. R., Loeber, R., & Stouthamer-Loeber, M. (2010). Anxiety as a

- predictor of age at first use of substances and progression to substance use problems among boys. *Journal Of Abnormal Child Psychology*, 38(2), 211-224.
doi:10.1007/s10802-009-9360-y
- McCormack, A. S., Laybold, A. M., Dickerman-Nelson, J., & Budd, C. F. (1993). Stress, and substance use: Student attitudes toward alcohol, marijuana and cocaine. *College Student Journal*, 27(2), 215-222.
- Miech, R., Schulenberg, J., Johnston, L., Bachman, J., O'Malley, P., & Patrick, M. (2017). National Adolescent Drug Trends in 2017: Findings Released. *Monitoring the Future*.
- Moskowitz, H. (1995). Marijuana and Driving. *Accident Analysis and Prevention*, 17: 323–345.
- O'Hare, T., & Sherrer, M. V. (2000). Co-occurring stress and substance abuse in college first offenders. *Journal Of Human Behavior In The Social Environment*, 3(1), 29-44.
doi:10.1300/J137v03n01_02
- Owen, C. L. (2004). The relationship between knowledge of blood-alcohol calculation, perceptions of drink-driving consumption levels, and perceived drink-driving behavior. *Dissertation Abstracts International*, 65, 1535.
- Pabst, S., Schoofs, D., Pawlikowski, M., Brand, M., & Wolf, O. T. (2013). Paradoxical effects of stress and an executive task on decisions under risk. *Behavioral Neuroscience*, 127(3), 369-379. doi:10.1037/a0032334
- Plutehik, R. (1980). A language for the emotions. *Psychology Today*, pp.68-78.
- Porath-Waller, A. (2008). Driving high: A study of student driving behaviors and attitudes towards marijuana use and driving (Order No. NR40531). Available from ProQuest Dissertations & Theses Global. (304663093). Retrieved from <http://0-search.proquest.com.lib.utep.edu/docview/304663093?accountid=7121>

ProCon.org (2017). 29 Legal Medical Marijuana States and DC: Laws, Fees, and Possession Limits. <http://medicalmarijuana.procon.org/view.resource.php?resourceID=000881>

Ramaekers, J. G., Robbe, H. J., & O'Hanlon, J. F. (2000). Marijuana, alcohol and actual driving performance. *Human Psychopharmacology: Clinical And Experimental*, 15(7), 551-558. doi:10.1002/1099-1077(200010)15:7<551::AID-HUP236>3.0.CO;2-P

Ramaekers, J. G., Berghaus, G., van Laar, M., & Drummer, O. H. (2004). Dose related risk of motor vehicle crashes after cannabis use. *Drug and alcohol dependence*, 73(2), 109-119.

Reynolds, E. K., Schreiber, W. M., Geisel, K., MacPherson, L., Ernst, M., & Lejuez, C. W. (2013). Influence of social stress on risk-taking behavior in adolescents. *Journal Of Anxiety Disorders*, 27(3), 272-277. doi:10.1016/j.janxdis.2013.02.010

Robbe, H.W.J., & O'Hanlon, J.F. (1993). Marijuana and Actual Driving Performance (National Highway Traffic Safety Administration Final Report No. DOT-HS 808078). Washington: U.S. Department of Transportation.

Robbe, H. W. J., & O'Hanlon, J. F. (1993). Marijuana and Actual Driving Performance (National Highway Traffic Safety Administration Final Report No. DOT-HS-808078). *US Department of Transportation*.

Robbe, H. W., & O'Hanlon, H. F. (1995). Marijuana and Actual Driving Performance. *Journal of Safety Research*, 4(26), 255.

Roberson-Nay, R., Strong, D. R., Nay, W. T., Beidel, D. C., & Turner, S. M. (2007). Development of an abbreviated Social Phobia and Anxiety Inventory (SPAI) using item response theory: The SPAI-23. *Psychological Assessment*, 19(1), 133-145. doi:10.1037/1040-3590.19.1.133

Ronen, A., Gershon, P., Drobiner, H., Rabinovich, A., Bar-Hamburger, R., Mechoulam, R., &

- Shinar, D. (2008). Effects of THC on driving performance, physiological state and subjective feelings relative to alcohol. *Accident Analysis & Prevention*, 40(3), 926-934
- Ronen, A., Chassidim, H. S., Gershon, P., Parmet, Y., Rabinovich, A., Bar-Hamburger, R., & Shinar, D. (2010). The effect of alcohol, THC and their combination on perceived effects, willingness to drive and performance of driving and non-driving tasks. *Accident Analysis & Prevention*, 42(6), 1855-1865.
- Salomonsen-Sautel, S., Min, S., Sakai, J. T., Thurstone, C., & Hopfer, C. (2014). Trends in fatal motor vehicle crashes before and after marijuana commercialization in Colorado. *Drug And Alcohol Dependence*, 140137-144. doi:10.1016/j.drugalcdep.2014.04.008
- Schepis, T. S., McFetridge, A., Chaplin, T. M., Sinha, R., & Krishnan-Sarin, S. (2011). A Pilot Examination of Stress-Related Changes in Impulsivity and Risk Taking as Related to Smoking Status and Cessation Outcome in Adolescents. *Nicotine & Tobacco Research*, 13(7), 611-615.
- Sewell, R. A., Poling, J., & Sofuoglu, M. (2009). The effect of cannabis compared with alcohol on driving. *The American Journal On Addictions*, 118(3), 185-193.
doi:10.1080/10550490902786934
- Sexton, B.F., Tunbridge, R.J., Brook-Carter, N., Jackson, P.G., Wright, K., Stark, M.M., et al. (2000). The influence of cannabis on driving (Transport Research Foundation Limited Technical Report No. 477). United Kingdom: Transport Research Foundation Limited.
- Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of personality and social psychology*, 48(4), 813.
- Spielberger, C. D., & Gorsuch, R. L. (1983). *State-trait anxiety inventory for adults: Manual, instrument, and scoring guide*. Mind Garden, Incorporated.

- Subramanian, R. (2005). *Alcohol Involvement in Fatal Motor Vehicle Traffic Crashes 2003*. National Center for Statistics and Analysis, National Highway Traffic Safety Administration, US Department of Transportation.
- Substance Abuse and Mental Health Services Administration (2014), Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-48, HHS Publication No. (SMA) 14-4863. Rockville, MD: Substance Abuse and Mental Health Services Administration, 2014.
- Substance Abuse and Mental Health Services Administration (SAMHSA). *Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014. HHS Publication No. (SMA) 14-4863. NSDUH Series H-48.
- The Washington Post, Ingraham, C. (2015, February 9). Stoned drivers are a lot safer than drunk ones, new federal data show. Retrieved June 15, 2015, from <http://www.washingtonpost.com/blogs/wonkblog/wp/2015/02/09/stoned-drivers-are-a-lot-safer-than-drunk-ones-new-federal-data-show/>
- Taylor, J. E., Deane, F. P., & Podd, J. V. (2007). Driving fear and driving skills: Comparison between fearful and control samples using standardised on-road assessment. *Behaviour Research And Therapy*, 45(4), 805-818. doi:10.1016/j.brat.2006.07.007
- Tu, A. W., Ratner, P. A., & Johnson, J. L. (2008). Gender differences in the correlates of adolescents' cannabis use. *Substance Use & Misuse*, 43(10), 1438-1463. doi:10.1080/10826080802238140
- Turner, S. M., Beidel, D. C., Dancu, C. V., & Stanley, M. A. (1989). An empirically derived inventory to measure social fears and anxiety: The Social Phobia and Anxiety Inventory.

Psychological Assessment: A Journal Of Consulting And Clinical Psychology, 1(1), 35-40. doi:10.1037/1040-3590.1.1.35

Ubel, P. A., Jepson, C., & Baron, J. (2001). The inclusion of patient testimonials in decision aids: effects on treatment choices. *Medical Decision Making: An International Journal Of The Society For Medical Decision Making*, 21(1), 60-68.

USA Today, Hair, C. (2015, February 17). New study shows no link between marijuana use and car accidents. Retrieved June 15, 2015, from <http://college.usatoday.com/2015/02/17/new-study-shows-no-link-between-marijuana-use-and-car-accidents/>

Wadman, R., Durkin, K., & Conti-Ramsden, G. (2011). Social stress in young people with specific language impairment. *Journal of adolescence*, 34(3), 421-431.

White, T. L., Lejuez, C. W., & de Wit, H. (2008). Test-retest characteristics of the Balloon Analogue Risk Task (BART). *Experimental And Clinical Psychopharmacology*, 16(6), 565-570. doi:10.1037/a0014083

Table 2. Correlates of the Perceived Risk, Dangerousness, and Willingness to DUI-SAMA (N=165)

	1	2	3	4	5	6	7	8	9	10	11
1. Marijuana Frequency ^a	--	--	--	--	--	--	--	--	--	--	--
2. Alcohol Frequency ^b	.22**	--	--	--	--	--	--	--	--	--	--
3. Combined Frequency ^c	.55**	.49**	--	--	--	--	--	--	--	--	--
4. DUI Alcohol Frequency ^d	.10	.49**	.38**	--	--	--	--	--	--	--	--
5. DUI Marijuana Frequency ^e	.68**	.24**	.57**	.32**	--	--	--	--	--	--	--
6. DUI Combined Frequency ^f	.28**	.46**	.60**	.69**	.49**	--	--	--	--	--	--
7. Perceived Risk of DUI-SAMA	-.12	-.14	-.14	-.33**	-.28**	-.31**	--	--	--	--	--
8. Non-Urgent DUI-SAMA Willingness	.30**	.23**	.25**	.44**	.37**	.42**	-.52**	--	--	--	--

9. Semi-Urgent DUI-SAMA Willingness	.30**	.25**	.23**	.43**	.40**	.44**	-.52**		.92**	--	--	--
10. Urgent DUI- SAMA Willingness	.28**	.18*	.23**	.25**	.30**	.27**	-.50*		.72**	.76**	--	--
11. Perceived Dangerousness	-.14	-.17*	-.22**	-.40**	-.24**	-.36**	.57**		-.61**	-.62**	-.56**	--

Note. Correlations are reported using Pearson Correlations.

^a Marijuana frequency refers to the frequency of use in past 12 months.

^b Alcohol frequency refers to the frequency of use in past 12 months.

^c Combined frequency refers to the frequency of the combined use of Marijuana and Alcohol in the past 12 months.

^d DUI Alcohol frequency refers to the frequency of driving under the influence of alcohol in the past 12 months.

^e DUI Alcohol experience refers to the frequency of driving under the influence of alcohol in the past 12 months.

^f DUI combined experience refers to the frequency of driving under the influence of marijuana in combination with alcohol in the past 12 months.

* $p < .05$

** $p < .01$

Table 3. Low and High Doses of Marijuana According to Ramaekers et al., (2000) and Robbe (1998)

	Micrograms per kilogram ($\mu\text{g/kg}$) ^a	Milligrams (mg)	Estimated size of joint ^b
Low Dose	100 $\mu\text{g/kg}$	7 mg	1/3 of a joint
High Dose	200 $\mu\text{g/kg}$	14 mg	2/3 of a joint

Note: Liguori, Gatto, and Jarrett, (2002) describe a marijuana cigarette (joint) to average about 85 mm in length and 25 mm in circumference.

^a Micrograms per kilogram ($\mu\text{g/kg}$) were converted into milligrams using Hartman and Huestis (2013) method of quantifying 100 $\mu\text{g/kg}$ as 7 mg of marijuana, 200 $\mu\text{g/kg}$ as 14 mg of marijuana, and 300 $\mu\text{g/kg}$ as 21 mg of marijuana.

^b Size of joint was estimated using Sewell, Poling, & Sofuoglu (2009) method of quantifying a third of a joint as 6.25 mg; thus 7 mg is a little over a third of a joint.

Table 4. Low and High Doses of Marijuana According to Liguori et al., (2002) and Downey et al., (2013)

	% THC ^a	Milligrams (mg)	Estimated size of joint ^b
Low Dose	1.75	16 mg	2/3 of a joint
High Dose	3.33	30 mg	1.33 joints

Note: Liguori, Gatto, and Jarrett, (2002) describe a marijuana cigarette (joint) to average about 85 mm in length and 25 mm in circumference.

^a Percent of THC was converted into milligrams using Liguori et al., (2002) and Huestis and Cone's (1998) method of quantifying 1.75% THC as approximately 16 mg of THC and 3.33% THC as 30 mg of THC.

^b Size of joint was estimated using Sewell, Poling, & Sofuoglu (2009) method of quantifying a third of a joint as 6.25 mg; thus 7 mg is a little over a third of a joint.

Table 5. Willingness to DUI-SAMA in urgent condition (N=165)

	Response	Frequency	Percent
Stress (<i>N</i> = 82)	(1) Not at all willing	11	13.4
	(2)	6	7.3
	(3)	8	9.8
	(4) Somewhat willing	6	7.3
	(5)	12	14.6
	(6)	16	19.5
	(7) Extremely willing	23	28
No Stress (<i>N</i> = 83)	(1) Not at all willing	3	3.6
	(2)	11	13.3
	(3)	12	14.5
	(4) Somewhat willing	9	10.8
	(5)	14	16.9
	(6)	13	15.7
	(7) Extremely willing	21	25.3

Note: Participants in the stress group were not significantly more willing to DUI-SAMA in urgent situations ($M = 4.73$, $SD = 2.14$) than participants in the non-stress group, $M = 4.72$, $SD = 1.90$; $t(163) = 0.03$, $p = .978$ (two-tailed).

Table 6. Willingness to DUI-SAMA in semi-urgent condition (N=165)

	Response	Frequency	Percent
Stress (<i>N</i> = 82)	(1) Not at all willing	15	18.3
	(2)	12	14.6
	(3)	14	17.1
	(4) Somewhat willing	8	9.8
	(5)	16	19.5
	(6)	9	11
	(7) Extremely willing	8	9.8
No Stress (<i>N</i> = 83)	(1) Not at all willing	9	10.8
	(2)	12	14.5
	(3)	20	24.1
	(4) Somewhat willing	11	13.3
	(5)	15	18.1
	(6)	9	10.8
	(7) Extremely willing	7	8.4

Note: Participants in the stress group were not significantly more willing to DUI-SAMA in semi-urgent situations ($M = 3.69$, $SD = 1.97$) than participants in the non-stress group, $M = 3.80$, $SD = 1.78$; $t(163) = -.343$, $p = .73$ (two-tailed).

Table 7. Willingness to DUI-SAMA in non-urgent condition (N=160)

	Response	Frequency	Percent
Stress (<i>N</i> = 82)	(1) Not at all willing	16	19.5
	(2)	11	13.4
	(3)	10	12.2
	(4) Somewhat willing	11	13.4
	(5)	12	14.6
	(6)	13	15.9
	(7) Extremely willing	9	11.0
No Stress (<i>N</i> = 83)	(1) Not at all willing	12	14.5
	(2)	13	15.7
	(3)	14	16.9
	(4) Somewhat willing	17	20.5
	(5)	14	16.9
	(6)	6	7.2
	(7) Extremely willing	7	8.4

Note: Participants in the stress induced group were not significantly more willing to DUI-SAMA in non-urgent situations ($M = 3.82$, $SD = 2.05$) than participants in the non-stress group, $M = 3.65$, $SD = 1.80$; $t(163) = .56$, $p = .58$ (two-tailed).

Table 8. Willingness to Knowingly DUI in urgent condition (N=165)

	Response	Frequency	Percent
Social Stress (<i>N</i> = 82)	(1) Not at all willing	23	28.0
	(2)	7	8.5
	(3)	7	8.5
	(4) Somewhat willing	13	15.9
	(5)	12	14.6
	(6)	6	7.3
	(7) Extremely willing	14	17.1
No Stress Group (<i>N</i> = 83)	(1) Not at all willing	22	26.5
	(2)	12	14.5
	(3)	10	12.0
	(4) Somewhat willing	13	15.7
	(5)	11	13.3
	(6)	7	8.4
	(7) Extremely willing	8	9.6

Note: Participants in the stress group were not significantly more willing to knowingly DUI in urgent conditions ($M = 3.71$, $SD = 2.21$) than participants in the non-stress group, $M = 3.39$, $SD = 2.02$; $t(163) = .975$, $p = .331$ (two-tailed).

Table 9. Willingness to Knowingly DUI in semi-urgent condition (N=165)

	Response	Frequency	Percent
Social Stress (<i>N</i> = 82)	(1) Not at all willing	41	50.0
	(2)	15	18.3
	(3)	10	12.2
	(4) Somewhat willing	7	8.5
	(5)	4	4.9
	(6)	5	6.1
	(7) Extremely willing	0	0.0
No Stress Group (<i>N</i> = 83)	(1) Not at all willing	38	45.8
	(2)	22	27.7
	(3)	7	7.2
	(4) Somewhat willing	10	12.0
	(5)	3	3.6
	(6)	2	2.4
	(7) Extremely willing	1	1.2

Note: Participants in the stress group were not significantly more willing to knowingly DUI in semi-urgent conditions ($M = 2.18$, $SD = 1.54$) than participants in the non-stress group, $M = 2.13$, $SD = 1.43$; $t(163) = .22$, $p = .83$ (two-tailed).

Table 10. Willingness to Knowingly DUI in non-urgent condition (N=165)

	Response	Frequency	Percent
Social Stress (<i>N</i> = 82)	(1) Not at all willing	44	53.7
	(2)	12	14.6
	(3)	12	14.6
	(4) Somewhat willing	6	7.3
	(5)	4	4.9
	(6)	3	3.7
	(7) Extremely willing	1	1.2
No Stress Group (<i>N</i> = 83)	(1) Not at all willing	44	53.0
	(2)	16	19.3
	(3)	7	8.4
	(4) Somewhat willing	11	13.3
	(5)	1	1.2
	(6)	3	3.6
	(7) Extremely willing	1	1.2

Note: Participants in the stress group were not significantly more willing to knowingly DUI in semi-urgent conditions ($M = 2.11$, $SD = 1.52$) than participants in the non-stress group, $M = 2.06$, $SD = 1.47$; $t(163) = .21$, $p = .832$ (two-tailed).

Table 11. Hierarchical regression predicting willingness to DUI-SAMA in urgent condition (N=164)

Variables	<i>B</i>	<i>SE B</i>	β	95% confidence intervals		<i>P</i>
				Lower	Upper	
Step 1						
Constant	1.89	.746				
Marijuana Frequency	.249	.077	.250	.098	.400	=.001
Alcohol Frequency	.196	.117	.128	-.036	.428	=.097
Step 2						
Constant	1.95	.856				
Marijuana Frequency	.249	.077	.251	.098	.401	=.001
Alcohol Frequency	.196	.118	.129	-.036	.429	=.098
Experimental group	-.043	.303	-.011	-.642	.555	=.886

Note. Experience is indexed by frequency of use in past 12 months.

Step 1 $R^2 = .093$, $p < .001$

Step 2 $R^2 = .093$; $\Delta R^2 = .00$, $p = .886$

Table 12. Hierarchical regression predicting willingness to DUI-SAMA in semi-urgent condition (N=164)

Variables	<i>B</i>	<i>SE B</i>	β	95% confidence intervals		<i>P</i>
				Lower	Upper	
Step 1						
Constant	.581	.680				
Marijuana Frequency	.244	.070	.264	.106	.382	=.001
Alcohol Frequency	.268	.107	.189	.057	.479	=.013
Step 2						
Constant	.833	.779				
Marijuana Frequency	.246	.070	.266	.108	.384	=.001
Alcohol Frequency	.270	.107	.190	.058	.482	=.013
Experimental group	-.184	.276	-.049	-.729	.361	=.506

Note. Frequency is indexed by frequency of use in past 12 months.

Step 1 $R^2 = .127$, $p < .001$

Step 2 $R^2 = .130$; $\Delta R^2 = .002$, $p = .506$

Table 13. Hierarchical regression predicting willingness to DUI-SAMA in non-urgent condition (N=164)

Variables	<i>B</i>	<i>SE B</i>	β	95% confidence intervals		<i>P</i>
				Lower	Upper	
Step 1						
Constant	.620	.701				
Marijuana Frequency	.252	.072	.265	.110	.394	=.001
Alcohol Frequency	.249	.110	.171	.031	.466	=.026
Step 2						
Constant	.520	.804				
Marijuana Frequency	.251	.072	.264	.108	.393	=.001
Alcohol Frequency	.248	.111	.170	.029	.466	=.027
Experimental group	.073	.285	.019	-.490	.636	=.798

Note. Frequency is indexed by frequency of use in past 12 months.

Step 1 $R^2 = .119$, $p < .001$

Step 2 $R^2 = .120$; $\Delta R^2 = .000$, $p = .798$

Appendix A

Survey #1

Instructions: Please answer the following questions to determine your eligibility for the study.

1. **Age:** _____
2. **Gender:** _____ Female (1) _____ Male (2) _____ Transgender (3)
3. **During the LAST 12 MONTHS, how often did you engage in moderate physical activity each week?**
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently
4. **During the LAST 12 MONTHS, how often did you eat fruits and vegetables each week?**
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently
5. **During the LAST 12 MONTHS, how often did you drink sodas each week?**
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently

6. During the LAST 12 MONTHS, how often did you use tobacco?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

7. During the LAST 12 MONTHS, how often did you use alcohol?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

8. During the LAST 12 MONTHS, how often did you use marijuana?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

9. During the LAST 12 MONTHS, how often did you drive a motor vehicle?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

Appendix B

Sociodemographic and Background Questionnaire

1. Age: _____
2. Gender: _____ Female (1) _____ Male (2) _____ Transgender (3)
3. Ethnic/ cultural background (Check all that apply)

_____ (1) Hispanic
_____ (2) Asian
_____ (3) Caucasian/White (non-Hispanic)
_____ (4) African-American
_____ (5) Native American
_____ (6) Other (write in) _____
4. What is your college level?

_____ (1) Freshman _____ (2) Sophomore
_____ (3) Junior _____ (4) Senior
_____ (5) Graduate _____ (6) Don't know
5. Height _____ (please estimate your height in feet and inches)
6. Weight _____ (please estimate your weight in pounds)
7. Have you driven a motor vehicle in the past year?

_____ (1) Yes _____ (2) No
8. Have you ever been in a motor vehicle accident that required a police report or medical attention?

_____ (1) Yes _____ (2) No

Appendix C

Experience Using Marijuana and Alcohol

Instructions: Please answer the following questions (choose only one response).

1. During your *lifetime* have you ever *drunk alcohol* (more than a few sips)?

_____ (1) Yes _____ (2) No

2. During the past three months, how often did you have a drink including beer, wine or liquor?

- a) I did not drink at all
- b) Less than once a month
- c) Once a month
- d) Two to three times a month
- e) Once or twice a week
- f) Three to four times per week
- g) Nearly every day
- h) Once a day or more

3. On the days when you drank beer, wine and/or liquor, how many drinks did you usually have?

___0 ___1 ___2 ___3 ___4 ___5 ___6 ___7 ___8 ___9 ___10 ___11 ___12 ___13 ___14
___15 ___16 ___17 ___18 ___19 ___20 ___21 ___22 ___23 ___24 ___25 ___26 ___27 ___28
___29 ___30 ___More than 30 drinks

4. In the past three months, what was the largest number of drinks of beer wine and liquor that you had on any one occasion?

___0 ___1 ___2 ___3 ___4 ___5 ___6 ___7 ___8 ___9 ___10 ___11 ___12 ___13 ___14
___15 ___16 ___17 ___18 ___19 ___20 ___21 ___22 ___23 ___24 ___25 ___26 ___27 ___28
___29 ___30 ___More than 30 drinks

5. During your *lifetime* have you ever *smoked or consumed marijuana*?

_____ (1) Yes _____ (2) No

6. If the recreational use of marijuana was legalized, would you try smoking or consuming marijuana at least once or twice?

<i>Not at all</i>				<i>50/50</i>				<i>Certain</i>			
<i>Likely</i>				<i>Chance</i>							
1	2	3	4	5	6	7	8	9	10		

7. During the **LAST 12 MONTHS**, how often did you use **MARIJUANA** (also known as "weed," "grass," "pot," hashish, "hash," hash oil, etc.)?

☐ Don't know what marijuana is
☐ Have never used marijuana in my lifetime
☐ Didn't use in the last 12 months
☐ 1 time
☐ 2 times
☐ 3 or 4 times
☐ 5 to 8 times
☐ 9 to 12 times (about once a month)
☐ 13 to 26 times (about twice a month)
☐ 27 or more times (more than twice a month)

8. During the **LAST 12 MONTHS**, how often did you drink **ALCOHOL** – (e.g., beer, wine, margaritas, liquor, coolers)?

<input type="checkbox"/> Have never drank alcohol in lifetime	<input type="checkbox"/> Once a week
<input type="checkbox"/> Didn't drink alcohol in last 12 months	<input type="checkbox"/> Twice a week
<input type="checkbox"/> Just a sip	<input type="checkbox"/> 3 times a week
<input type="checkbox"/> Once a month or less often	<input type="checkbox"/> 4 or 5 times a week
<input type="checkbox"/> 2 or 3 times a month	<input type="checkbox"/> Almost every day

9. During the **LAST 12 MONTHS**, how many times (if any) have you drank alcohol **AND** smoked MARIJUANA within one hour of each other?

___0 ___1 ___2 ___3 ___4 ___5 ___6 ___7 ___8 ___9 ___10 ___11 ___12 ___13
 ___14 ___15-20 ___21-25 ___26-30 ___31- 35 ___36-40 ___41- 45 ___46- 50

____more than 50 times

10. During the last 12 months, how often have you driven a motor vehicle within one hour of drinking alcohol?

- ____Never
- ____Once
- ____2 times
- ____3 times
- ____4 times
- ____5 times
- ____6 times
- ____7 times
- ____8 or more times

11. During the last 12 months, how often have you driven a motor vehicle within one hour of using MARIJUANA?

- ____Never
- ____Once
- ____2 times
- ____3 times
- ____4 times
- ____5 times
- ____6 times
- ____7 times
- ____8 or more times

12. During the last 12 months, how often have you driven a motor vehicle within one hour of drinking alcohol AND also using MARIJUANA in combination?

- ____Never
- ____Once
- ____2 times
- ____3 times
- ____4 times
- ____5 times
- ____6 times
- ____7 times
- ____8 or more times

13. Have you ever been in a motor vehicle accident that required a police report or medical attention after consuming marijuana or alcohol?

____ Yes ____ No

14. If you had to categorize yourself as a marijuana user, which of the three categories best describes your use?

____ (1) “Experimental user (e.g., I have tried marijuana a 1-3 times),”

____ (2) “Occasional user (e.g., I use marijuana once a month or less),”

____ (3) “Regular user (e.g., I use marijuana weekly or daily).”

Appendix D

Instructions:

Thank you for agreeing to participate in our project. We want to understand your opinions regarding the legalization of marijuana. We will ask you to spend a few minutes completing surveys regarding your opinions about legalizing marijuana and your own personal experiences. We'll also ask you to complete a decision making task on the computer. The task only requires a few minutes of your time to complete and is part of a second study that we are conducting in the lab on decision making. Similar to the legalization of marijuana, there are a number of topics that have elicited a national conversation regarding the legalization, criminalization, or change in policies for a particular activity. To give you a sense of such topics, we will ask you to watch a brief video related to removing vending machines from public schools.

Appendix E

Instructions:

Thank you again for participating in our project. In a few minutes you will be asked to write and deliver a brief speech in front of a small audience of students and professors in a room down the hall.

The speech needs to be approximately **five** minutes in duration. You will be given **ten** minutes to prepare the speech (*using a pen and notepad*). If your speech is less than five minutes then a research assistant will enter the room and ask you questions that will help lengthen your presentation for the audience members. Audience members will subsequently be asked to respond to your comments.

Potential Speech Topics and Goal:

We are trying to learn more about how students and community members make decisions, especially health related decisions. Such decisions often arise out of national debates addressing important topics.

Below is a list of 4 topics that have recently been in the national news. You will be randomly assigned to discuss the pros and cons of **ONE** of the following topics: 1) removing vending machines from elementary schools, 2) allowing tobacco use on college campuses, 3) legalizing the recreational use of marijuana, and 4) requiring vaccinations for students enrolled in public school.

You will be provided with a brief fact sheet that includes information that may help you prepare your speech. You can use this information when preparing your speech, but the fact sheet will be removed prior to delivering the speech. We've asked you to wear this small apparatus on your finger to help us learn more about how people respond both verbally and non-verbally to conversations involving some of these national debates. In order to provide audience members enough time to arrive at the room that we've reserved down the hall, we will ask you to spend a few minutes completing some additional health related surveys and tasks.

Note: During the speech, you will not need to provide information about your own health related experiences.

For the next few minutes we will ask you to complete a computerized decision making game. To make the game 'fun', you will have the opportunity to win a \$150 raffle, \$100 raffle, or \$75 raffle.

Appendix F

Mood Survey

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate response below the statement to indicate how you feel right now, at this moment. There are no right or wrong answers. Do not spend too much time on any statement but give the answer which seems to describe your present feeling best.

1. I feel calm

Not at all Somewhat Moderately Very much

2. I am tense

Not at all Somewhat Moderately Very much

3. I feel upset

Not at all Somewhat Moderately Very much

4. I am relaxed

Not at all Somewhat Moderately Very much

5. I feel content

Not at all Somewhat Moderately Very much

6. I am worried

Not at all Somewhat Moderately Very much

Appendix G

Health Survey

Instructions: As noted earlier, we are interested in learning about the attitudes of young people regarding several topics in the news including: 1) removing vending machines from elementary schools, 2) allowing tobacco use on college campuses, 3) legalizing the recreational use of marijuana, and 4) requiring vaccinations for students enrolled in public school. We will be randomly assigning you to one of these topics for you to prepare a brief speech later in the session.

1. During the LAST 12 MONTHS, how often did you engage in moderate physical activity each week?
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently

2. During the LAST 12 MONTHS, how often did you eat fruits and vegetables each week?
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently

3. During the LAST 12 MONTHS, how often did you drink sodas each week?
 - a. Not at all
 - b. Very little
 - c. Sometimes
 - d. A lot
 - e. Frequently

4. During the LAST 12 MONTHS, how often did you use tobacco?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

5. During the LAST 12 MONTHS, how often did you use alcohol?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

6. During the LAST 12 MONTHS, how often did you use marijuana?

- a. Not at all
- b. Very little
- c. Sometimes
- d. A lot
- e. Frequently

Attitudes Towards Marijuana Use, Alcohol Use, and Driving

We would like to learn more about your own attitudes towards the use of marijuana, alcohol, and driving. Please answer the next set of questions, even if you have never driven a motor vehicle while under the influence of marijuana or alcohol. Please only select one response.

1. In your opinion, how would you rate your driving ability within one hour of drinking a LARGE amount of ALCOHOL (e.g., 4-5 beers)?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

2. In your opinion, how would you rate your driving ability within one hour of using a LARGE amount of MARIJUANA?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

3. In your opinion, how would you rate your driving ability within one hour after drinking a LARGE amount of ALCOHOL (e.g., e.g., 4-5 beers) AND consuming a LARGE amount of MARIJUANA?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

4. In your opinion, how would you rate your driving ability within one hour of drinking a SMALL amount of ALCOHOL (e.g., 1 ½ beers)?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

5. In your opinion, how would you rate your driving ability within one hour of using a SMALL amount of MARIJUANA?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

6. In your opinion, how would you rate your driving ability within one hour after drinking a SMALL amount of ALCOHOL (e.g., 1 ½ beers) AND using a SMALL amount of MARIJUANA?

*Not at all
impaired*

*Moderately
impaired*

*Very much
impaired*

1

2

3

4

5

6

7

7. Imagine that you want to drive to a fast food restaurant because you and your friend are both hungry. How willing would you be to drive to the restaurant WITHIN ONE HOUR of using a small of amount of alcohol (e.g., 1 ½ beers)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

8. Imagine that you want to drive a friend home from a party to help your friend avoid getting punished for violating a parental curfew. How willing would you be to drive your friend home WITHIN ONE HOUR of using a small of amount of alcohol (e.g., 1 ½ beers)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

9. Imagine that you want to drive a severely injured friend to a hospital. How willing would you be to drive your friend to the hospital **WITHIN ONE HOUR** of using a small amount of alcohol (e.g., 1 ½ beers)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

10. Imagine that you want to drive to a fast food restaurant because you and your friend are both hungry. How willing would you be to drive to the restaurant **WITHIN ONE HOUR** of using a small amount of MARIJUANA?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

11. Imagine that you want to drive a friend home from a party to help your friend avoid getting punished for violating a parental curfew. How willing would you be to drive your friend home **WITHIN ONE HOUR** of using a small amount of MARIJUANA?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

12. Imagine that you want to drive a severely injured friend to a hospital. How willing would you be to drive your friend to the hospital **WITHIN ONE HOUR** of using a small amount of MARIJUANA?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1

2

3

4

5

6

7

13. Imagine that you want to drive to a fast food restaurant because you and your friend are both hungry. How willing would you be to drive to the restaurant **WITHIN ONE HOUR** of using a small amount of marijuana in combination with a small amount of alcohol (e.g., 1 ½ beers).

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

14. Imagine that you want to drive a friend home from a party to help your friend avoid getting punished for violating a parental curfew. How willing would you be to drive your friend home **WITHIN ONE HOUR** of using a small amount of marijuana in combination with a small amount of alcohol (e.g., 1 ½ beers).

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

15. Imagine that you want to drive a severely injured friend to a hospital. How willing would you be to drive your friend to the hospital **WITHIN ONE HOUR** of using a small amount of marijuana in combination with a small amount of alcohol (e.g., 1 ½ beers).

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

16. How dangerous do you think it is to drive within one hour of using a LARGE amount of MARIJUANA?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1 2 3 4 5 6 7

17. How dangerous do you think it is to drive within one hour of drinking a LARGE amount of ALCOHOL (e.g., 4-5 beers)?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1

2

3

4

5

6

7

18. How dangerous do you think it is to drive within one hour of drinking a LARGE amount of ALCOHOL (e.g., 4-5 beers) and using a LARGE amount of MARIJUANA?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1

2

3

4

5

6

7

19. How dangerous do you think it is to drive within one hour of using a SMALL amount of MARIJUANA?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1

2

3

4

5

6

7

20. How dangerous do you think it is to drive within one hour of drinking a SMALL amount of ALCOHOL (e.g., 1 ½ beers)?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1

2

3

4

5

6

7

21. How dangerous do you think it is to drive within one hour of drinking a SMALL amount of ALCOHOL (e.g., 1 ½ beers) and using a small amount of MARIJUANA?

*Not at all
dangerous*

*Moderately
dangerous*

*Extremely
dangerous*

1

2

3

4

5

6

7

22. Imagine that you want to drive to a fast food restaurant because you and your friend are both hungry. How willing would you be to drive to the restaurant **WITHIN ONE HOUR OF DRINKING ENOUGH ALCOHOL** that you would get into **TROUBLE WITH THE POLICE IF YOU WERE STOPPED WHILE DRIVING** (That is, your blood alcohol content reached the legal limit of 0.08)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

23. Imagine that you want to drive a friend home from a party to help your friend avoid getting punished for violating a parental curfew. How willing would you be to drive your friend home **WITHIN ONE HOUR OF DRINKING ENOUGH ALCOHOL** that you would get into **TROUBLE WITH THE POLICE IF YOU WERE STOPPED WHILE DRIVING** (That is, your blood alcohol content reached the legal limit of 0.08)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

24. Imagine that you want to drive a severely injured friend to a hospital. How willing would you be to drive your friend to the hospital **WITHIN ONE HOUR OF DRINKING ENOUGH ALCOHOL** that you would get into **TROUBLE WITH THE POLICE IF YOU WERE STOPPED WHILE DRIVING** (That is, your blood alcohol content reached the legal limit of 0.08)?

*Not at all
willing*

*Somewhat
willing*

*Very much
willing*

1 2 3 4 5 6 7

25. In your opinion, how many alcoholic drinks could you consume within a **ONE** hour period before your driving skills would be seriously affected?

_____ 1/2 a drink _____ 1 drink _____ 1 & 1/2 drinks _____ 2 drinks _____ 3 drinks
 _____ 4 drinks _____ 5 drinks _____ 6 drinks _____ 7 drinks _____ 8 drinks
 _____ 9 drinks _____ 10 or more drinks

26. In your opinion, how many alcoholic drinks could you consume during the same *ONE* hour period before your driving skills would be seriously affected?

Number of alcoholic drinks: _____

27. During the last 12 months, have you driven a motor vehicle after you had drunk enough alcohol to be in trouble if the police had stopped you?

_____ (1) Yes _____ (2) No

28. During the last 12 months, have you driven a motor vehicle after you had consumed enough marijuana to be in trouble if the police had stopped you?

_____ (1) Yes _____ (2) No

29. Do you have any friends that have participated in this study?

_____ (1) Yes _____ (2) No

30. Please see the image below that is depicting a marijuana cigarette. In your opinion, how much marijuana could you consume during a 1 hour period before your driving skills would be seriously affected (circle one)?



Appendix H

Marijuana Facts Sheet

Reminder of Speech Topic and Goal:

What are the pros and cons of legalizing marijuana? The national conversation regarding the legalization of marijuana has led to the investigation of the biological, physiological, and psychological effects of using marijuana. We are trying to learn more about how students and community members respond to issues that address the legalization of marijuana. In addition, we want to learn more about the types of verbal and non-verbal cues that influence an audience's reaction to presentations on various topics.

Marijuana Facts Sheet

The following information was published by *Psychology Today* on their website on July 28, 2014. The title of the article is “7 Short-Term Effects of Marijuana on the Brain.”

Direct link to the website: <https://www.psychologytoday.com/blog/you-illuminated/201407/7-short-term-effects-marijuana-the-brain>.

1. Impaired memory

Marijuana may not destroy memories, but it can prevent you from forming new ones. One way researchers test memory is by reading a list of words to someone and later asking them to repeat the list or recognize the original words from a new list. A number of studies have shown that when the researcher read the words before participants smoked, the participants remembered the words just as well if the joint contained marijuana or a placebo. If the researcher read the words after participants smoked, however, they remembered less if the joint contained marijuana. Since we know that marijuana can disrupt memory, the likely target in the brain is the hippocampus, the region most linked to memory formation. When cannabinoid receptors in the hippocampus are activated, they interfere with a cellular process called long term potentiation, a long-lasting booster of cross-talk between neurons. Studying for a test high may not be the best idea because THC disrupts the hippocampus' cellular process of creating new memories.

2. Reduced anxiety

A group of multiple sclerosis patients were given marijuana as an experimental treatment, and they reported a consistent side-effect. Eighty-nine percent reported reduced anxiety after smoking. Since regular marijuana users tend to have higher than normal anxiety levels, they may smoke in part to ease their worries. The brain produces a chemical, anandamide, that targets the cannabinoid receptor, the body's own form of THC. Anandamide gets deactivated by an enzyme called FAAH, or fatty acid amide hydrolase. A group of researchers at the National Institute on Alcohol Abuse and Alcoholism injected a chemical into the amygdala region of mice brains to block FAAH from deactivating anandamide, which allows it to have longer-lasting effects. The

amygdala has a high concentration of cannabinoid receptors and is the brain region most associated with fear and anxiety. When FAAH was blocked in the amygdala, mice were less afraid of cues previously paired with shocks. The authors found a similar effect in humans. People with a gene that produces a lower functioning version of FAAH, and who consequently have more anandamide, were quicker to learn that a threatening cue was harmless. Marijuana may reduce anxiety because THC binds to cannabinoid receptors in the amygdala, reducing the brain's threat response.

3. Stoked appetite

At Seattle's 2013 Hempfest, police wanted to remind attendees of the state's pot laws. To make sure Hempfesters got the message, they attached the rules to bags of Doritos. They capitalized on a long-held belief about marijuana: it boosts desire to eat junk food, also known as the munchies. A 2001 study in the journal *Nature* offers an explanation. The study found that activating cannabinoid receptors in a part of the brain called the hypothalamus could trigger the release of leptin and neuropeptide Y, hormones that stimulates appetite. You don't need much coordination to down a handful of Doritos.

4. Altered sleep

This is the effect with the least solid evidence. According to pot critic William Breaches, some strains of marijuana help him fall asleep. But research into this has produced mixed findings, with some evidence suggesting that high THC concentrations can even prevent sleep, inducing restlessness instead. The subjects in that study did not have a history of heavy cannabis use, so the effect on sleep may have to do with tolerance. One effect on sleep seems fairly consistent: THC reduces the amount of time a person spends in rapid eye movement sleep, the phase of sleep where most dreaming occurs.

5. Reduced pain

Dating back over 1,500 years, one of the earliest recorded uses of marijuana was to numb pain during surgery. They didn't have microscopes to look at nerve cells back then, but they were already observing something that modern neuroscientists have only explained in the past 20 years. Many of the nerve cells in our body that carry pain signals have cannabinoid receptors, from the body to the spinal cord up into the brain. When researchers activated the cannabinoid receptors in the spinal cords of rats, they would leave their tail on a hot plate for longer before moving it, suggesting that it didn't hurt as much. One of the brain's main pathways of pain signals, the periaqueductal gray region, is heavily populated with cannabinoid receptors. Similarly, activating these receptors makes rats less sensitive to pain. Marijuana's ability to numb pain is one of the reasons some patients seek it to deal with cancer treatment.

Direct link to the website: <https://www.psychologytoday.com/blog/you-illuminated/201407/7-short-term-effects-marijuana-the-brain>.

Appendix I

Debriefing Form

You just participated in a study that investigated one of the following important health issues, such as removing vending machines from elementary schools, requiring vaccinations in public schools, legalizing recreational use of marijuana, and allowing tobacco use on college campuses. You were asked to provide comments about one of the topics mentioned above and informed that we were investigating verbal and non-verbal cues that may influence one's reaction to important health issues. In actuality, this portion of the study focused on examining physiological responses to stress while making decisions about important health issues. To protect the integrity of this research, we could not fully divulge the details of this study at the start of this procedure. **TO PROTECT THE INTEGRITY OF THE REST OF THE STUDY PLEASE DO NOT DISCUSS THE INTENT OF THIS STUDY WITH ANY OF YOUR FRIENDS WHO MAY ALSO PARTICIPATE IN THIS PROJECT. THANK YOUR FOR YOUR HELP IN THIS REGARD.** We also think it is important to understand that we do not condone any illegal drug use or driving under the influence of alcohol or any drug.

Now and then students might get stressed out when providing their opinions about these issues. Counseling services are available at the UTEP University Counseling Center if you feel uncomfortable or distressed after participating in our project. The Counseling Center is located at 202 Union West, (915) 747-5302 or online at www.utep.edu/counsel/; Open Monday and Tuesday 8 am to 7 pm and Wednesday to Friday 8 am to 5pm. Please do not talk to other students about this study. We think it is important that each student approaches our project with a fresh eye. Now that we have provided more information about this project, you may request that we not use the data that we collected from you. If you decide that you do not want the researchers to use the data we collected from you, there is no penalty. The investigator would like to thank you for your time. If you would like a brief summary of our results then please leave your name and email with the investigator. The study will take approximately six months to one year to complete, at which point we would be happy to send you a summary of our results. Do you have any questions?

***Raffle Information** – At the completion of the study, three random winners of the raffle will be selected. Contact information provided on the raffle tickets will be used to contact the three winners. If you are one of the winners you will be asked to come back to the psychology department to pick up your \$150, \$100, or \$75 UTEP bookstore gift card.

For more information about drugged driving please visit the following websites:

https://www.cdc.gov/motorvehiclesafety/impaired_driving/index.html

<https://www.cdc.gov/marijuana/factsheets/driving.htm>

Please sign below acknowledging that you have read the debriefing form and permit the use of all data collected from you. Your survey responses will be confidential and none of your survey responses will be connected to your name or student ID number.

I consent the use of all data collected from me and I am aware that I can receive a copy of the consent form and get information about the results of the study later if I wish.

Signature

Date

Vita

Gabriel A. Fietze was born in El Paso, Texas and earned his bachelor's degree in 2009 from the University of Texas at El Paso. Gabriel A. Fietze entered the doctoral program in Psychology at the University of Texas in 2012. Gabriel A. Fietze received his master's degree in Experimental Psychology in 2017.

While pursuing his doctorate degree, Gabriel A. Fietze worked as a research assistant in the School of Pharmacy, taught Introduction to Statistics in the Department of Psychology, received his certification in Quantitative Methods, and co-authored two meta-analyses.

Gabriel A. Fietze's dissertation entitled, "Factors that Influence the Perceived Risk of Driving Under the Influence of Small Amounts of Marijuana and Alcohol (DUI-SAMA)," was supervised by Dr. Lawrence D. Cohn.