Public Perceptions of the Risk and Social Acceptability of Driving Under The Influence of Cannabis

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Abstract

Aside from alcohol, cannabis is the most commonly used substance amongst Canadians, especially those aged 18-24. A prominent risk associated with cannabis use is driving under the influence. Cannabis impairs key motor abilities and executive functions necessary for driving and increases the likelihood of being involved in a fatal accident. Despite this, many people believe that driving under the influence of cannabis is safe, particularly compared to driving under the influence of alcohol. Utilizing an experimental vignette design, the primary purpose of the current study was to examine public opinions about the dangerousness and social acceptability of driving under the influence of cannabis compared to alcohol or driving while tired. An additional aim was to determine how attitudes differed based on the sex of the driver. Participants (N=453) between the ages of 18 and 65 completed an online survey in which they were randomly assigned to one of six vignettes describing a 22-year-old driving under the influence. Participants then answered six questions about the dangerousness and social acceptability of the behavior described. A series of ANOVAs revealed a significant main effect of substance use across items. A significant main effect of sex was found on a measure of social acceptability. Post hoc tests revealed that driving under the influence of cannabis was considered less dangerous and more socially acceptable than driving under the influence of alcohol. Additionally, it was considered more socially acceptable for a female to drive while impaired than a male. Overall, these findings highlight the misconceptions that exist about the harms associated with cannabis use and have implications for the importance of awareness campaigns to educate about cannabis and driving.

Keywords: cannabis, driving under the influence, dangerousness, social acceptability

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List of Abbreviations

Analysis of Variance	ANOVA
American Psychiatric Association	APA
Blood Alcohol Concentration	BAC
Canadian Alcohol and Drug Use Monitoring Survey	CADUMS
Canadian Cannabis Survey	CCS
Canadian Community Health Survey	CCHS
Canadian Community Health Survey – Mental Health	CCHS-MH
Canadian Council of Motor Transport Administrators	CCMTA
Center for Behavioral Health Statistics and Quality	CBHSQ
Colorado Department of Public Health and Environment	CDPHE
Contingency Management	CM
Delta-9-tetrahydrocannabinol	THC
Diagnostic and Statistical Manual of Mental Disorders, 5th Edition	DSM-5
Driving Under the Influence	DUI
Driving Under the Influence of Alcohol	DUIA
Driving Under the Influence of Cannabis	DUIC
Drug Recognition Expert	DRE
Immediate Roadside Prohibition	IRP
Lysergic Acid Diethylamide	LSD
Mean	M
Monitoring the Future Survey	MTF
Mothers Against Drunk Driving	MADD
Motivational Interviewing	MI
National Cannabis Survey	NCS
National Highway Traffic Safety Administration	NHTSA
Odds Ratio	OR
Perceived Behavioral Control	PBC
Protection Motivation Theory	PMT
Ride With a High Driver	RWHD
Royal Canadian Mounted Police	RCMP
Standard Field Sobriety Test	SFST
Standard Deviation	SD
Students Against Destructive Decisions	SADD
Substance Abuse and Mental Health Services Administration	SAMSHA
Theory of Planned Behavior	TPB
Traffic Injury Research Foundation	TIRF
United States of America	US

Public Perception of the Risk and Social Acceptability of Driving Under the Influence of Cannabis

Cannabis (or marijuana, weed, pot, etc.) is a dried preparation of the flowers, fruiting tops, or leaves of the cannabis plant, *Cannabis Sativa* (Beirness & Porath, 2019). Cannabis is a psychoactive drug and its active ingredients – cannabidiol and delta-9-tetrahydrocannabinol (THC) – produce effects that include euphoria, calmness, attention deficits, decreased motor control, and distorted perceptions of reality and time (Canadian Centre on Substance Use and Addiction, 2017; Gabrys & Porath, 2019). The degree of intoxication experienced by cannabis users depends on the method of consumption (e.g., smoking, consuming orally, vaporizing), type of cannabis, amount consumed, and individual factors such as weight and tolerance levels (Colonna et al., 2019). The potency of cannabis (e.g., levels of THC) ranges from about 1-15% in the most common plant material (American Psychiatric Association, 2013).

Aside from alcohol, cannabis is the most frequently used substance amongst Canadians (Imtiaz et al., 2017; Task Force on Cannabis Legalization and Regulation, 2016; United Nations Office on Drugs and Crime, 2014). In 2019, daily or almost daily cannabis use was reported by 6.1% of Canadians, with males reporting higher rates than females (7.6% and 4%, respectively) and 18-24 year old's using more frequently than any other age group (Rotermann, 2019).

Cannabis use, particularly chronic use, can lead to many short and long-term developmental, physical, mental, and psychosocial impairments (Adlaf & Paglia-Boak, 2007; Henderson, 2015; Lubman, et al., 2007; Volkow et al., 2014). For example, researchers have found that: (1) for those who are predisposed, cannabis use is a risk

factor for developing schizophrenia (Arseneault, et al., 2002; Manrique-Garcia, et al., 2012; Semple et al., 2005) and is associated with increased rates of mood and anxiety disorders (Goodman & George, 2015; Patton et al., 2002; Zvolensky et al., 2009); (2) heavy cannabis use can lead to the development of a Cannabis Use Disorder (CUD) (American Psychiatric Association, 2013); (3) regular cannabis use is associated with respiratory concerns, including increased susceptibility to respiratory disease (Canadian Center on Substance Use and Addiction, 2019); (4) executive functions including learning, memory, attention span, impulse control, inhibition, emotion regulation, sensitivity to risk/reward, and decision-making are negatively affected by regular cannabis use (Lubman et al., 2007; Solowij et al., 2012; Sowell et al., 2003; Squeglia et al., 2009); and (5) chronic users are more likely to engage in risky behaviours, including driving under the influence (DUI) (Canadian Center on Substance Use and Addiction, 2019; De Bellis et al., 2013; Jager et al., 2010).

Cannabis use, regulation, and enforcement has long been a significant burden for the government and law enforcement agencies (Henderson, 2015). In 2018, the Federal Government of Canada passed Bill C-45, the Cannabis Act, to legalize recreational cannabis use for those 18 years of age and older (Government of Canada, n.d.). The purpose of the Cannabis Act is to protect public health and safety by limiting the access of cannabis to youth, reducing the illicit production and distribution of cannabis, implementing penalties for illegal activities, regulating and controlling the quality of cannabis products, and providing widespread public education about the risks associated with cannabis use (Cannabis Act, 2018). The legal changes associated with the Act include strict criminal penalties for any entity who sells or provides cannabis to youth

under the age of 18 and increased penalties for driving under the influence of cannabis (DUIC; Statutes of Canada, 2018).

DUIC is a significant public health concern due to the interference of cannabis with driving ability and the increased risk of being involved in a fatal driving accident (e.g., Sewell et al., 2009). This is particularly true for young people aged 18-24, who use cannabis more often than other age groups and more frequently report DUIC (Statistics Canada, 2019). Despite this, public opinions about DUIC do not echo these risks and many people consider DUIC to be a relatively safe and acceptable behavior (Statistics Canada, 2019; see below). As such, the primary purpose of the current study was to examine public opinions about the dangerousness and social acceptability of a young adult (i.e., a 22-year-old) DUIC. The goal was to compare perceptions about DUIC to those about driving under the influence of alcohol (DUIA) – a behaviour widely condemned and accepted as dangerous – to see if/how Canadians' opinions differ. Understanding how attitudes about DUIC and DUIA differ can help to inform the development of awareness campaigns aimed at educating the public about the risks of cannabis use and decreasing the likelihood of DUIC. Two additional research questions were included to explore whether attitudes towards DUI differed based on the sex of the driver and to examine how frequency of personal cannabis use impacts opinions about DUIC. The prevalence, impact on driving ability, legal implications, and public awareness efforts for DUIA and DUIC will be reviewed below, followed by research findings on public attitudes toward DUIA and DUIC.

Driving Under the Influence of Alcohol

Prevalence

Alcohol-impaired driving is a significant road safety concern. According to Statistics Canada, despite decreases over the past 30 years, alcohol-impaired driving remains one of the most frequent criminal charges and causes of death in Canada (Perreault, 2016; Robertson et al., 2018). Since 1986 (when data were first collected on DUIA) there has been a significant decrease in the rates of alcohol-related fatal crashes and self-reported instances of DUIA (Clermont, 2018; Perreault, 2016). For example, the number of police documented traffic incidents involving alcohol decreased from approximately 575 per 100,000 people in 1986 to 200 in 2016 (Clermont, 2018). In particular, police report a 55% decrease in alcohol-impaired driving causing death and a 73% decrease in alcohol-impaired driving causing bodily harm since 1986 (Perreault, 2016). However, according to the most recently available data, 480 people died in a crash involving a drunk driver in 2016, an increase from the previous two years (Traffic Injury Research Foundation [TIRF], 2019). The number of incidents resulting in bodily harm remains even higher, with 605 documented cases in 2014 (Perreault, 2016).

Youth and young adults are at particularly high risk for substance use, DUIA, and unsafe driving behaviors (Canadian Centre on Substance Use and Addiction, 2017; Robertson et al., 2017). While young people demonstrated the largest decline in police reported incidents of DUIA between 2009 and 2015, drivers aged 20-24 still exhibit the highest rates of alcohol-impaired driving (Perreault, 2016). In fact, youth and young drivers are involved in a higher number of alcohol-related crashes than any other age group and those under the age of 20 are five times more likely to be involved in a crash

than adults 30 years of age and older (Harrison & Fillmore, 2011; Keall et al., 2004; Mayhew et al., 1986). In particular, males are significantly more likely to engage in and be charged with DUIA than females, with 80% of impaired driving cases in 2015 being related to male drivers (Perreault, 2016). However, there has been a significant increase in impaired female drivers in recent years (Robertson et al., 2011; Tsai, 2010; Vaos et al., 2011). For example, while only 8% of DUIA incidents involved females in 1986, women were responsible for 20% of DUIA incidents in 2015 (Perreault, 2016).

According to the Canadian Community Health Survey (CCHS, 2014), 4.3% of respondents reported DUIA (e.g., driving after consuming two or more drinks in the previous hour) at least once in the 12 months prior to the survey. Furthermore, 76% of the respondents who reported DUIA did so at least twice in the previous year, while 10% of those respondents did so more than 10 times (Perreault, 2017). Overall, drivers between the ages of 18 and 34 were the most likely to report DUIA and almost four in 10 impaired drivers fell within this age range. Additionally, there appears to be a link between frequency of alcohol use and likelihood of DUIA, as 10% of daily drinkers and 10% of those who report weekly drinking reported DUIA compared to only 0.4% of those who drink once per month (Perreault, 2016). More recently, the TIRF survey (2019) found that 14.6% of Canadian respondents reported driving after consuming any amount of alcohol and 8.6% believed they had done so when their blood alcohol concentration (BAC) was over the legal limit (Lyon et al., 2019). More specifically, 11.3% of males and 6.1% of females reported DUIA, which is consistent with research indicating that males are more likely to DUIA than females (Brown et al., 2017; Lyon et al., 2019).

Research also suggests that those who report DUIA are also more likely to accept a ride from a driver who is impaired by alcohol (e.g., Zuckerman & Kuhlman, 2000). In 2001, approximately 4% of Canadians aged 12 and older reported riding with an alcohol-impaired driver in the previous year (Cartwright & Asbridge, 2011; Health Canada, 2008) and provincial surveys indicate that 20-30% of high school students engaged in this behaviour (Perez, 2005). More recent data suggests that rates of being a passenger with an alcohol-impaired driver have doubled with approximately 8% of Canadians 15 years of age or older riding with an alcohol-impaired driver (CCHS, 2014 as cited by Perreault, 2016). Among students in grades 7-12, over 25% reported riding with a driver who consumed alcohol and over 17% with a driver who was alcohol-impaired (Beirness, 2014). Moreover, passengers account for a significant portion of fatalities in alcohol-related crashes. For example, between 2003-2005, 22% of people killed in an alcohol-related crash were passengers and 97% were between the ages of 16 and 24 (Transport Canada, 2008). Additionally, 27% of the passengers of alcohol-impaired drivers report DUIA themselves (Perreault, 2016; Shults et al., 2009). This relationship appears to be bidirectional as 59% of Canadians who report DUIA also endorsed being passengers with an impaired driver in the previous year (Perreault, 2016).

There also appears to be a link between DUIA and other risky driving behaviors including, speeding, aggressive driving, driving while tired (Perreault, 2016), and driving without a valid driver's license (Valen et al., 2019). For example, 7.7% of Canadians who reported speeding also reported DUIA compared to only 2.9% of those who drive at or below the legal driving speed. Similarly, individuals who endorse aggressive driving are more likely to DUIA than those who drive more safely (9.2% versus 2.9%, respectively)

(Perreault, 2016). Finally, drivers who report DUIA and driving while tired significantly increase their likelihood of being involved in a crash and/or being charged for DUIA even when BAC levels are below the legal limit (RCMP, 2016b).

Taken together, data clearly indicate that DUIA remains a significant road safety concern despite decreases in its prevalence over the past 30 years. In particular, youth and young adults appear to be at an especially high risk for DUIA. As such, it is not only important for the public to understand the risks associated with DUIA (e.g., how alcohol impairs driving, etc.), it is also necessary to educate individuals about the potential personal and legal consequences of DUIA.

Impact of Alcohol on Driving Ability

It has been well-documented that alcohol can have a detrimental impact on driving ability and driving-related judgement (Harrison & Fillmore, 2011; Zhao et al., 2014). DUIA has been found to increase the risk of a serious motor-vehicle accident exponentially (Keall et al., 2004). In fact, consuming even small amounts of alcohol before driving (e.g., <0.050% BAC) can double the risk of a crash (Arnedt, 2000; Martin et al., 2013; Zhao et al., 2014) and the likelihood of being involved in a fatal crash increases as BAC increases (Zador et al., 2000). Taylor et al. (2010) conducted a meta-analysis of 28 studies to determine the likelihood of experiencing a motor-vehicle injury based on the number of drinks consumed in the previous three hours. They found that having one standard drink increased the risk of motor-vehicle injury by 57% and two drinks increased the risk by 145%.

Alcohol impairs normal brain/body functioning and interferes with the psychomotor and cognitive abilities required for safe driving (Center for Addictions and

Mental Health, 2020). Research indicates that alcohol impairs complex driving tasks that require concentration and cognitive control (Sewell et al., 2009). In particular, laboratory studies involving driving simulation tasks have demonstrated that alcohol inhibits drivers' short term memory (Hindmarch et al., 1991), signal detection abilities, divided attention, pursuit tracking, ability to perceive and respond to hazards on/near the road (Gengo et al., 1990; Irving & Jones, 1992; West et al., 1993), simple and complex reaction time (Holloway, 1995), ability to maintain attention on a single task, hand-eye coordination (Couper, 2004; Geiringer, 1988) and hand steadiness (Laberg & Loberg, 1989). These studies revealed that individuals who DUIA drive faster, make more attempts to overtake/pass other vehicles on the road, and have shorter following distances than sober drivers (also see Dott, 1971; Ellingstad et al., 1973). Alcohol also significantly impairs one's ability to respond correctly to emergency situations on the road and increases the number of driving errors made by drivers (e.g., swerving to avoid an accident) (Breitmeier et al., 2007; Cheng et al., 2010; Maylor et al., 1990; Smiley, 1986; Vermeeren & O'Hanlon, 1998).

Martin et al. (2013) conducted a study to determine the impact of alcohol on driving ability at low to moderate doses (e.g., when BAC's are below 0.050%) and found significant impairment across all driving related tasks. For example, the authors found that complex reaction time (e.g., driver's ability to respond to two or more stimuli in the environment) and divided attention were impaired at BAC's as low as 0.015%. Research also indicates that visual information processing and perception are impaired at BAC's ranging from 0.022% - 0.035% (Breitmeier et al., 2007; Grant et al., 2000; Landauer & Howat, 1983; Moskowitz et al., 1985; Moskowitz et al., 2000; Tzambazis & Stough,

2000). As the amount of alcohol increases, both sustained and overall attention decrease (Sewell et al., 2009) and drivers have to focus on major driving tasks (e.g., steering) at the expense of peripheral driving abilities (e.g., monitoring speed or distance) (Martin et al. 2013).

Alcohol not only impacts driving ability, it also interferes with individuals' ability to judge their level of impairment. Research suggests that drinking drivers tend to underestimate their level of impairment and consider themselves able to drive even when legally impaired (Beirness, 1987; Marczinski et al., 2007; Ogurzsoff & Vogel-Sprott, 1976; Robbe & O'Hanlon, 1993; Sewell et al., 2009). This impaired judgement is particularly pronounced amongst heavy drinkers or those who report binge drinking (i.e., drinking five or more drinks on a single occasion for men and four or more for women). For example, Marczinski and Fillmore (2009) found that despite similar levels of impairment in driving ability, binge drinkers (in this case, college students aged 20-29) reported feeling less sedated and having greater overall driving ability than their non-binge drinking peers. These findings are in line with previous research indicating that binge drinkers report feeling less impaired by alcohol, are less able to use performance cues (e.g., driving performance) to judge their level of intoxication, and experience an increased disinhibitory effect of alcohol compared to casual drinkers (Brumback et al., 2007; Holdstock et al., 2000; Marczinski et al., 2007).

Overall, research has shown that alcohol increases disinhibition and decreases the perceived risk of negative consequences related to dangerous driving behaviors (Fromme et al., 1997). DUIA significantly impairs key driving skills even at low BACs and increases the risk of being involved in a fatal crash, particularly amongst young people

(Burian et al., 2002; Cohen et al., 1958; Waller, 1985). This behavior is not only detrimental to physical health but can also negatively impact social and occupational life due to the potential for legal consequences.

Legal Implications

According to the Criminal Code of Canada, it is an offense to operate a motor vehicle when impaired to any degree by alcohol or non-alcohol drugs, or when an individual has a BAC of 80mg per 100ml of blood (80mg/dL) (Government of Canada, 2020). Driving with a BAC of 120mg/dL is considered a more severe offense and can result in long prison sentences (e.g., 14 years to life) if a driver impaired at this level causes bodily harm or death to another person (Canadian Center on Substance Use and Addiction, 2019). Moreover, each province and territory in Canada is entitled to pass additional legislation to implement penalties for DUI of lesser amounts of alcohol. For example, most provinces/territories impose license suspensions, vehicle impoundment, and/or mandatory rehabilitation or driver education programs for individuals who drive with a BAC of 50mg/dL or more, and have .00% BAC requirements for individuals under the age of 21 and novice drivers (Canadian Center on Substance Use and Addiction, 2019; Mothers Against Drunk Driving [MADD] Canada, n.d.).

Penalties for DUIA differ based on the number of previous offenses and the severity of the crime (Department of Justice, 2019). For a first DUIA offence, drivers face a mandatory minimum fine of $1000 and up to 10 years in prison. The penalties increase with each subsequent offense with the minimum penalty for a second offense being 30 days in prison and for a third being 120 days imprisonment (see Department of Justice, 2019). For an impaired driving causing bodily harm charge individuals face

between two and 14 years imprisonment, and for DUIA causing death the maximum penalty is life in prison. Furthermore, with higher BAC levels individuals face higher fines: for a BAC of 120-159mg the minimum fine is $1500 and for BAC of 160mg or more drivers are fined $2000 (Department of Justice, 2019).

The first step for police officers to determine whether a driver is DUIA involves one (or more) of the following screening measures: collecting a breath sample at the roadside using an approved device (e.g., breathalyser), taking an oral sample, or completing a Standardized Field Sobriety Test (SFST) (e.g., an observational method during which the police officer asks suspected impaired drivers to complete a number of sobriety tests) (Royal Canadian Mounted Police, 2018). Failure on any of these measures (e.g., presence of alcohol on breath, positive oral fluid test, or poor performance during the SFST) can result in further testing and/or an arrest. Following an arrest, impaired drivers are required to provide a blood sample to measure BAC or to undergo a 12-step Drug Recognition Evaluation (DRE) at the police station (RCMP, 2018). A DRE typically includes sobriety tests similar to the SFST, measures of blood pressure and body temperature, and examination of pupil size under different lighting. If individuals have a BAC over the legal limit or are deemed to have failed the DRE they can be charged with impaired driving under the criminal code.

As mentioned above, impaired driving offenses are among the most common heard in criminal courts in Canada (Maxwell, 2015). Since 1986, the number of impaired driving charges has decreased and 2015 represented the lowest rates prior to 2017 at 201 incidents per 100,000 people (Perreault, 2017). While this appears promising, difficulties arise when using criminal cases as a measure for the frequency/prevalence of DUIA. For

example, according to the National Highway Traffic Safety Administration (NHTSA, 2008c) only about one in every 139 drivers who DUIA are arrested in the US. Additionally, arrest rates only partly represent actual behavior due to differences in arrest policies, policing strategies, and the climate towards DUIA in a particular area at any given time (Mosher et al., 2011; O'Brien, 1996).

Public Awareness Efforts

Given the high cost of DUIA, many awareness campaigns, ranging from grassroots initiatives to large scale prevention strategies (e.g., policy change), have been developed over the past three decades to educate the public and decrease engagement in DUIA (DeJong & Hingson, 1998; Holder, 2000; Schermer et al., 2006).

Grassroots Initiatives. Grassroots organizations, such as MADD and Students Against Destructive Decisions (SADD), have played a leading role in creating public awareness about the harms associated with DUIA and in lobbying for changes to DUI legislation (Dunaway et al., 2011; Merki & Ling, 1987; NHTSA, 2007b). The mission of MADD Canada (n.d.) is to pursue education and awareness efforts that highlight the impact of impaired driving from the perspective of victims and their families, and to provide widespread education about the legal consequences of DUIA. This includes programming for a wide age range, notably targeting youth who are approaching the legal drinking age. For example, MADD Canada describes initiative for Grades 7-12 that use youth friendly language and emphasize the emotional impact of DUIA through videos and testimonials from victims and their families (e.g., the over the edge program) (MADD Canada, n.d.). Additional campaigns include the SmartWheels program, which provides an interactive classroom for children in Grades 4-6 to learn about the impact of

drugs and alcohol on brain development; SAFEgrad, which promotes an alcohol-free after party for graduating high school seniors; the Red Ribbon campaign in which people display a red ribbon on their vehicle as a reminder about the dangers of DUIA and a commitment to sober driving; and Campaign 911 which encourages and empowers the public to call the police if they suspect impaired driving (MADD Canada, n.d.).

Research examining the effectiveness of these interventions in reducing rates of DUIA have provided mixed results. For example, Rojek et al., (2003) found that victim impact panels are effective for reducing the re-offending rate of individuals convicted of DUIA for the two years following the program, but not in the longer term. Wheeler et al. (2002) found that recidivism rates for attendees of a victim impact panel were 8% compared to about 45% for non-attendees. However, this intervention had no additional impact over and above the effect of a 28-day education program for DUIA offenders. Eisenberg (2003) compared MADD programs to laws reducing the legal BAC limit (e.g., the 0.08% law) and graduated licensing programs and found that lowering the legal limit was associated with a 3.1% reduction in fatal crashes and graduated licensing was associated with a 9.2% DUIA crash rate reduction, but MADD programming had no significant effect on reducing DUIA. Finally, Shults et al., (2002) reported that the MADD “Rate the States Program”, an initiative that involves evaluating the DUI laws of States in the US, giving them a grade (A through D), and providing publicized reports of the data was effective for promoting legislation change and prompting leaders to enact new laws. In fact, States that received high grades from MADD were significantly less likely to report DUIA than states that did not meet this criteria.

Overall, the evidence suggests that grass roots campaigns have been instrumental in raising public awareness about the dangers of DUIA and promoting changes to BAC laws (Fell & Voas, 2006; NHTSA, 1995; Voas et al., 2000). However, data on the effectiveness of MADD campaigns are limited and results are mixed due to the challenges associated with evaluating these campaigns, including the initiation of many campaigns simultaneously, unrelated changes in policing practices or enforcement, and other unrelated variables that impact rates of DUIA independently (Cismaru et al., 2009).

Mass Media Campaigns. Another strategy used to raise awareness about the dangers of DUIA is mass media intervention (Augustyn & Simons-Morton, 1995; Dunaway et al., 2011). Historically, media campaigns consisted of traditional advertising (e.g., through ads in magazines or billboards), television or radio-based advertisements, and personally owned media including websites or brochures (Yadav & Kobayashi, 2015). More recently, social media and the Internet have become tools for health-related media campaigns (e.g., Livingston et al., 2013). These campaigns include information to promote behavior change and deter drunk-driving (e.g., using a designated driver), to empower observers or peers to intervene if they suspect DUIA (e.g., "friends don't let friends drink and drive" campaigns; Buckley et al., 2016), to create fear about the consequences of DUIA and increase perceptions about the likelihood of being charged, and to promote public involvement with community or school-based initiatives (Cheng et al., 2010; DeJong & Atkin, 1995; DeJong & Hingson, 1998; Elder et al., 2004).

In general, mass media campaigns are most likely to promote change if they are paired with other prevention efforts, including increased law enforcement, multiple types of media messaging, and grass roots activities, etc. (Elliot, 1993; Lazarsfeld & Merton,

1971). In fact, Elder et al. (2004) conducted a systematic review to determine the effectiveness of mass media campaigns implemented before 2001 for reducing drinking and driving and found that media campaigns were associated with a 13% decrease in alcohol-related crashes when the campaigns were carefully planned, widely distributed, and combined with targeted law enforcement efforts. More recently, Yadav and Kobayashi (2015) conducted an updated systematic review and found that while most individual studies report reductions in their measurement of DUIA engagement, the research is too heterogenous to make overarching statements about the effectiveness of these campaigns.

Policy and Legal Initiatives. Research suggests that changes to laws regarding BAC level, the implementation of administrative license revocation, and harsher penalties for individuals convicted of DUIA have been successful strategies for reducing DUIA fatalities in the US and Canada (Dang, 2008; Fell, 2009). For example, between 1982-1997 in the US, impaired driving decreased by 18% in States that implemented these measures (particularly, the BAC limit of 0.08%) (Dunaway et al., 2011; Fell & Vaos, 2006; Fell et al., 2016; Tippetts et al., 2005). Across Canada, administrative laws have been passed to implement penalties for driving with a BAC of 0.05%, including loss of driver's license, vehicle impoundment, and potential fines. Notably, British Columbia introduced the Immediate Roadside Prohibition (IRP) law that imposes a $200 fine, 3-day license suspension, and 3-day vehicle impoundment for a driver's first offense (Fell et al., 2016). Research examining the effectiveness of this law found that the proportion of drivers with BAC's of 0.08% and 0.05% decreased significantly (by 59% and 44%, respectively) (Beirness & Beasley, 2014), a decline in alcohol-related crashes overall

(Macdonald et al., 2013), and reductions in fatal crashes, hospital admissions, and ambulance calls for impaired driving incidents (Brubacher et al., 2014). Related strategies used to deter DUIA on a wide scale include sobriety check points, where law enforcement officers stop a large number of vehicles and administer breath testing to detect alcohol (Dunaway et al., 2011), and saturation patrols. Sobriety checkpoints are one of the most effective tools for spreading awareness about DUIA prevention efforts and frequent, highly advertised checkpoints can reduce impaired driving (Epperlein, 1985; Lacey et al., 1986; Lacey et al., 2006; Levy et al., 1990; Shults et al., 2001; Wells et al., 1992).

Many policy changes have also aimed to target DUIA recidivism. In particular, ignition interlock devices may be installed in the vehicles of DUIA offenders requiring them to pass a breath test before being able to operate their vehicles. Several meta-analyses conducted to determine the effectiveness of interlock devices revealed that they reduce rates of re-offending by approximately 66% while installed on the vehicle (see Elder et al., 2011; Willis et al., 2004). However, once removed, recidivism rates increase to pre-intervention levels and the long-term effectiveness of these devices is limited (Dunaway et al., 2011; Elder et al., 2011; Willis et al., 2004). Other technologies have been developed with the goal of preventing DUIA through feedback about intoxication levels. For example, tissue spectroscopy uses infrared light to detect alcohol levels in the tissue beneath the skin and is more efficient than breath testing; transdermal technology may be utilized in devices worn on the body to detect BAC levels through perspiration; and ocular measurement devices can be installed in vehicles to monitor drivers' eye movement (e.g., ability to maintain focus, rates of eye closure, etc.) (MADD, 2007).

Finally, deterrence strategies that have been found to reduce dangerous alcohol consumption include, alcohol tax (Elder et al., 2010; Wagenaar et al., 2015), zoning laws to decrease the density of establishments that serve/sell alcohol (Freisthler et al., 2003), and responsible beverage service programs to train restaurant and bar staff to identify impaired customers and take steps to help them become less intoxicated (e.g., encourage food, stop serving alcohol, etc.) (DeJong & Hingson, 1998; Fell et al., 2017).

In sum, research shows that the most effective DUIA prevention efforts are those that are widely publicized and promoted, consistently enforced, and that combine many different strategies (e.g., awareness campaigns, increased enforcement, change in DUI policy) rather than relying on any single method (Sanem et al., 2015).

Driving Under the Influence of Cannabis

Prevalence

As discussed above, DUIA has been the target of initiatives aimed at reducing the frequency and increasing the social disapproval of this behavior for many years (Beirness & Porath, 2017). Recently, due to high rates of cannabis use and its legalisation across Canada, DUIC has become a similar public health concern, particularly amongst young people (Beirness & Porath-Waller, 2019; Bergeron & Paquette, 2014; Brubacher et al., 2020; Canadian Automobile Association, 2019). In fact, besides alcohol, cannabis is the most common drug associated with motor vehicle accidents (MADD Canada, n.d.) and has been present in over 20% of crashes that result in fatalities (Soloman et al., 2017).

Data suggest that rates of DUIC are increasing across Canada, particularly amongst young drivers (Colonna, 2019). According to the TIRF (2017), the percentage of fatally-injured drivers who were under the influence of cannabis increased from 12.4% in

2000 to 18.6% in 2014. Furthermore, law enforcement reports and roadside testing indicate that approximately 4-6% of all drivers have driven within two hours of cannabis use in the previous year (Beirness & Beasley, 2010; Capler et al., 2017), with about 6.1% of young Canadians (aged 16-24) engaging in this behavior (Robertson et al., 2017). Young Canadians appear to be at an especially high risk of being involved in fatal crashes when impaired as data suggests that 25% of all fatally-injured drivers under the age of 24 tested positive for cannabis (Robertson et al., 2017). In addition to roadside data, rates of DUIC are also measured through community surveys and self-report measures. According to the Canadian Cannabis Survey (CCS, Health Canada, 2018), 39% of cannabis users reported driving within two hours of using cannabis and 43% of those did so in the previous 30 days (Health Canada, 2017).

Prevalence Post-legalization. Post-legalization data from the National Cannabis Survey (NCS, 2019) indicated that 13.2% of cannabis users reported driving within two hours of cannabis use – a rate that was unchanged from the previous year (Statistics Canada, 2019). The prevalence of DUIC was higher among young people, with 30% of those aged 15-24 using cannabis compared to 16% of adults aged 25 and older. Gender differences in DUIC were also noted with males reporting DUIC twice as often as females (Rotermann, 2020). Finally, individuals who reported daily or almost daily use of cannabis were nearly five times more likely to report DUIC than less frequent users (Rotermann, 2020). These data represent an increase from the 2010 Canadian Alcohol and Drug Use Monitoring Survey (CADUMS). At this time, 20% of respondents reported DUIC at least once, and 5% reported DUIC over 20 times in the previous year (Health Canada, 2013). Similarly, according to the CCS (2019), 26% of cannabis users reported

driving after smoking or vaping cannabis and 43% of those respondents did so in the previous 30 days (a rate unchanged from the year prior to legalization). Sixteen percent of respondents reported driving within four hours after ingesting cannabis and 37% of those did so in the previous 30 days (Health Canada, 2019).

Although prevalence of cannabis use and DUIC post-legalization is important to consider to understand legalization's impacts on these behaviours, cannabis legalization in Canada is still in its infancy and several factors have impacted the availability of legal cannabis products across Canada including supply shortages and backlogged orders, difficulty for business owners and retailers to become licensed to sell cannabis, and limitations on the number of cannabis retail outlets permitted in certain provinces, particularly Ontario (Levinson-King, 2019). As a result, it is too early to determine the extent to which legalization may impact the prevalence of cannabis use and DUIC.

However, research from States in the US where cannabis has been legal for a longer period of time (e.g., Colorado, Oregon, and Washington) indicates that usage rates and the prevalence of DUIC increased following legalization (Cerda et al., 2017; Parnes et al., 2018; Substance Abuse and Mental Health Services Administration [SAMHSA], n.d.; Zvonarev et al., 2019). For example, data from 2014-2016 (after legalization) in Colorado suggest that rates of cannabis use increased from the 2002-2013 rates. Moreover, in 2016 Colorado reported the highest usage rates compared to all other US States (Center for Behavioral Health Statistics and Quality [CBHSQ], 2016). In accordance with this, decreases in the perceived risk of cannabis use were also reported across age groups, with risk perceptions in Colorado falling below the US national average (CBHSQ, 2016; Reed, 2016). Data from Washington and Oregon indicate that

past-year cannabis use increased significantly following legalization, particularly amongst 18-25 year olds (Kerr et al., 2017; Miller et al., 2017; SAMHSA, n.d.). Similar increases were noted in terms of DUIC across these states. For example, Lee et al. (2018) found that the relative number of cannabis-related fatal crashes increased following recreational legalization in both Colorado and Washington by 63.1% and 32.1%, respectively. This finding is congruent with results from Tefft et al., (2016), who revealed that rates of DUIC doubled from 2013-2014 following the recreational legalization of cannabis in Washington. Relatedly, Ghosh et al., (2017) found that DUIC increased by 16% in 2016 compared to 2014 in Colorado and fatalities due to DUIC increased by 80% post legalization.

In sum, prior to legalization, rates of DUIC were increasing in Canada and youth were disproportionately involved in fatal crashes involving cannabis. Preliminary post-legalization data revealed that rates of DUIC remain unchanged from the previous year. However, issues with legalization and access to cannabis have impacted the ability to develop a clear picture of how legalization will impact DUIC in the years to come. Post-legalization data from the US suggests that Canada may see an increase in both usage rates and DUIC across age groups.

DUIC Passengers. In addition to DUIC prevalence, rates of passengers riding with a cannabis-impaired driver are also of concern. Data from the NCS (2019) indicate that nearly 40% of respondents rode as passengers of someone who used cannabis less than two hours prior to driving. This behaviour was even more common amongst cannabis users as 79% of users reported riding in a car with a cannabis-impaired driver compared to 27% of non-users (Health Canada, 2017). Instances of being the passenger

of an impaired driver are highest amongst young adults aged 19-24 and the vast majority of cannabis users (70%) report engaging in this behaviour (EKOS Research Associates, 2016). Additionally, the NCS revealed that 4% of all Canadians aged 15 years or older have been a passenger with a driver DUIC (Statistics Canada, 2019). The high prevalence of this behavior and of DUIC in general are problematic given the significant impact that cannabis use has on driving ability and crash rates.

Impact of Cannabis on Driving Ability

During acute cannabis intoxication, various motor and cognitive abilities are impaired including, processing speed, motor control (Richer & Bergeron, 2009), visual attention, coordination (Weinstein et al., 2008), reaction time, concentration, tracking ability, short-term memory, and divided attention (Berghaus & Guo, 1995; Hartman & Huestis, 2013; Hartman et al., 2015; Ramaekers et al., 2000). These impairments result in significant driving-related deficits. On road and simulation studies have found that drivers who report DUIC show increased variability in lane position, shorter following distances between vehicles, increased speed, decreased tracking ability, distorted time perception, and increased braking and reaction time (Anderson et al., 2010; Bierness & Porath, 2019; Capler et al., 2017, Riedel & Davies, 2005; Watson & Mann, 2016). Cannabis use also impairs divided attention, limiting drivers' ability to handle unexpected events on the road (e.g., a pedestrian running into the street) (Beirness & Porath, 2019). In addition, infrequent cannabis users may be more impaired by THC than regular users and consequently display more driving errors, including impaired peripheral vision, slower reaction time, and overall greater driving impairment resulting in a higher

frequency of collisions (Marks & McAvoy, 1989; Papafotiou, 2001; Ramaekers at al., 2011).

A number of reviews and meta-analyses have found that cannabis use significantly increases the risk of motor vehicle collision (Asbridge et al., 2012; Li et al., 2012; Rogeberg & Elvik, 2016). For example, Asbridge et al., (2012) systematically reviewed observational epidemiological studies to determine whether acute cannabis impairment increases the risk of motor vehicle accidents and found that cannabis use before driving nearly doubles the likelihood of being involved in a serious motor vehicle accident (Odds ratio [OR] of 1.92), with the risk of a fatal crash increasing the most (OR of 2.10). Similarly, Li et al. (2012) reviewed observational case control studies and found that cannabis use increases crash risk by an OR of 2.66. Finally, a more recent review by Rogeberg and Elvik (2016) that included studies from the previous reviews and more recent research concluded that DUIC increases the risk of a motor vehicle accident by 20-30% (OR of 1.22).

There are a number of factors that contribute to an individual's level of impairment following cannabis consumption. In particular, evidence suggests that chronic cannabis users may develop a tolerance to the impairing effects of THC on both cognitive and motor abilities (D'Souza et al. 2008; Hart et al. 2001; Jones et al. 1981; Ramaekers et al. 2009). For example, Ramaekers et al., (2011) found that heavy cannabis users were unimpaired by cannabis on tasks measuring cognition, inhibition, divided attention, and motor control suggesting that chronic users may become tolerant of the effects of cannabis overtime. Research also suggests that unlike alcohol-impaired drivers, cannabis-impaired drivers may overestimate their degree of impairment and thus, employ

compensatory behaviors such as driving more slowly (even when expected to maintain a certain speed) to counteract their impairment (Sewell et al., 2009). Such compensatory activity may help limit the dangerous driving behaviors (e.g., lane swerving) demonstrated by individuals who have used cannabis in some scenarios; however, they are unlikely to compensate for specific cannabis related impairments such as impaired motor control and visual attention.

Additionally, factors including method of ingestion (e.g., whether smoked, inhaled, or ingested), amount of THC consumed, and the type of THC used impact an individual's level of impairment and resultant driving ability (Government of Canada, 2020). As such, there is no clear guideline about how much cannabis can be consumed before becoming impaired or how long one should wait after cannabis use to drive, leading the Government to promote no driving at any point after consuming cannabis (Government of Canada, 2020). Despite the noted variability in cannabis impairment as a function of individual differences, the Canadian Public Health Association (2018) recommends that people wait at least six hours before driving after smoking cannabis and eight hours after ingesting it. This is in line with the "lower risk cannabis guidelines" outlined by Fischer et al., (2017) and MADD Canada (2019).

Overall, cannabis use impairs cognitive abilities that are essential to driving including processing speed, attention, and executive functioning. This significantly increases the likelihood of being involved in a motor vehicle accident. However, there are many individual factors that influence one's level of impairment after cannabis use (e.g., frequency of use, method of consumption, etc.) making it difficult for the Government to provide specific driving related guidelines.

Legal Implications

As with DUIA, it is a criminal offence for an individual to operate a motor vehicle when their ability to do so is impaired to any degree by a non-alcohol drug (Beirness & Porath, 2019). According to Canadian law, a blood concentration of 2ng/ml to 5ng/ml of THC is considered a lower criminal offence, while concentrations higher than 5ng/ml of THC are considered a more severe criminal offense (Department of Justice, 2019). Penalties for DUIC range from a mandatory minimum fine of $1000 with the possibility of receiving a maximum penalty of 10 years in prison for a first time offender with 5ng or more THC in their blood to a 120 day imprisonment minimum penalty (with a 10 year imprisonment maximum) for a third DUIC offence (Department of Justice, 2019). For individuals who drive with a blood THC concentration between 2 and 5ng the maximum penalty is a $1000 fine. Finally, those who are convicted of DUIC resulting in bodily harm to another person or death face the same penalties as DUIA, which include 2-14 years or life in prison, respectively.

Many provinces in Canada also have provincial level restrictions in place for DUIC, including immediate license suspension (for three days) for non-alcohol drug-impaired driving, additional monetary fines, and documenting license suspensions on individuals' driving records (Canadian Centre on Substance Use and Addiction, 2019). Comparable to the rules for DUIA, most provinces also have zero tolerance laws prohibiting the use of any amount of cannabis before driving for individuals under the age of 21 and novice drivers (Beirness & Porath, 2019).

Unlike the use of a breathalyser to assess DUIA, there is no equally reliable method that police officers can utilize for detecting individuals DUIC. Current detection

methods for DUIC include DRE, relying on visual cues (e.g., red eyes, tremors, agitation, abnormal speech patterns, or lapses in attention), SFST, or oral fluid samples to detect the presence of THC (Government of Canada, 2019). If police suspect a driver may be impaired by cannabis (based on visual cues) they can demand that the driver complete an SFST and/or provide an oral fluid sample at the roadside (Beirness & Porath, 2019; Department of Justice, 2019). If positive, the results from the oral screener combined with the police officer's observational data provide enough evidence to proceed with further testing, including an evaluation by a DRE and/or providing a blood sample.

Unfortunately, there are issues with these methods, such as sample testing delays that result in an underestimation of THC concentration in the blood of drivers, difficulty detecting visual signs of cannabis impairment at low doses, and human error, that make detecting DUIC unreliable (Sewell et al., 2009). For example, research indicates that DRE's may not be able to definitively detect cannabis impairment at the 5ng/ml level (Armentano, 2013; Logan et al., 2016), which has implications for the likelihood of apprehending and charging impaired drivers (Robertson et al., 2016). Furthermore, cannabis has a short half-life, with peak levels occurring about 15 minutes after smoking (Hunault et al., 2014). As such, police officers have a limited amount of time during which they can gather accurate data regarding cannabis impairment or administer drug-testing at the roadside (Robertson et al., 2016).

Studies of roadside testing indicate that rates of non-alcohol drug-impaired driving exceed rates of DUIA, particularly amongst young people aged 16-24 (Beirness & Beasley, 2018; Soloman et al., 2018). However, incidents of drug-impaired driving are less likely to result in criminal charges than DUIA. For example, in 2015, only 59% of

drug-related driving incidents resulted in the driver being charged compared to 71% of those involving DUIA (Perreault, 2016). This may be due to the complexity of accurately detecting drug-impaired driving (as noted above for cannabis) and the time and resources required to clear a drug-impaired driving case. In particular, Statistics Canada revealed that in 2015, 28% of drug-impaired driving cases took 30 days or more to clear compared to only 16% of DUIA (Perreault, 2016). Moreover, these cases were less likely to lead to a guilty verdict, with only 61% of drug-impaired drivers found guilty compared to 81% of alcohol-impaired drivers (Perreault, 2016). These data are relevant as they highlight the discrepancy in ability to detect and punish drug-impaired driving in general, an issue that is likely compounded when considering difficulties related to DUIC specifically.

In general, significant legal penalties exist for DUIC ranging from fines to imprisonment. Unfortunately difficulties with reliable detection methods and the increased time and resources required to prosecute DUIC cases means that fewer drivers are found guilty for drug-impaired driving than DUIA. These issues highlight the need for widespread awareness campaigns designed to increase knowledge about and curb incidents of DUIC and other drugs.

Public Knowledge and Awareness Efforts

As part of the legalization plan, the Federal government budgeted $100 million for the implementation and evaluation of cannabis awareness programs from 2018-2023 (The Canadian Press, 2018). Early public outreach efforts have focused on understanding Canadians' knowledge and perceptions of cannabis use and DUIC, tailoring campaigns to effectively target youth and young adults, building on lessons learned from initiatives in

the US, and engaging stakeholders to educate the public about cannabis use (Government of Canada, 2018).

MADD Canada has developed and implemented a number of campaigns about the risks of DUIC. For example, the "Don't Drive High" campaign, developed in partnership with Uber and Tweed, focuses on promoting alternatives to DUIC, including a list of 101 options for individuals other than DUIC and providing $5 Uber vouchers to members of the public (Draaisma, 2018; MADD Canada, n.d.). Other initiatives include the School Assembly Program and the SmartWheels program, which aim to educate school-aged children and youth about the risks of DUIC and DUIA, and the Weed Out the Risk program, which is designed specifically for high school students. MADD Canada (n.d.) has also created television and radio ads designed to have an emotional impact on audiences and to highlight the dangers of DUIC and other drugs.

Awareness efforts in the US also provide valuable knowledge about the types of campaigns that may be effective (or not) in promoting public knowledge about cannabis. For example, following legalization the Colorado Department of Public Health and Environment (CDHPE) launched the "Good to Know" television/radio campaign - a widely accessible campaign designed to educate the Colorado public about safe and responsible cannabis use, with a focus on the laws surrounding recreational cannabis and deterrence of high-risk use amongst youth (CDHPE, 2015). Evaluation of this initiative revealed an overall increase in knowledge about cannabis laws, with significant knowledge gains found for non-users but less so amongst cannabis users (Brooks-Russell et al., 2017). Similarly, the "Don't Be a Lab Rat" campaign was launched in Colorado post-legalization with the goal of educating youth about cannabis related harms.

However, this initiative was criticized for its focus on abstinence-based messaging (Roberts, 2014) which has been shown to be ineffective for preventing drug use and negative outcomes (e.g., Allara et al., 2015; Hyshka, 2013; Werb et al., 2011).

Given the recency of cannabis legalization in Canada, education and awareness campaigns are still in the early stages of development and implementation (Watson et al., 2019) and there is little data available evaluating the efficacy of existing cannabis awareness efforts. Examples of recent initiatives across Canada include, the "Know the Risks" campaign in Manitoba which aims to highlight the risks associated with cannabis use (e.g., risk for addiction and impaired brain development) (Government of Manitoba, n.d.), a website launched by the Quebec Government that promotes open dialogue between parents and children about cannabis use and encourages involving youth in cannabis education and discussions (Government of Quebec, 2020), and a partnership between the Ontario government and Kids Help Phone to create a fact sheet about the effects of cannabis use and DUIC (Kids Help Phone, n.d.). The Government of Canada (2019) also launched a website to provide the public with facts about cannabis use and health, impairment, implications for travelling across the border, DUIC, and other cannabis education resources.

Taken together, early outreach efforts in Canada have focused on promoting public awareness of cannabis related harms and involving children and youth in conversations about cannabis use. Despite these examples, there has been a lag in the implementation of widespread campaigns that promote harm reduction rather than abstinence (which has been found to be ineffective in the US) and that are designed for youth and young adults (Watson et al., 2019). The limited availability of such campaigns

about DUIC is concerning given the widespread acceptance of cannabis use and the role that attitudes towards DUIC play in predicting this behavior. Attitudes towards DUIA and DUIC will be discussed below.

Public Perceptions of DUIA and DUIC

For many years, DUIA has been considered a vital road safety concern. For example, in 1991 the NHTSA administered the first national survey to assess perceptions of DUIA in the US (NHSTA, 1995). The survey revealed that 83% of respondents considered DUIA to be a "major threat" to public safety and 77% of respondents reported that driving after consuming any amount of alcohol should be prohibited. In 2008, the NHTSA found similar results with 81% of the driving aged public reporting DUIA to be a major safety concern (Drew et al., 2010). More recent research suggests that DUIA is also a prominent concern for many Canadians. In 2019 the TIRF found that nearly 81% of Canadians rated DUIA as a "very or extremely serious problem" (Lyon et al., 2019). In fact, DUIA was rated the most significant concern for 9 of the 14 years that this survey was conducted (2005-2019) compared to all other societal issues (including crime, economic concerns, global warming, etc.).

While the majority of Canadians (75%) also believe that cannabis has a negative impact on driving ability (Koundakjian et al., 2018), only 50% of cannabis users hold this belief, and 19% of users report that cannabis has no effect on driving ability. Watson et al. (2019) interviewed adults with impaired driving convictions and found that participants considered DUIC to be convenient and cost-effective, and most believed that cannabis did not impair driving ability or require compensatory behavior (see also Wickens et al., 2019). The CCS (2019) found similar results with 28% of cannabis users

reporting that the effect of cannabis on driving ability depends on certain factors or does not exist (Health Canada, 2019). Frequency of cannabis use also appears to be associated with beliefs about safe driving behaviors such that 18% of those who use cannabis almost daily or more believe it is safe to drive within three hours compared to only 7% of less frequent users, 5% of former users, and 4% of non-users (Health Canada, 2019). According to the NCS, a small gender effect exists such that female drivers are more likely to believe that using cannabis within an hour of driving increases motor vehicle crash risk, and males are more likely to believe DUIC is not associated with increased risk of harm (Arnold & Tefft, 2016).

In a survey conducted by the Canadian Council of Motor Transport Administrators (CCMTA), respondent data allowed for direct comparisons of attitudes toward DUI of different substances including cannabis and alcohol. Eighty percent of Canadian respondents reported being very concerned about DUIA, more so than about DUI of any other licit or illicit drug including cannabis, with 58% of respondents reporting concern about DUIC (Jonah, 2013). Furthermore, while 90% of respondents reported that alcohol impairs driving ability to a significant degree, only 68% reported that cannabis impairs driving ability. Of note, attitudes regarding the dangerousness of DUIA and DUIC were lowest amongst 20-24 year old's and females expressed higher levels of concern about DUIA and DUIC than males across all age groups (Arnold & Tefft, 2016; Jonah, 2013). Similarly, Danton et al. (2003) evaluated attitudes toward DUI amongst young people (aged 16-25) in the UK and found a widespread cultural belief that DUIA is dangerous and should be condemned, but that the same extreme attitudes did not exist about DUIC and young people held more lenient beliefs about the danger of DUIC.

Relatedly, research from Canada and Australia found that the majority of cannabis users surveyed in these studies believed that DUIA increases crash risk significantly more than DUIC (Fischer et al., 2006; Swift et al., 2010). Furthermore, Greene (2018) assessed the opinions of rural Americans towards DUIC and found that some participants believed that cannabis improves driving ability and that drivers who drive under the influence of cannabis are able to compensate for their impairment effectively enough to mitigate the potential crash risk.

Overall, this research highlights a widespread discrepancy in opinions about DUI. On one hand, members of the public largely consider DUIA to be dangerous and unacceptable, and express an unwillingness to engage in this behavior. On the other hand, opinions about DUIC seem to be more liberal, especially amongst users, and people believe that DUIC is less detrimental to driving ability and safer than DUIA (Government of Canada, 2020).

According to the Theory of Planned Behavior (TPB), individuals' attitudes about a behavior, beliefs about their ability to control the behavior, and societal norms (Ajzen, 1985; 1991) all contribute to the likelihood of engaging in risky health behavior, such as DUIC. As such, understanding public perceptions about DUIC is necessary because attitudes about DUIC play a key role in determining the likelihood of participating in this behavior (Collins & Carey, 2007). In line with this, research has demonstrated a strong association between the perceived risk of DUIC and the likelihood of DUIC (Capler et al., 2017). In particular, individuals who believe that cannabis use does not impair driving ability are more likely to DUIC than those who understand the risks (Arterberry et al., 2013; Aston et al., 2007; Fischer et al., 2006; Jones et al., 2007; Kelly et al., 2004;

Matthews et al., 2014; McCarthy et al., 2007; Swift et al., 2010). For example, data from the NCS (2019) found that 36% of cannabis users who believed it was safe to drive within two hours after use reported engaging in this behavior compared to only 2% of people who believed you should wait longer. Relatedly, cannabis users who reported it was safe to drive within two hours after use were five times more likely to report being a passenger of a driver DUIC (20%) than those who believed it was not safe to drive within two hours following cannabis use (4%) (Statistics Canada, 2019).

The Current Study

Cannabis is the second most frequently used substance in Canada (after alcohol), with the highest rates of use among young people aged 18-24 (Health Canada, 2017; Rotermann, 2019). With the recent legalization of recreational cannabis in Canada, there has been a strong push by the federal government for more research on cannabis related risks in young people (Webster, 2018). One of the highest risk behaviors associated with cannabis use among young people is DUIC (Colonna, 2019; Robertson et al., 2017; Statistics Canada, 2019). Cannabis use affects important motor and cognitive abilities involved in driving including processing speed, motor control, and reaction time, and significantly increases the risk of being involved in an automobile accident (Asbridge et al., 2012; Hartman & Huestis, 2013). Despite this, survey based research suggests that many people believe DUIC is not dangerous (a belief held more frequently by people who use cannabis; Statistics Canada, 2019), or at least that DUIC is safer than DUIA (Fischer et al., 2006; Swift et al., 2010), and that cannabis-impaired drivers may be able to compensate for their level of impairment (Greene, 2018; Sewell et al., 2009). Such beliefs are cause for concern given the harms associated with DUIC including significant

impairment in key driving abilities and an increased risk of being involved in a motor vehicle accident, all of which are experienced more frequently by young people DUIC (Asbridge et al., 2012; Li et al., 2012; Rogenberg & Elvik, 2016).

While there has been a long history of public awareness efforts and campaigns targeting DUIA such initiatives for DUIC remain underdeveloped and less widespread (Watson et al., 2019). It is important that more effective education and awareness programs on DUIC be developed and implemented with the primary aims of educating the public on DUIC harms and reducing instances of DUIC behaviour (Government of Canada, 2018; MADD Canada, n.d.). In order to help facilitate this process, further research intended to help better understand attitudes toward DUIC is imperative.

As demonstrated in the above introduction, to date, our primary method for understanding public perceptions of DUIC has been data from survey based research where respondents have been asked generic questions about their attitudes toward DUIC (e.g., “do people your age think driving after marijuana use is more or less dangerous then driving after alcohol use?”; Danton et al., 2003; Greene, 2018) and their engagement in DUIC and related behaviours (e.g., “In the past 3 months, have you been a passenger in a motor vehicle driven by someone who had used cannabis in the previous two hours?”; NCS, 2019). Such research has been instrumental in understanding how DUIC is perceived in general, and relative to DUIA – a behaviour that is considered dangerous and unacceptable (Jonah, 2013; Lyon et al., 2019). The current study sought to expand on this survey based research by utilizing vignettes to measure public opinions about a realistic impaired driving scenario. The use of vignettes in a survey-based study allowed

the researcher to directly manipulate the variables of interest and provided participants with real-world context through which to evaluate the DUI behavior.

Using an experimental vignette design, the current study aimed to assess the perceived dangerousness and social acceptability of the driving behavior of a young adult (i.e. a 22-year-old) vignette character. To the authors knowledge, this is the first study to utilize this design to measure the perceived dangerousness and social acceptability of DUIC. A young adult character was chosen due to the high rates of DUIC exhibited by this age group and their increased vulnerability to injuries and death associated with DUI. The primary purpose of the study was to examine public opinions about the risk and social acceptability of DUIC, DUIA, or driving while tired (control condition). Given that DUIA has been the focus of awareness campaigns for many years, the public is well-informed about the dangers associated with DUIA and it is widely considered a major threat to safety. As such, the goal was to use these opinions as a baseline with which to compare opinions about DUIC. Of additional interest was determining how attitudes about DUIC and DUIA differ depending on the sex of the driver (i.e., male or female), as males drive under the influence of cannabis more frequently than females. The secondary purpose of the study was to examine if participants' self-reported cannabis use frequency was related to their attitudes about DUIC. To address these areas, the following research questions and hypotheses were devised:

1. How do participants' beliefs about the danger and social acceptability of a young adult (i.e., a 22-year-old) DUIC compare to attitudes about DUIA? It was hypothesised that participants would perceive DUIC to be less dangerous and more socially acceptable for a 22-year-old than DUIA. It was also hypothesized

that both DUIC and DUIA would be considered more dangerousness and less socially acceptable than driving while tired.

2. How do participants' attitudes about the perceived risk and social acceptability of DUI vary based on the sex of the young adult (i.e., 22-year-old) driving the vehicle (i.e., male versus female driver)? No formal hypothesis was proposed for this research question. Although research suggests sex differences in both DUI behaviours (e.g., young adult males drive under the influence of cannabis more frequently) and attitudes (e.g., females perceive DUIC to be more dangerous), research to date does not allow for a formal hypothesis as to whether attitudes toward a male or female DUI would differ. As such, this research question was exploratory in nature.
3. How do participants' attitudes about the perceived risk and social acceptability of a young adult (i.e., 22-year-old) DUIC vary depending on their reported frequency of cannabis use? It was hypothesised that more frequent cannabis use would be related to lower ratings of perceived dangerousness and higher ratings of social acceptability.

Methods

Participants

Four hundred and fifty-three participants between the ages of 18 and 65 completed this study (M = 35.50 years; SD = 13.06). The majority of participants identified as female (n = 342; 75.5%), followed by male (n = 92; 20.3%), gender neutral (n = 2; 0.4%), and two participants identified as "other" (0.4%). Sixteen participants (3.5%) chose not to report their gender. The ethnicity of the sample was homogeneous

with 92% of participants identifying as Caucasian/White (*n* = 417). The remaining participants identified as Indigenous (*n* = 6; 1.3%), "Other" (*n* = 6; 1.3%), Hispanic/Latino (*n* = 3; 0.7%), Middle Eastern (*n* = 3; 0.7%), and Asian (*n* = 2; 0.4%). Sixteen participants (1.3%) did not report their ethnicity (3.5%). While we did not ask directly, most participants were likely living in Canada when they completed the study. Participants completed an average of 16.62 years of education.

Procedure

Data for this study were collected through the online survey platform, Qualtrics. Data collection occurred between August 27, 2018 and October 8, 2018. Participants were recruited through social media sites such as Facebook, and word-of-mouth. The recruitment information included a short description of the research study, ethics approval information, a link to the survey, and an additional link for participants to enter into a draw to win one of five $50 restaurant gift cards. The surveys were linked separately to ensure that participants' responses to the experimental survey remained anonymous. Upon clicking the survey link, participants were presented with an informed consent form (see Appendix A).

If participants chose to participate they were randomly assigned to one of six vignettes where the independent variables (1) sex of the vignette character (i.e., male or female) and (2) substance used by the character (i.e., cannabis, alcohol, or no substance) were varied. Participants were then asked to complete a series of questions assessing the perceived dangerousness and social acceptability of the vignette character's behavior (six questions), participants' personal cannabis and alcohol use, and demographic information (see appendices B-D for instruments). Participants completed the demographic

information questionnaire first followed by the questions related to the vignette they were assigned. Questions assessing personal alcohol use, cannabis use, and driving behaviours were answered last as to not bias respondents before completing the vignette questionnaire. Completion of the survey took approximately 10 to 15 minutes and participants were able to discontinue at any time by clicking on an exit button present on every survey page. Upon completion, participants were thanked for their participation and provided with a debriefing statement. The protocol for the study was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR # 20190587-SC).

Vignettes

Vignettes are commonly used in social science research to examine attitudes, perceptions, beliefs, and norms (Evans et al., 2015; Gould, 1996). Vignettes have been used previously to assess attitudes about a range of topics, including mental illness (e.g., Angermeyer & Dietrich, 2006; Winters & Harris, 2019), substance use (McGinty et al., 2015; Harris-Lane et al., 2020; Sordahl et al., 2012), and dangerous driving (e.g., DUIA) (Farrow, 1987). Based on previous research, the vignettes in the current study were created by the researcher to elicit participants' reactions to a dangerous driving situation involving alcohol and cannabis. They were designed to depict a typical social scenario in which a young adult may use alcohol or drugs and resultantly DUI (Finken et al., 1998).

There are a number of benefits to using vignettes in attitudinal-focused research. First, vignettes can be created and modified to directly assess the variables of interest to the researcher. Second, vignettes allow the researcher to provide context and detail about the behavior of interest rather than asking generic questions about DUI (in this case). Third, vignettes allow for depersonalization, which enables respondents to analyze the

scenario from a variety of perspectives rather than responding based on their own circumstances (Schoenberg & Ravdal, 2000). Fourth, the use of vignettes can help reduce respondents' social desirability bias by having them respond to the behavior of a character rather than their own actions (Pescosolido et al., 2010). Finally, vignettes are a cost-effective research tool that enable participants to be randomly assigned to experimental conditions (Winters & Harris, 2019).

In the current study, participants were randomly assigned to read one of six vignettes describing a scenario in which a young adult drove while impaired. Specifically, the vignettes described a 22-year-old character named Barry or Betty who drove a vehicle after consuming cannabis, or alcohol, or while tired. A 22-year-old character was chosen due to the impending legalization of cannabis (at the time) for individuals over the age of 18 and the associated zero tolerance driving laws for novice drivers (i.e., new drivers and those under 21 years of age). We believe that because of the changing laws respondents may have viewed the behavior of a younger vignette character more severely (as it would clearly be illegal) and thus rated the behavior by default as dangerous and unacceptable, whereas it is less clear whether our 22-year-old character has broken the law. Additionally, research has demonstrated that the cannabis use of a younger adult (i.e., a 21-year-old) is not considered more dangerous than that of a 28-year-old (see Harris-Lane et al., 2020) suggesting that choosing an older age for our character would not have significantly influenced how respondents viewed their behavior.

The information in each vignette was consistent except for the variation of the independent variables (i.e., sex and substance used). The six vignettes described: (1) a male who was DUIC; (2) a male who was DUIA; (3) a male who drives without using

any drug (i.e., who drives while tired); (4) a female who was DUIC; (5) a female who was DUIA; and (6) a female who drives without using any drug (i.e., who drives while tired) (see Appendix E). The vignettes where the character is driving while tired served as the control conditions.

To create the vignettes, several vignette-based studies were reviewed to provide examples of acceptable length, structure, and content (e.g., Harris-Lane et al., 2020; McGinty et al., 2015; Winters & Harris, 2019). Based on this, the vignettes were created using simple language (Hughes 2000b) to depict a realistic/plausible scenario that could occur in daily life (i.e., was not dramatized). Research suggests that vignettes are most effective when they are relevant and realistic (Hughes & Huby, 2004), and lack of plausibility can result in negative feedback and disengagement from participants (Hughes, 1998). The content of the vignettes was then vetted by a group of doctoral students in clinical psychology. They reviewed the vignettes for clarity/readability, to ensure the scenario described was realistic and believable, and that the material was presented in an objective, non-biased format.

Measures

Perceived dangerousness and social acceptability (See Appendix B). A series of single-item measures were used to assess the perceived risk and social acceptability of the vignette character's driving behaviour (i.e., DUIC, DUIA, or driving while tired). These questions were created for this study as there does not appear to be an existing vignette based measure assessing perceived dangerousness and social acceptability of DUI behaviours. Six items were developed to both directly and indirectly (i.e., likelihood of engaging in behaviors that support or challenge DUIC, for example, stopping a driver

from DUIC, etc.) assess DUI related attitudes. Participants rated the risk of the behaviour posed in the vignette using a 4 or 5-point Likert scale.

To assess the overall perceived dangerousness and social acceptability of the scenario (questions 1 and 2 from the vignette questionnaire, see Appendix B), participants were asked to rate their perceptions on a 5-point Likert Scale from 0 (*Not At All Dangerous*) to 4 (*Extremely Dangerous*). For example, "Based on this scenario, to what extent do you think Barry driving himself home is dangerous?" and "Based on this scenario, to what extent do you think Barry driving himself home is socially acceptable?". These questions were created based on previous research that has used single item Likert scale questions to assess the perceived dangerousness and social acceptability of driving within two hours of smoking cannabis (see Arterberry et al., 2013; Aston et al., 2015; CCS, 2018). For example, Aston et al., (2015) measured perceived dangerousness as follows: "how dangerous is it to drive within 2 hours after smoking cannabis?".

To assess the perceived risk of physical harm, participants were asked to rate how much the vignette character risks harming themselves or others based on their actions, for example, "Based on this scenario, how much do you think Barry risks harming himself physically by using cannabis and driving?". These questions were rated on a 4-point Likert Scale ranging from 0 (*No Risk*) to 3 (*Severe Risk*). These questions were developed based on the Monitoring the Future Survey (MTF, 2017), which asks participants to rate "how much do you think people risk harming themselves (physically or otherwise) if they smoke marijuana regularly?" on a 4-point Likert scale. The content/wording of this

question was adapted to measure the perceived risk of physical harm associated with DUI (see questions 3 and 4 from the vignette questionnaire; see Appendix B).

Finally, two additional questions were included to measure how participants would respond behaviorally (e.g., what action they may or may not take) if faced with the vignette scenario in real life. The question "if you were at the party with Barry and saw him getting in his car to drive home, how likely would you be to try and stop him?" was included as a behavioral measure of perceived dangerousness. Research suggests that in order for an observer to intervene to prevent someone from DUI they must perceive the event as dangerous or an emergency (see Buckley et al., 2016). As such, responses to this question provide a nuanced measure of perceived dangerousness (see question 5 from the vignette questionnaire; see Appendix B). This question was rated on a 4-point Likert scale from 0 (*Not Likely At All*) to 3 (*Very Likely*). The final question, "if you needed a ride home, how likely would you be to get a ride with Barry"?, was adapted from previous research that used similar questions to determine participants normative beliefs about DUIC (Aston et al., 2016; McCarthy et al., 2007). For example, these studies asked participants to rate how many of their three closest friends would accept a ride from a cannabis-impaired driver. This concept was adapted for the current study and we created the final question to measure participants' social beliefs about DUIC (see question 6 from the vignette questionnaire; see Appendix B). This question was rated on the same 4-point Likert scale as question five.

Alcohol and Cannabis Use (see Appendix D). Questions from the CCS (2017) and the CCHS-MH (2012) (Statistics Canada, 2013; see the following link for more information about the CCHS-MH

https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5015) were used to measure participants' frequency of alcohol and cannabis use and whether they had driven under the influence of either substance. Based on the CCHS-MH, participants were asked to report their substance use behaviour, for example, "Have you ever used or tried marijuana, cannabis or hashish?" to which they responded "*Yes, just once*; *Yes, more than once*; or *No*". From the CCS, a question to assess impaired driving behaviour was included "Have you ever driven or operated a vehicle while under the influence of cannabis?" The same response options were provided for the CCS questions to keep the survey consistent.

General Attitudes about DUIC (See Appendix D)**.** Questions from the CCS (2017) were also included to directly measure attitudes regarding the risk and social acceptability of DUIC in general. The content and wording of the questions was unchanged from the CCS survey, for example "To what extent do you agree or disagree with the following statement: Cannabis use impairs one's ability to drive or operate a vehicle?" These questions were rated on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) and were given to all participants, as a general measure of respondents' attitudes, regardless of vignette condition.

Demographic information (See Appendix C)**.** Participants were asked questions regarding their age, years of education, gender identity, and ethnicity.

Data Analysis

The survey data was analyzed using descriptive statistics in order to characterize the sample in terms of the demographic variables, scores on items assessing alcohol and cannabis use frequency, reported DUI behaviours, and general attitudes about DUIC.

Primary analyses included a series of 2 (sex: male or female) x 3 (substance use: cannabis, alcohol, or no substance) ANOVAs (Between Subjects Factorial Design) to examine independent variable effects (i.e., vignette character's substance use while driving and vignette character's sex) on outcome measures assessing perceived danger and social acceptability of the activity. Lastly, among the participants assigned to one of the two vignettes depicting a character using cannabis before driving, a series of Pearson *r* correlation coefficients were utilized to examine the relationships between participants' reported cannabis use frequency and their attitudes toward the vignette character driving under the influence of cannabis. All data analyses were completed using IBM SPSS Statistics Software version 25.

Results

Analyses of Frequency of Missing Data

Four hundred and eighty-three participants clicked on the survey link, however, 30 participants completed less than 20% of the survey questions and their data were removed from the analyses. It is likely that these participants began the survey but chose to forfeit their participation. For the remaining 453 participants who were included in data analysis participants were missing < 3.6 % of data points on average. If a participant failed to respond to an item they were not included in any analyses involving that item.

Descriptive Statistics for Participant Reported Substance Use, DUI Behaviours, and General Attitudes about DUIC

Means and standard deviations were calculated to describe the frequency of participants' substance use behaviors. Regarding cannabis use, 65.4% of the current sample reported using cannabis more than once in their lifetime, 9.9% used cannabis only

once, and 24.7% reported never using cannabis. Forty-six percent of respondents who used cannabis reported doing so in the previous 12 months with an average usage rate of less than once per month (M = 0.73 times per month, SD = 1.3). Participants' responses on these items indicated that cannabis use frequency (e.g., using more than once) and rates of past-year cannabis use were higher amongst our sample than amongst Canadians surveyed in the CCHS-MH (2012). According to the CCHS-MH (2012), only 33.5% of people reported using cannabis more than once in their lifetime and 12.2% reported past-year cannabis use.

To determine if this discrepancy was the result of demographic differences (e.g., age and sex) between our sample and the CCHS-MH respondents (i.e. females were overrepresented in our sample) an age- and sex-matched sample was created from the CCHS-MH data set and two independent samples t-tests were conducted to compare this new data set with our data set on lifetime cannabis use (i.e. using cannabis once or more than once in their lifetime). Results revealed significant differences between the current sample and the CCHS age and sex-matched respondents, with respondents from the current study reporting higher rates of using cannabis once ($t(709) = -5.84$) and more than once in their lifetime ($t(749) = -8.70$) (see Appendix F). This discrepancy may be related to the change in cannabis attitudes in more recent years and the move towards legalization that occurred at the time of the current study. Alternatively, because our recruitment materials specified that the purpose of this study was to explore public perceptions of cannabis use, potential respondents may have been more likely to participate if they used cannabis themselves due to the relevance of the topic or personal interest in the subject matter.

When asked about DUIC, 15.7% of respondents reported doing so more than once in their lifetime, 6.9% of respondents DUIC just once, and 77.3% reported never DUIC. Relatedly, 41.9% of our sample were passengers with a cannabis-impaired driver more than once, 11.6% were once, and 46.5% had never rode with a cannabis-impaired driver. These data are comparable to results from the CCS (2020), however, rates of riding with a high driver were higher amongst our sample (e.g., 53.5% total compared to 23% total from the CCS).

Respondents reported higher levels of alcohol use with 97% of the sample indicating that they used alcohol more than once in their lifetime, 1.9% using only once, and 1.2% reported never trying alcohol. Ninety-three percent of respondents who used alcohol did so within the previous 12 months. Specifically, these participants reported using alcohol about 1 to 3 times per month (M = 2.3 times per month, SD = 1.2) on average. This finding is slightly higher than prevalence rates reported in previous surveys. For example, past-year prevalence rates from both the Canadian Alcohol and Drug Use Monitoring Survey (Health Canada, 2013) and Canadian Tobacco, Alcohol, and Drugs Survey (CTADS) (Canadian Centre on Substance Use and Addiction, 2017) were 78%. Regarding lifetime rates of DUIA, 21.3% of people reported doing so more than once, 10.4% of respondents DUIA just once, and 68.3% reported never DUIA. Additionally, 35% of the current sample reported riding with an alcohol-impaired driver more than once in their lifetime, 16.7% did so once, and 48.4% have never driven with a driver DUIA.

Means and standard deviations were also calculated to determine participants' general opinions about the dangerousness and social acceptability of DUIC. On average,

participants agreed with the statements "cannabis impairs driving ability" (*M* = 4.3, *SD* = 1.0) and "driving or operating a vehicle under the influence of cannabis is dangerous" (*M* = 4.3, *SD = 0*.9). Participants on average rated that they disagreed with the statement "driving or operating a vehicle under the influence of cannabis is socially acceptable" (*M* = 2.3, *SD* = 1.2). Responses from the CCS (2020) were comparable with the vast majority (83%) of respondents agreeing that cannabis impairs driving ability.

Preliminary Analyses

A number of one-way ANOVAs and chi-squares were conducted to examine group differences on demographic and substance use variables including age, gender, ethnicity, years of education, and frequency of cannabis and alcohol use in the previous 12 months. No significant differences were found between the six groups on any of the variables measured (Appendix F).

Primary Analyses

Six 2 (sex: male or female) x 3 (substance use: cannabis, alcohol, or no substance) univariate ANOVAs were conducted to assess the perceived dangerousness and social acceptability of DUIC. The dependent variables were measured using six items that directly assessed participants' perceptions of the dangerousness and social acceptability of DUIC as well as the perceived likelihood that DUIC poses a risk to the driver or others, and how likely participants were to accept a ride from or to stop a driver who DUIC. Levene's Test of Equality of Variances was significant on all six of the outcome items. An alpha level of .01 was used to correct for multiple analyses and for significant heterogeneity of variances.

Results from the first ANOVA revealed a significant main effect of substance use on the item "to what extent do you think Barry/Betty driving is dangerous?", $F(2, 453) = 82.56$, $p < .001$, Partial $\eta^2 = .270$. Post hoc tests revealed significant group differences between all three groups such that participants perceived DUIA to be more dangerous than DUIC which was considered to be more dangerous than driving while tired. See Table 1 for group means and Table 2 for measures of effect size. Results did not indicate a main effect of sex, $F(2, 453) = .71$, $p = .399$, Partial $\eta^2 = .002$ or an interaction between sex and substance use, $F(2, 453) = 1.31$, $p = .272$, Partial $\eta^2 = .006$. Results of this ANOVA can be found in Figure 1.

Figure 1

Means Ratings of Perceived Dangerousness Based on Substance Used and Sex of the Driver

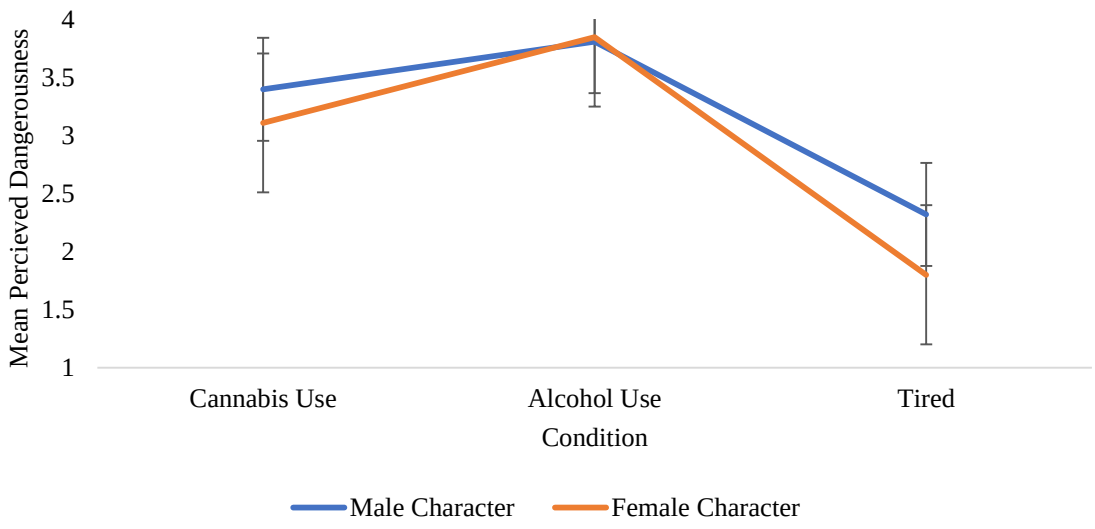


Table 1. *Mean scores for the six dependent variables as a function of substance used by the vignette character.*

	Perceived	Social	Harm to	Harm to	Stop	Accept a

	Dangerousness	Acceptability*	Self	Others	Driver	Ride
Cannabis	3.25 (1.08)	2.53 (1.45)	2.91 (0.86)	3.01 (0.88)	2.78 (1.12)	1.72 (0.95)
Alcohol	3.83 (0.99)	2.08 (1.45)	3.38 (0.69)	3.45 (0.68)	3.37 (0.88)	1.26 (0.59)
Tired	2.33 (0.89)	3.94 (1.32)	2.31 (0.77)	2.34 (0.91)	1.68 (0.97)	2.75 (1.06)

Note: Standard deviations are in parentheses
**Higher scores indicate that the behavior is perceived as more socially acceptable*

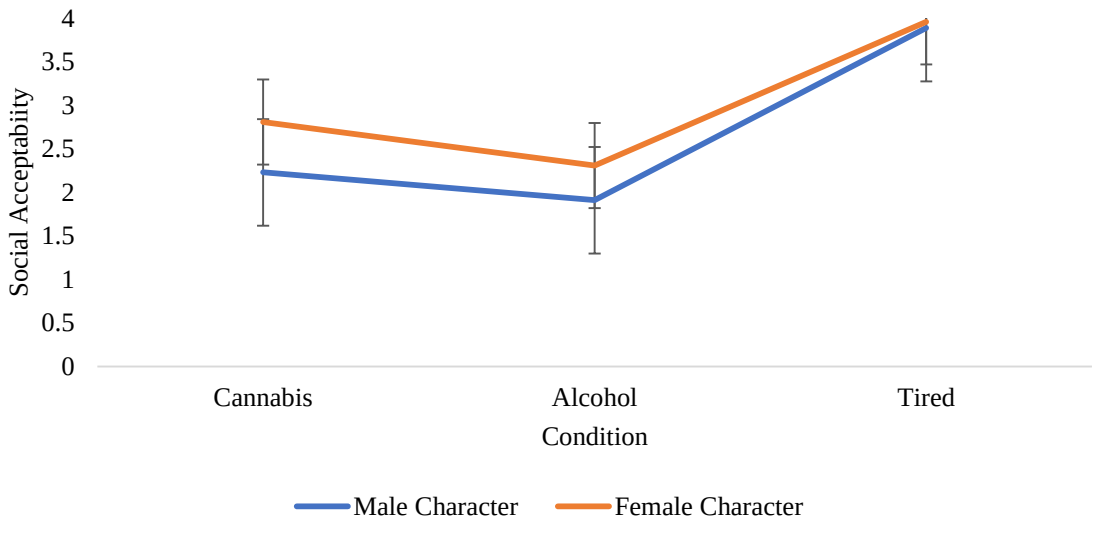
Table 2. *Measures of significance (p) and effect size (Cohen's d) for the main effect of substance use as a function of the dependent variables.*

	Cannabis vs Alcohol		Cannabis vs Tired		Alcohol vs Tired	
	Cohen's *d*	*p*	Cohen's *d*	*p*	Cohen's *d*	*p*
Perceived Dangerousness	0.560	<.001	0.934	<.001	1.60	<.001
Social Acceptability	0.308	.006	1.015	<.001	1.337	<.001
Harm to Self	0.607	<.001	0.742	<.001	1.473	<.001
Harm to Others	0.562	<.001	0.799	<.001	1.506	<.001
Stop from Driving	0.586	<.001	1.043	<.001	1.827	<.001
Accept a Ride	0.594	<.001	1.018	<.001	1.736	<.001

Results of the second ANOVA indicated significant main effects of sex, $F(2, 453) = 7.08$, $p = .008$, Partial $\eta^2 = .016$ and substance use, $F(2, 453) = 66.83$, $p < .001$, Partial $\eta^2 = .230$ on the item "to what extent do you think Barry/Betty driving is socially acceptable?". Participants assigned a male vignette character ($M = 2.6$, $SD = 1.5$) significantly differed in their ratings of social acceptability than those who were assigned a female character ($M = 3.1$, $SD = 1.7$) such that a male driver was considered less socially acceptable than a female driver regardless of the substance used. Post hoc tests revealed significant differences across all three substance use groups indicating that participants perceived driving while tired to be the most socially acceptable, followed by DUIC, then DUIA. See Tables 3 and 4 for means and effect sizes. No significant interaction effect was found between sex and substance use, $F(2, 453) = 1.2$, $p = .293$, Partial $\eta^2 = .005$. Results of this ANOVA can be found in Figure 2.

Figure 2

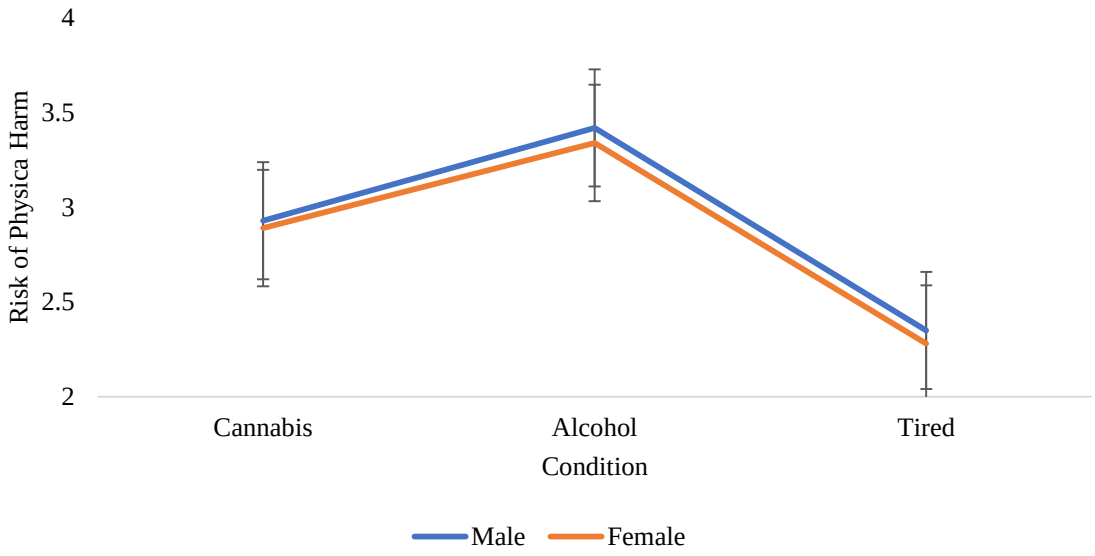
Mean Ratings of Social Acceptability Based on Substance Used and Sex of the Driver



A third ANOVA was conducted that revealed a significant main effect of substance use on the item "how much do you think Barry/Betty risks physically hurting themselves by using [cannabis, alcohol, or being tired] and driving?", $F(2, 453) = 64.56$, $p < .001$, Partial $\eta^2 = .224$. Post hoc tests indicated significant group differences across all three groups such that participants rated DUIA as posing the highest risk of physical harm to the vignette character, followed by DUIC, then driving while tired. See Tables 3 and 4 for means and measures of effect size. There was no significant main effect of sex, $F(2, 453) = .68$, $p = .410$, Partial $\eta^2 = .002$, and no significant interaction effect $F(2, 453) = .04$, $p = .958$, Partial $\eta^2 < .001$. Results of this ANOVA can be found in Figure 3.

Figure 3

Mean Ratings of the Risk of Physical Harm Based on Substance Used and Sex

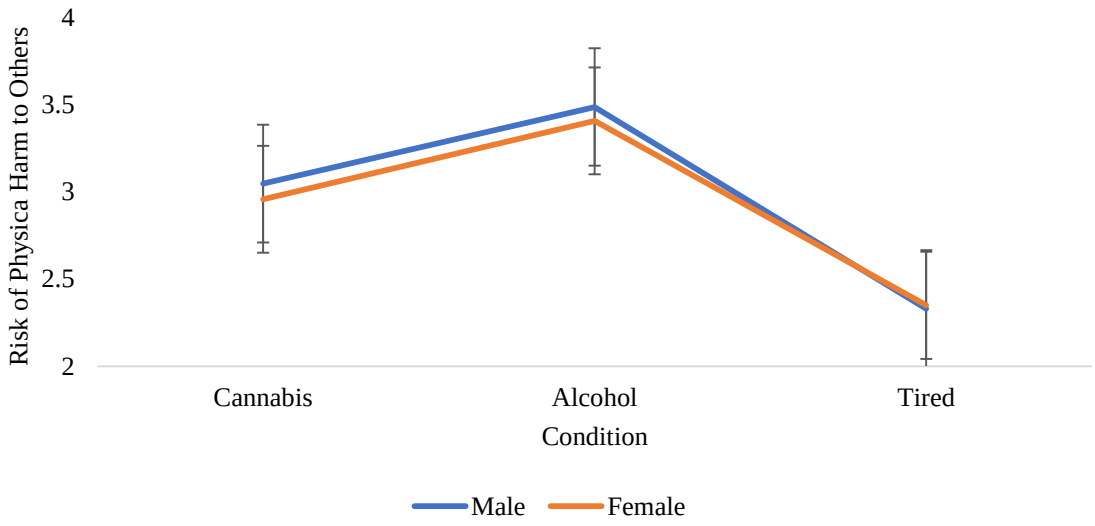


Results of the fourth ANOVA revealed a main effect of substance use on the item "how much do you think Betty/Barry risks harming others physically by using [cannabis, alcohol, or being tired] and driving?", $F(2, 453) = 68.58$, $p < .001$, Partial $\eta^2 = .235$. Post hoc tests indicated differences across all three substance use groups. Participants rated

DUIA as posing the highest risk of physical harm to others, followed by DUIC, then driving while tired. See Tables 3 and 4 for means and effect sizes across the groups. Results did not indicate a main effect of sex, $F(2, 453) = .42$, $p = .519$, Partial $\eta^2 = .001$, or a significant interaction between sex and substance use, $F(2, 453) = .20$, $p = .822$, Partial $\eta^2 = .001$. Results of this ANOVA can be found in Figure 4.

Figure 4

Mean Ratings of the Risk of Physical Harm to Others Based on Substance Used and Sex

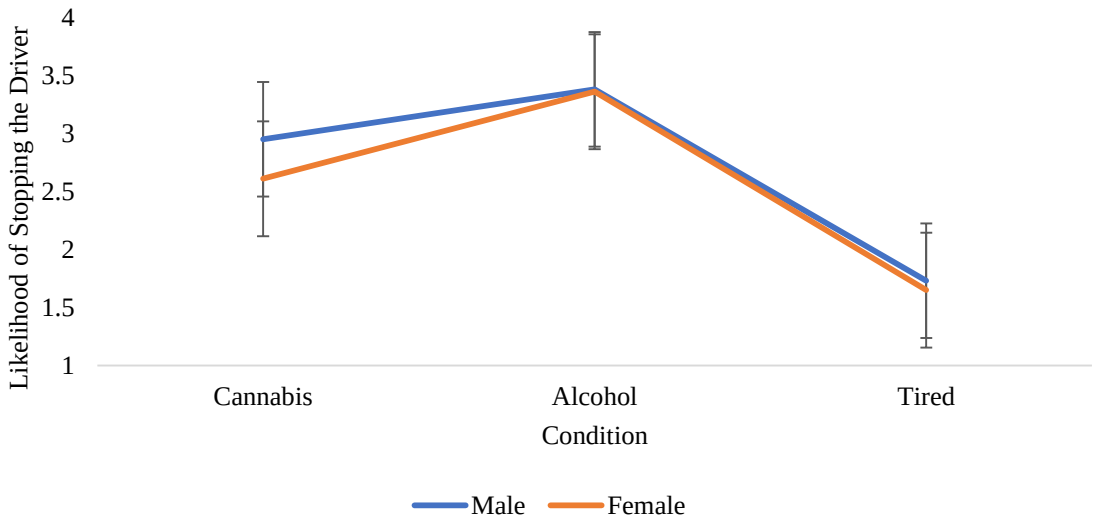


The fifth ANOVA that was conducted indicated a main effect of substance use on the item "how likely would you be to try to stop Barry/Betty from driving?", $F(2, 453) = 101.62$, $p < .001$, Partial $\eta^2 = .313$. Post hoc tests revealed significant differences between all three groups such that participants rated themselves as most likely to try to stop a driver who was DUIA, followed by DUIC, then driving while tired. See Tables 3 and 4 for means and effects sizes. Results did not indicate a main effect of sex, $F(2, 453) = 2.24$, $p = .120$, Partial $\eta^2 = .005$, nor did analyses indicate a significant interaction

between sex and substance use, $F(2, 453) = 1.08$, $p = .342$, Partial $\eta^2 = .005$. The results from this ANOVA can be found in Figure 5.

Figure 5

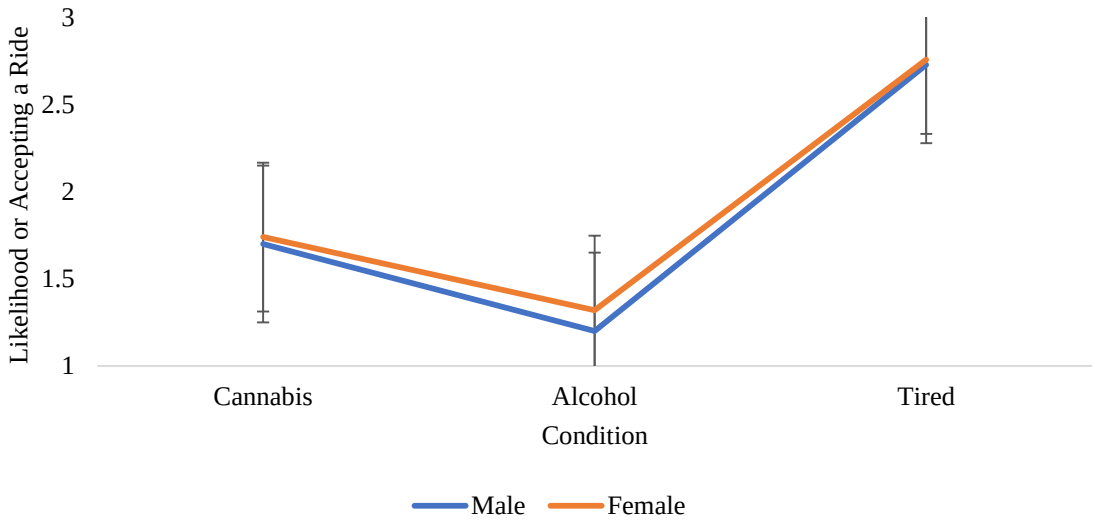
Mean Likelihood of Stopping the Character from Driving Based on Substance Used and Sex



Results of the sixth ANOVA revealed a main effect of substance use on the item "how likely would you be to get a ride with Barry/Betty?", $F(2, 453) = 99.65$, $p < .001$, Partial $\eta^2 = .308$. Participants indicated that they were significantly more likely to accept a ride from a driver who was tired than a driver who was impaired by either substance. Additionally, participants rated themselves as more likely to accept a ride from a driver who DUIC than a driver who DUIA. See Tables 3 and 4 for means and effects sizes. Results did not reveal a significant main effect of sex, $F(2, 453) = .48$, $p = .490$, Partial $\eta^2 = .001$, or a significant interaction effect, $F(2, 453) = .09$, $p = .891$, Partial $\eta^2 = .001$. Results of this ANOVA can be found in Figure 6.

Figure 6

Mean Likelihood of Accepting a Ride from the Character Based on Substance Used and Sex



Finally, among the participants assigned to one of the two vignettes depicting a character DUIC (n = 159), a series of Pearson r correlation coefficients were conducted to examine the relationships between participants' reported cannabis use frequency and their attitudes toward the vignette character DUIC. Cannabis use frequency was negatively correlated with four of the six dependent variables, indicating that participants who used cannabis more frequently were less likely to consider DUIC as dangerous. Cannabis use frequency was positively correlated with two of the dependent variables, which suggested that participants who used cannabis more frequently considered cannabis use to be socially acceptable and were more likely to accept a ride from a driver who had recently used cannabis. See Table 3 for correlation results.

Table 3. *Correlations between cannabis use frequency in the previous 12 months and the dependent variables.*

	Perceived Dangerousness	Social Acceptability	Harm to Self	Harm to Others	Stop Driver	Accept a Ride
Cannabis use frequency (12 months)	-.43	.22	-.40	-..40	-.36	.49

Note: All correlations are significant at the .01 level

Discussion

Utilizing an experimental vignette design, the purpose of the current study was to examine public perceptions (i.e., adults between the ages of 18 and 65) about the dangerousness and social acceptability of DUIC (compared to DUIA and driving while tired). Additional aims of the study included determining how respondents' perceptions of DUI varied depending on the sex of the driver, and how their reported frequency of cannabis use was related to attitudes about DUIC.

Results revealed a main effect of substance use on all measures of perceived dangerousness and social acceptability. A main effect of sex was found for ratings of social acceptability. Finally, significant inverse relationships were found between past-year cannabis use frequency and four of the six dependent variables (i.e., variables that indicated DUIC was dangerous), while significant positive relationships were found for the remaining two dependent variables (i.e., variables that indicated DUIC is socially acceptable). To the current author's knowledge, this was the first study to have

implemented an experimental vignette design to examine the perceived dangerousness and social acceptability of DUIC.

Perceived Dangerousness and Social Acceptability Based on Substance Use of the Driver

The results of this study demonstrated that respondents perceived DUIC to be more dangerous than driving while tired but less dangerous than DUIA. Findings revealed a similar pattern regarding the social acceptability of DUIC in that participants perceived DUIC to be less socially acceptable than driving while tired but more acceptable than DUIA. In general, both DUIC and DUIA were considered to be more dangerous and less socially acceptable than driving while tired. These findings are in line with our first hypothesis which predicted that participants would consider DUIC to be less dangerous and more socially acceptable than DUIA, and with research demonstrating that the public (particularly cannabis users) holds favorable attitudes towards cannabis use (McHale et al., 2016) and believes that cannabis has minimal impact on driving ability (Arnold & Tefft, 2016; Capler et al., 2017; Watson et al., 2019; Wickens et al., 2019).

The fact that respondents viewed DUIC as more dangerous and less socially acceptable than driving while tired suggests that they believe there is some degree of risk associated with DUIC. For example, cannabis acutely impairs driving-related abilities including attentiveness, perception of time and speed, reaction time, steering ability, vision, and use of learned driving-related knowledge (Sewell et al., 2009; Richer & Bergeron, 2008; Weinstein et al., 2008) – all of which increase the likelihood of being involved in a motor vehicle accident. However, respondents indicated that they consider

DUIC to be safer and more acceptable than DUIA, suggesting that misconceptions about the seriousness of DUIC and the degree of impairment caused by cannabis exist within the Canadian public. This finding is comparable to data from previous research studies and population surveys which indicate that a proportion of the public believes cannabis use does not impair driving ability, that impairment only results under certain circumstances (e.g., depending on the driver's body weight, frequency of use, etc.), and/or that DUIA is a more serious road safety concern (e.g., Arnold & Tefft, 2016; CCS, 2019; Jonah, 2013; Watson et al. 2019).

The results from the first research question are concerning given the documented link between attitudes towards a behavior and the likelihood of engaging in that behavior. The TPB is a widely used framework for predicting behavior in health and social domains (McMillan & Conner, 2003). According to the TPB (Ajzen, 1985; 1991), intention to engage in any behavior is determined by three factors: attitude toward the behavior (what an individual thinks about the behavior), subjective norms (what other people think about the behavior), and perceived behavioral control ([PBC] whether the person believes it is possible) (Collins & Carey, 2007; LaMorte, 2019). A person's attitude toward a behaviour is determined by whether they anticipate positive or negative consequences from engaging in the behavior, subjective norms reflect one's belief about how the behavior will be perceived by others (e.g., if it will be considered acceptable), and PBC represents perceptions about the ease of performing the behavior of interest in the face of barriers (Cooke et al., 2016). These three factors together determine intention or readiness to perform a behavior which in turn predicts the likelihood of actually completing the behavior. This theory has been found to predict engagement in a range of

health behaviors including binge drinking (Collins & Carey, 2007), use of illicit drugs such as cannabis, LSD, amphetamines, and ecstasy (McMillan & Conner, 2003), physical activity and sport participation (Downs & Hausenblaus, 2005), and oral health behaviors (Dumitrescu et al., 2011), etc.

Of particular relevance to the current study is research examining the connection between the TPB and cannabis-related driving behaviors. For example, Earle et al., (2020) examined the role of TPB in predicting college students' intention to drive under the influence of cannabis or ride with a high driver (RWHD). They found that attitudes towards DUIC and RWHD and PBC were positively related to intentions to engage in these behaviors. Similarly, Ward et al., (2018) surveyed a nationally representative sample of Americans to determine the role of cultural variables (e.g., attitudes, social norms) on DUIC and related behavior. They found that positive attitudes towards DUIC and the perception that DUIC was commonplace amongst cannabis users predicted past instances of DUIC, intention to drive under the influence of cannabis in the future, and overall willingness to drive under the influence of cannabis. Additionally, beliefs that significant others disapprove of DUIC decreased the probability of reporting DUIC behavior. These findings clearly demonstrate that attitudes towards DUIC are a key factor in predicting DUIC. Taken together, our data and research supporting the applicability of the TPB for predicting behavior highlight the importance of measuring public attitudes towards DUIC and of developing awareness campaigns/strategies to target these attitudes and decrease the likelihood of DUIC.

There are a number of factors that may have contributed to the findings from our first research question. First, while it is promising that participants acknowledged some

degree of risk associated with DUIC (e.g., that it is more dangerous than driving while tired), inaccurate beliefs about the severity of cannabis impairment and the ability to compensate for such impairment may have impacted our results. For example, research suggests that cannabis users tend to overestimate their degree of impairment and attempt to compensate for the effects of cannabis on driving ability by decreasing driving speed, making fewer passes or lane change attempts, and increasing their following distance (Sewell et al., 2009; Smiley, 1999; Ramaekers et al., 2004). In contrast, individuals who DUIA underestimate their level of impairment and engage in dangerous driving behaviors including driving at high speeds, more frequent attempts to overtake other vehicles, and driving closer to vehicles (Sewell et al., 2009; Smiley, 1986).

Given that those who drive under the influence of cannabis may appear to drive safer than people who DUIA, participants in the current study may believe that these compensatory behaviors are sufficient to mitigate the risk associated with DUIC. However, while compensatory driving behavior may decrease the likelihood of lane swerving or other tasks that require conscious control, it is unlikely to compensate for impairments in motor control, visual attention, and automatic driving behaviors (e.g., response time) (Ramaekers et al., 2009; 2011; Sewell et al., 2009). Therefore, the perception that DUIC is relatively safe may be based on incorrect or incomplete evidence. Similarly, a second explanation for our results may be related to beliefs about cannabis tolerance. Research has shown that chronic cannabis users are more likely to drive under the influence of cannabis than less frequent users. They are also more likely to develop a tolerance to the effects of cannabis (D'Souza et al., 2008; Hart et al., 2001; Jones et al. 1981; Ramaekers et al., 2009; Ramaekers et al., 2011; Sewell et al, 2009). As

such, participants from the current study may have assumed that the vignette character DUIC had a high cannabis tolerance and therefore was less prone to experiencing impairment while driving.

A third possible explanation for our findings is related to the lack of concrete/specific guidelines about when it is safe to drive after cannabis use. Current guidelines recommend waiting at least six hours before driving after consuming *any* amount of cannabis with much of the messaging by the Canadian Government promoting abstinence from driving at any point after cannabis use. Additionally, information about cannabis impairment and driving clearly highlights that the effects of cannabis can vary significantly on a person-by-person basis (Government of Canada, 2020). For example, level of cannabis impairment differs based on body weight, frequency of use, method of consumption, type of cannabis consumed, etc. (Government of Canada, 2021). This suggests that there are many factors involved in determining one's level of cannabis impairment and blanket/general guidelines from the Government may not be perceived as accurate or specific enough by the public. In fact, some people go so far as to say that regulating DUIC in the same way as DUIA, by implementing *per se* laws, is not effective given the variability of cannabis impairment on a person-to-person level (Bayern, 2015).

This lack of clear and specific information may lead people to rely on their own judgment when estimating level of cannabis impairment and determining when it is safe to drive. Because the language used in the vignettes used in the current study was intentionally vague and provided limited information about the physical attributes of the vignette character, the distance they would be driving, and the amount of cannabis they consumed, etc. respondents may have felt they did not have sufficient information to

consider the behavior dangerous. Alternatively, because participants relied on their own judgment to make these ratings, they may have made assumptions about the vignette character (e.g., that they used a small amount of cannabis, only drove a short distance to their home, or were of larger stature), that resulted in decreased ratings of dangerousness and higher ratings of social acceptability.

A fourth explanation comes from research highlighting that detecting DUIC is more difficult and less likely to result in criminal charges than DUIA (Ginsburg, 2019; Jonah, 2013). Current methods of detecting cannabis-impairment, including SFST's and blood sampling, rely on there being consistent relationships between amount of cannabis consumed and resultant impairment across individuals which, as outlined above, is untrue (Ginsburg, 2019). Research also indicates that there is little agreement between detected levels of cannabis in the blood, amount consumed, and its behavioral effects (Ginsburg, 2019). Additionally, current methods of detection are prone to testing delays, which can lead to underestimations of impairment, and human error (associated with subjective SFST's) (Armentano, 2013; Logan et al., 2016; Sewell et al., 2009).

Based on this, respondents in the current study may have rated DUIC to be safer and more acceptable than DUIA as difficulties with detection methods suggests that drivers who drive under the influence of cannabis are more likely to go undetected by police and less likely to face legal repercussions. In fact, legal data indicates that DUIC cases require significantly more time and resources to prosecute than DUIA cases, and are less likely to result in criminal charges (Perreault, 2016). As a result, respondents may have considered the safety of DUIC in terms of the likelihood of being caught and charged and therefore rated it as safer than DUIA. Furthermore, given the negative social

connotations/stigma associated with an impaired driving charge (Tatch, 2019), DUIC may be viewed as more socially acceptable given that it is less likely to lead to a criminal charge.

Fifth, differences in the amount and distribution of awareness campaigns about DUIC compared to DUIA may help to explain the current results. For example, awareness campaigns outlining the risks associated with DUIA exist in many forms, ranging from grass roots initiatives to large scale policy change, and have been widely distributed within the public for decades (DeJong & Hingson, 1998; Holder, 2000; Schermer, 2006). As such, it is likely that this messaging has permeated society and that most members of the public have been impacted by these campaigns in some form. However, given the recency of cannabis legalization in Canada, awareness campaigns about DUIC are in the early stages of development and distribution (Government of Canada, 2018) and are unlikely to have effectively reached all members of the public. Furthermore, much of the early cannabis outreach efforts have focused on targeting youth and young adults (Government of Canada, 2018). As most respondents in the current study fall outside this targeted age range, education about the harms associated with DUIC may not yet be common knowledge within our sample. As a result, the finding that DUIC is considered less dangerous and more socially acceptable than DUIA may be partially accounted for by lack of education/awareness about DUIC in our sample.

Finally, the overall finding that DUIC is considered more socially acceptable than DUIA is in line with research indicating that there is a culture surrounding cannabis use in which people view the drug positively and believe it has beneficial effects for both

society and individual users (Holm et al., 2014). These beliefs are deeply engrained in many users who consider cannabis to be a harmless, natural product.

Perceptions of Social Acceptability Based on the Sex of the Driver

While the results revealed a main effect of substance use across all dependent variables, a main effect of sex was only found for our variable measuring social acceptability. This finding means that respondents considered it to be more socially acceptable for females to drive under any condition of impairment than for males. One possible explanation for this may stem from research indicating that young females engage in less risky driving (Rhodes & Pivik, 2011) and are involved in fewer fatal crashes than male counterparts (e.g., Amarasingha & Dissanayake, 2014; Williams & Shabanova, 2003; Williams & Karpf, 1984). For example, Williams and Shabanova (2003) examined data from the NHTSA's fatality reports and found that young males (ages 16-30) had the highest rates of fatal crash involvement and were responsible for more deaths than females of the same age.

Other researchers have found that males in general exhibit more dangerous driving behaviors, receive more traffic fines and other violations, and are involved in more accidents than females (Butters et al., 2012). Amarasingha and Dissanayake (2014) found that young males were at increased risk for motor-vehicle crash than young females and were also more likely to experience a crash when driving without a valid driver's license, without wearing a seatbelt, and when DUI. Further, young males (in this case 21 years old) are also more likely to take driving risks for fun, to speed up when attempting to be passed, and to drive faster than the speed limit and other drivers (Begg & Langley, 2001).

Several reasons for this discrepancy in driving behavior have been proposed in the literature, including that males report higher levels of driving aggression and thrill-seeking behavior in general, and that they are more likely to downplay their chances of being involved in a crash (Begg & Langley, 2001; Turner & McClure, 2003). Taken together, data clearly highlights that young males engage in risky driving behaviors more often than females, even when driving unimpaired. As such, it is possible that respondents in the current study believed it was more acceptable for the female vignette character to DUI because she was less likely to engage in risky driving behaviors over and above the risk inherent to DUI. This may also explain why we did not find any difference in perceived dangerousness across sex; our sample appears to believe that DUI for either sex is dangerous, but may be more acceptable for females because they are safer drivers in general.

Alternatively, as the vast majority of the current sample identified as female, this finding may be explained by the fact that female respondents identified more strongly with the female vignette character and thus considered her behavior to be more acceptable than a vignette character of the opposite sex. Research by Rudman and Goodmwin (2004) examining gender differences in automatic in-group bias lends support to this theory. This study revealed that women have a stronger automatic in-group bias than males, meaning that they inherently prefer other women (e.g., same sex people) over men. Specifically, the authors propose that women compared to men have developed a cognitive mechanism that promotes own group preference. Relatedly, research in the field of social identity has highlighted that due to lower societal status, women share a stronger group bond than men (Ellemers et al., 1997; Scmitt et al., 2002).

Relationship Between Cannabis Use Frequency, Perceived Dangerousness and Social Acceptability

Among participants assigned a vignette with a character DUIC, results indicated significant inverse relationships between cannabis use frequency and variables measuring the perceived risk of DUIC. Specifically, respondents who used cannabis more frequently rated DUIC lower on measures of perceived dangerousness and on measures assessing the likelihood of stopping someone from DUIC than those who used cannabis less frequently. Positive correlations were revealed between cannabis use frequency and variables measuring the social acceptability of DUIC and the likelihood of accepting a ride from a driver who DUIC. This indicates that respondents who used cannabis more frequently rated DUIC higher on measures of social acceptability and on measures assessing the likelihood of accepting a ride from a cannabis-impaired driver than less frequent users.

These results are in line with our third hypothesis which predicted that respondents who used cannabis more frequently would rate DUIC to be lower on measures of perceived dangerousness and higher on measures of social acceptability. These findings are also consistent with previous research that has established a link between cannabis use frequency and the perceived risk associated with DUIC. In particular, research has revealed a positive relationship between cannabis use and DUIC such that the more frequently individuals use cannabis, the less likely they are to consider DUIC as harmful (e.g., Bergeron et al., 2014; Danseco et al., 1999; Hemmelstein, 1995; Fergusson et al., 2008; Statistics Canada, 2019).

A possible explanation for this finding is related to the psychological concept of cognitive dissonance. Festinger (1962) proposed the theory of cognitive dissonance which states that when two pieces of information psychologically contradict each other people will attempt to make them more consistent in a variety of ways. This applies to information about behavior, feelings, opinions, objects in the environment, etc. Festinger (1962) described the experience of cognitive dissonance as a motivator for change (e.g., in behavior or opinion) in order to reduce the discomfort of being faced with dissonant information.

In the current study, 21% of the sample reported DUIC at least once in their lifetime. If respondents understand the harms associated with DUIC and choose to engage in this behavior anyway, they create a situation in which their beliefs and actions are psychologically dissonant. In response, they may be motivated to reduce the experience of dissonance and resultantly change their opinion about the risks of DUIC to make their beliefs congruent with their behavior. This may help explain why more frequent cannabis users (those who are also more likely to drive under the influence of cannabis) rated DUIC as safer and more acceptable - to reduce their own cognitive dissonance.

Implications

The results of this study highlight significant discrepancies in how members of the public view DUIC compared to DUIA. Misguided beliefs about the relative safety of DUIC and about individuals' ability to compensate for the impairment caused by cannabis use emphasize the need for more widespread and effective awareness campaigns about the harms of DUIC. In further support of this, rates of DUI recidivism and fatal crashes do not decrease as the severity of punitive measures (e.g., fines, DUI laws)

increases (see Department of Justice, 2015) and rates of drug-impaired driving continue to rise despite increased law enforcement efforts (Public Safety Canada, 2021), highlighting the need for more effective preventative measures such as educational campaigns.

Research suggests that campaigns designed using a theoretical framework, such as the Protection Motivation Theory (PMT), are effective for promoting change to cognitions and behaviors associated with health behaviors, including drunk-driving (Cismaru et al., 2009). The PMT is a comprehensive theory of health communication (Boer & Seydel, 1996) that stipulates that protection motivation, or the desire to protect oneself, is enhanced when individuals believe that a behavior (e.g., drunk-driving) is severely threatening to their health, that they are vulnerable to the risks associated with the behavior (e.g., causing a crash), that a more adaptive response is effective (e.g., having a designated driver, calling a cab), that the costs of the adaptive response are low, and that they are able to choose and implement the adaptive response successfully (Rogers, 1983).

In general, evaluations of the risk associated with a behavior such as DUI depend upon perceived vulnerability (e.g., likelihood of being in a car accident) and perceived severity (e.g., likelihood of experiencing injury/death or social consequences) (Cismaru et al., 2009), otherwise known as “threat” variables. Protection motivation also depends on “coping” variables including the person’s belief that recommended solutions are effective and achievable. Data suggests that higher self-efficacy, strong beliefs about the effectiveness of alternative behaviors, and lower perceived costs lead to high levels of protection motivation (Floyd et al., 2000; Milne et al., 2000). Notably, one’s belief about their ability to engage in adaptive behavior, or self-efficacy, is one of the strongest

predictors of behavior change (Milne et al., 2000) and coping variables play a more important role in promoting change than threat variables (e.g., vulnerability and severity) (see Eagly & Chaiken, 1993; Floyd et al., 2000; Milne et al., 2000).

In sum, PMT suggests that the commonly used threat-based messaging of awareness campaigns is unlikely to be effective in promoting awareness and decreasing instances of DUIC. In fact, based on this theory, emerging campaigns about DUIC should utilize messaging that enhances the target audiences' belief in their ability to implement alternatives to DUIC and to follow the available recommendations about when it is safe to drive after cannabis use. In other words, awareness efforts should aim to increase individuals' self-efficacy to refuse to drive under the influence of cannabis and to choose alternative behaviors. Additionally, awareness efforts should clearly provide advice about how to avoid DUI by promoting low cost and easy to implement solutions (Cismaru et al., 2009).

Furthermore, research suggests that sensationalized messaging (e.g., images that show people hallucinating after using cannabis [Washington Traffic Safety Commission, 2014] or comparing users to sloths [Nudd, 2015]) is largely considered unrealistic and unbelievable by viewers. Even messaging that is more realistic and representative of the impairments experienced while under the influence of cannabis are less effective than simple campaigns that provide clear and concise information about cannabis impairment and driving (Colorado Department of Transportation, 2016). In particular, the most effective campaigns provide detailed information about how to determine level of impairment, about when to drive after using, and about safe alternatives to DUIC (Colorado Department of Transportation, 2016). Brief evidence-based interventions that

present information using short, fact-based and non-judgmental language are more likely to reduce dangerous cannabis-related behaviors including DUIC (Fischer et al., 2012; Fischer et al., 2013).

Finally, given that youth and young adults are most vulnerable to cannabis related harms, campaigns should make an active effort to appeal to this target demographic. Research suggests that stimulating and non-traditional messaging is more likely to attract and maintain the attention of youth (Capler et al., 2017). Similarly, given that social norms and peer approval play a significant role in the behavior of adolescents, creating interventions that focus on changing normative beliefs about DUIC and that use interactive, creative formats to promote information sharing between peers and from peer leaders may be particularly effective (Cuijpers, 2002).

Clinical implications. In addition to general implications, findings from the current study have implications for those who work with cannabis users in a clinical or mental health setting. In line with the need for campaigns about the risks of DUIC, clinicians may need to provide psychoeducation about cannabis use/DUIC to clients for whom cannabis use is a concern or for those who risk endangering themselves and others by DUIC. However, data suggests that psychoeducation/preventative education about cannabis use and DUIC alone are ineffective at reducing DUI behavior (Miller et al., 2015). Education is most effective when used as part of a larger intervention strategy that includes motivational enhancement and development of a safety plan (e.g., alternative plan to DUI) (Rider et al., 2006; Robertson et al., 2009).

Motivational interviewing (MI) is a therapeutic technique used to enhance clients' motivation to change a harmful behavior (e.g., substance use) by facilitating the

resolution of ambivalence (Hall et al., 2012). Ambivalence exists when individuals hold contradictory attitudes or feelings about a behaviour, especially when there is conflict between the immediate reward and potential long-term consequences of said behavior (Hall et al., 2012).

According to Prochaska and DiClemente (1986), people progress through five stages when deciding to make a change – precontemplation, contemplation, preparation, action, and maintenance. Individuals move from the beginning stage where they are not considering change, through to ambivalence, and on to planning for and maintaining change (Prochaska & DiClemente, 1986). Clinically, therapists provide nonjudgmental feedback, collaborate with clients to set goals, and take an empathic approach to elicit "change talk", which predicts future behavior change (Sherman & McRae-Clark, 2016). Following this model, clinicians tailor their MI techniques to meet clients' stage of change and gradually move them closer toward their goal. Research indicates that MI has been effective in decreasing negative health behaviors including smoking (Gray et al., 2005) and risky sexual behaviors, increasing medication compliance (Swanson et al., 1999), and facilitating diabetes management (West et al., 2007).

As related to the current study, MI has also been found to be effective in reducing alcohol and drug use across the lifespan (Burke et al., 2003; Hettema et al., 2005; Lundahl et al., 2010; Jensen et al., 2011). For example, a meta-analysis by Sayegh et al. (2017) comparing the long-term effects of MI and a contingency management (CM) intervention on decreasing rates of substance use including alcohol and cannabis revealed that both treatments were effective in reducing rates of substance use for all substances measured. Specifically, MI had a small but enduring effect (e.g., results lasted for 6

months) on reducing substance use. This suggests that MI (and CM) interventions are effective in targeting problematic substance use and may be employed to reduce instances of this behaviour.

Similarly, a review by Sherman and McCrae (2016) revealed that brief motivational interventions (e.g., the Marijuana Check-up, see Stephens et al., 2004; 2007) consisting of one or two sessions of MI are effective at engaging clients and reducing cannabis use behaviors, including days of use, number of dependence symptoms, and quantity of use, compared to no treatment conditions (de Gee et al., 2014; Martin & Copeland, 2008; Stevens et al., 2004; 2007). This was true for adults and adolescents, and was particularly useful for those who were the heaviest cannabis users.

Regarding the use of MI for DUI behaviors specifically, research presents some promising results about the effectiveness of MI for reducing alcohol-related driving behaviors. For example, Ouimet et al., (2013) found that a brief MI intervention was more effective than a control condition at delaying at-risk driving behaviors (including DUIA) amongst adult DUI offenders under the age of 43. Stein et al., (2006) found that MI reduced rates of DUIA and of riding with an impaired driver amongst adolescent DUI offenders when compared to relaxation training. However, the impact of MI was moderated by levels of depression such that it was more effective with adolescents who had low levels of depression.

Steinka-Fry et al., (2015) conducted a systematic review and meta-analysis on the impact of brief alcohol interventions on youth DUIA behaviors and found that these interventions (most of which were brief MI) led to a reduction in DUI behaviors. Unfortunately, most of the research on MI for DUI to date has focused on DUIA and

there is little to no available data on the impact of MI for DUIC. It has also been noted that there is a general lack of scientifically rigorous research evaluating interventions for DUI, indicating the need for more research in this area (Miller et al., 2015; Steinka-Fry et al., 2015).

Overall, data on the effectiveness of MI for reducing substance use in general and DUIA are promising and extending the use of MI principles to individuals at risk for DUIC in a clinical setting may help reduce ambivalence about this behavior. In particular, clinicians should utilize the four principles of MI – engaging, focusing, evoking, planning – to inspire change in clients who engage in dangerous driving behaviors. According to Miller and Rollnick (1991), effective use of MI in a clinical setting involves building a strong therapeutic relationship, developing a shared goal for clients' recovery journey, highlighting clients' own arguments for change, and helping clients plan and implement the necessary steps to produce change. Given the legalization of cannabis, and the existing culture of acceptance around cannabis use within the public, cannabis users may be increasingly ambivalent to recognizing the risks associated with cannabis and its impact on driving (Addiction Center, 2021). As such, using MI techniques that facilitate intrinsic motivation and personal accountability in a nonjudgmental and supportive environment may be the most fruitful option for changing cannabis-related behaviors.

Limitations and Future Research

The current study had several limitations. First, the vast majority of our sample was female (75.5%) and Caucasian (92%), which may limit the generalizability of our findings to other groups of people. Furthermore, the average age of our sample was higher than expected (e.g., 35 years old), meaning our results may not represent the

opinions of younger adults who are at the highest risk for problematic cannabis use and DUIC. As such, future research could utilize a similar vignette design but specifically target youth and young adults to determine their attitudes about DUIC. Another avenue for future research could be to use a similar study design but compare public attitudes about DUI of substances compared to driving and texting, which has been found to adversely impact all aspects of driving (e.g., visual, cognitive, and physical driving skills) (Caird et al., 2014). It may be particularly beneficial to understand how youth and young adults perceive DUI compared to driving while texting as they are also the group at highest risk for both (Olsen et al., 2013).

Second, due to the nature of our recruitment methods most of our sample was well-educated and the majority completed some form of post-secondary education (16 years of education on average). Consequently, the opinions expressed by the current sample may not be representative of the public as a whole and may not have captured the opinions of individuals who did not complete high school and/or attend university or college.

Third, to measure the perceived dangerousness and social acceptability of DUI, the authors created a series of six single items based on previous research that used a single item measure to assess the perceived dangerousness and social acceptability of driving within two hours of smoking cannabis (see Arterberry et al., 2013; Aston et al., 2015; CCS, 2018). While it would have been more rigorous to use a previously developed and validated vignette based measure of our dependent variables, such a measure does not appear to exist; however, research indicates that single item measures can be reliable and valid (Robins, et al., 2001; Von Hippel et al., 2018). The development

of a measure assessing attitudes toward DUIC may be beneficial for future research. Finally, the results from the current study and the body of research surrounding DUIC indicates the need for more research on factors that influence individual's decisions to drive under the influence of cannabis in order to inform targeted awareness campaigns.

Conclusion

The current study utilized an experimental vignette design to examine public perceptions about the dangerousness and social acceptability of a young person DUIC, DUIA, or driving while tired. Additional aims of the study included determining how attitudes differed based on the sex of the driver, and whether respondents' self-reported frequency of cannabis use impacted attitudes about DUIC. Results revealed that members of the public considered DUIC to be safer and more acceptable than DUIA in a variety of contexts. Participants also considered it to be more socially acceptable for females to drive while impaired than males. Taken together, these results highlight important misconceptions about the harms associated with DUIC that exist within the general public and have implications for predicting/preventing future DUIC. Specifically, research indicates that favorable attitudes towards DUIC are strongly related to individuals' intention and willingness to drive under the influence of cannabis. Based on this, it is imperative for future awareness campaigns about cannabis to utilize effective messaging (e.g., that provides detailed information about how to judge level of impairment, when it is safe to drive after using, and safe alternatives to DUIC) and innovative methods (e.g., peer-to-peer communication) to educate the public about the impact of cannabis on driving ability/crash risk across genders to decrease the likelihood of DUIC.

The current data also indicated that individuals who use cannabis more frequently consider DUIC to be safe and socially acceptable. This suggests that widespread misconceptions about cannabis use are amplified amongst cannabis users – those most likely to drive under the influence of cannabis. In addition to reinforcing the need for effective, far-reaching cannabis awareness initiatives, this has implications for healthcare providers who may work with cannabis users in a clinical setting. In particular, psychoeducation, motivational enhancement strategies, and DUIC safety planning may be effective tools for shifting client's ambivalence about DUIC when there is a concern for those who risk endangering themselves and others by DUIC.

In sum, the current study adds important information to the cannabis literature regarding public misconceptions about the safety and acceptability of cannabis use and DUIC. Moving forward, the government and other regulating bodies will benefit from continued efforts to understand factors that contribute to individuals' decisions to drive under the influence of cannabis and from educational initiatives that target these factors amongst highest risk populations.

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Appendix A: Informed Consent Form

Faculty of Science
Department of Psychology
www.mun.ca/psychology

Informed Consent Form

Title: Public Perceptions of Driving Under the Influence of Cannabis or Alcohol

Researchers: Megan Pollard, M.Sc.

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Dr. Nick Harris, PhD, R Psych

Assistant Professor, Department of Psychology
Memorial University of Newfoundland
Phone: (709) 864-7676
email: nharris@mun.ca

You are invited to take part in a research project entitled:

"Public Perceptions of Driving Under the Influence of Cannabis or Alcohol"

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the

researchers, Megan Pollard or Dr. Nick Harris, if you have any questions about the study or would like more information before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction:
My name is Megan Pollard and I am a graduate student in the Department of Psychology at Memorial University of Newfoundland. I am completing this study as part of my doctoral dissertation.

Purpose of study:
The purpose of this study is to examine people's views and opinions about driving under the influence of cannabis or alcohol. The results of this study will be used to further investigate perceptions of cannabis and alcohol use and the associated risks, help generalize existing findings, and explore areas with little research.

Are you eligible to participate?
To be eligible to participate in this study, you must be 18 years of age or older.

What you will do in this study:
In this study, you will be asked to complete an online survey. Participation involves answering questions about your age, gender, education, ethnicity, frequency of cannabis use and alcohol consumption, and information regarding the respondents' history of driving under the influence. You will also be asked to complete a series of questionnaires. Please note that during your participation in this study you may skip any questions that you do not want to answer.

Length of time: Completion of the online survey will take approximately 10 minutes.

Withdrawal from the study:
There are no consequences to withdrawing from the study. You are free to withdraw from the study at any time, up until the point when you submit your survey responses to the researchers. If at any time you wish to discontinue the survey, you can simply click the EXIT button, which will be present on each page. As there is no identifying information collected on the survey, once you submit the survey to us, it is not possible to identify your survey so it is not possible to remove it from the study. Should you decide to close the browser at any time during the study without submitting your survey, any responses will be lost and not included in the study.

Possible benefits:
Although you may not receive any immediate, direct benefits yourself, your participation will help us to better understand public perceptions of cannabis and alcohol use related issues.

Possible risks:
During your participation in this study it is possible that you may become aware that you are struggling with a substance use related issue. If you have any concerns about your current mental health or psychological functioning, you can contact the Mental Health Helpline at 709-737-4668 or if you are a Memorial University student you may contact the MUN Student Wellness and Counselling Centre at 709-864-8500.

Compensation:
To thank you for your time, you may enter your e-mail address into a draw to win one of five $50 restaurant gift cards. Please note that to ensure your anonymity your e-mail address will be kept separate from the information you provide on the survey.

Confidentiality vs. Anonymity:
There is a difference between confidentiality and anonymity: Confidentiality is ensuring that identities of participants are accessible only to those authorized to have access. Anonymity is a result of not disclosing participant's identifying characteristics (such as name or description of physical appearance).

Confidentiality:
Confidentiality will be ensured at all times. Only the researchers will have access to any and all data. As well, the researchers will have no way of knowing who, or who did not, complete a survey.

Anonymity:
The survey will be anonymous. In no way will the researcher have the ability to link the participant's responses back to them. All information presented or published from the results will be in aggregate form.

Storage of Data:
All data will be stored on a password-protected computer located in Dr. Nick Harris's lab on Memorial University campus. The researchers will be the only individuals with access to the data. Data will be kept for a minimum of five years as required by Memorial University policy on Integrity of Scholarly Research. Following this five-year period all data will be fully deleted. The online server, Qualtrics, hosting this survey stores all data on a server in Toronto, Ontario and thus is not subject to the US Patriot Act.

Reporting of Results:
The data collected will be compiled into a report and may be presented and published through peer reviewed forums, and will also be publicly available through the QEII Library. These outputs will be a summary of the information obtained and will not include identifying features.

Sharing of Results with Participants:
Once the report is complete, it will be shared online via the following website:

www.ucs.mun.ca/~nharris. It will also be available at http://collections.mun.ca/cdm/search/collection/theses.

Questions:
You are welcome to ask questions at any time during your participation in this research. If you would like more information about this study, please contact Megan Pollard or Dr. Nick Harris.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861.

Consent:
Your submitting the survey to the researchers means that:

- You have read the information about the research.
- You have been able to ask questions about this study, if so desired.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw from the study at any time, up until you submit the survey to the researchers, and that doing so will not affect you now or in the future.

If you submit the survey to the researchers, you do not give up your legal rights and do not release the researchers from their professional responsibilities.
By submitting the survey to the researchers, and thus consenting to participate in this study:

- I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions, if so desired, and any questions have been answered.
- I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation at any time up until I have submitted my survey.

A copy of this Informed Consent Form can be printed for my records.

Please click below to proceed to the survey:

LINK to survey (next button)

Appendix B: Vignette Perceived Dangerousness and Social Acceptability Items

Note: the names and pronouns of the following items will change based on the randomly assigned vignette.

Instructions: Please rate/respond to the following questions using the Likert Scales provided.

1. Based on this scenario, to what extent do you think Barry driving himself home is dangerous?

   0 - Not at all dangerous
   1 - A little dangerous
   2 - Moderately dangerous
   3 - Very dangerous
   4 - Extremely dangerous

2. Based on this scenario, to what extent do you think Barry driving himself home is socially acceptable?

   0 - Not at all socially acceptable
   1 - A little socially acceptable
   2 - Moderately socially acceptable
   3 - Very socially acceptable
   4 - Extremely socially acceptable

3. Based on this scenario, how much do you think Barry risks harming himself physically by using cannabis [alcohol or no substance] and driving?

   0 – No Risk
   1- Minor Risk
   2 – Moderate Risk
   3 - Severe Risk

4. How much do you think Barry risks harming others physically by using cannabis [alcohol or no substance] and driving?

   0 – No Risk
   1 – Minor Risk
   2 – Moderate Risk
   3 – Severe Risk

5. If you were at the party with Barry and saw him getting in his car to drive home, how likely would you be to try and stop him?

0 – Not Likely At All
1 – Somewhat Likely
2 – Moderately Likely
3 – Very Likely

6. If you needed a ride home, how likely would you be to get a ride with Barry?

0 – Not Likely At All
1 – Somewhat Likely
2 – Moderately Likely
3 – Very Likely

Appendix C: Demographic Information

1) What is your age? _____

2) With which gender do you identify?

a. Male
b. Female
c. Transgender
d. Prefer not to say
e. Other – Please specify: _____

3) What is your ethnic background?

a. Caucasian/White
b. African-Canadian/Black
c. Hispanic/Latino
d. Asian
e. Indigenous (First Nation, Métis or Inuit)
f. Middle Eastern
g. East Indian
h. Other – Please specify: _____

4) How many years of education in total have you completed (including primary, secondary, high school, college, university, and post-graduate)?

_____

Appendix D: Substance Use Questions

Instructions: Please read each of the following questions and mark the response alternative that best describes your use of cannabis. *Note that the term cannabis is being used to refer to marijuana, hashish, cannabis concentrates, and cannabis-infused edibles.*

1. Have you ever used or tried cannabis?
   a) Yes, just once
   b) Yes, more than once
   c) No

2. Have you used cannabis in the past 12 months?
   a) Yes
   b) No

3. How often (did you use cannabis in the past 12 months)?
   a) Less than once a month
   b) 1 to 3 times a month
   c) Once a week
   d) More than once a week
   e) Every day

4. Have you ever driven or operated a vehicle while under the influence of cannabis?
   a) Yes, just once
   b) Yes, more than once
   c) No

5. Have you ever been a passenger in a vehicle where the driver was under the influence of cannabis?
   a) Yes, just once
   b) Yes, more than once
   c) No

Instructions: Please read each of the following questions and mark the response alternative that best describes your consumption of alcohol. *Note that the term alcohol includes beer, wine, spirits, etc.*

1. Have you ever used or tried alcohol?
   a) Yes, just once
   b) Yes, more than once
   c) No

2. Have you used alcohol in the past 12 months?
   a) Yes
   b) No

3. How often did you use alcohol in the past 12 months?
   a) Less than once a month
   b) 1 to 3 times a month
   c) Once a week
   d) More than once a week
   e) Every day

4. Have you ever driven or operated a vehicle while under the influence of alcohol?
   a) Yes, just once
   b) Yes, more than once
   c) No

5. Have you ever been a passenger in a vehicle where the driver was under the influence of alcohol?
   a) Yes, just once
   b) Yes, more than once
   c) No

To what extent do you agree or disagree with the following statements?
**These questions were given to all participants, regardless of vignette group.*

a) Using cannabis impairs one's ability to drive or operate a vehicle.

   1 – Strongly Disagree
   2 – Disagree
   3 - Neutral
   4 - Agree
   5 – Strongly Agree

b) Driving or operating a vehicle under the influence of cannabis is socially acceptable.

   1 – Strongly Disagree
   2 – Disagree
   3 - Neutral
   4 - Agree
   5 – Strongly Agree

c) Driving or operating a vehicle under the influence of cannabis is dangerous.

   1 – Strongly Disagree
   2 – Disagree
   3 - Neutral
   4 - Agree
   5 – Strongly Agree

Appendix E: Vignettes

Participants will be presented with one of the following vignettes followed by questions related to the activity in the vignette:

1. A description of a Caucasian male follows: Barry is a 22-year-old male attending a birthday party for his friend. He and his friends regularly get together on the weekends and use cannabis (also known as weed, marijuana, etc.). Barry can't stay out late that night, but he does use some cannabis before he has to leave. He starts to feel the effects of the cannabis and stops. Shortly after he leaves to drive himself home.
2. A description of a Caucasian male follows: Barry is a 22-year-old male attending a birthday party for his friend. He and his friends regularly get together on the weekends and drink alcohol. Barry can't stay out late that night, but he does drink some alcohol before he leaves. He starts to feel the effects of the alcohol and stops. Shortly after he leaves to drive himself home.
3. A description of a Caucasian male follows: Barry is a 22-year-old male attending a birthday party for his friend. He and his friends regularly get together on the weekends and drink beer. Barry can't stay out late that night and chooses not to have any beer. He starts to feel tired and shortly after he leaves to drive himself home.
4. A description of a Caucasian female follows: Betty is a 22-year-old female attending a birthday party for her friend. She and her friends regularly get together on the weekends and use cannabis (also known as weed, marijuana, etc.). Betty can't stay out late that night, but she does use some cannabis before she leaves. She starts to feel the effects of the cannabis and stops. Shortly after she leaves to drive herself home.

5. A description of a Caucasian female follows: Betty is a 22-year-old female attending a birthday party for her friend. She and her friends regularly get together on the weekends and drink alcohol. Betty can't stay out late that night, but she drinks some alcohol before she leaves. She starts to feel the effects of the alcohol and stops. Shortly after she leaves to drive herself home.
6. A description of a Caucasian male follows: Betty is a 22-year-old female attending a birthday party for her friend. She and her friends regularly get together on the weekends and drink beer. Betty can't stay out late that night so she chooses not to have any beer. She starts to feel tired and shortly after she leaves to drive herself home.

Appendix F

Comparison of the CCHS and the Current Sample on Lifetime Cannabis Use Frequency

Independent Samples T-test

	t	*df*	sig.
Cannabis Used Once (lifetime)	-5.842	790	0.000
Cannabis Used More Than Once (lifetime)	-8.702	749	0.000

Descriptive Statistics

		N	Mean	Standard Deviation
Cannabis Used Once	Current Sample	394	1.25	0.435
	CCHS	395	1.45	0.498
Cannabis Used More Than Once	Current Sample	353	1.28	0.450
	CCHS	395	1.58	0.494

Analyses of Group Differences on Demographic and Substance Use Variables

ANOVA

		Sum of Squares	*df*	Mean Square	*F*	Sig.

Age	Between Groups	1344.902	5	268.980	1.59	.162
	Within Groups	66212.347	391	169.341		
	Total	67557.249	396			
Education (years)	Between Groups	98.203	5	19.641	1.638	.149
	Within Groups	4484.984	374	11.992		
	Total	4583.187	379			
Cannabis use (12 months)	Between Groups	3.376	5	.675	.382	.861
	Within Groups	753.010	426	1.768		
	Total	756.387	431			
Alcohol use (12 months)	Between Groups	12.382	5	2.476	1.600	.159
	Within Groups	657.762	425	1.548		
	Total	670.144	430			

Chi-Square

	Vignette assigned	Sex	Ethnicity
Chi-square	12.947	711.128	1951.783
df	5	3	5
Asymp. sig.	.024	.000	.000