Western University

Scholarship@Western

Electronic Thesis and Dissertation Repository

8-1-2019 10:00 AM

Cannabis Legalization and Driving: Exploring Young Ontarians' Knowledge, Perceptions and Attitudes

Robert Colonna, *The University of Western Ontario*

Follow this and additional works at: https://ir.lib.uwo.ca/etd

Abstract

The legalization of recreational cannabis may increase driving under the influence of cannabis (DUIC) among youth, a behavior proven to increase the risk of collisions. We conducted a mixed methods study including an online survey (N=426; 53% female) and two focus groups (N=12) exploring young drivers' knowledge, perceptions, and attitudes towards cannabis use and DUIC. 83.6% (356) of survey's participants had used cannabis, 69% (296) in the past year. Among past-year users, 47.9% (142) have previously DUIC. Quantitative predictors of future DUIC included: prior DUIC, minor accident risk, dangerousness, perceived enforcement of penalties, punishment avoidance, and moral awareness. Qualitative themes included: Being high is a change in one's natural state; it is hard to tell if a driver is high; DUIC is convenient, socially acceptable, and safe; legalization makes cannabis more attractive to use; and there is a need for testing, education, and prevention efforts that are relevant to youth.

Keywords

Driving under the influence of cannabis [DUIC], Cannabis-impaired driving, Cannabis legalization, Young driver, Risk profile, Motor vehicle collision, General deterrence

Lay Summary

The legalization of recreational cannabis may increase driving under the influence of cannabis (DUIC) among youth, a behavior proven to increase the risk of collisions. We conducted a mixed methods study including an online survey (N=426; 53% female) and two focus groups (N=12) exploring young drivers' knowledge, perceptions, and attitudes towards cannabis use and DUIC. 83.6% (356) of survey's participants had used cannabis, 69% (296) in the past year. Among past-year users, 47.9% (142) have previously DUIC. Quantitative predictors of future DUIC included: prior DUIC, minor accident risk, dangerousness, perceived enforcement of penalties, punishment avoidance, and moral awareness. Qualitative themes included: Being high is a change in one's natural state; it is hard to tell if a driver is high; DUIC is convenient, socially acceptable, and safe; legalization makes cannabis more attractive to use; and there is a need for testing, education, and prevention efforts that are relevant to youth.

Acknowledgments

I would first and foremost like to thank my supervisor, Dr. Liliana Alvarez, for her meaningful support and heartfelt guidance throughout my study. Your willingness to give time and feedback so generously is very much appreciated. Without you, I would not be in the position I am today, nor would I have decided to pursue a PhD. I am beyond excited to continue working together and exploring research opportunities in this growing field.

Second, I would like to thank my advisory committee, Dr. Carri Hand and Dr. Jeff Holmes, for their ongoing support and feedback on my abstract submissions and this thesis dissertation. I appreciate all you have done and I look forward to working with you two in the future.

Next, I express my very great appreciation towards my lab mates, Melissa Knott and Sarah Krasniuk, for their warm company in the i-Mobile Research Lab and assistance with defense preparation. It was a pleasure and inspiration working alongside you two. I also would like to acknowledge Dr. Jessie Wilson and Dr. Rebecca Timbeck, along with Melissa and Sarah, for their contributions and feedback as expert panel members for the focus group guide refinement. This was instrumental in acquiring an outsider perspective on pertinent topics that should be further explored. For this, I am extremely grateful.

Finally, I wish to thank my parents and loving family members for their support and encouragement throughout my study. In addition, my close friends, colleagues and classmates for shaping an amazing graduate student experience. I look forward to reflecting on our experiences with each other in the future.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1

1   Introduction

Youth between the ages of 18 to 24 have both the highest rates of cannabis use in Canada and account for over 20% of road traffic fatalities and serious injuries, although they make up only 13% of the driving population (Grant & Bélanger, 2017; Parachute Canada, n.d.; UNICEF, 2011). Based on the experiences of other countries, the recent legalization of recreational cannabis in Canada may result in increased cannabis use among youth and a subsequent increase of driving under the influence of cannabis (DUIC; Hartman et al., 2016; Joffe & Yancy, 2004; Kalant, 2016; Palamar, Ompad, & Petkova, 2014; Parnes, Bravo, Conner, & Pearson, 2018). In a recent study, the Canadian Center on Substance Use and Addiction found that youth between the ages of 14 and 19 years old expressed a lack of concern regarding DUIC (McKiernan & Fleming, 2017). Although this study did not aim to explore the perceptions of youth regarding cannabis in relation to driving specifically, findings suggest that youth may be unaware of the risks that DUIC poses on road safety. This is problematic considering DUIC increases the risk of motor vehicle collisions (MVCs), especially fatal crashes (Asbridge, Hayden, & Cartwright, 2012; Bondallaz et al., 2016; Capler, Bilsker, Van Pelt, & MacPherson, 2017; Li et al., 2012; Rogeberg & Elvik, 2016), and has become more prevalent in Canadian youth than alcohol-impaired driving (Boak, Hamilton, Adlaf, & Mann, 2017; Health Canada, 2013). In addition, Ogourtsova, Kalaba, Gelinas, Korner-Bitensky, & Ware (2018) found that young recreational cannabis users (ages 18 to 24) exhibited impairments in complex diving tasks and lower self-perceived driving ability and safety up to 5 hours following cannabis use.

Youth's attitudes and perceptions regarding the risks, acceptability, and prevalence of DUIC influences their engagement in this risky behavior (Holmes, Vanlaar, & Robertson, 2014). In order to develop effective and suitable strategies to prevent DUIC among this high-risk population, we must first establish young drivers' knowledge (constructed through modeled behavior, the outcomes of exploratory activities, and verbal instruction;

Bandura, 1986), perceptions (responses to information, perceived benefits or risks associated with a behaviour; Rosenstock, 1974) and attitudes (feelings of favorableness or un-favorableness towards an object, policy or behavior; Fishbein & Ajzen, 1975) around the use and legalization of cannabis in relation to driving. Such data is critical to the development of targeted interventions that can address the underlying issues related to DUIC prevention. Therefore, this study aimed to explore knowledge, perceptions and attitudes around cannabis and driving, in young drivers between the ages of 18 to 24, in the province of Ontario.

Following this introduction, Chapter 2 provides an overview of the current literature pertaining to cannabis use, the recent legalization of cannabis, and DUIC in Canada. In addition, this chapter provides an evidence-based description of the risks related to DUIC, the factors influencing this behaviour, and how this study applied the theoretical framework of general deterrence and general prevention to explore DUIC in young Ontarian drivers. Chapter 3 describes the study methods, including the theoretical positioning for this mixed-methods study, the overarching study design, and Phase's One (i.e., Describing DUIC profiles and identifying predictors) and Two (i.e., Understanding DUIC views and beliefs among young drivers) of the study. Phase One (quantitative) was utilized to inform the data collection of Phase Two (qualitative), making this data connection the first point of integration of the quantitative and qualitative components, the defining characteristic of a mixed- methods study (Morse & Niehaus, 2016). Chapter 4 presents the results for both the Phase One (quantitative) and Phase Two (qualitative). As such, Chapter 4 describes the DUIC profiles of young Ontarian drivers, indicates which factors can predict DUIC expectancy, and describes the values and beliefs of youth regarding the use of cannabis when driving. Key findings and the resulting implications are then discussed in Chapter 5. Data from both quantitative and qualitative phases are integrated in this chapter, making interpretation the second point of integration. Finally, Chapter six provides final concluding remarks.

Chapter 2

2 Background

2.1 Cannabis

Cannabis, also commonly referred to as marijuana, is the most prevalently used drug in Canada, especially among youth (Health Canada, 2019). The 2017 Canadian Tobacco Alcohol and Drugs survey reported that 14.8% (4.4 million) of Canadians had used cannabis in the past year, an increase compared to 2015 (12% or 3.6 million) and 2013 (11% or 3.1 million; Health Canada, 2019). In addition, cannabis use was more prevalent among youth between the ages of 15 to 19 years old (19%) and young adults between the ages of 20 to 24 (33%), than those ages 25 and older. Furthermore, initiation of cannabis use typically occurs between the ages of 17 and 18 years old (Health Canada, 2019).

Cannabis is known to have many short term effects including "euphoria and relaxation, changes in perception, time distortion, deficits in attention span and memory, body tremors, increased heart rate and blood pressure, and impaired motor functioning" (Gabrys & Porath, 2019, p. 2). These effects are dependent on several factors, such as the type of cannabis (i.e., plant/ strain), composition of cannabinoids, the mode of use, dosage, and an individual's tolerance.

There are two main types of cannabis plant: Cannabis Sativa and Cannabis Indica (World Health Organization, 2016). Many users refer to these types as the "strains". Medical cannabis users report Sativa is preferred for euphoria and enhancing energy, while Indica is useful for pain management, helping with sedation and sleep (Pearce, Mitsouras, & Irizarry, 2014). The plants themselves are composed of a diverse number of compounds known as cannabinoids. The two most common cannabinoids are delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD). THC is the main psychoactive component as it acts on neurotransmitters in the brain that affect cognition, emotion, and memory (World Health Organization, 2016). This compound is responsible for the "high" that individuals describe when consuming cannabis. Generally, THC is found in higher

concentrations than CBD in cannabis, though the content varies greatly between different sources and preparations (Ashton, 2001). Over the past few decades, improvements in cultivation have led to the increase in the concentrations of THC in illicit cannabis, from 4% in 1995 to 12% in 2014, while levels of CBD are decreasing (ElSohly et al., 2016). Recently, Smart, Caulkins, Kilmer, Davenport, & Midgette (2017) examined over 30 million legal retail cannabis sales in Washington between 2014 and 2016, revealing that THC concentrations in traditional dried cannabis (mot popular purchase) were on average 20.6%. If cannabis was manufactured into extracts for inhalation (e.g., cartridges for vaporizers; 21% of expenditures), then THC potency rose to an average of 68.7%. On the other hand, CBD does not have psychoactive properties but is often studied for its medical applications, such as relieving pain, appetite stimulation and mitigation of nausea (Kalant & Porath-Waller, 2016). More recent investigations into potential therapeutic uses of CBD products are underway for conditions such as multiple sclerosis, psychiatric disorders, epilepsy, inflammatory diseases, cancer, obesity, glaucoma and neurodegenerative disorders (Kalant & Porath-Waller, 2016).

The two most common modes of using cannabis are inhalation (i.e., smoking or vaporizing) and ingestion (i.e., through edibles). Given that the body has specific absorption methods and rates for each, they have different effects (Capler et al., 2017). When cannabis is inhaled, THC blood levels rise rapidly and generally decline over a one-hour period. When it is ingested, THC absorption gradually increases and peaks at around three to four hours, and then gradually declines. The peak concentration levels with ingestion are generally lower than with inhalation, however, its effects can be experienced as stronger (Capler et al., 2017). Among Canadians who have used cannabis in the past year, the Canadian Tobacco Alcohol and Drugs survey reports smoking was the most common mode of use, followed by mixing cannabis with alcohol, chasing (i.e., smoking a tobacco product right after smoking cannabis), consuming cannabis in edibles (e.g., brownies), and finally vaporizing (Health Canada, 2019).

Cannabis dosage and an individual's tolerance will influence the effects they experience. The greater the amount of cannabis consumed or higher THC blood levels, the greater the impairment (Bondallaz et al., 2016). In addition, those who use more frequently, such as

more than four times a week, are more likely to be tolerant to the impairment effects (Capler et al., 2017). Tolerance can also be a factor contributing to variation in effects between individuals. In a review on naturalistic and laboratory studies by Green, Kavanagh, & Young (2003), tolerance was suggested as a factor that may explain opposite cannabis effects being experienced by different individuals, as well as the same individual experiencing different effects between occasions of use. Overall, the impairing effects of cannabis are influenced by a complex interaction between the type of cannabinoids and the associated concentrations, method of use, dosage and an individual's tolerance. These factors can vary between producers, vendors, and an individual's occasions of use, making the effects of cannabis and their impact on a drivers' performance somewhat difficult to predict at any given time point.

2.1.1   Factors influencing cannabis use

A growing body of literature has explored the factors that influence cannabis use including personality traits, perceptions, motives, and availability of cannabis. These factors are interrelated and shape cannabis use through complex transactions. A comprehensive discussion of these factors is beyond the scope of this study, however, the following sections describe these factors briefly as they have been represented in the extant literature.

Personality characteristics have been recognized across the literature as factors that influence overall drug use, including cannabis. According to behavior change theories such as the Health Belief Model (Rosenstock, 1974), the Theory of Planned Behavior (Ajzen, 1985), and the Social Cognitive Theory (Bandura, 1986), personality influences an individual's beliefs and perceptions, which in turn influence behavior. Four primary personality traits have been associated with an increased risk of cannabis use: impulsivity (reacting to internal/external influences without considering possible negative outcomes); sensation seeking (pursuing exciting/thrilling/pleasurable or even dangerous activities); introversion/hopelessness (depressed affect which reflects depression-specific pathways to substance use); and anxiety sensitivity (fearing bodily sensations associated with arousal which induces substance use for their anxiety-relieving effects; Conrod, Pihl,

Stewart, & Dongier, 2000; Pearson, Hustad, Neighbors, Conner, & Bravo, 2018; Spriggens & Hides, 2015; Woicik, Stewart, Pihl, & Conrod, 2009). Individuals exhibiting these traits have been identified as having a greater likelihood of using cannabis.

Cannabis related perceptions including normative beliefs, internalization of college cannabis use culture, and perceptions around friend's use affect cannabis use behaviors (Pearson et al., 2018). Among college/university students, normative beliefs, consisting of descriptive norms (i.e., perceived prevalence, quantity, and/or frequency of cannabis use by others) and injunctive norms (i.e., the extent to which one believes that others approve/disapprove of one's cannabis use), are associated with the frequency with which an individual uses cannabis (Buckner, 2013; Neighbors, Geisner, & Lee, 2008; Pearson et al., 2018). Beliefs regarding the internalization of college cannabis use culture (i.e., degree to which cannabis is perceived to be an integral part of the college experience) interestingly mediated the relationship between personality and cannabis use, specifically for individuals with sensation seeking and impulsivity traits (Pearson et al., 2018). Perceptions of friends' cannabis use is also associated with cannabis use frequency and was demonstrated to have a stronger association than perceived injunctive norms for both current college students (Buckner, 2013) and those entering college (Neighbors et al., 2008).

An individual's motives also affect their likelihood to try and use cannabis. Simons, Correia, Carey, & Borsari (1998) established a five factor Marijuana Motives Measure, illustrating five motives that are significant predictors for cannabis use. Although the measure does not explicitly explore environmental conditions and their relationship with these five overall motive categories, the item content makes it evident that many of the factors are related to cultural and social understandings of cannabis, as well as with socially acceptable or normative behavior. The five motives include: enhancement (to get high, like the feeling, it's exciting, it's fun); conformity (to not feel left out, to be liked, to fit in with a group, peer pressure), which is related to beliefs around social norms; expansion (to know one's self better, to expand awareness, to be more creative, to think differently); coping (to forget worries, to cheer up mood); and social motives (to be sociable, to make social gatherings more fun, to celebrate special occasions). It is

interesting to note that these motives have also been associated with the four personality traits listed above. For example, Hecimovic, Barrett, Darredeau, & Stewart (2014) demonstrated that impulsivity traits were associated with using cannabis because it was readily available; sensation seeking traits were associated with cannabis use for expansion motives (and experimentation motives for initial cannabis use; Muro i Rodríguez, 2015); introversion/hopelessness traits were associated with cannabis use for coping motives; and lastly anxiety seeking traits were associated with cannabis use for conformity motives. Additional motives, not yet linked with personality, have also been strongly associated with cannabis use. Benschop et al. (2015) recently extended the Marijuana Motives Measure to include a sixth factor labelled routine motives (to relax, to sleep better, out of boredom, out of habit). Likewise, Lee, Neighbors, & Woods (2007) generated 19 motives using open-ended questions that were determined to be significant predictors of cannabis use. These motives support the Marijuana Motives Measure and introduced new motives such as experimentation, activity enhancement (specific to an activity), rebellion, and relaxation.

Cannabis use is also influenced by an individual's perceptions of availability and actual availability of cannabis. Several studies reveal that individuals who believe they can successfully obtain cannabis have a greater chance of using it (Knibbe et al., 2005; Piontek, Kraus, Bjarnason, Demetrovics, & Ramstedt, 2013; Schuermeyer et al., 2014). Likewise, those who have cannabis readily available or accessible are also more likely to use (ter Bogt et al., 2014).

Although these factors cannot be explored in isolation, many of the abovementioned sources explore their influences as such, in an attempt to understand the mechanisms of influence and derive hypotheses for targeted intervention strategies. Beyond empirical evidence, however, one theoretical approach in particular has attempted to understand the relationship between some of these factors and the environmental conditions that influence and are influenced by them. According to Social Cognitive Theory (Bandura, 1986), the likelihood of an individual using a substance, such as cannabis, is a result of their outcome expectancies or the beliefs regarding the positive and negative consequences of cannabis use; as well as refusal self-efficacy, that is the confidence that

an individual has the ability to resist or refuse cannabis in specific situations. These mechanisms of social cognition, namely cannabis outcome expectancy which largely reflects motives, and refusal self-efficacy, have a related influence on cannabis use. This in turn, is also mediated by factors such as personality traits (Papinczak, Connor, Harnett, & Gullo, 2018). Recently, Papinczak et al. (2018) found that individuals with heightened reward sensitivity personality traits (to which cannabis use is motivated by positive reinforcement) experience greater cannabis outcome expectancies and are therefore more likely to use cannabis. Additionally, individuals with greater rash impulsiveness, meaning they are prone to use cannabis without regard for future negative consequences, have lower refusal self-efficacy and are more likely to use cannabis. The authors suggest that efforts to prevent cannabis use should target social cognition rather than the personality traits in isolation.

In summary, the extant literature supports a myriad of personal and social factors that influence cannabis use and has illuminated some of the existing relationships between them as they influence cannabis use behaviors. Of particular relevance for the current study, however, are the factors influencing DUIC, a decision that represents a public health safety risk. Thus, understanding the current landscape of DUIC is critical to the exploration of youth knowledge, perceptions and attitudes.

2.2   Driving under the influence of cannabis (DUIC)

2.2.1   Cannabis legalization and DUIC

Up to October 17, 2018, Cannabis was classified as a Schedule II drug, meaning the Canadian federal government had categorized it as having a higher-than-average potential for abuse or addiction (Controlled Drugs and Substances Act, 1996). Moreover, the production, distribution, sale and possession of cannabis for non-medical purposes was illegal in Canada and could result in substantial penalties such as incarnation and/or a criminal record (Controlled Drugs and Substances Act, 1996; Criminal Code, 1985).

Recently, the Cannabis Act (Bill C-45) came into force and legalized recreational cannabis use for those 18 years of age and older across Canada (Government of Canada, n.d.). With the exception of Quebec and Alberta, however, most provinces are enacting legislation only for those 19 years of age and older. The purpose of the Cannabis Act is to develop a legal and regulatory framework for the production, distribution, sale and possession of cannabis in Canada (Cannabis Act, 2018). The regulations within this framework include imposing strict criminal penalties for selling or providing cannabis to those under 18 years of age (Cannabis Act, 2018), as well as amending the Criminal Code to increase current penalties for those engaging in DUIC (Statutes of Canada, 2018).

The Canadian federal government anticipates many potential benefits of this legislation including: protecting youth by restricting access and promotion to those under 18; protecting public health through strict product safety and quality requirements; deterring and reducing criminal activity (e.g., selling to youth, selling outside of the regulatory framework and DUIC) by imposing serious criminal penalties (Cannabis Act, 2018); and reducing the burden on the criminal justice system by removing simple possession offences (Government of Canada, 2016). However, international experiences reveal that a potential unintended consequence of cannabis legalization may be an increase in cannabis use among youth and greater rates of DUIC.

The first three states in the United States (U.S.) to legalize cannabis for recreational use for adults ages 21 and older were Washington and Colorado in 2012, and Oregon in 2014. Data from the U.S. National Survey on Drug Use and Health revealed that past year cannabis use increased significantly among those ages 18 to 25 from 2014 to 2016 in both Washington (35% to 38%) and Oregon (39.8% to 44%; Substance Abuse and Mental Health Services Administration, n.d.). Likewise, significant increases in cannabis use were reported post legalization among high school students (Cerdá et al., 2017) and university students (Miller, Rosenman, & Cowan, 2017) in Washington, along with university students in Oregon (Kerr, Bae, Phibbs, & Kern, 2017). In the state of Colorado, however, no significant changes were observed in the past year or past 30 day prevalence of cannabis use among adults between 2014 (once legal sale of cannabis

became available) to 2015, and adolescence between 2013 to 2014 (Colorado Department of Public Health and Environment, 2016; Ghosh et al., 2017). However, the National Survey on Drug Use and Health state cannabis use in 2014 and 2015 were higher overall than from 2002 to 2013 (Substance Abuse and Mental Health Services Administration, 2016). In addition to the changes in prevalence, and in spite of Colorado's recent stable rates of use among youth, evidence shows that recreational legalization significantly decreased the perception of risk associated with regular cannabis use among youth in each of these states (Cerdá et al., 2017; Ghosh et al., 2017; Kerr et al., 2017).

In a Canada-based 2018 survey, three in ten Canadians indicated they would likely use cannabis for recreational purposes once it became legal (IPSOS, 2018). Furthermore, among youth, 8% of Ontario students in grades seven to twelve indicated they intended to try cannabis once it was legal, with 4% indicating they would use it more often and 14% unsure of their intentions (Boak et al., 2017). Although it will remain illegal to use cannabis for those under 18, if the Canadian experience with legalization is similar to that in the U.S. (where it is illegal to use under the age of 21), we may observe an increase in cannabis use among youth (Palamar et al., 2014).

Increased cannabis use among Canadian youth is a significant concern as it can lead to DUIC. Early onset of cannabis use (under 21 years old) has been associated with both experiencing cannabis dependence (assessed using The National Institute on Alcohol Abuse and Alcoholism's Alcohol Use Disorder and Associated Disabilities Interview Schedule) and DUIC (Le Strat, Dubertret, & Le Foll, 2015). For example, in a 2015 study by Le Strat and colleagues, youth who used cannabis before the age of 14 (grade ten) were three times more likely to DUIC than those who started using after age 21 (Le Strat et al., 2015). It is still unclear what influence the legalization of cannabis may have on the driving habits of young drivers in Canada. However, predictions can be made based on evidence of the legalization experiences within the U.S. and our current knowledge on Canadian youth.

Further evidence from Washington, Colorado, and Oregon suggests that recreational legalization increased the prevalence of DUIC and the number of MVC fatalities

involving cannabis. Specifically, when Washington went from medical to recreational legalization in 2012, fatal MVC's that involved cannabis rose 31.2% relative to states with only medical legalization (i.e., Hawaii, Montana, and New Mexico; J. Lee, Abdel-Aty, & Park, 2018). These findings are consistent with Tefft, Arnold, & Grabowski (2016), who reported that in Washington, the American Automobile Association Foundation for Traffic Safety found that the percentage of those involved in a fatal MVC that tested positive for THC rose from 8% to 17% from 2013 to 2014. Similarly, the frequency of drivers in fatal crashes that tested positive for THC (alone or with other drugs) was highest in 2014 (75 drivers) compared to the previous four-year average (36 drivers; Washington Traffic Safety Commission, 2016). In Colorado, there was a 63.1% relative increase in fatal MVC's that involved cannabis after recreational legalization replaced a combination of decriminalization and medical legalization (relative to California and Nevada, where it remains decriminalized and medically legalized; J. Lee et al., 2018). Moreover, according to Ghosh et al. (2017), driving under the influence charges with cannabis noted as an impairing substance (alone or with other drugs) were 16% higher in 2016 than 2014 in Colorado. Additionally, fatalities of drivers that tested positive for active THC increased 75% from 2015 (44) to 2016 (77), with a 168% increase in those testing over the impairing limit of 5 ng/ml (nanograms/milliliter) of THC from 2015 (19) to 2016 (51; Colorado Department of Transportation, 2017). Lastly, when examining variation in state-wide cannabis policies and pre and post- legalization collision data from 2009 to 2015 in Washington, Colorado, and Oregon, Vogler (2017) estimated that legalization increased quarterly (3-month) vehicle fatality rates by 7.8%, which is equivalent to approximately 52 fatalities per year relative to states without recreational legalization. Although the latter does not necessarily mean drivers were impaired by cannabis at the time of the MVC, this finding shows prevalence of cannabis detected among fatally injured drivers has increased following recreational legalization. Overall, evidence from these states strongly suggests that recreational cannabis legalization increases DUIC and MVC fatalities involving cannabis.

In Canada, legislation will permit cannabis use for individuals 18 years of age and older (unlike the 21-years of age limit in the US). As such, the 18 to 24 years of age

demographic, which currently has the highest rates of cannabis use and the highest risk for impaired driving (Jonah, 2013; Statistics Canada, 2016a), constitutes a high-risk population. Young drivers' increased risk-taking behaviors and lack of driving experience position them at a greater risk for a MVC relative to other age groups (Holmes et al., 2014). Even when not impaired by drugs or alcohol, drivers ages 20 to 24 have a fatality crash rate that is almost three times as high as that of drivers aged 25 to 34 and over five times as high as drivers aged 45 to 54 (Mayhew, Simpson, & Singhal, 2005). With regards to impaired driving, Jonah (2013) found that Canadian youth ages 20 to 24 were the age cohort that expressed the least concern about DUIC when compared to other age groups, followed by those ages 16 to 19. These findings suggest that this population may be less aware of the risks associated with DUIC, which is concerning considering the recent cannabis legalization and their high-risk status. The risks that legalization poses on this population are reflected in public opinion. A recent Canadian Automobile Association national poll revealed that 69% of Canadians are concerned that roads will become more dangerous with cannabis legalization (Canadian Automobile Association, 2017). Many individuals fear an increase in DUIC and that law enforcement lacks the tools and resources to appropriately address this problem. If this legislation increases youth cannabis use and alters their knowledge, perceptions and attitudes associated with cannabis and driving, they can be at a greater risk for DUIC. But several factors influence cannabis use and DUIC in Canada. Exploring the current understanding of such factors informs and situates this study.

2.2.2   DUIC in Canada

DUIC poses a public health and safety risk to all road users. In 2012, MVC's across Canada resulting from DUIC were estimated to have caused 75 fatalities, 4407 injuries, and 7794 people involved in property damage only collisions, totaling over a billion dollars in associated costs ($1,094,972,062; Wettlaufer et al., 2017). DUIC is also increasing in prevalence across Canada, especially in young drivers. The percentage of fatally injured drivers who were tested for drugs and tested positive for cannabis rose from 12.4% in 2000 to 18.6% to 2014 (Traffic Injury Research Foundation, 2017). In

addition, Canadian law enforcement reports the drug-impaired driving rates have been increasing since 2009 (Statistics Canada, 2016a). Roadside tests indicate approximately 4% to 6% of all drivers have driven within two hours of using cannabis within the previous year (Beirness & Beasley, 2010; Capler et al., 2017). Amongst cannabis users, population surveys reveal about 20% reported they engaged in DUIC within two hours of use (Capler et al., 2017). Moreover, between 2000 and 2012, 15.5% of fatally injured drivers who were tested for drugs tested positive for cannabis (Robertson, Mainegra Hing, Pashley, Brown, & Vanlaar, 2017). In addition, public opinion reflects the increasing trends of DUIC. Amongst Canadian drivers, 58% expressed concerns regarding DUIC, 68% agreed that cannabis use impairs driving, and 41% believe that DUIC has been increasing over the last five years (Jonah, 2013). Additionally, around one in five Canadians (22%) say they have been a passenger in a vehicle where the driver has consumed cannabis (Canadian Automobile Association, 2017).

Young drivers, however, have the greatest prevalence and express the least concern regarding DUIC. Between 2000 and 2015, an average of 6.1% of Canadian young drivers ages 16 to 24 reported driving within two hours of using cannabis in the previous year (Robertson et al., 2017). Among those fatally injured drivers who were tested for drugs, drivers under 24 had the largest percentage (24.8%) that tested positive for cannabis (Robertson et al., 2017). Many young drivers first engage in DUIC behavior during high school. In 2014-2015, 4.7% of Canadian grade 11 to 12 students (ages 16 to 18) reported driving within two hours of using cannabis in the last 30 days and 9.4% at least once in their lifetime (Minaker et al., 2017). Additionally, 20% of students reported being a passenger with a driver who was DUIC. In Canada, DUIC has become more prevalent among youth than alcohol-impaired driving (Boak et al., 2017; Health Canada, 2013). According to a public opinion survey, Canadians ages 20 to 24 expressed the least concern regarding DUIC compared to all other ages, yet they were most likely to agree that cannabis impairs driving ability (Jonah, 2013). Canadians in this age range also perceived there was a low chance (lowest of all other age ranges) of being stopped and charged by police for DUIC. This suggests that youth may be less aware on the risks associated with DUIC, in spite of the threat this poses to public health and safety.

2.2.3 Risks related to DUIC

There are two primary risks associated with DUIC: first and foremost, the risk of a MVC, and second, the risk of legal repercussions. A number of reviews in the literature have demonstrated that cannabis use impairs driving capacity and increases the risk of a MVC, especially fatal crashes (Asbridge et al., 2012; Bondallaz et al., 2016; Capler et al., 2017; Li et al., 2012; Rogeberg & Elvik, 2016), with varied odds ratio (OR) across studies. OR is a statistical term used to express association between exposure and an outcome, where an OR of 1 indicates no increased risk of the outcome occurring, and an OR of 4, for example, indicates four times the risk. A systematic review by Asbridge et al. (2012) indicated DUIC was associated with an almost doubled risk of MVC's compared with unimpaired driving (OR 1.92). A similar review by Li et al. (2012) concluded a pooled OR of 2.66, although the crash risk reported in these studies ranged from an OR of 0.85 to 7.16. A later review by Rogeberg & Elvik (2016) that was meant to replicate results of the two previous ones with some corrections in methodology, concluded a pooled OR of 1.22 (1.11- 1.36). This suggests a 20-30% increase in MVC risk from cannabis. Recently, Ogourtsova et al. (2018) tested young recreational cannabis users (ages 18 to 24) one, three and five hours following cannabis use (100mg dose, 12.9% THC). Findings suggest complex driving-related performance was affected (assessed with useful-field-of-view tasks) and participants were more likely to be classified as having a high crash risk on the basis of driving simulator tasks (OR 4.31). In addition, youth reported significantly lower perceived driving ability and safety after using cannabis up to five hours relative to no cannabis. Overall, findings from these studies indicate that DUIC increases MVC risk. The effects of cannabis that can compromise driving performance include: impairment of lane position, short distance/time between vehicles, low dynamic tracking, distorted perception of time, increase in braking and reaction times, and reduction in divided and sustained attention (Anderson, Rizzo, Block, Pearlson, & O'Leary, 2010; Capler et al., 2017; Riedel & Davies, 2005; Watson & Mann, 2016).

As previously discussed, there are many factors that can influence the effect of cannabis and an individual's level of impairment. In relation to driving, evidence reveals those

who inhale cannabis (e.g., smoking or vaporizing) will have impaired driving skills for at least two and up to four hours after consumption, whereas those who ingest cannabis orally (e.g., eating or drinking) could experience impairment up to six hours after use (Capler et al., 2017; Kelly, Darke, & Ross, 2004; Rogeberg & Elvik, 2016). With regards to dosage, epidemiological studies have suggested that a THC blood concentration of 2-5 ng/ml is generally associated with impairment and an increased MVC risk (Busardo et al., 2017; Hartman & Huestis, 2013).

The second main risk factor of DUIC involves legal repercussions. Impaired driving from cannabis can result in and will remain a criminal offence under the Criminal Code of Canada, even after legalization. New legislation permits Canadian law enforcement to demand an oral fluid sample using an approved drug screening device and/or conduct Standard Field Sobriety Testing if they suspect a driver is impaired (Royal Canadian Mounted Police, 2018). Depending on the results of these tests, drivers may be arrested and brought to a police station to receive a 12-step evaluation from a Drug Recognition Expert and/or have blood drawn from a trained medical technician. If drivers are deemed impaired or fail to comply, this will result in a criminal offence. Penalties for criminal offences are uniform across all Canadian jurisdictions and may include license suspension, fines (suspension and a minimum fine of less than $1,000 for a first offence), incarceration (jail time for at least 30 days for a second offence and at least 120 days for every subsequent offence), periods of probationary sentences, and substance abuse education or treatment (Criminal Code, 1985; Government of Canada, 2017). Individuals convicted of impaired driving causing bodily harm can be sentenced to prison for a maximum of 10 years, and those convicted of impaired driving causing death can be sentenced to prison for life. Apart from criminal penalties, provincial, state or territorial governments may have additional administrative laws and penalties such as 24-hour roadside license suspension, vehicle impoundment, seven-day license suspension and additional fines.

2.2.4   Factors influencing DUIC

There is a large body of literature exploring the factors that influence an individual's decision to DUIC. Initially, characteristics of an individual's cannabis use behaviors may predispose their risk for DUIC. For example, drivers who use cannabis more frequently (Bergeron & Paquette, 2014; Fischer et al., 2014), at heavier doses (Davis et al., 2016), and with other substances such as alcohol, illicit, and/ or non-medical drugs (Capler et al., 2017), have been associated with a higher likelihood of DUIC. Additionally, those experiencing cannabis dependence (assessed with the Severity of Dependence Scale; Gossop, Best, Marsden, & Strang, 1997; Gossop et al., 1995) were found to be more than twice as likely to report DUIC in the past year (Jones, Swift, Donnelly, & Weatherburn, 2007). Moving beyond characteristics of use, this decision is influenced by an individual's knowledge, perceptions and attitudes with regard to DUIC, similar to how such factors influence cannabis use in the first place.

A visual depiction illustrating the multiple factors that influence DUIC, and the intricate relationship between them, is depicted in Figure 1. Using pertinent literature and theoretical models such as the Theory of Reasoned Action (Fishbein, 1979), the Theory of Planned Behavior (Ajzen, 1985), the Health Belief Model (Rosenstock, 1974) and the Social Cognitive Theory (Bandura, 1986) - which have frequently been applied to study the factors influencing risky driving behavior and DUIC – this visual depiction outlines the relationships between cannabis use and the factors influencing DUIC.
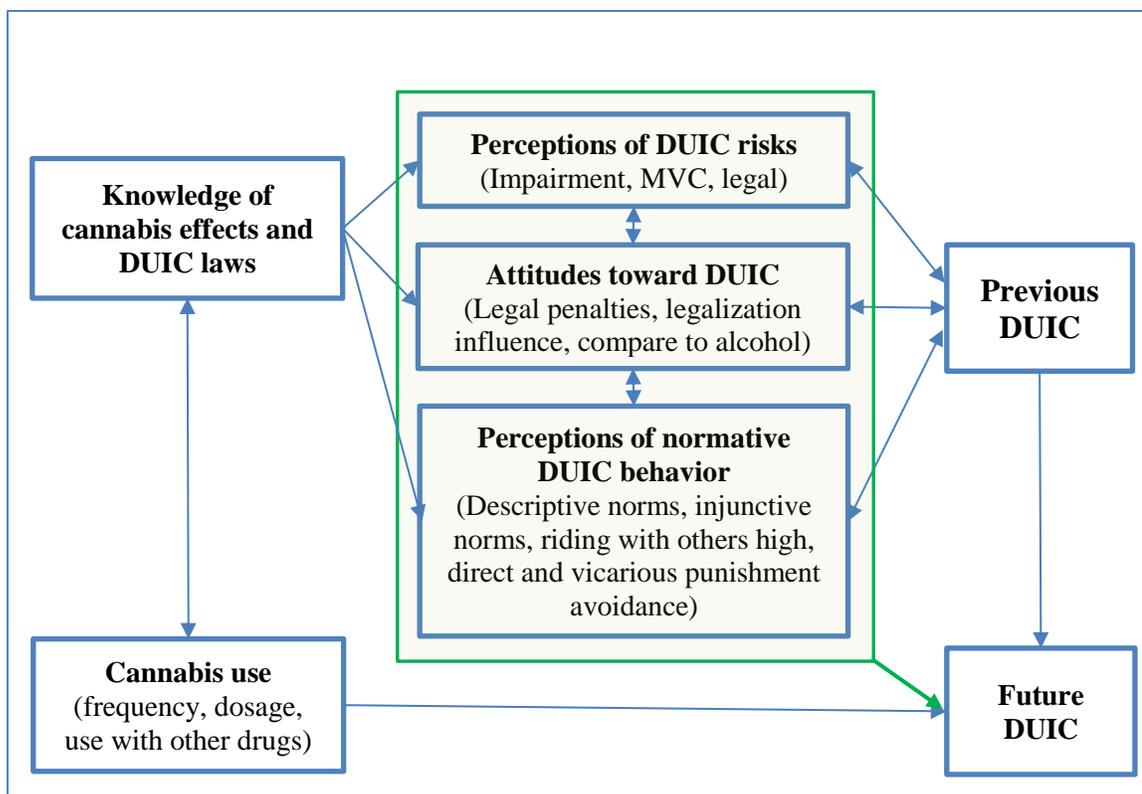
Figure 1: Conceptualization of factors influencing DUIC. This visual depiction was derived from current literature around cannabis use, as well as theoretical models that address the determinants of behaviour and action

2.2.4.1   Knowledge of cannabis effects and DUIC laws

An individual's knowledge regarding the risks of DUIC can distally influence their decision of DUIC. Behavioral theories such as the Health Belief Model (Rosenstock, 1974) and Social Cognitive Theory (Bandura, 1986) contend that an individual's perceptions and attitudes about a behavior, which directly influences behavior, are shaped by their knowledge. In this case, youths' knowledge on the effects of cannabis and DUIC legal repercussions can influence their perceptions and attitudes and in turn, influence DUIC.

However, the current literature has demonstrated that youth lack accurate knowledge regarding the risks of DUIC. A public opinion poll revealed only 48% of Canadian youth ages 16 to 19 recognized the danger of DUIC, compared to 79% recognizing the risk of

alcohol impaired driving (Jonah, 2013). Similarly, a study by the Canadian Center on Substance Use and Addiction revealed that youth can list risks associated with driving while high, but lack adequate understanding of why and how cannabis affects driving (McKiernan & Fleming, 2017). It seems youth may still be unaware of the impairing effects that cannabis has on driving and the risk for MVC's. In terms of DUIC laws and legal repercussions, Jonah (2013) found the majority of Canadians under the age of 24 were aware that drug impaired driving is a Criminal Code offence. Likewise, the Mckiernan & Fleming (2017) study stated that "youth were aware that getting caught driving high would result in the same punishment as being caught driving while impaired by alcohol" (p. 24), yet youth were often unaware of the specific legal ramifications of DUIC and the likelihood of apprehension. In addition, these studies were conducted before the existence of the legalization bill and thus such perceptions might have changed. The lack of knowledge can influence perceptions of risk (Capler et al., 2017) and may be a factor influencing the high rates of DUIC within this demographic. Davis et al. (2016) found that increased knowledge of DUIC laws is associated with lower odds of DUIC.

Therefore, determining the current state of knowledge specifically within the sample of this study is important to understand how their knowledge influences their perceptions and attitudes regarding DUIC. This is imperative considering perceptions and attitudes are both known determinants of impaired driving.

2.2.4.2   Perceptions of DUIC risks

Previous research has demonstrated that the perceived risks of DUIC (i.e., risk of impairment, risk of a MVC, risk of legal repercussions) influence DUIC (Capler et al., 2017). Specifically, individuals who believe cannabis impairs driving performance and that it is unsafe, report no future intention of DUIC (Davis et al., 2016; Ward et al., 2017). Furthermore, greater perceived dangerousness of DUIC (Arterberry et al., 2013; Aston, Merrill, McCarthy, & Metrik, 2016; McCarthy, Lynch, & Pedersen, 2007) followed by negative marijuana legal repercussions (Arterberry, Treloar, & McCarthy, 2017; Arterberry et al., 2013) are associated with a decreased likelihood of DUIC.

Perceptions of MVC risk have been shown as a more important contributor to DUIC activity than perceptions of legal repercussions (Capler et al., 2017).

Although, to date, no studies have specifically examined the perceptions of youth regarding cannabis recreational legalization and DUIC. Canadian youth seem to have mixed perceptions regarding cannabis use and DUIC to begin with. In fact, Mckiernan & Fleming (2017) expressed "regardless of [their] knowledge, participants felt youth did not care about the dangers of cannabis-impaired driving" (p. 23) and that "youth were not concerned with being reprimanded for driving while high or driving with cannabis in the vehicle" (p. 34). In addition, some youth believed cannabis has a negative influence on driving (i.e., slower reaction times and reflexes, impaired cognitive functions and motor skills, and distort perceptions of time and space), while others believed it has a positive influence (i.e., more careful on the road; since he or she is more aware of their impairment and would not want to get caught by police; Mckiernan & Fleming, 2017).

In terms of legal repercussions, only about a quarter of Canadian drivers in a 2013 study thought that it was very likely that a driver impaired by cannabis would be stopped and charged, with beliefs of lowest probability common among those in the 20 to 24 age range (Jonah, 2013). More recently, youth ages 14 to 19 often have not heard of any peers reprimanded for DUIC or driving with cannabis in the vehicle, as well they believe that law enforcement may not currently have the capacity to detect if a driver has used cannabis or not (McKiernan & Fleming, 2017). This will influence how credible they believe the law to be, which may influence their future intentions to drive under the influence (Berger, Snortum, Homel, Hauge, & Loxley, 1990; Taxman & Piquero, 1998). Although youth may be knowledgeable on the risks, the way they perceive these may be different. Therefore, assessing both knowledge and perceptions of risk are crucial to better understand DUIC behavior of this demographic.

2.2.4.3   Attitudes toward DUIC

Attitudes around cannabis and impaired driving influence an individual's decision to DUIC. Attitude refers to a person's general feeling of favorableness or un-favorableness

towards an object, person, group, situation, policy or institution, or even towards a behavior (Fishbein & Ajzen, 1975). This section will explore attitudes towards DUIC behaviour and attitudes towards DUIC laws.

Positive attitudes toward DUIC have been demonstrated to increase the probability of reporting past DUIC behavior, general DUIC willingness, and future DUIC intention (Ward, Schell, Kelley-Baker, Otto, & Finley, 2018). Drivers who have a positive attitude towards DUIC, felling it is enjoyable, were 3.5 times more likely to have the intention to DUIC in the next six months (Ward et al., 2017). Mckiernan & Fleming (2017) reported that Canadian youth lacked attitudes of concern towards DUIC and the risk for MVC's. Youth often compared DUIC to alcohol-impaired driving, stating that DUIC is safer and that they have never (or rarely) heard of MVC's due solely to cannabis. Attitudes toward DUIC laws can also influence DUIC behavior. Previous research has demonstrated that those with negative attitudes towards traffic safety and low respect for law and authorities will engage in more risk-taking while driving (Ulleberg & Rundmo, 2003). Considering Canadian youth have expressed that their peers and themselves do not care about cannabis laws (McKiernan & Fleming, 2017), they may be at a greater risk for DUIC.

Since many Canadians, including youth, have already expressed intent to use cannabis once legal (Boak et al., 2017; IPSOS, 2018), it is worth exploring youth's attitudes towards cannabis legalization and how this may influence DUIC. Mckiernan & Fleming (2017) revealed a majority of Canadian youth in their study were in support of legalization, although many lack knowledge and clarity regarding the current legal status of cannabis and its effect on driving. Several studies internationally have suggested that support for cannabis legalization is higher among current and past cannabis users than those who have never used and that as the number of cannabis users in the population increase, so will support for legalization (Palali & van Ours, 2017; Trevino & Richard, 2002; J. Williams, van Ours, & Grossman, 2016). Understanding youths' general feelings toward DUIC, DUIC laws, and the influence of legalization on DUIC can help develop strategies targeting this high-risk population.

2.2.4.4   Perceptions of normative DUIC behavior

Lastly, perceptions on normative behaviors also influence an individual's decision to drive following cannabis use. These beliefs include descriptive norms- the perceived prevalence of peers engaging in DUIC- and injunctive norms- the perceived peer acceptance or approval towards DUIC-, and have been associated with an individual's intention and willingness towards DUIC (Aston et al., 2016; Ward et al., 2018). Individuals who perceived that DUIC is normative have been associated with a greater history of DUIC (Aston et al., 2016; Ward et al., 2018). Likewise, individuals who perceived that most drivers think DUIC is enjoyable had an increased likelihood of DUIC (Ward et al., 2017). In terms of injunctive norms, those who perceived that important others would be disappointed about their own DUIC have a lower likelihood of reporting DUIC behavior (Aston et al., 2016; Ward et al., 2017, 2018). Injunctive social norms were associated with decreased likelihood of riding with a high driver (Arterberry et al., 2013). Secondary to peers, adults have an influence on DUIC behavior. Youth who reported more frequent experiences of riding with adults that drink alcohol or use cannabis and drive have a higher risk of DUIC (Leadbeater, Foran, & Grove-White, 2008). Lastly, an individual's knowledge of others who have avoided punishment for driving following drug use (vicarious experiences of punishment avoidance) influence future drug driving likelihood (Armstrong, Watling, & Davey, 2018; Watling, Palk, Freeman, & Davey, 2010).

Canadian youth have expressed that they have not heard of many of their peers being caught and punished for DUIC (McKiernan & Fleming, 2017). Additionally, many who were unaware of the risk for apprehension and legal ramifications of DUIC had opinions that were formed through what they heard from friends or older peers and siblings. This is concerning since youth DUIC may be unaware or misinformed on the risks. Determining the extent to which perceived peer behaviors influence an individual's perception toward DUIC is important to identify their risk for future DUIC.

Summary

Overall, this section has described a number of factors that influence an individual's decision to DUIC. The extant literature, however, has explored each of these factors in isolation and not specifically in relation to DUIC within the Canadian context. Now that recreational cannabis is legal across Canada, the landscape in which these factors influence cannabis use and DUIC has changed. Additionally, based on the experiences of other countries, legalization may result in an increase in DUIC among young drivers, an already high-risk population. However, there is a lack of evidence regarding Canadian young drivers' knowledge, perceptions and attitudes around cannabis use and driving. Understanding such information is critical to the development of targeted interventions that can address the underlying issues related to DUIC prevention. Thus, this study aims to explore the knowledge, perceptions, and attitudes of young Ontarian drivers between the ages of 18 to 24 as factors that can influence DUIC. This study will utilize the general deterrence and general prevention framework as a way to systematically examine the evidence-based factors influencing DUIC and establish the relationships between them and potential DUIC behavior.

2.3   General deterrence and general prevention

The theoretical framework of general deterrence and general prevention has been used in alcohol literature to investigate predictors of alcohol impaired driving (DUI) behavior by establishing DUI risk profiles. Risk profiles are conceptualized as the sum of general deterrence (knowledge and credibility of DUI laws) and general prevention (personal attitudes towards DUI and the influence of social controls) constructs, as well as past driving experiences and future DUI expectancy (Berger & Marelich, 1997; Berger et al., 1990; Pinsky, Labouvie, Pandina, & Laranjeira, 2001; Snortum & Berger, 1989; Snortum, Hauge, & Berger, 1986, 1988). Although comprehensive, this framework has yet to be applied to DUIC and drug impaired driving. Doing so could prove to be beneficial, as it would allow the systematic examination of various factors influencing cannabis use and DUIC, within the same data collection method (i.e., survey). Thus, the framework will be utilized to frame this study's survey (Phase One).

General deterrence refers to strategies designed to prevent crime in the general population through fear of legal repercussions. Classical deterrence theory describes than an individual will be deterred from committing a criminal act when they perceive the certainty of apprehension as high, the punishment as severe, and the administration of punishment as swift (Taxman & Piquero, 1998). In this sense, general deterrence refers to an individual's control in response to fear of punishment. General deterrence is based on an individual's knowledge of the laws and perceived credibility of the laws (how strongly they believe the laws will be enforced).

General prevention expands the concept of deterrence by referring to the process whereby a law changes personal perceptions and social norms overtime, which in turn determine behavior (Berger et al., 1990; Snortum et al., 1986, 1988). Evidence suggests that enacting a new law can change moral values, provide education on the law/behaviour's importance and build peer pressure for compliance (Snortum et al., 1986). Thus, general prevention refers to personal attitudes (i.e., includes the relationship of substance use and being a dangerous driver, opinions on DUI penalties, moral awareness and the risk of a MVC; Pinsky et al., 2001), and social controls, based on observations of actions of family, friends, peers, and society at large (Berger & Marelich, 1997).

For the purposes of this study, the use of this framework informs the selection of constructs to explore, the selection of question items, and data analysis. This is especially helpful in this regard considering that prior alcohol-related literature has established the predictive validity of each of the factors included in a risk profile on the general deterrence and the general prevention of impaired driving. Thus, the use of this framework can enable a future comparison with alcohol-related risk profiles while ensuring the various factors captured in the literature to date are explored and analyzed in a systematic manner. In addition, the focus on general deterrence and general prevention provides a helpful approach to develop targeted interventions based on problematic factors, a long-term objective of this study.

Table 1: Mapping of the reviewed existing DUIC literature onto the framework of general deterrence and general prevention (Pinsky et al., 2001)

Factors influencing DUIC as identified in the literature	Corresponding constructs under the general deterrence and general prevention framework
Knowledge DUIC laws	Knowledge of the law concerning the behaviour
Perceptions of DUIC legal risks	Credibility of the law concerning the behaviour
Knowledge of cannabis effects	Personal attitudes toward the behaviour
Perceptions of DUIC risks	
Attitudes toward DUIC	
Perceptions of normative DUIC behavior	Social controls toward the behaviour
	Riding experiences

Table 1 depicts how the evidence-based factors identified in previous DUIC literature can be mapped unto the theoretical constructs of general deterrence and general prevention. While most factors influencing DUIC fit within this framework, some that are specific to cannabis use and DUIC are not encompassed. Therefore, adjustments were necessary to ensure that the study could benefit from using this framework, while capturing the necessary variables related to DUIC. First, since general deterrence focuses exclusively on legal repercussions, it does not account for the knowledge or perceptions of dangers that cannabis poses specifically on driving. Thus, this study will incorporate the knowledge of the effects of cannabis variable in the personal attitudes section within general prevention (as shown in Table 1). Similarly, the framework does not account for an individual's perceptions of DUIC risks. These include subjective beliefs regarding the risk that cannabis poses on their own driving performance (i.e., perceived dangerousness and accident risk). Research shows that these subjective perceptions influence future willingness of DUIC (Capler et al., 2017; Davis et al., 2016). Thus, the perceptions of DUIC risks component will also be added in the personal attitudes section within general prevention. Both of these were added under personal attitudes (see Table 1) to allow

general deterrence constructs to continue to focus exclusively on the legal repercussions. Next, it does not account for an individual's direct experiences of punishment avoidance (personally avoiding punishment for driving following drug use) and vicarious experiences of punishment avoidance (knowledge of others who have avoided punishment for driving following drug use), which has been shown to influence future drug driving likelihood (Armstrong et al., 2018; Stafford & Warr, 1993; Watling et al., 2010). Therefore, this section will be incorporated within social controls. Lastly and unique to this study, the framework does not account for the influence that a legislative change such as legalization may have on future DUIC expectancy. This will be explored as a part of the DUIC expectancy variable. With these modifications in place, this study will use the framework of general deterrence and prevention to explore cannabis use and DUIC within this high-risk population (see Figure 2). Figure 2 captures the various factors corresponding to the framework that will be explored as potential predictors of DUIC expectancy, that is, whether individuals expect they will engage in DUIC behaviors in the future.
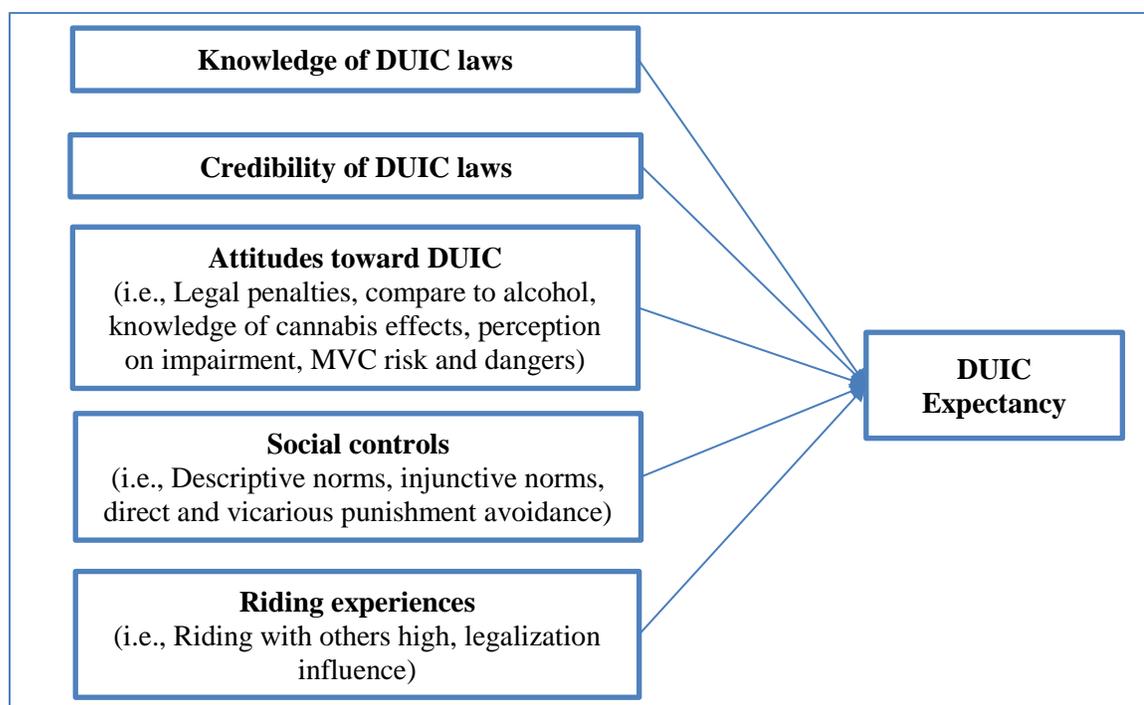
Figure 2: Potential determinants of DUIC expectancy that will be explored through Phase One of this study.

2.4 Objectives

The **primary objective** of this study is to examine the knowledge, perceptions and attitudes of young Ontarian drivers between the ages of 18 to 24 years regarding cannabis use and DUIC. Based upon the theoretical framework of general deterrence and general prevention, this study will lay the foundation for the development of targeted cannabis-impaired driving education and intervention strategies for young Ontarian drivers. The primary objective will be achieved via three specific aims:

Specific Aim 1: To describe the DUIC profiles of young Ontarian drivers.

Specific Aim 2: To establish the predictive validity of general deterrence (knowledge and credibility of DUIC laws) and general prevention (personal attitudes and social controls) measures on the DUIC expectancy of young Ontarian drivers

Specific Aim 3: To understand the perceptions and attitudes of young Ontarian drivers regarding the use of cannabis when driving, and understand the values and meanings attributed to such perceptions.

Chapter 3

3 Methods

3.1 Philosophical approach

An important consideration in any research approach involves "the intersection of philosophy, research designs, and specific methods" (Creswell, 2014, p. 5). The following sections will outline the philosophical worldview in which this study is positioned, the related research design, and the specific methods used to operationalize this approach.

This study adopts a pragmatic philosophical worldview. Creswell (2014) describes 'worldview' as a "general philosophical orientation about the world and the nature of research that a researcher brings to a study" (p. 6). The four main worldviews that are widely discussed in the literature include post positivism (connected to quantitative research; focuses on empirical observation, measurement, and theory verification), constructivism (connected to qualitative research; focuses on social and historical construction and theory generation), transformative (focuses on a political change agenda to confront social oppression), and pragmatism (connected with mixed methods; focuses on a research problem and using all approaches available to understand it; Creswell, 2014). Pragmatism was chosen because it is not committed to any one system to explore and understand a phenomenon, but rather integrates different perspectives and approaches. As stated by Creswell, positioning one's research from a pragmatic worldview allows for the use of multiple research methods, the integration of different assumptions, and the use of different forms of data collection and analysis suited to the research questions (Creswell, 2014). In addition, "many (or most) mixed methods writers have argued for some version of pragmatism as the most useful philosophy to support mixed methods research" (Johnson, Onwuegbuzie, & Turner, 2007, p. 125). Therefore, this study adopts a pragmatic view to examine the knowledge, perceptions and attitudes of young drivers regarding cannabis use and DUIC.

3.2 Overarching study design

This study was approved by the Office of Human Research Ethics Non-Medical Research Board (see Appendix A), and utilized a two phase explanatory sequential mixed methods research design (Creswell, 2014), where quantitative data (Phase One, addressing Specific Aims 1 and 2: Describing DUIC profiles and identifying predictors) informed a subsequent collection of qualitative data (Phase Two, addressing Specific Aim 3: Understanding DUIC perceptions and attitudes among young Ontarian Drivers). A mixed methods design was chosen to provide a more comprehensive understanding of the research problem and minimize the weaknesses associated with a single method study (e.g., the detail of qualitative data can provide insights not available through general quantitative surveys; Creswell, 2014; Johnson & Onwuegbuzie, 2004). The explanatory nature of this design allows quantitative data to provide a general picture of the research problem, and qualitative data to refine and explain this general picture by exploring participants' views more in depth (Ivankova, Creswell, & Stick, 2006). This design provides the opportunity to explore quantitative results in more detail and is especially useful when unexpected results arise from a quantitative study (Ivankova et al., 2006).

In Phase One I collected quantitative data using an online survey, followed by Phase Two in which I obtained qualitative data through two focus groups. Both quantitative and qualitative data are integrated and interpreted in the discussion section of this thesis, to provide a more robust and meaningful picture of the knowledge, perceptions and attitudes of young drivers regarding cannabis use and DUIC. The following two sections will describe the specific research methods of each phase in more detail.

3.3 Phase One: Describing DUIC profiles and identifying predictors

3.3.1 Data collection

The goal of the first phase was to describe the DUIC profiles and establish the predictive validity of general deterrence and general prevention factors on the DUIC expectancy of

young Ontarian drivers (Specific Aim's 1 and 2) via an online survey. An online survey was chosen because it can reach a large number of respondents with relatively minimum expenditure and can collect data on numerous variables (Kielhofner, 2006). Descriptive data from the online survey was used to described the DUIC profiles of young Ontarian drivers and inferential statistical analysis was employed to establish the predictive validity of general deterrence and general prevention constructs on the DUIC expectancy (i.e. self-reported likelihood of driving within two hours of using cannabis in the next year) of these drivers.

3.3.2   Participants and sampling

Participants in this study were young drivers licensed in Ontario. Individuals were included if they were 18 to 24 years of age, held a valid G2 or G driver's license, and self-reported proficiency in English. An eligibility and consent page in the survey excluded: individuals under 18 years of age, since legislation prohibits cannabis to this group (Health Canada, 2017d); those over 24 years of age, because they are beyond the high-risk demographic for MVC's in Canada targeted in this study (Statistics Canada, 2016a); drivers with a G1 driver's license (available at age 16 by passing a written test), because they are restricted from night-time driving, highway driving, and must be accompanied by a full G license driver at all times (with minimum four years of driving experience and a blood alcohol content [BAC] of less than 0.05%; Ministry of Transportation, 2013b); as well as non-drivers. Drivers with a G2 license (available 8-12 months after obtaining a G1 and passing a road test) were included since they can drive on all Ontario roads and highways with minimal restrictions (i.e., must maintain a BAC of zero, restrict passengers to the number of working seat belts and restrict passengers under the age of 19 if driving at night). In spite of these minimal restrictions, G2 drivers over the age of 18 (19 in some provinces) will still legally be able to purchase and use cannabis, which positions them at risk for DUIC. Additionally, G2 drivers constitute approximately 7.3% of the licensed driver population in Ontario (Ministry of Transportation Ontario, 2014).

Survey data was collected through an institutional license of Qualtrics, a leading survey technology provider. The questionnaire link was distributed online via social media (i.e., Facebook and Twitter), both through the i-Mobile research lab official channels, as well as the student researcher's and supervisor's social media accounts and handles. Key stakeholder organizations were contacted and requested to promote the survey link. As a result, the survey was shared and promoted (i.e., Facebook shares, likes, retweets) by a number of organizations including: the Ontario Public Health Association, Parachute Canada, Young Drivers of Canada, Arrive Alive Drive Sober, and the London Youth Advisory Council. Participants who completed the survey had an option to enter into a draw that randomly selected twenty winners to be awarded a $20 online gift card for Amazon.ca for each winner, given that previous research has shown that lotteries are an effective incentive for completing online surveys and increase response rates compared to vouchers or donations (Deutskens, de Ruyter, Wetzels, & Oosterveld, 2004). Additionally, twenty smaller prizes were awarded rather than one large prize since greater odds of winning can increase response rates (Deutskens et al., 2004).

A minimum of 385 responses were required to achieve a representative sample of young drivers ages 18 to 24 in Ontario to provide accurate profile data of young Ontarian drivers. This sample size was based on calculations derived from the number of licensed drivers in Ontario reported in 2014 and 2016 (see Table 2; Ministry of Transportation Ontario, 2014, 2016). Since 2016 data did not specify the number of licensed drivers by each age group or license class at the time of this study, a calculation was required to estimate this figure. The number of licensed drivers (all license classes) ages 18 to 24 reported in 2014 (1,079,180) was divided by the overall number of licensed drivers that year (9,704,044; Ministry of Transportation Ontario, 2014): approximately 11.12% of licensed drivers in Ontario are within the 18 to 24 years of age demographic. To ensure the accuracy of this ratio, the same calculation was conducted using 2013 (1,075,607/9,592,489 = 0.112130126) and 2012 data (1,065,375/9,480,919 = 0.112370436), which yielded similar results (Ministry of Transportation Ontario, 2012, 2013a). The 2014 ratio was then multiplied by the total number of licensed drivers in the

2016 report (9,932,211), to provide an estimate of the number of licensed drivers in the 18 to 24 demographic in 2016. This estimate was 1,104,554.

Table 2: Estimated number of licensed drivers ages 18 to 24 in 2016

2014			2016	
Number of licensed drivers ages 18 to 24 in Ontario	Total number of licensed drivers in Ontario	Ratio of drivers ages 18 to 24 over general population (1,079,180/ 9,704,044)	Total number of licensed drivers in Ontario	Estimated number of licensed drivers ages 18 to 24 in Ontario in 2016 (0.111209306 x 9,932,211)
1,079,180	9,704,044	0.111209306	9,932,211	**1,104,554**

A representative sample size calculation (necessary sample size = [Z-score] ^{2} * StdDev* [1-StdDev] / [margin of error] ^{2}) was then based on this estimate (see Table 3), which determined a required 385 responses.

Table 3: Sample size calculation

Estimated number of licensed drivers ages 18 to 24 in Ontario in 2016 (using 2014 ratio)	Desired confidence level (%)	Z-score (associated with 95% confidence)	Margin of error	Representative sample size required
1,104,554	95%	1.96	0.05	**385**

3.3.3   Survey questionnaire

A survey questionnaire instrument was developed using pertinent literature to obtain data for this phase (see Appendix B). The questionnaire is based on the theoretical framework of general deterrence and general prevention and the corresponding questionnaires developed by Berger et al. (1990) and Pinsky et al. (2001). Since previous questionnaires using this framework were specific to alcohol and lacked some factors that influence DUIC, some modifications were made to existing questionnaire items. For example, questions were reworded from "alcohol" and "DUI" to relate to "cannabis" and "DUIC". Questions that were specific to alcohol were replaced with relevant ones used throughout cannabis literature and will be discussed in the following section (3.3.3.1). Upon survey

completion, participants were asked if they are interested in participating in a future focus group (as part of Phase Two), with an optional field to provide contact information.

The online questionnaire was pre-tested with five individuals in the target population to solicit feedback to improve comprehension and time efficiency. Previous literature does not provide clear guidance on the sample size that should be used for a pre-test. Hunt, Sparkman Jr., & Wilcox (1982) showed authors report a variation in pre-test sizes, with some recommending "small" samples, and others recommending up to 30 individuals. Since individuals who pre-tested would not be able to be respondents for the survey, only five were chosen. Individuals in the pilot pre-test would be disqualified (i.e., asked not to participate) from the subsequent survey because some questions are purposely put before others to mitigate potential effects of exposure to evidence-based standards integrated into question wording (e.g., a two-hour time frame from cannabis use to driving). If individuals have previously seen the survey, their future responses would not accurately reflect their knowledge. Hunt et al., (1982) suggested pre-tested items should include: items about the questionnaire itself (i.e., layout, format, sequencing of questions), items about the specific questions (i.e., ambiguity, terminology, alternative answers) and items about data analysis (i.e., coding, data extraction). Therefore, five individuals were asked to fully complete the questionnaire and comment (either in writing or in person) on the layout, formatting, comprehension, terminology, ambiguity, and if they experienced any confusion. The pretest showed that overall the questionnaire was clear, easy to follow and took approximately 15 minutes to complete. Following the pre-test, responses were reviewed and a couple of questions were reworded to improve comprehension and a few were combined to improve time efficiency.

3.3.3.1   Measures

The questionnaire was comprised of six parts, including: demographics, past cannabis use and DUIC, DUIC expectancy, riding experiences, constructs of general deterrence, and constructs of general prevention.

Demographics: The first part of the questionnaire obtained relevant demographic information including gender, current driver's license status, level of educational attainment, visible minority status and occupation. All participants were between the 18 to 24 years of age group, although their specific age was not assessed as cannabis was still an illegal substance at the time of the survey. Further rationale for this decision is discussed in Section 5.3. Each of the demographic data was treated as discrete variables. The question regarding visible minority was in accordance with Statistics Canada's updated standards from the 2016 Canadian census profile (Statistics Canada, 2016b). The question assessing education was adopted from the 2017 Canadian Tobacco, Alcohol and Drugs Survey (Health Canada, 2017c).

Past cannabis use and DUIC: Cannabis use was assessed within terms of prevalence and frequency within an individual's lifetime, past 12 months and past 30 days (Health Canada, 2017b, 2017c). The questionnaire also assessed if cannabis was used primarily recreationally or for medical purposes. Non-users were questioned on any future intention to try cannabis, including as a result of the upcoming legalization, and were asked to provide remarks on why or why not. Previous research has shown good reliability and validity from anonymous online self-report cannabis use data (assessing prevalence and frequency) among those aged 18 to 25 years (Ramo, Liu, & Prochaska, 2012).

Respondents who indicated cannabis use were asked three questions regarding DUIC. First, they were asked if they have previously operated a motor vehicle within two hours of using cannabis (i.e., DUIC) in the past 30 days, past 12 months and more than 12 month ago. DUIC was assessed within two hours of cannabis use as per the Canadian Tobacco, Alcohol and Drugs Survey (Health Canada, 2017c) and previous literature (Arterberry et al., 2017, 2013; Capler et al., 2017; Jonah, 2013; McCarthy et al., 2007; Minaker et al., 2017; Robertson et al., 2017). In addition, evidence has shown that driving skills are significantly impaired within this time frame (Capler et al., 2017; Kelly et al., 2004; Rogeberg & Elvik, 2016). If they respond yes to any DUIC, they were asked if they had done so in combination with alcohol and then with other drugs. Next, those who indicated DUIC were asked a question adopted from Davis et al. (2016) that assessed subjective risk of cannabis impairment using a single averaged score of five items. A

sixth item was added to assess experiences with punishment avoidance that stated "I regularly drive after using cannabis and don't get caught" (Armstrong et al., 2018; Watling et al., 2010).

DUIC expectancy: This section is comprised of three questions. The first acts as an indicator of whether an individual will drive at all in the next year. The next was the dependent variable (DV) that assessed DUIC expectancy. This question asked "During the next year, do you think that at least once you will drive within 2 hours of using cannabis", with the following options: "definitively no", "slight chance", "moderate chance", "large chance", and "definitively yes". This question was adopted and modified (i.e., replaced "alcohol" with "cannabis") from previous deterrence and prevention literature exploring drinking and driving (Pinsky et al., 2001), as most studies exploring DUIC only assessed past DUIC and not future expectancy (Arterberry et al., 2017, 2013; Capler et al., 2017; Health Canada, 2017c; Jonah, 2013; McCarthy et al., 2007; Minaker et al., 2017; Robertson et al., 2017). The few studies that did assess future DUIC, asked a yes or no response with the statement "I do intend to drive after using cannabis in the next six months" (Ward et al., 2017, 2018) or agreement (i.e., answering "definitely yes" or "probably yes") with statements "I might drive high even though I know I shouldn't" and "In certain situations, I might drive high" (Davis et al., 2016). Therefore, due to the inconstancy and lack of previous literature exploring DUIC expectancy, the question was adopted from Pinsky et al. (2001), and since the extant literature has assessed past DUIC within two hours of cannabis use. The final question asked the perceived influence that recreational cannabis legalization may have on the number of young drivers DUIC.

Riding experiences: This section consisted of two questions (Pinsky et al., 2001). The first measured past experiences riding with someone impaired from cannabis and if the driver was either a young driver (ages 16 to 24) and/or an adult (over the age of 25). The next question indicated an individual's refusal to ride with someone who was DUIC.

General deterrence: *Knowledge of DUIC laws* were assessed by three questions on impaired driving laws. The first two asked if driving after using cannabis and if driving while using cannabis are legal and were combined to a single score assessing knowledge

on legality of DUIC. The third assessed knowledge on whether a person convicted for DUIC can experience any of the following repercussions: a criminal offence, financial penalties, license suspension, incarceration, probationary sentencing, vehicle impoundment, and demerit points. These response options were developed based on the current legal repercussions for impaired driving in Canada (Criminal Code, 1985), since the knowledge measures on the previous questionnaires developed by Berger et al. (1990) and Pinsky et al. (2001) were not relevant to cannabis and displayed low internal consistency. These scores were treated as discrete (nominal) variables and correct answers were added to a single score assessing knowledge on legal repercussions.

Credibility of DUIC laws was assessed by three questions measuring an individual's perceptions of the enforcement of impaired driving laws in Canada. The first question consisted of four dichotomous variables that were summed to create a single score assessing vicarious experiences of punishment (i.e., if they personally know someone who was stopped by police, who was arrested for DUIC, had license suspended and/or paid financial penalties; Pinsky et al., 2001). The next question averaged four five-point variables to measure their perceptions on the probability that an individual DUIC will experience punishment (i.e., stopped and drug tested, financial penalties, license suspension, and incarceration). The last question used a single five-point scale to measure their perception about the probability of someone convicted for DUIC actually receiving the penalties required by law.

General prevention: *Personal attitudes towards DUIC* were assessed in five areas including: knowledge on effects of cannabis, opinions on DUIC penalties, moral awareness, dangerousness, and the perceived risk of being involved in a MVC. One question assessed knowledge on the impairing effects that cannabis pose on cognitive and psychomotor functions relevant to driving (Bondallaz et al., 2016; Health Canada, 2017a). Effects were measured using four options: positive effect, neutral, negative effect, or I don't know. Opinions on penalties for DUIC were assessed using the average of three five-point scales questions that collected opinions on incarceration, license suspension and financial penalties. The third area assessed moral awareness (i.e., how wrong DUIC is) using single five-point scale (Pinsky et al., 2001). The fourth included a

relevant measure of general perceived dangerousness of DUIC that replaced a similar question used in the previous alcohol questionnaire. This question has been used throughout cannabis literature and has been strongly associated with past DUIC (Arterberry et al., 2013; Aston et al., 2016; McCarthy et al., 2007). Lastly, two five-point scale questions evaluated the perceived probability that DUIC will result in a light or a severe MVC.

Social controls were measured by six questions assessing perceptions about reactions toward DUIC in their social environments (Pinsky et al., 2001). The first two questions used a five-point scale to assess number of friends that disapprove of DUIC and using cannabis while driving. Using the same scale, peer DUIC behavior was assessed by averaging two questions that indicated DUIC among their friends and people their age. Participants were also asked their level of agreement with a statement regarding the number of friends that DUIC without being caught. This question was adopted from Armstrong et al. (2018) and Watling et al. (2010) to assess vicarious punishment avoidance. Lastly, a final question adopted from Pinsky et al., (2001) consisted of a five-point scale that measured based on their experience, how many drivers generally avoid using cannabis at social events if they are responsible for driving. It is worth noting that each of the five survey parts, including the sub sections (i.e., Knowledge of DUIC laws, Credibility of DUIC laws, Personal attitudes towards DUIC, and Social controls), did not have any summary scores, as questions within each component addressed specific constructs.

3.3.4   Data analysis

3.3.4.1   Descriptive

IBM SPSS Statistics (Version 25, 2017) was used to conduct all quantitative analyses. Measures of central tendency (mean, median, mode) and measures of dispersion (variance, standard deviation) were calculated for each of the questions within the survey instrument. These findings were primarily used to assist with the focus group guide development (later discussed in Section 3.4.4). In addition, frequency counts and

percentages were used to describe demographics, past cannabis use and DUIC variables, and general attitudes towards cannabis use by non-users.

3.3.4.2   Inferential

Chi squares were first used to compare cannabis users vs. non-users for demographic variables, perceptions of time after cannabis use until safe to drive, and perceived influence of legalization.

Regression analysis was used to examine relationships between variables in Figure 2. This analysis involved a six step purposeful selection procedure described by Hosmer, Lemeshow, & Sturdivant (2013) to seek a parsimonious model, that is, a model that balances complexity by attempting to achieve an adequate level of prediction with as few predictor variables as possible (Vandekerckhove, Matzke, & Wagenmakers, 2015). Such a model can accurately reflect the data while prioritizing the variables that can be addressed through resource allocation of health education and prevention efforts. In addition, entering all variables may cause overfitting, producing unrealistically large estimated coefficients and/or estimated standard errors (Hosmer et al., 2013). It is worth noting that the original procedure by Hosmer et al. (2013) includes an additional step where evidence-based clinical plausibility is used to inform the assessment of interaction terms between variables. Given that this preliminary analysis is based on current gaps in the understanding of risk profiles in youth, as well as the emergence of the literature in this area in the Canadian context, the current study did not involve this step. However, future work would require an assessment of such interactions, based on clinically significant and empirical data from studies currently underway across the country.

Step 1: We conducted a univariate analysis (i.e., chi-square of independence or ordinal regression) for each independent variable (IV) to identify candidates for the first multivariable model. For categorical variables, a contingency table was created between each IV and the DV (DUIC expectancy). This was used to screen for zero cells (i.e., zero frequencies). If a zero cell is present when analyzed, most currently available statistical software, including SPSS, will be unable to converge and instead will produce an OR

point estimate of zero or infinity (Hosmer et al., 2013). In that case, it is suggested to collapse categories of the IV. For categorical IVs where zero cells were detected, levels of the variable were collapsed. For example, a scale that used "100% Chance" and "Large Chance" were collapsed into "Large chance". Further description of collapsed variables is provided in the results section (4.2). A chi-square of independence was then conducted for each IV and the DV.

The continuous variables were individually screened using a univariate ordinal logistic regression model between each IV and the DV. Only variables with a univariate p-value < 0.25 from either the chi-squares or ordinal regression were considered for the first multivariable model. A p-value < 0.25 for variable selection was used since a traditional level (e.g., 0.05) used for significance may fail to initially identify important variables (Hosmer et al., 2013).

Step 2: An ordinal logistic regression was then conducted with the IVs identified for inclusion in Step 1. Multicollinearity was tested. If variables yielded a tolerance level over 0.1 and a variance inflation factor under 5, then multicollinearity was deemed to not be present (O'Brien, 2007). Following the Hosmer et al. (2013) procedure, the importance of each co-variate was then established by using the p-value associated with its corresponding Wald statistic. Variables that were found to not be contributors at a significance of $p<0.05$ were eliminated and a new model fit assessed. The initial and reduced models were compared using a partial likelihood ratio test with the following formula: $G(1, p1) = -2 [L(1) - L(p1)]$ (Hosmer et al., 2013, p. 97). This test can be used to compare two successive models, as long as the reduced model is nested in the full model (Heck, Scott, & Tabata, 2014). In addition, the models goodness-of-fit were compared using the deviance goodness-of-fit test and log-likelihood values. The Deviance test compares the fitted model to the observed values (determined by the number of covariates in the model), with a smaller deviance indicating a better fit (Heck et al., 2014; Hosmer et al., 2013). This test, however, may not provide a reliable goodness-of-fit measure if many cells have zero frequencies (Hosmer et al., 2013). The log-likelihood values will also be examined and are obtained in the goodness-of-fit table in SPSS ordinal regression output, with the larger values indicating a better fit (Heck et

al., 2014; Hosmer et al., 2013). If a difference between the models was not identified, the model with the least number of predictors was chosen, following the principal of parsimony.

Step 3: The values of the estimated coefficients in the reduced model ($\hat{\theta}_1$) were compared to their respective values in the initial model ($\hat{\beta}_1$) using $\Delta\hat{\beta}\% = 100 \frac{(\hat{\theta}_1 - \hat{\beta}_1)}{\hat{\beta}_1}$ (Hosmer et al., 2013, p. 67), as variables whose coefficient shows a marked change in magnitude between the two models may reflect that variables have been excluded that were necessary. Although the threshold of change that can be considered as a marked change is discretionary depending on the data set and research question, a convention of greater than 20% is provided in the utilized framework. As such, if variables with large changes over 20% were observed, the remaining variables with $p < 0.25$ were individually added back in to the model to determine effects on goodness-of-fit. This process was continued until adequate thresholds for all variables were observed.

Step 4: The variables initially excluded in Step 1 were then added back into the reduced model one at a time. This was used to test if there were any effects in the presence of these variables. If the added variables continued to show no significant relationship to the DV and deviance increased, they were excluded.

Step 5: This step is meant to check for the linearity assumption in continuous variables. Since all significant variables are categorical, the assumptions for an ordinal regression were re-examined (i.e., multicollinearity and proportional odds).

Step 6: In the last step, the model adequacy and final goodness-of-fit was assessed.

3.4 Phase Two: Understanding DUIC perceptions and attitudes among young drivers

3.4.1 Data collection

In the second, qualitative phase, two focus groups were conducted to understand the perceptions and attitudes of young Ontarian drivers regarding the use of cannabis when driving, and understand the values and meanings attributed to such perceptions (Specific Aim 3). The purpose of this phase was to explain and build on the quantitative data to provide a richer picture of the knowledge, perceptions and attitudes of DUIC among young Ontarian drivers, as per the overall objective. Focus groups were selected for this phase to allow participants to engage in semi-structured discussion resulting in data that might not be accessible through surveys or one-on-one interviews (Morgan, 1996; Smithson, 2000). Compared to individual interviews, semi-structured group discussions provide the ability to observe interactions on a topic (Kitzinger, 1994; Morgan, 1996; Smithson, 2000). These group interactions can be complementary (e.g., sharing common experience) or argumentative (e.g., questioning, challenging, and disagreeing with each other; Kitzinger, 1994). This can provide evidence regarding the similarities and differences in the participants' opinions and experience, which may help explain insights on why they think the way they do (Morgan, 1996, 2012). In addition, focus groups provide the possibility for participants to construct ideas collectively, which can bring forward their own priorities and perspectives (Smithson, 2000).

3.4.2 Participants and sampling

Participants for the focus group were recruited through the online survey (same inclusion and exclusion criteria as the survey). The online survey's final question asked participants if they would like to participate in a future focus group regarding this topic. If they expressed interest, the survey automatically saved their data and re-directed them to a new page. The new page contained an optional field allowing them to provide an email that could be used to connect with them following the quantitative stage.

A target of five to seven participants per focus group was set. Qualitative methodology suggests that the ideal size of focus groups range between five to eight participants (Krueger & Casey, 2015). However, in previous qualitative cannabis research, the average size for focus groups has generally been smaller and ranged from three to seven participants (Danton, Misselke, Bacon, & Done, 2003; McKiernan & Fleming, 2017; Neale, Mckeganey, Oliver, & Hay, 2000), because "topics are complex, controversial and can illicit emotional responses" (Mckiernan & Fleming, 2017, p. 15).

There is mixed guidance in literature regarding the number of focus groups necessary for a research study. The use of three to five focus groups is well-documented (Morgan, 1997; Twohig & Putnam, 2002), yet Cleary, Horsfall, & Hayter (2014) stated this may just be another "rule-of-thumb" and that more groups do not necessarily provide new information (i.e., the point of data saturation). Additionally, a review of 220 focus group publications by Carlsen & Glenton (2011) discovered that the number of focus groups within studies varied greatly (mean 8.4, median 5, range 1 to 96). Recently, an empirical study by Guest, Namey, & McKenna (2017) revealed more than 80% of themes were discoverable within two to three focus groups, and 90% were discoverable within three to six focus groups. As a result, and given that qualitative data obtained from these focus groups were used to elaborate on the existing quantitative data, only two focus groups were conducted based on user status (i.e., one with cannabis users and one with non-users). This division based on user status promoted homogeneity in background, and therefore allowed for a better flow of conversation among participants in the groups (Morgan, 1997). In addition, this allowed me to examine the emerging contrasts and similarities between user and non-users perspectives (Morgan, 1997).

3.4.3   Focus group process

Each focus group lasted approximately 90 minutes and took place in a private room in Elborn College at Western University, London, Ontario. The groups started by welcoming and thanking participants, along with providing snacks and refreshments in an effort to build rapport and make participants feel comfortable. Following obtaining informed consent, the topic of discussion was outlined and all ethical considerations were

reviewed. Participants were informed that both notes and audio recordings would remain confidential, that there were no "right" or "wrong" answers, and that they could feel comfortable saying what they think and feel. Participants were also asked to respect the privacy of other participants and not repeat what was said in the focus group.

I moderated and facilitated flow of the conversation using the semi-structured focus group guide (Appendix C) to ensure each topic had adequate time and member participation. I did not provide any of my own comments and probes were used to clarify questions and if participants were not responding. I attained previous experience moderating, transcribing and analyzing focus group data using inductive thematic analysis in a health sciences course offered by Western University (Advanced Health Promotion; HS 4200). In addition, I recorded brief notes on group interaction and agreement/disagreement between topics. For example, if multiple participants were seen nodding, then agreement was recorded. On some occasions, the participants seen nodding were asked if they agreed with the previous statement, which often led to them providing further input. These notes were recorded on a laptop and time stamped so they could be referred to later once reading over the transcripts. After participating, all participants received a $25 gift card of their choice.

3.4.4   Focus group guide

The semi-structured focus group guide was developed based on those used in previous cannabis research (Danton et al., 2003; McKiernan & Fleming, 2017; National Science Foundation, 1997; Neale et al., 2000), on the findings of Phase One, and on input from an expert panel. Based on focus group guides used in previous research we included questions related to how cannabis affects driving ability, why does DUIC occur, and how might DUIC be prevented. The findings of Phase One suggested that topics of recreational versus medical cannabis, vicarious experiences of punishment avoidance (i.e., the statement "My friends often use cannabis and drive without being caught"), why youth believe DUIC to be safer than to drinking and driving, and credibility in roadside testing were worth exploring in more depth and informed questions in these areas. The expert panel was composed of three university professors involved in research and/or

clinical practice with youth, as well as two PhD students in the faculty of Health Sciences at Western University conducting driving research. We discussed descriptive data from Phase One with this panel and as a result further refined questions and included questions on how to judge if someone and/or a driver is high, why individuals still decide to be a passenger with someone driving high, and the impact of legalization. See Appendix C for the finalized focus group guide.

3.4.5   Data analysis

The focus groups were audio-recorded, transcribed verbatim and analyzed using inductive thematic analysis (Braun & Clarke, 2013). Thematic analysis is a technique used to break down the data within a transcript and uncover the recurring themes (Braun & Clarke, 2013). I engaged with the data using a semantic approach, meaning codes and themes were derived from explicitly stated ideas and experiences from the participants (i.e., direct quotes). In addition, the approach to data analysis and theme development was inductive given it was led by the data (i.e., "bottom-up") and did not use a preconceived framework or theoretical concept. Thematic analysis was conducted in six steps as per Braun & Clarke (2013). First, data was transcribed by a professional Transcription services provider, Transcript Heroes Services Inc., a leading academic transcription service. Transcript-based analysis was chosen because it is the most rigorous compared to other methods, such as tape-based analysis (listening to an audio recording and creating an abridged and shorter transcript), note-based analysis (analysis of moderator notes from the group) and memory-based analysis (moderator recalling events from the focus group; Bertrand, Brown, & Ward, 1992; Onwuegbuzie, Dickinson, Leech, & Zoran, 2009). Next, I read the transcripts in full while listening to the audio recording. I also read the focus group notes and connected these notes to the different parts of the transcripts. This approach provided an opportunity to gain familiarity with the data (i.e., process of immersion) and recognize salient topics that could be relevant to the research question. Throughout this stage I took reflexive notes about trends I noticed in participant statements (e.g., participants frequently referred to drinking and driving campaigns but none to ones related to DUIC) and how these may relate to my

experiences as a researcher and current university student. For example, I could relate to students not seeing any campaigns regarding DUIC, as most students that I know do not have cable. My experiences have led me to believe that recreational cannabis use is acceptable, as long as it is used in a safe manner, and that legalization can have both benefits (e.g., safer cannabis) and unintended negative consequences (e.g., easier access for youth). However, I do believe that DUIC is both wrong and dangerous. In order to prepare for focus groups and be in a frame of mind where I would not be tuned to comments that were in agreement with my own perspective, as opposed to those that were in disagreement, I decided to separate groups into users and non-users. This also allowed participants to avoid confrontational perspectives and to express their comments safely.

Third, I re-read and coded transcripts in NVivo (Version 12.3, 2019), a software that facilitates the organization, management, and analysis of qualitative data. NVivo was chosen over paper and pencil coding to increase organization and allow for quick searching of codes. Complete coding was used in order to identify all that was relevant to answering the question (Braun & Clarke, 2013). Fourth, the codes were reviewed and organized then clustered around emerging provisional themes and subthemes. A theme "captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set" (Braun & Clarke, 2006, p. 82). Themes have a central organizing concept comprised by a number of different ideas or aspects (i.e., subthemes and codes). As such, themes and sub-themes (when appropriate) were identified. The codes, themes and sub-themes were discussed with the thesis supervisor. We discussed findings and reflected on interpretations, all of which helped to shape the final findings. The last two steps involved reviewing and modifying the themes and subthemes to reduce overlap, and then defining and naming each. Throughout this process, excerpts were selected for the report that provided a rich descriptive experience from the participants.

Rigor in this stage was promoted using transcript-based analysis (Bertrand, Brown, & Ward, 1992; Onwuegbuzie, Dickinson, Leech, & Zoran, 2009) and following the systematic, six phase process for thematic analysis described by Braun & Clarke (2013).

In addition, a 15-point checklist on criteria for a good thematic analysis was used (Braun & Clarke, 2013, p. 287). Braun & Clarke (2013) recommend coding by two or more independent researchers to promote reliability (i.e., refers to generating the same results if different researchers administer the same methods on different participants). For the purposes of this thesis dissertation, it was decided that I would code and develop themes to maintain the integrity of the work and have an independent researcher (thesis supervisor) discuss and review these with me. Reliability was enhanced by avoiding issues of stability (i.e., arise when the same group convenes more than once and some participants may be missing) and equivalence (i.e., arise when multiple moderators or coders are used; Kidd & Parshall, 2000). In addition, internal consistency was promoted since I moderated and conducted all analysis for both groups, rather than multiple team members (Kidd & Parshall, 2000). Further, our focus groups were used to expand our previously collected survey data, as a method to enhance our overall findings (Kidd & Parshall, 2000).

Chapter 4

4 Results

4.1 Describing DUIC profiles

This section will describe cannabis use and the DUIC profiles of young Ontario drivers who participated in this study, according to the quantitative survey data (Specific Aim 1). A total of 426 complete survey responses were obtained, exceeding the representative sample size that was calculated in Section 3.3.2 (Target N=385). Partial or incomplete responses were automatically deleted by the Qualtrics system one week after the respondent's last activity. In addition, 358 emails were entered by participants for the anonymous online draw and 63 for the subsequent focus groups.

4.1.1 Demographics

Demographic characteristics for the total sample and a comparison between those who indicated having DUIC in the past versus those who have not are shown in Table 4. In the total sample there was a fairly even distribution of gender with slightly more females (52.6%). Most participants were white (79.3%), and had a full G-license (72.3%), which was expected given Ontario drivers can obtain their G license before the age of 18. Most had also completed a bachelor's degree (40.1%) and 87.8% were in school and/or full time employed.

Table 4: Demographics of the survey respondents

Characteristic	Total Sample N=426 (%)	Previous DUIC n=147 (%)	No past DUIC n=279 (%)	Test Statistic
Gender				
Female	224 (52.6)	56 (38.6)	168 (60.6)	$\chi^2 = 18.546$**
Male	198 (46.5)	89 (61.4)	109 (39.4)	$df = 1$
Other	4 (0.9)	-	-	
Ethnicity				
White mono-racial	338 (79.3)	108 (73.5)	230 (82.4)	$\chi^2 = 14.461$
South Asian (e.g., Indian, Pakistani) mono-racial	22 (5.2)	11 (7.5)	11 (3.9)	$df = 9$

East/ Southeast Asian (e.g., Chinese, Filipino) mono-racial	16 (3.8)	8 (5.4)	8 (2.9)	
White mixed	16 (3.8)	7 (4.8)	9 (3.2)	
West Asian/ Arab mono-racial	9 (2.1)	2 (1.4)	7 (2)	
Other	9 (2.1)	5 (3.4)	4 (1.4)	
Aboriginal (First Nations, Métis, Inuit) mono-racial	5 (1.2)	4 (2.7)	1 (0.4)	
Latin American/ Hispanic mono-racial	4 (0.9)	1 (0.7)	3 (1.1)	
Mixed non-white	4 (0.9)	1 (0.7)	3 (1.1)	
Black mono-racial	3 (0.7)	-	3 (1.1)	
License status				
G	308 (72.3)	99 (67.3)	209 (74.9)	$\chi^2 = 2.750$
G2	118 (27.7)	48 (32.7)	70 (25.1)	$df = 1$
Level of educational attainment				
Less than high school diploma or its equivalent	4 (0.9)	-	-	$\chi^2 = 18.080*$ $df = 4$
High school diploma or equivalent	167 (39.2)	64 (44.4)	103 (37.1)	
Trade certificate or diploma	8 (1.9)	5 (3.5)	3 (1.1)	
College/University certificate (not bachelor's level)	57 (13.4)	28 (19.4)	29 (10.4)	
Bachelor's degree (e.g. B.A., B.Sc.,)	171 (40.1)	44 (30.6)	127 (45.7)	
Graduate degree (e.g., M.Sc., MA, etc.)	19 (4.5)	3 (2.1)	16 (5.8)	
Occupation				
Student and employed	153 (35.9)	39 (26.5)	114 (40.9)	$\chi^2 = 9.807*$
Student only (unemployed)	121 (28.4)	45 (30.6)	76 (27.2)	$df = 4$
Employed full time	100 (23.5)	42 (28.6)	58 (20.8)	
Employed part time	40 (9.4)	15 (10.2)	25 (9)	
Unemployed	12 (2.8)	6 (4.1)	6 (2.2)	

* $p < .05.$, ** $p < .001.$

A chi-square of independence was conducted to determine if there was a significant relationship between demographic characteristics and past DUIC history (see Table 4). Since it is recommended that at least 80% of the cells have an expected cell count greater or equal to five (Cochran, 1954), some categories were removed or collapsed (i.e., the "other" category was removed from gender and "less than high school" category was removed from education). Since participants were able to select more than one option for

ethnicity, for the purposes of comparison, the categories were refined into mono-racial or mixed. In an effort to preserve the diversity of the sample for analysis, the distinct ethnicities were not collapsed. Therefore, caution should be taken into account when interpreting ethnicity results, as 10 cells (50%) had an expected cell count under five. Lastly, occupation was left untouched because only one cell (10%) had an expected count under five. Three of the variables showed statistically significant differences between participants reporting previous DUIC and the rest of the sample, although the associations were small (Cohen, 1988). Those who indicated prior history of DUIC were mostly males (61.4%, Cramer's V= .210), had completed less than a bachelor's degree (67.3%; Cramer's V= .207) and were students without employment (30.6%; Cramer's V= .152). In contrast, those with no prior DUIC history were mainly female (60.6%), had completed a bachelor's degree or above (51.5%) and were mainly students who were employed (40.9%).

The next section compares cannabis users and non-users in relation to demographic variables, perceptions toward DUIC, and perceptions on the impact of cannabis legalization on DUIC (see Table 5). A chi-square of independence was conducted for each of the variables to determine if there was a significant relationship with user status. The following categories were removed or collapsed so at least 80% of the cells had an expected cell count greater or equal to five (Cochran, 1954): the "other" category was removed from gender; "less than high school" category was removed from education and the "Trade certificate or diploma" was combined with "College/University certificate", and "Bachelor's degree" combined with "Graduate degree". Ethnicity again should be interpreted with caution as cells were not collapsed and 13 cells (65%) had an expected cell count under five. Three of the variables showed statistically significant results between user and non-user status, although the associations were small (Cohen, 1988). These included: gender (Cramer's V= .170), time after cannabis until safe to drive (Cramer's V= .233), and perceived influence of legalization (Cramer's V= .245). Cannabis users were more likely to be male (54.9%), to report that it is safe to drive within five hours following cannabis use (67.2%), and that DUIC will increase with cannabis legalization (49%). In contrast, non-users were more likely to be female

(66.7%), to report you should wait at least five hours after cannabis use until driving, and that legalization will again increase DUIC (80%).

Table 5: Comparison of selected variables for past year cannabis users vs. non-users

	User n=296 (%)	Non-user n=70 (%)	Test statistic
Gender			
Male	161 (54.9)	23 (33.3)	$\chi^2 = 10.440$*
Female	132 (45.1)	46 (66.7)	$df = 1$
License status			
G2	84 (28.4)	20 (28.6)	$\chi^2 = 0.001$
G	212 (71.6)	50 (71.4)	$df = 1$
Level of education			
High school diploma or equivalent	123 (42.1)	34 (48.6)	$\chi^2 = 3.776$
College/University/Trade certificate (not bachelor's level)	47 (16.1)	5 (7.1)	$df = 2$
Bachelor's/Graduate degree	122 (41.8)	31 (44.3)	
Ethnicity			
White mono-racial	234 (79.1)	52 (74.3)	$\chi^2 = 9.042$
South Asian (e.g., Indian, Pakistani) mono-racial	16 (5.4)	3 (4.3)	$df = 9$
East/ Southeast Asian (e.g., Chinese, Filipino) mono-racial	11 (3.7)	4 (5.7)	
White mixed	10 (3.4)	5 (7.1)	
Other	8 (2.7)	-	
West Asian/ Arab mono-racial	5 (1.7)	3 (4.3)	
Aboriginal (First Nations, Métis, Inuit) mono-racial	5 (1.7)	-	
Mixed non-white	3 (1)	1 (1.4)	
Latin American/ Hispanic mono-racial	3 (1)	1 (1.4)	
Black mono-racial	1 (0.3)	1 (1.4)	
Occupation			
Student and employed	100 (33.8)	31 (44.3)	$\chi^2 = 8.539$
Student only (unemployed)	84 (28.4)	23 (32.9)	$df = 4$
Employed full time	73 (24.7)	9 (12.9)	
Employed part time	27 (9.1)	7 (10)	
Unemployed	12 (4.1)	0 (0)	
Time after smoking cannabis until safe to drive			
Reported under 5 hours	197 (67.2)	27 (38.6)	$\chi^2 = 19.646$**
Reported 5 or more hours	96 (32.8)	43 (61.4)	$df = 1$
Perceived influence of legalization on future population rates of DUIC			
Decrease in DUIC	28 (9.5)	3 (4.3)	$\chi^2 = 22.029$**

No change	123 (41.6)	11 (15.7)	df = 2
Increase in DUIC	145 (49)	56 (80)	

Note. N=366.

* p < .05., ** p < .001.

4.1.2   Past cannabis use and DUIC

Overall, 356 (83.6%) study participants had used cannabis in their lifetime and the remaining 70 (16.4%) had not. Of those who used cannabis, 296 (83.1%) reported they had used in the previous year, 54 (15.2%) used over a year ago, and the remaining six (1.7%) reported not knowing/remembering whether they had used cannabis before. Table 6 presents the cannabis use patterns and the incidence of DUIC behaviors among current cannabis users (i.e., only those that indicated cannabis use in the previous year). Most cannabis users in the sample reported having used cannabis in the 30 days prior to the survey (79.1%). Among users, 142 (47.9%; 33.3% of the entire sample) reported a prior history of DUIC, meaning using cannabis up to two hours prior to driving at least once in their lifetime, with some doing so in combination with alcohol or with other drugs (12.4% of cannabis users).

Table 6: Cannabis use and DUIC history among past-year users

Characteristic	n (%)
Cannabis use frequency	
Past 30 days	234 (79.1)
Daily	62 (20.9)
DUIC history [a]	
Over a year ago	32 (10.8)
Within past year	43 (14.5)
Within past 30 days	67 (22.6)
DUIC in combination with alcohol	23 (7.7)
DUIC in combination with other drugs	14 (4.7)

N=296

[a] Excludes five individuals who reported cannabis use over a year ago

For those with a prior history of DUIC, Table 7 displays their perceptions regarding safety of DUIC. The majority of respondents "agree" or "strongly agree" that they can safely drive within two hours of using cannabis, that DUIC is safer than drinking and driving, and that being "a little high" does not impair their driving ability. Fewer believed "being high" doesn't affecting their driving, and that DUIC is a not big deal. For the last

statement, "I regularly drive after using cannabis and don't get caught", the majority of responses were reported in both the strongly disagree and strongly agree categories, presenting mixed perceptions among this sub-set of the sample.

Table 7: Perceptions of those who previously DUIC

Statement	Mean	SD	Min	Max
I can safely drive within two hours of cannabis use	3.80	1.37	1	5
It is safer driving under the influence of cannabis than under the influence of alcohol	4.17	1.11	1	5
If I am just a little bit high, I don't think my ability to drive is impaired	3.58	1.35	1	5
Being high on cannabis doesn't affect my driving	2.90	1.50	1	5
Driving high is not a big deal	2.79	1.43	1	5
I regularly drive after using cannabis and don't get caught	3.13	1.61	1	5

Note. 1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree.
N=147

For the 16.4% of the total sample who indicated not having used cannabis in the past, Table 8 outlines their general attitudes towards cannabis use. While 50.7% indicated they have no desire to try cannabis, only 39% indicated this same belief would persist once cannabis became legal, with many indicating a slight chance of trying. In the survey, an open question was included for participants to comment on the reasons behind these perceptions. Comments included: no desire or interest to use, not using because it is illegal, because it is dangerous, it is not regulated, and they have a fear of addiction. In addition, just over one quarter (27.5%) indicated a moderate to definite chance of using cannabis once legal. Responses for why they might want to try cannabis included: curiosity, for recreational use, seems like a way to relax.

Table 8: General attitudes towards cannabis use by non-users

Characteristic	n (%)
Desire to try cannabis	
No	35 (50.7)
Yes	22 (31.9)
Don't know	12 (17.4)
Desire to try cannabis once legal	
No	27 (39.1)
Slight chance	23 (33.3)
Moderate chance	9 (13)
Large chance	3 (4.3)
Yes	7 (10.1)

Note. 1 missing response,
N= 69.

4.1.3 DUIC expectancies and riding experiences

When participants were asked whether there was a chance they would drive within two hours of using cannabis in the next year, 179 (42%) indicated at least a slight chance. It should be noted that this is higher than the 147 participants who indicated previous DUIC. A further breakdown of responses by chance of DUIC includes: 45 (10.6%) reporting 'definitely yes"; 31 (7.3%) reporting "large chance"; 28 (6.6%) reporting "moderate chance"; and 75 (17.6%) reporting "slight chance". The remainder reported no chance (246; 57.9%).

In regards to riding experiences, 172 (40.4%) reported being a passenger with a young driver ages 18 to 24 who they thought "had consumed too much cannabis to drive safely". Similarly, 43 (10%) reported the same experience but with an adult driver aged 25 or older. When participants were asked if they ever decided not to be a passenger with a driver they thought had consumed too much cannabis to drive, only 88 (20%) decided to refuse, whereas 119 (28%) decided to be a passenger.

4.1.4 General deterrence and general prevention

Questions on general deterrence and general prevention are presented in Table 9. The table further presents the proportions among those with and without a prior history of DUIC. The knowledge questions indicated that participants knew that DUIC is illegal (85.2%), but did not know the specific legal penalties associated with it (e.g., criminal

offence, fines, license suspension, jail, substance abuse training, vehicle impoundment and demerit points). Both those with and without a prior history of DUIC had similar responses to the knowledge questions.

Under credibility, most (78.3%) of the participants did not know of anyone who underwent a roadside drug test, was arrested for DUIC, was subjected to fines, or experienced license suspension. Similarly, one third to one quarter believed that there is a large chance for experiencing any of these penalties (33.6% for fines; 27.8% for license suspension), and few believed there is a large chance of jail time (6.3%). Moreover, if someone is reprimanded for DUIC, most (54.8%) participants believed that under half actually receive the penalties required by law. Overall, the subset of those previously DUIC provided similar responses as the total sample for knowledge and credibility questions.

Under personal attitudes, most (67%) believed that the effects of cannabis on various driving aspects were negative (e.g., in regard to effects on reaction time and reflexes, short term memory, attention, thinking and decision making, maintaining lane position, impulsivity, and overall driving performance). Similar to the finding that the total sample had a higher mean score for knowledge on the effects of cannabis compared to those with a prior history of DUIC, participants with no prior history were more likely to report that these effects were negative, rather than positive or neutral. In addition, many (58%) believed DUIC is safe within five hours of cannabis use, with the majority (85.4%) of the respondents in this category being those with a prior history of DUIC. Most (60.5%) participants believed fines should be given for DUIC, although few supported license suspension (28.2%) and jail time (5.1%), especially among past DUIC participants. Interestingly, while over a third of the sample stated DUIC is always wrong, few (23.2%) reported it is very dangerous or could lead to a minor (28.3%) or severe accident (12.8%). These beliefs were especially low for those with a prior history of DUIC.

Responses to questions under social controls indicated that almost half of the sample believed most (45%) friends would disapprove of DUIC and very few (11.4%) reported their friends do DUIC, although it was perceived more peers DUIC than friends do. In

addition, a few (24.2%) participants think most drivers would avoid cannabis at social events. Many (27.9%) participants reported they still decided to be a passenger with someone DUIC when they thought it to be unsafe. Not surprisingly, responses for those with prior history of DUIC were rather different for these categories compared those with no past DUIC.

Table 9: Survey responses on general deterrence and general prevention questions

	Total Sample (N=426)	Previous DUIC (n=147)	No past DUIC (n=279)
Knowledge			
Knew DUIC is illegal	85.2%	86.4%	84.5%
Knew using cannabis while driving is illegal	92.5%	91.2%	93.2%
Knew DUIC is a criminal code offence	77.2%	79.6%	75.9%
Knew DUIC can lead to jail time	57.9%	57.8%	57.9%
Credibility of the law			
Did not know of anyone subjected to penalties for DUIC	78.3%	73.1%	81.1%
Think large chance of roadside drug test	17.2%	16.6%	17.6%
Think large chance of fines for DUIC	33.6%	34.0%	32.4%
Think large chance of license suspension for DUIC	27.8%	26.4%	28.1%
Think large chance of jail time for DUIC	6.3%	7.7%	6.1%
Think less than half of all convicted actually receive the legal penalties required by law	54.8%	55.9%	54.6%
Personal attitudes			
Knowledge on the effects that cannabis has on driving (correct score is 7/7)	Mean=4.7 SD=2.4	Mean=3.1 SD=2.6	Mean=5.5 SD=1.9
Believe it is safe to drive within five hours of using cannabis	58%	85.4%	43.3%
Believe fines should be imposed in most situations	60.5%	28.5%	77.7%
Believe license suspension should be imposed in most situations	28.2%	9.6%	37.9%
Believe jail time should be imposed in most situations	5.1%	2.1%	7.2%
Think that DUIC is always wrong	39.8%	11.7%	54.5%
Think that DUIC is very dangerous	23.2%	4.8%	32.9%
Think DUIC has large chance for minor MVC	28.3%	11.0%	37.2%
Think DUIC has large chance for severe MVC	12.8%	4.8%	17%
Social Controls			
Think most friends would disapprove of DUIC	45%	14.5%	61%
Think most friends DUIC	11.4%	28.2%	2.5%

Think most peers DUIC	17.4%	30.3%	10.1%
Think most drivers avoid cannabis at social events because they are responsible for driving	24.2%	9.7%	31.8%
Decided to be a passenger when they thought driver had consumed too much cannabis to drive safely	27.9%	42.9%	20.1%

4.2 Predictive validity

This section will present the predictors (Specific Aim 2) of DUIC derived from the six-step purposeful selection procedure described by Hosmer, Lemeshow, & Sturdivant (2013) and discussed in Section 3.3.4.2 of this thesis.

Step 1: After conducting a univariable analysis (i.e., chi-square of independence for categorical variables or ordinal regression for continuous variables) for each IV, it was noticed that several of the categorical IV's using a five-point scale had zero cells. Therefore, the last two categories of each of these scales, namely "100% Chance" and "Large Chance", as well as "Always" and "In Most Situations", were collapsed into one respectively, resulting in four-point scales. Most of the zero frequencies were specifically amongst those categories. The only five-point scale variables that were not modified, and instead continued to be measured on a five point scale were: percentage of those convicted of DUIC who actually receive the penalty required by law, moral awareness (i.e., how wrong they think DUIC is), and vicarious punishment avoidance (i.e., agreement with the statement "my friends often use cannabis and drive without being caught"). In addition to this collapsing, question 24 in Riding Experience (see Table 10) was dummy coded into two variables (i.e., intentional decision to be/ not be a passenger with a high driver). This question assessed if an individual intentionally refused to be a passenger knowing a driver was high and unfit to drive. Two variables were necessary to capture a sense of agency in regards to those who have been exposed to a situation like this and actively decided not to, instead of having them all grouped into those who may not have made a decision. A new contingency table was computed and test statistics are reported in Table 10. The estimated coefficients, standard errors, univariable Wald statistics and confidence intervals are also reported in this table for all continuous variables.

Table 10: Univariable relationships between IVs and DUIC Expectancy (5pt scale)

Variable	Score (recoded)	Source	Test statistics [95% CI]
Gender	Nominal (0=other, 1=male, 2=female)	Q4	χ2 = 47.873** *df*= 8
Past Cannabis Use			
Past cannabis use incidence	Nominal (0=n, 1=y)	Q9	χ2 = 34.158** *df*= 4
Past cannabis use frequency [a]	5 pt. scale	Q10	χ2 = 206.823** *df*= 16
Past DUIC			
Past DUIC incidence	Nominal (0=n, 1=y)	Q13	χ2 = 229.601** *df*= 4
Past DUIC history [a]	1= 30 days, 2= 1 year, 3=over a year	Q13	χ2 = 313.609** *df*= 12
Past DUIC perceptions of risk [a]	5 pt. scale (average 6 items)	Q16	Est= 1.669 SE= 0.191 Wald= 76.676** [1.295-2.042]
Riding experience			
Passenger with a young driver thought to be unfit to drive due to cannabis	Nominal (0=n, 1=y)	Q22	χ2 = 7.932 *df*= 4
Passenger with an adult driver thought to be unfit to drive due to cannabis	Nominal (0=n, 1=y)	Q23	χ2 = 8.622 *df*= 4
Intentional decision not to be a passenger with high driver	Nominal (0=n, 1=refused)	Q24	χ2 = 6.605 *df*= 4
Intentional decision to be passenger with high driver	Nominal (0=n, 1=did not refuse)	Q24	χ2 = 32.565** *df*= 4
Knowledge			
Knowledge on legality	Correct score x/2	Add Q25,26	Est= -0.093 SE= 0.168 Wald= 76.676 [1.295-2.042]
Knowledge on legal ramifications	Sum of correct items	Q27 (7 items)	Est= 0.038 SE= 0.046 Wald= 0.672 [-0.053-0.128]
Credibility			
Vicarious experiences of punishment	Sum of correct items	Q28 (4 items)	Est= 0.200 SE= 0.105 Wald= 3.672 [-0.005-0.405]

Likelihood being stopped/drug tested	4 pt. scale [b]	Q29	$\chi2 = 10.661$ *df*= 12
Likelihood being paying fines	4 pt. scale [b]	Q29	$\chi2 = 19.762$ *df*=12
Likelihood of license suspension	4 pt. scale [b]	Q29	$\chi2 = 16.175$ *df*= 12
Likelihood of jail time	4 pt. scale [b]	Q29	$\chi2 = 15.273$ *df*= 12
Percent convicted that receive penalty	5 pt. scale	Q30	$\chi2 = 34.583*$ *df*= 16
Attitudes			
Knowledge on cannabis effects	Correct score x/7	Q31	Est= -0.503** SE= 0.045 Wald= 123.11 [-0.592-(-)0.414]
Opinion on jail time	4 pt. scale [b]	Q32	$\chi2 = 105.495**$ *df*= 12
Opinion on license suspension	4 pt. scale [b]	Q32	$\chi2 = 120.818**$ *df*= 12
Opinion on fines	4 pt. scale [b]	Q32	$\chi2 = 177.334**$ *df*= 12
Moral awareness	5 pt. scale	Q33	$\chi2 = 285.755**$ *df*= 16
Dangerousness	4 pt. scale	Q34	$\chi2 = 274.190**$ *df*= 12
Minor accident risk	4 pt. scale [b]	Q35	$\chi2 = 163.177**$ *df*= 12
Serious accident risk	4 pt. scale [b]	Q35	$\chi2 = 99.668**$ *df*= 12
Social controls			
Friend disapproval DUIC	4 pt. scale [b]	Q36	$\chi2 = 192.071**$ *df*= 12
Friend disapproval of using cannabis while also driving	4 pt. scale [b]	Q37	$\chi2 = 185.332**$ *df*= 12
Perceived friends DUIC	4 pt. scale [b]	Q38	$\chi2 = 185.075**$ *df*= 12
Perceived peers DUIC	4 pt. scale [b]	Q40	$\chi2 = 71.805**$ *df*= 12
Vicarious punishment avoidance	6 pt. scale	Q39	$\chi2 = 144.371**$ *df*= 20
Perceived cannabis social avoidance	4 pt. scale [b]	Q41	$\chi2 = 58.111**$ *df*= 12

Note. Source refers to survey question; Q= survey question; n= no; y= yes

[a] Not assessed in regression; n=147

[b] 5 pt. scales were converted to 4 pt.

* $p < .05.$, ** $p < .001.$

After evaluation, the following three variables were removed from the model: Knowledge on legality (p=0.580), Knowledge on legal ramifications (p=0.412) and Likelihood being stopped/drug tested (p= 0.558). In addition, past cannabis use frequency, past DUIC history, and DUIC perceptions of risk were excluded since these questions were specific to cannabis users and those who indicated previous DUIC. An opportunity for future analysis of cannabis users that includes these variables will be described in Section 5.2. The described analysis for Step 1 resulted in a preliminary model with 26 IV's (24 categorical, 2 continuous variables).

Step 2: An ordinal logistic regression was then conducted with the 26 IV's (N=411) identified in Step 1. Eight of the participants were initially excluded since they indicated they will not drive in the next year, and the remaining seven were excluded by SPSS since they did not respond to all questions (i.e., system missing values). As per the procedure, variables significant at the p<0.05 level (IV's = past DUIC incidence, percent convicted that receive penalty, moral awareness, dangerousness, minor accident risk and vicarious punishment avoidance, N=413) were selected for the reduced model. Two more participants were included in the reduced model since the questions they did not respond to were only assessed in the other model. Multicollinearity was tested in the reduced model and was not present. The two models were then compared using a partial likelihood ratio test:

$$G = -2 \; [\text{log-likelihood (26 IV model)} - \text{log-likelihood (6 IV model)}]$$
$$G = -2 \; [\text{-256.993} - \text{-258.898}]$$
$$G = \text{-3.81}$$

Since the value of 3.81 is less than the critical value of 31.41 (obtained using a chi square table with 20 degrees of freedom [26 IV – 6 IV] and p=0.05), a significant difference between the two models was not identified. Therefore, the 6 IV model was chosen following the principal of parsimony. In addition to the partial likelihood ratio test, models were compared using log-likelihood values and deviance. Therefore, the model with 6 IV's (Deviance= 480.687) was a better fit than the model with 26 IV's (Deviance = 513.986).

Step 3: Since three of the variables showed changes slightly over 20% between models, the remaining variables with a significance of $p < 0.25$ in the 26 IV model (i.e., Friend disapproval of using cannabis while also driving, Perceived Friends DUIC, Decided to be passenger with high driver, Knowledge on cannabis effects, and Opinion on fines) were individually added to the 6 IV model and tested for confounding effects. However, once added, greater changes in β were exhibited among some variables whiles others decreased relative to before. In addition, none of the added variables showed significance (in the 7 IV models) and in each iteration the deviance increased meaning the model had a poorer fit. Therefore, the 6 IV model remained the best fit.

Step 4: The variables initially exuded in Step 1 were then added back into the reduced model one at a time. Since Knowledge on legality (p=0.926), Knowledge on legal ramifications (p=0. 871) and Likelihood being stopped/drug tested (p= 0. 590) continued to show no significance and deviance increased, they were excluded.

Step 5: Multicollinearity was tested and not present. The assumption of proportional odds was met, as assessed by a full likelihood ratio test comparing the fit of the proportional odds location model to a model with varying location parameters, χ^2 (60) = 25.290, p = 1.000.

Step 6: Prior to assessing goodness of fit, we assessed the number of covariate patterns and expected cell frequencies using the Aggregate function in SPSS. This is an important step, as goodness of fit measures are influenced by the number of covariates in the model (Hosmer et al., 2013). A covariate pattern is a unique combination of the values of the IV's existing in the dataset. For example, one pattern was: reporting "no previous incidence" of DUIC, selecting "21% to 41%" of all individuals convicted for DUIC will receive penalties required by law, selecting DUIC is "always wrong", selecting DUIC is "very dangerous", selecting "large chance" for minor accident risk, and selecting "strongly disagree" with the statement their friends often DUIC and don't get caught. Overall, 297 unique covariate patterns were identified when 6 IV were entered in Aggregate, and 321 patters when the DV was added to the 6 IV mix. Since the total number of possible cells are 1485 (279 patterns x 5 levels of the DV), there were 1164

(78.4%) cells with zero observed frequencies (1485 – 321). This means that 1164
responses (i.e., categories) on the DV were missing, given a particular covariate pattern.
Since there are a large number of cells with zero frequencies, overall goodness-of-fit
measures should be viewed with caution (Hosmer et al., 2013).

A cumulative odds ordinal logistic regression was run to determine the effect of the
following six IV's on DUIC expectancy, the identified predictors in the previous steps:
past DUIC incidence, percent convicted that receive penalty, moral awareness,
dangerousness, minor accident risk and vicarious punishment avoidance. There were
proportional odds, as assessed by a full likelihood ratio test comparing the fitted model to
a model with varying location parameters, $\chi2$ (60) = 25.290, p = 1.000. The deviance
goodness-of-fit test indicated that the model was a good fit to the observed data, $\chi2$
(1164) = 480.687, p = 1.000, although most cells (i.e., DV levels by observed
combinations of predictor variable values) were sparse with zero frequencies in 78.4% of
cells. However, the final model statistically significantly predicted the DV over and
above the intercept-only model, $\chi2$ (20) = 450.392, p < .001. Parameter estimates are
reported in Table 11.

Past DUIC incidence: The OR of indicating a lower expectancy of being involved in
DUIC in the future for those without a prior history of DUIC versus those with a history
of DUIC is 0.087, 95% CI [0.047, 0.160], a statistically significant effect, $\chi2$ (1) =
61.159, p < .001. This means that those who indicated past DUIC have an 11.5 (equal to
$e^{\wedge 2.447}$ or 1/0.087) times greater chance than those with no past DUIC, to indicate a higher
level on the DUIC expectancy variable (i.e., driving within two hours of using cannabis
in the next year; 1=definitely not, 2=slight chance, 3=moderate chance, 4=large chance,
or 5=definitely yes).

Percent convicted that receive penalty: The perceptions about the probability of someone
convicted for DUIC actually receiving the penalties required by law, had a statistically
significant effect on the prediction of future DUIC expectancy, $\chi2$ (4) = 10.139, p = .038.
Those who believed "0% to 20%" convicted would actually receive penalties, had a
0.594, 95% CI [0.224, 1.575] times chance of indicating lower future DUIC expectancy,

than those who believed "80 to 100%" would (reference category). Although, the differences between each of these categories were not significant. It is important to note that the OR reported for this categorical variable and the ones to follow show differences in the first category with reference to the last one.

Moral awareness: had a statistically significant effect on the prediction of future DUIC expectancy, $\chi 2$ (4) = 23.652, p < .001. Participants who thought DUIC was not wrong had a 14.486, 95% CI [3.498, 59.987] times greater chance to indicate some level of future DUIC than those who thought it is always wrong (reference category), a statistically significant effect, $\chi 2$ (1) = 13.595, p < .001.

Dangerousness: $\chi 2$ (3) = 24.539, p < .001 and Minor accident risk: $\chi 2$ (3) = 13.606, p = .003 were also statistically significant predictors of future DUIC expectancy. Individuals believing DUIC is not at all dangerous had a 38.256, 95% CI [8.476, 172.673] times chance to report some level of future DUIC expectancy than those who think DUIC is very dangerous (reference category), a statistically significant effect, $\chi 2$ (1) = 22.426, p < .001. In addition, those believing there is no chance of a minor accident while DUIC were 31.439, 95% CI [3.723, 265.459] times more likely to report some level of future DUIC expectancy than those who think there is a large chance for a minor accident (reference category), a statistically significant effect, $\chi 2$ (1) = 10.034, p = .002.

Vicarious punishment avoidance: this variable assessed agreement with the statement "my friends often use cannabis and drive without being caught" and was statistically significant on the prediction of future DUIC expectancy, $\chi 2$ (5) = 32.471, p < .001. The OR of being in a higher category of the DV for those who strongly disagreed versus strongly agreed (reference category) is 0.144, 95% CI [0.060, 0.347], a statistically significant effect, $\chi 2(1)$ = 18.753, p < .001. This means those who strongly disagreed were 7 (equal to $e^{1.935}$ or 1/0.144) times less likely than those who strongly agreed to indicate any future DUIC chance.

Table 11: Ordinal regression parameter estimates of significant predictors for DUIC expectancy

Parameter	B	Std. Error	95% Wald CI Lower	95% Wald CI Upper	Wald χ2	df	Exp (B)	95% Wald CI for Exp(B) Lower	95% Wald CI for Exp(B) Upper
Previous DUIC incidence									
No	-2.447**	0.3129	-3.061	-1.834	61.159	1	0.087	0.047	0.160
Yes	0 ª						1		
Perceived percent convicted receiving penalties									
0% to 20 %	-0.521	0.4974	-1.495	0.454	1.095	1	0.594	0.224	1.575
21% to 40 %	0.025	0.4858	-0.927	0.977	0.003	1	1.025	0.396	2.657
41% to 59%	0.663	0.5030	-0.322	1.649	1.740	1	1.941	0.724	5.203
60% to 79%	0.257	0.5658	-0.852	1.365	0.206	1	1.292	0.426	3.917
80% to 100%	0 ª								
Moral awareness									
I don't think DUIC is wrong	2.673**	0.7250	1.252	4.094	13.595	1	14.486	3.498	59.987
Wrong only in a few specific situations	2.296**	0.5047	1.307	3.286	20.696	1	9.937	3.695	26.723
Wrong in several situations	1.894**	0.4773	0.959	2.829	15.749	1	6.646	2.608	16.936
Wrong in several situations	1.255*	0.4010	0.469	2.041	9.789	1	3.507	1.598	7.697
Always wrong	0 ª								
Dangerousness									
Not at all dangerous	3.644**	0.7689	2.137	5.151	22.462	1	38.256	8.476	172.673
Slightly dangerous	2.171*	0.6345	0.927	3.415	11.708	1	8.767	2.528	30.402
Moderately dangerous	1.277*	0.5806	0.139	2.415	4.841	1	3.587	1.150	11.194
Very dangerous	0 ª								
Minor accident risk									
No chance	3.448*	1.0885	1.315	5.581	10.034	1	31.439	3.723	265.459
Slight chance	-0.374	0.4444	-1.245	0.497	0.708	1	0.688	0.288	1.644
Moderate chance	-0.032	0.3811	-0.779	0.715	0.007	1	0.968	0.459	2.044
Large chance	0 ª								
Vicarious Punishment Avoidance									
No opinion	-2.113**	0.5389	-3.169	-1.057	15.371	1	0.121	0.042	0.348
Strongly disagree	-1.935**	0.4468	-2.811	-1.059	18.753	1	0.144	0.060	0.347
Somewhat disagree	-1.403*	0.5012	-2.386	-0.421	7.840	1	0.246	0.092	0.656
Neither agree nor disagree	-2.017**	0.5137	-3.024	-1.010	15.419	1	0.133	0.049	0.364

| Somewhat agree | -1.246** | 0.3398 | -1.912 | -0.580 | 13.448 | 1 | 0.288 | 0.148 | 0.560 |
| Strongly agree | 0 [a] | | | | | | | | |

[a] Set to zero because this parameter is redundant (i.e., reference category)

* $p < .05.$, ** $p < .001.$

4.3 Perceptions and attitudes of youth regarding use of cannabis when driving

This section presents the findings of the qualitative data analysis resulting from the focus group data, with both cannabis non-user and cannabis user focus groups. Sixty-three individuals expressed interest in the focus groups and provided their contact information, and 12 were available in the selected location, dates, and time slots and participated in the focus groups (six in each). Participants' age ranged from 18 to 24 years. The cannabis user group had three males and three females, and the non-user group had one male and five females.

Following the steps for thematic analysis as per Braun & Clarke (2013, p. 202-203), the first round of coding yielded 121 codes for the non-user focus group and 119 for the user focus group. These codes were reviewed, organized, and collapsed into 81 codes for the non-user group and 88 codes for the user group. Theme development was an iterative process that involved comparing non-user and user data, and re-examining transcripts to further refine themes and to select quotes that best describe the themes. Throughout discussion and reflection on the findings with my thesis supervisor, five themes emerged from the transcripts. These include: 1) Being high is a change in one's natural state, 2) It is hard to tell if a driver is high, 3) DUIC is convenient, socially acceptable, and safe, 4) Legalization makes cannabis more attractive to use, and 5) There is a need for testing, education, and prevention efforts that are relevant to 'us' [youth].

4.3.1 Theme 1: Being high is a change in one's natural state

Participants in both groups described "being high" as a change in one's natural state, referring to the observable differences in a person's behavior. As such, two sub-themes emerged from participants' comments: 1) cannabis changes you, as well as 2) how you take cannabis and what you take it for matters.

4.3.1.1   Cannabis changes you

Non-users reflected on these changes as having a negative connotation and including physical (e.g., puffy eyes, slowed movements and reaction, sleepiness, hunger etc.), cognitive (e.g., fogginess, changes in perception), and emotional (e.g. disinhibition, depressed or inappropriate heightened mood) changes. When asked to comment on the signs of being high that they notice in others, a participant expressed:

> I feel like a combo, like psychological and physiological ones, so psychological being perhaps like they're seeing things that aren't actually there, or perhaps like there's changes to their vision being impaired or perhaps their eyes are red. They might be talking slower, moving slower so sort of signs like that. (Female 3, Non-user)

Another participant further commented that cannabis-induced emotions can lead to happiness or have a negative effect and make them more depressed. Nevertheless, participants expressed that being high is very subjective and should be treated as a gradient.

> Right now we're talking about like high or not high but I feel like to simplify it in that way is like just not realistic and not as helpful to people who are actually in situations where they're trying to determine if they are high or not high or if they're safe to drive. (Female 2, Non-user)

Although users also described the physical, cognitive, and emotional changes that take place when high, they emphasized the variability among individuals and therefore the different behavioral changes that might occur in one person versus another. For example, one user stated:

> One person's high is different from another person's high. Someone's paranoid. Someone else is mellowed out. So it depends on what type of state they're in. (Male 2, User)

They further described that while one person might experience distraction and difficulty focusing, another's focus might be heightened:

> If someone's really focused on one thing… someone else could just be energetic and all over the place. So there's no one way of being high.
> (Male 3, User)

Overall, cannabis experiences were described as very subjective and while some deemed the changes to be positive, others perceived them to be negative or neutral. In addition, the view on these changes also depended on an individuals' intentions for cannabis use (e.g., sleepiness may be a desired change for someone who wants to relax/ help fall asleep, compared to someone who uses cannabis at a social event for excitement). The common ground in all identified experiences was both non-users and users view cannabis as something that changes their behaviour.

4.3.1.2   How you take cannabis and what you take it for matters

Participants spoke of many factors that can cause variability in the effects of cannabis and the impact on driving. Based on their comments, participant expressed cannabis effects can depend on purpose, method of consumption, strain, and tolerance. The first mentioned was the purpose of use. Participants explained that while some use cannabis to experience a high, others use it to experience pain reduction, stress relief, sleep aid, to relax, etc. The cannabis user focus group suggested that cannabis may be beneficial prior to driving for some. For example:

> Some people take it to reduce pain. So maybe they actually might be a better driver because they don't have as much pain. (Female 1, User)

Another user added:

> What if some [are] treating something like anxiety … [and] a benefit of them actually taking it is … they're more in control, not as anxious, don't panic as much, and what if that's better for them as a driver. (Male 2, User)

Although participants seemed to be reflecting on the experiences of others and not their own, the users expressed that there is more to cannabis use than just getting high. Moreover, they described that the effects are often dependent on the method of consumption (e.g., smoking vs edibles) and the strain (e.g., Sativa vs Indica).

Both non-users and users expressed that smoking is the most common method and results in immediate effects, whereas edibles have a delayed onset (e.g., approximately 45 to 60 minutes) and often the effects are more intense and experienced for a longer duration. Since effects of smoking are immediate, both focus groups spoke of smoking as providing more control when driving. However, mixed opinions were expressed regarding edibles. The non-users attributed a negative connotation to edibles:

> If your intention was to get high and you eat [an edible] and you realize within 10 minutes oh I haven't had that response yet, I'll just have another bite. And that could lead in this bad pattern where you know, and then all of a sudden you end at a point where you've had way too much now cause it all kind of kicks in. (Female 4, Non-user)

In contrast, some users stated it may provide more control if the THC content is labeled and/or knowing that the onset is delayed. However, oftentimes edibles are made at home providing no indication of strength, onset, or effect. With regard to driving, one mentioned:

> I'll take the edible before I leave. I know it's not hitting me for another 60 minutes. He lives 10 minutes away. I think there's a good chance I'll be able to [drive] there without falling asleep. (Female 1, User)

While others agreed this may only work for short distance drives, they stated if an edible kicks in during a drive then safety is certainly at risk. In addition, users reflected on the effect that differing strains of cannabis can have. On one hand, Sativa often may make a person euphoric (users referred to this as a head high) whereas Indica might make that person more relaxed (body high). Although, variability was still mentioned and may be a factor of user experience:

The thing with cannabis is, you could take it multiple ways and have
different effects. So if you're not a regular user or you don't regularly
take it the same way, then you could underestimate what's okay for you
to take. (Male 3, User)

The participants in each focus group mentioned that experienced users will have a higher tolerance, meaning they will need to consume more cannabis to experience the effects compared to when they originally started using. In regard to driving, participants in the user focus group stated they would rather get in a car with an experienced user who is about to drive than a new user. Agreement was noted when one stated:

An experienced user knows what he's doing. He knows the effects. He
knows what's going on… They're like, okay, "if I smoke this joint, I'm
going to get like this amount of high. If I eat this edible, I'm going to get
this amount of high"… Them knowing their level of control could …
[be] more trustable than someone who's new and doesn't even know…
and that's why we trust [experienced users] more behind the wheel.
(Male 2, User)

Overall, participants described being high as a change in one's natural state, resulting in physical, cognitive and emotional changes. In addition, these changes are often dependent on the purpose of use, method of consumption, strain, and tolerance. Users appeared overconfident in their perception of safety when it came to characteristics of the users experience. In contrast, non-users appeared suspicious of all cannabis while driving.

4.3.2   Theme 2: It is hard to tell if a driver is high

The second theme involves difficulties that might emerge given that is hard to objectively determine whether a driver is high. This was perceived by non-users and users alike, to translate into: 1) passengers being unaware of whether a driver is high; 2) trustworthiness of roadside testing methods and their effectiveness.

4.3.2.1   Passengers may be unaware of whether a driver is high

Although participants describe the changes associated with being high, they agreed that it is often hard to determine if a driver is high and to what extent. Both non-users and users reflected on their experiences as passengers and referred to instances where they were unable to tell if the driver was high. One participant stated:

> I mean, do I want to get in the car with him [Dad] when he's high? No. I usually don't find out until we're halfway down the road and I'm like, oh, what do I do? (Female 1, User)

Similarly,

> You get in the car and sometimes you wouldn't even know, until you're already at your destination and you're like, you were high this whole time? (Male 2, User)

These instances suggest that passengers may not have adequate information to make informed decisions when riding with a driver. This may be reflective of the transparency of the driver; the participant possibly feeling uncomfortable having conversations with known users about whether they are high. For example, this would be especially difficult if participants feel to need to have this conversation with someone in a position of authority, such as a parent. This may also be a factor of a lack of education and how to objectively recognize the signs. One of the participants offered a comment regarding this:

> I think the signs and symptoms of being drunk are more commonly, like, taught than the ones for being high even in school… So it might be difficult for cannabis because the signs aren't a) taught as well and b) we don't know the different types [of high] that people experience. (Female 3, Non-user)

Other challenges mentioned related to method of consumption and strain of cannabis. Participants expressed it is hard to know if someone smoked cannabis rather than

ingested it through an edible. In addition, a Sativa would have a different effect on someone driving than an Indica. One stated:

> If you're unaware of what the person, how they took it before you got in the car then that could be a big point. (Female 4, Non-user).

In addition to passengers, this may also pose challenges for law enforcement.

4.3.2.2   Uncertainty on roadside testing methods and effectiveness

Both non-users and users expressed a lack of knowledge and uncertainty on the procedure and effectiveness of roadside DUIC testing. The participants believed officers can't objectively test at the roadside if someone is driving high and that it is subjective and up to the officers' discretion. Concerns regarding racial and gender bias were then raised in response to perceived subjectivity. Non-users also believe users can mask symptoms of being high. One stated:

> As long as my eyes aren't red or as long as I don't smell like it, how are they going to tell. (Female 5, Non-user).

In addition, this lack of credibility of roadside testing may be a factor influencing DUIC.

> For some people the deterrent to a behavior is the consequences and so because we don't have a way to tell if someone is objectively under the influence of cannabis while they're driving, for some people that may be a reason to continue doing it. (Female 2, Non-user)

The users expressed similar beliefs. An exchange between the cannabis users illustrates their uncertainty about roadside testing and barriers police may be facing:

Facilitator: So what do you know about roadside testing? What do you think of it?

Male 2:   I think it's like pee a cup, or something, right?

Male 1:   I don't know.

Female 2:   I just assumed you went back to the station and gave a sample.

Female 1:   I literally know nothing.

Male 3:   I know the police, they came out with the saliva test, and that's what they were doing. The problem is that they didn't work in the cold weather, which is like welcome to Canada. So that's a waste of time... So a lot of police forces didn't buy them.

The participants were also uncertain on how long cannabis can last in an individual's system, which led to confusion about which kind of tests would be accurate for impairment, as opposed to ones that just detect presence of THC.

One of the issues with inadequate roadside testing was brought up regarding accuracy on collision reports as a result of DUIC:

> I think that makes you think how many accidents have happened that
> have been a result of somebody being high, right? It's probably due to
> the fact that they haven't been able to adequately test people to
> determine that. So, I mean, we have all these reports for drunk drivers,
> but the ones that were high and got into an accident, it's not labelled as
> like, oh, this death was caused by a high driver. It was just a car accident.
> (Female 1, User)

Overall, participants conveyed difficulties in objectively determining if a driver is high from both their perspective and from that of law enforcement, especially at roadside, as well as a lack of knowledge of how cannabis use can be detected.

4.3.3 Theme 3: DUIC is convenient, socially acceptable, and safe

Both non-users and users expressed justifications for DUIC, including that it is often convenient, socially acceptable for some and deemed to be safer than drinking and driving. In regards to convenience, non-users discussed a number of possible reasons. These were summed up by one participant's statement:

> You don't want to leave your car somewhere, you don't have the money
> for a cab or don't want to pay for it. You don't want to admit that you're

really as high as you actually are. Maybe you agreed to drive your

friends home and you don't want to let them down. (Female 5, Non-user)

While these seem to emphasize that it is a personal decision, justifications from users focused more on a lack of alternatives. For instance, one expressed:

My friends do it, too, but I'm from a really small town. So I think that's why, because we don't have any other way to get around. Like the bus comes once an hour, and usually our designated driver is the one that smokes and everyone else drinks. (Male 2, User)

Users agreed that while prevention efforts currently emphasize calling a cab or taking a bus, oftentimes they have difficulties finding and affording cabs, and stated some rural locations don't have an adequate bus system. Further, users described on some occasions when they visit their friends, they end up all getting high without previously planning to, leading to some having to drive home or leaving their car. On these occasions, oftentimes they decide they also want to go out and do something, or to eat, and this leads to one driving for convenience.

Participants also seemed to express that DUIC is socially acceptable among some peer groups. The non-users stated some may be more willing to justify a friend's DUIC behavior because they are friends, however this will be dependent on their relationship. They provided a point from the flip side, suggesting if someone is very against DUIC, they may be more willing to confront a friend rather than a stranger. The users had a similar view but suggest it may depend on location and culture. One stated:

At university, all my friends are like, if I'm high, we're not getting behind the wheel, whereas, in Toronto it's like a lot of them will get high and then just be like it's almost normal practice... [Its] not a barrier to not drive at all. If you're too drunk, it's okay, I know we're not going to drive, but it's like the same rules don't apply to being high. (Male 2, User)

It may also be seen as socially acceptable since many participants stated that DUIC is safer than driving after using alcohol and other drugs. As seen in an abovementioned quote, for some, the designated driver is the one who uses cannabis while others use alcohol. In addition, both non-users and users shared the belief that cannabis is safer to use when driving compared to alcohol.

> I know from all of the campaign ads and the research that I've read and a ton of other sources and societal norms that drinking and driving is really dangerous and causes death. But I just haven't heard much at all about cannabis. (Female 2, Non-user)

The users expressed they would feel more in control if they had to drive high, as opposed to drive drunk. They believed the same level of impairment can be reached quicker with alcohol compared to cannabis, and that the impairment associated with alcohol would pose a greater danger. Overall, participants agreed DUIC may be more convenient, socially acceptable for some, and considered safe compared to drinking and driving.

4.3.4   Theme 4: Legalization makes cannabis more attractive to use

Both non-users and users expressed similar beliefs that legalization will provide regulated and safer cannabis products, making cannabis more attractive to use. One of the non-users expressed:

> I think the legalization was a really positive thing because it's, you know, more controlled and safer. And so I, like in the future I would see myself like probably using it. (Female 2, Non-user)

In addition, participants mentioned youth may try cannabis to exercise their freedom since it is now legal. One of the participants stated

> It just got legalized so they want to exercise that freedom that they feel that they have. (Male, Non-user)

Similarly, a user provided the example:

> [People may state] "It's legalized. Let's join the revolution of it being legalized". (Male 2, User)

Therefore, participants believed there will be an initial spike in cannabis use as a result of legalization. Cannabis users also expressed a greater likelihood to use since they now know what's in it, whereas before there was a chance it could be laced with other substances. In addition to safer cannabis, they can now select products labeled with the strain and levels of THC/CBD. One participant contrasted with previous experiences:

> Before it was legalized it wasn't like, "oh wow, this is Sativa, I'm going
> to really smoke this". It's literally whatever's available and who's ever
> rolling whatever they're rolling … We're smoking it and then you let the
> effects hit you and you go. (Male 2, User)

Participants expressed cannabis could also be a first alternative for medical relief, before getting medical professional help. Both non-users and users expressed hearing that CBD can be really beneficial and may be an appropriate alternative to prescription drugs (e.g., depression and anxiety medications). A participant stated:

> Now that it's legalized if you feel like you're having problems sleeping or
> anxiety or anything like that … you might think to go to [cannabis] first
> before going to a doctor. (Female 5, Non-user)

The users expressed very similar beliefs and also think many will turn to cannabis just to help fall asleep at night. Overall, both focus groups clearly stated that legalization will have a positive impact on the safety and quality of cannabis being offered. However, the focus group participants did not speak to the influence of legalization on DUIC.

4.3.5   Theme 5: There is a need for testing, education, and prevention efforts that are relevant to 'us' [youth]

The last theme focuses on participants' beliefs regarding intervention strategies for DUIC prevention. These include: 1) objective detection, 2) early education, and 3) effective intervention.

4.3.5.1   Objective detection

Both non-users and users agreed that law enforcement needs to be able to objectively and accurately detect cannabis among drivers, similar to the extent that alcohol can be detected. One participant stated:

> I think we need to find a way, like a really accurate, objective measure to
> see what level of intoxication you are. And I think while subjective
> should be a component, I think objectivity is what's going to not allow
> for those biases to come up in situations. (Female 1, User)

Users also noted that tests should involve a functional component. They believed that since cannabis affects everyone differently, a level test (e.g., THC %) may not accurately reflect someone's level of impairment.

Participants expressed concern regarding cannabis use among medical users, given that law enforcement would have to consider if cannabis in that person's system is causing impairments or improvements in their driving performance. Participants also mentioned access is a key benefit of legalization including: the opportunity to conduct more research on cannabis and its effect on driving (e.g., accident risk). Participants expressed this could hopefully result in objective limits and better detection for roadside testing.

4.3.5.2   Early education

The other preventive strategy identified by individuals in both focus groups was early education coming from a number of sources. Participants expressed that schools should be the first and most prominent point of education. Participants recalled learning not to drink and drive in elementary school, which led to strong beliefs not to do it, but haven't heard anything regarding cannabis. One of the users described it as:

> I think youth [are] an extremely impressionable group in the sense that I
> remember going through elementary school and there are things that
> have just stuck with me, like don't drink and drive… if you start at a
> young age really emphasizing the kind of values you want to instill in

people as they grow up, then I think targeting below the ages of 18 to 24

is probably going to get you that. (Female 1, User)

In addition, this education should continue throughout all levels of school, including high school and university. High school is ideal since that is the time youth obtain their license. One expressed:

Every year in high school, there was someone who died from a drunk

driving accident. So there's that personal connection that you feel to it.

It's just like, "oh yes. No, I don't want to be them". (Male 1, User)

Participants also brought up that hearing about the negative effects of cannabis on driving from a well informed source, such as professors in university, could alter their perceptions. According to participants, one aspect of education that should not be overlooked is how cannabis affects driving. Participants in the focus groups knew cannabis had impairing effects, but could not speak to how this translates into driving. One participant stated:

I think individuals also aren't as aware of how cannabis impairs

driving…does it make people drive slower? Does it make people veer off

the road? … I feel like people don't realize what kind of impairments it

does so then they misjudge the risk. (Female 3, Non-user)

Another source of education mentioned by non-users was driving schools. Participants in this focus group agreed with this idea, although this was not brought up in the user focus group. One of the non-users expanded:

With youth one of the biggest, I guess, rights that you gain is the fact that

you can drive… I don't think there was a lot of time spent on things that

can impair you're driving when we went to driving school. So talking

about marijuana in that context might reinforce its role in driving

specifically. (Female 3, Non-user)

Social media and internet campaigns were discussed as a strategy that could reach young people since they are so often on the internet. There was strong agreement noted when one of the participants said:

> Effective marketing I think that is critical, because like no offence to the government or whoever is making these cannabis ads that are popping up on social media, but they're really not speaking to young people. (Female 2, Non-user)

The participants believed campaigns need to be well researched to effectively target the appropriate audience. In addition, non-users suggested that partnering with celebrities and big well-known brands (e.g., Nike) would be able to educate people in a shorter period of time.

Finally, education must resonate with the people. One stated:

> It shouldn't just engage my mind, it should also engage my feelings… rather than just facts. (Male, Non-user)

Participants believed that anecdotes from those who experience a near crash or a crash could be effective. They suggested this could be a relatable and compelling way to highlight the risks, in a way that becomes personal and goes beyond statistics. Overall, participants believed that the combination of education, stronger research, and the anecdotal evidence and experiences of those who have done it could be effective deterrence strategies.

4.3.5.3   Effective Intervention

The final component discussed to deter and prevent DUIC was the need for effective interventions with appropriate legal penalties. Both non-users and users advocated that license suspension would be a greater deterrent than current fines, since it really inconveniences an individual and affects their day to day life. There was mixed opinion regarding jail time, where some believed it to be too extreme, and others stated that extreme penalties are needed for deterrence. One participant commented:

> If revoking your license for a period of time is just as effective as jail
>
> time then may as well do that. (Female 1, Non-user)

The user focus group expressed penalties should have the same consequences as a DUI of alcohol. The rationale was that associating DUIC with the same penalties as drinking and driving, may make participants believe they are as equally dangerous. One participant stated:

> If you get caught drinking and driving, your life's basically ruined
>
> because you have a DUI, which is a criminal record, not like a small
>
> charge. It's like a big thing. If that's what society feels marijuana drivers
>
> should be at the same level, then they just need to do the same tactics, I
>
> guess. (Male 2, User)

There was firm agreement that a DUI would be an appropriate penalty for DUIC. However, participants mentioned that there must first be clear evidence on the risks to back up the legal penalties.

Overall, this chapter presented both quantitative data (DUIC profiles and predictive factors) and qualitative data (perceptions and attitudes of youth regarding use of cannabis when driving) obtained in the online survey and two focus groups, respectively. The next chapter will integrate these findings and discuss the implications.

Chapter 5

5 Discussion

The present study aimed to examine the knowledge, perceptions and attitudes of young Ontarian drivers regarding cannabis use and DUIC, in relation to general deterrence (effect of fear of legal punishment) and general prevention (more encompassing, includes personal perceptions and social norms). Now that cannabis is legally available across Canada and young drivers constitute a high-risk population for DUIC, understanding their perceptions and attitudes, which are proven to influence this behavior, is vital in order to inform the development of targeted preventative interventions. Using a mixed methods approach, the first phase (quantitative) of this study described the DUIC profiles of young Ontarian drivers, and identified the predictors of DUIC through an online survey. Subsequently, the second phase (qualitative) used focus groups to expand these findings and understand the meaning that Ontarian youth attribute to cannabis and driving. The following sections will discuss key findings, including the significant predictors and how this study's focus group findings can help explain them, as well as the implications and limitations of this study.

5.1 Key findings

The results from this study suggest an increasing trend towards cannabis use and DUIC among young drivers. Overall, we found that over three in four drivers (83.6%) had used cannabis in their lifetime, with 69.5% of the sample doing so in the previous year. Recent evidence from Health Canada (2019) indicated that in 2017, past-year cannabis use among those ages 20 to 24 was only 33%. This difference in prevalence suggests cannabis may have increased among youth since legalization was announced. In fact, 61% of non-users in this survey expressed there is a chance they will try cannabis once legal (data was collected prior to the enactment of legalization). Moreover, focus group participants suggested that legalization makes cannabis more attractive to use by regulating safer products and offering an alternative to traditional prescription medications. These findings are consistent with previous literature that reported

Canadians will be more likely to try cannabis once legal (Boak et al., 2017; IPSOS, 2018) and that legalization in the USA decreased perceptions of risk associated with cannabis and increased use among youth (Cerdá et al., 2017; Ghosh et al., 2017; Kerr et al., 2017; Miller et al., 2017; Substance Abuse and Mental Health Services Administration, n.d.). This hypothesis, however, requires empirical testing once official data is released. As such, differences can also be a result of the location of the sample, or other sample characteristics.

A concerning finding, however, was that many users expressed cannabis can be a natural alternative for seeking medical help. Around 33% of our survey respondents indicated they use cannabis for both medicinal and recreational purposes. In addition, focus groups participants expressed many are turning to cannabis to assist them with sleep and relieve symptoms of anxiety and depression. Cannabis use was perceived to be safe, especially when compared with alcohol and other drugs. However, the World Health Organization (2016b) reports acute cannabis use among youth may be linked with anxiety and psychotic symptoms, and that long term use is associated with cannabis dependence, poorer cognitive functioning, other illicit drug use, psychosis, and schizophrenia. In addition to these unintended consequences, if this trend increases general cannabis use among youth, there will be at a greater risk for DUIC (Le Strat et al., 2015). Therefore, stronger efforts will be needed to encourage safe cannabis use and to prevent and deter this increasing number of users from DUIC.

Our data further suggests DUIC is very common among cannabis users and many admit to a future chance of DUIC. Overall, 35% (147) of our sample reported previous DUIC, with 26% (111) doing so in the past year. It is worth noting that the majority of these individuals were males, had completed less than a bachelor's degree and were students without employment. Other studies have indicated that between 2000 and 2015, on average, only 6.1% of Canadians ages 16 to 24 reported past-year DUIC (Robertson et al., 2017) and between 2014 to 2015, 9.4% of those ages 16 to 18 reported DUIC at least once in their lifetime (Minaker et al., 2017). While our findings are higher than the official data, differences could be a result of previous research reporting proportions among all youth (including G1 and non-drivers), while we only studied drivers with a G

or G2 license. It is likely, for example, that G1 drivers would have lower incidence of DUIC, as they must always be accompanied by a driver that holds a G license, often their parents, and have a zero tolerance for impaired driving. In addition, our findings suggest almost half (142) of current past-year cannabis users in the sample have DUIC, with some doing so in combination with alcohol or with other drugs. This is consistent with findings from a recent survey of cannabis users across the USA (n=1773) that identified over 50% had previously DUIC (Cuttler, Sexton, & Mischley, 2018). Therefore, as rates of cannabis use increase, so does DUIC. It is concerning to note that our findings indicate that 42% of the sample (179) expressed there is a chance they will DUIC in the future (compared to 35% who DUIC in the past) and the majority of survey participants (more non-users than users) believed this will increase with legalization. Previous evidence indicated legalization in the USA did increase the prevalence of DUIC and the number of MVC fatalities that involved cannabis (Colorado Department of Transportation, 2017; Ghosh et al., 2017; J. Lee et al., 2018; Tefft et al., 2016; Vogler, 2017; Washington Traffic Safety Commission, 2016). Therefore, increasing efforts to prevent DUIC will be required. One critical consideration for prevention, is directing resources and efforts towards factors shown to predict future DUIC.

Our study identified six significant predictors of DUIC (in order to be discussed) among a sample of Ontarian youth ages 18 to 24: past DUIC, minor accident risk, dangerousness, perceptions on those convicted actually receiving penalties, vicarious experiences of punishment avoidance, and moral awareness. Interestingly, gender was not a predictor for DUIC expectancy in our regression, although it was significant for prior DUIC history and cannabis user status. Consistent with our findings, previous research has failed to identify gender as a predictor for future DUIC (Armstrong et al., 2018; Aston et al., 2016; Cuttler et al., 2018), although in other studies it has been associated with past DUIC (McCarthy et al., 2007).

The fact that minor accident risk and dangerousness were both significant predictors was not surprising, as it is consistent with previous international literature (Arterberry et al., 2013; Aston et al., 2016; McCarthy et al., 2007). It is worth noting that survey participants believed DUIC is more likely to result in a minor MVC than a serious one

(i.e., resulting in fatalities and/or serious injuries) and less than a quarter believed that DUIC is very dangerous. Those in the focus group were able to reflect on instances where they heard of fatal crashes as a result of alcohol, but none of them had heard of any attributed solely to cannabis. These findings were similar with those expressed among other Canadian youth (Jonah, 2013; McKiernan & Fleming, 2017). In addition, almost all survey participants who previously DUIC, agreed that DUIC is safer than drinking and driving. While MVC's that involve cannabis are occurring in Canada, youth are not aware of this. Robertson et al., (2017) reported that 15.5% of fatally injured Canadian drivers who were tested for drugs between 2000 and 2012, tested positive for cannabis. The fact that none of the participant had heard of even one cannabis- related MVC could mean that this knowledge is not being translated to youth. This lack of awareness of others involved in MVCs may be one of the reasons why only few participants believed DUIC is very dangerous or could lead to a serious accident. On another note, users believed that dangerousness can be reduced by certain characteristics of the driver. For example, if the driver is an experienced cannabis user, this is likely to result in a lower risk for a collision. However, interestingly, users also expressed agreement with the fact that it is very difficult to determine if someone is high. As a result, their overconfidence in the trustworthiness of the driver and being able to determine their level of experience seems compromised. In an effort to prevent this behaviour, focus groups participants expressed a need for media coverage on the MVC's resulting from DUIC to effectively reach young people. Increasing knowledge on these MVC's may change perceptions of the dangers and risks of DUIC, which were suggested to be a more important contributor to DUIC activity than perceptions of legal repercussions (Capler et al., 2017). This was true in our survey since the variables on legal repercussions were not significant.

The fact that both knowledge and credibility of the law variables in our survey were comparatively low in level and only one of the credibility variables was identified as a predictor of DUIC expectancy, suggests that law enforcement is not effectively deterring this behaviour. In the focus groups, participants expressed beliefs that police officers do not have the ability to objectively detect if someone is using cannabis and suggested a fairly low risk of being caught or experiencing punishment for DUIC. These findings are

similar with those reported by other young Canadians ages 14 to 19 (Mckiernan & Fleming, 2017) and may be contributing to the increasing rates of DUIC. The credibility variable that was a significant predictor demonstrated that majority of survey participants believed that very few reprimanded for DUIC will actually receive full penalties required by law. This suggests that along with enhancement of evidence-based objective detection, improvements must be made in the criminal justice system to effectively convict those DUIC. One explanation for this lack of knowledge and credibility in the law may be that DUIC legislation is fairly new and that youth aren't yet aware of the penalties. One of the regulations within the Cannabis Act (Bill C-45) was an amendment to the Criminal Code to increase current penalties for those engaging in DUIC. However, participants seemed to be unaware of this and focus groups participants recommended the need for appropriate legal penalties, suggesting DUIC should result in a license suspension or DUI charge, although these already currently exist (Criminal Code, 1985; Government of Canada, 2017). While more participants in the survey were in favor of fines, focus group participants explained that fines are easy to resolve and are not a good deterrent for DUIC. These beliefs are likely a result of not knowing anyone who experienced punishment for DUIC, which may lead to them underestimating the associated legal penalties. Therefore, intervention efforts should focus on increasing awareness of both the MVCs resulting from DUIC (to promote awareness of accident risk and dangerousness), and the associated legal penalties that were imposed (to increase credibility in the law).

Our regression analysis also identified vicarious experiences of punishment avoidance as a predictor for future DUIC. This variable refers to an individual's knowledge of others who have avoided punishment for this behaviour. Previous research has demonstrated that this influences likelihood of driving following drug use (Armstrong et al., 2018; Watling et al., 2010). Interestingly, most participants in our study either expressed strong disagreement or agreement with the statement "my friends often use cannabis and drive without being caught", with very few in the middle categories of agreement. We asked participants in the focus group to comment on this and they suggested that those who disagreed may believe their friends don't DUIC at all, and those who agreed are ones

whose friends have previously DUIC and haven't gotten caught. This view coincides with findings from the credibility section, suggesting very few youth know of others who have experienced punishment. Therefore, disagreement with this statement is likely a result of their friends not DUIC, rather than doing so and having experienced consequences. In addition, participants expressed that people are more likely to associate themselves with likeminded individuals, meaning many who agreed with this question may have previously DUIC themselves. As was displayed in Table 6, over a quarter of those who previously DUIC reported that most of their friends do and few believe their friends would disapprove of this behaviour. Knowing this behaviour is socially acceptable for some peer groups should be taken into account, so that interventions aim to target DUIC prevention beyond the individual level.

In addition to developing early education and effective intervention strategies that address the dangers of DUIC, and the need to improve the credibility of the law, our findings suggest that messaging around the moral implications of DUIC can also be an effective avenue for deterrence and prevention. Our survey findings indicate moral awareness (i.e., beliefs about whether DUIC is "morally wrong") is a significant predictor of future DUIC. The majority of our sample (40%) viewed DUIC as always wrong, compared to less than 12% of those who previously DUIC. Participants in focus groups explained they were taught at a young age not to drink in drive, including the moral repercussions of putting others in danger as a result of one's own decisions. Yet, they expressed not receiving the same messaging around DUIC. This speaks to health promotion and education efforts which have achieved great progress in their concentrated efforts to deter drinking and driving, but have concentrated less on DUIC. One month post-legalization, few participants in the focus groups stated seeing the Government of Canada's "don't drive high" campaign and those who have saw it believed it to be ineffective. In addition, many survey and focus group participants did not understand how exactly cannabis effects and impairs driving, with 26% stating it has positive or neutral effects. Similarly, Mckiernan & Fleming (2017) reported young Canadians in their study (ages 14 to 19) lacked adequate understanding of why and how cannabis

affects driving. These findings are consistent and confirm the need for education and stronger prevention efforts.

5.2 Implications of study findings

This study adds to the growing body of literature exploring cannabis use and DUIC among youth. While cannabis use and DUIC are very common among young drivers and seem to be on an up rise with legalization, targeted prevention efforts are needed. Understanding the factors that are likely to influence a young driver's decision to DUIC is critical, if interventions and education strategies are to be efficacious. For example, educating youth on the dangers of DUIC and the risk for a MVC, may be more likely to result in DUIC deterrence, as dangerousness was identified as a predictor. Social media might offer an effective channel that can reach large audiences and be leveraged to develop messaging around prevention and deterrence, including, for example, testimonies of those who have experienced cannabis-related MVCs. In addition, efforts should also focus on educating youth on the legal penalties resulting from DUIC, as well as the ways in which the law is effectively able to convict those who DUIC. This would increase the credibility in the law and may deter some. Societal views on DUIC need to shift, if youth are to be deterred from DUIC behaviors, a much as drinking and driving perceptions have largely shifted to have negative moral connotations and thus decrease alcohol-related fatalities over the past few decades (Sweedler et al., 2004; Vanlaar et al., 2012; A. F. Williams, 2006).

This was the first study to apply the theoretical framework of general deterrence and general prevention to investigate cannabis-impaired driving. Since it had only been previously applied in alcohol literature, certain distinctions had to be made in order for it to be suitable to explore cannabis use and DUIC (previously discussed in Section 3.3.3.1). However, our experiences suggest that this framework is appropriate in exploring this topic and that it can help inform the selection of constructs, question items, and data analysis.

Our findings offer many opportunities for further research within this context. It is necessary to develop and implement early evidence-based interventions, including in

school and driving school settings, in order to prevent DUIC in the first place. In regard to cannabis use among youth, in depth qualitative investigations on the beliefs of those who use cannabis for medical purposes could provide an understanding on how to effectively promote safe cannabis use within this population. While our data touched on this topic, few participants spoke on the benefits they experience when using cannabis for medical purposes, and its impact on driving. Since social stigma around substance use behaviours shape youth perceptions, future research should explore stigma around cannabis use for recreational and medicinal purposes, in comparison with alcohol. In addition, some participants mentioned that while alcohol is commonly accepted and used socially by all generations (e.g., children, parents, grandparents), cannabis is not. Understanding different family experiences with cannabis and DUIC discussion within households may offer insight on how to effectively target and educate parents on discussing this with their children. This might provide another pathway for prevention.

With respect to education and prevention, future studies are needed to understand which marketing channels are the most appropriate to target and reach youth (e.g., using social media, internet ads, TV based ads, bill boards, celebrity endorsements, etc.). These are crucial for prevention, as many focus group participants believed the current interventions to be ineffective. While our focus groups provided some insight, this may not be the case for other demographic groups, including younger drivers or those with a G1 license. In addition, focus groups introduced the idea that DUIC is socially acceptable among some peer groups. Further investigation into DUIC perceptions and attitudes across peer groups of different geographical contexts (e.g., rural vs urban), and education levels could provide further insight into how to prevent this behaviour.

In regard to our dataset, further analyses (e.g., regression) could be conducted to determine which factors are associated with past DUIC and compare this to future expectancy. This would include variables specific to cannabis users (frequency) and those who have DUIC (history and perceptions of risk) that were initially excluded. The perceptions of risk variables has been associated with past year DUIC (Davis et al., 2016), although it was excluded since it was not administered to the whole sample.

5.3   Limitations

The present study should be viewed in light of several limitations of the data and design. Since this survey was administered online, we are limited to only capturing the perceptions of those with internet access and who regularly engage in social media, as that was the primary channel of distribution. Therefore, we were unable to capture perceptions of those limited by internet or geographic access (e.g., rural areas, farming communities, aboriginal reserves). If this survey were to be expanded, the implementation of paper questionnaires and other means of survey distribution would be required to reach youth.

In regard to participation, our online survey posed potential for sampling bias, recall bias, and the influence of concurrent cannabis use while taking the survey. First, since this study used a convenience/voluntary sample instead of random sampling, there is potential for sampling bias. This occurs when some members of the population are less likely to take part in the study than others, which can result in a biased sample and undermine external validity (i.e., ability of results to be generalized to the population; Portney & Watkins, 2009). Since individuals who completed the survey did so on a voluntary basis, there is potential that cannabis users were more likely to express their beliefs and participate in the survey. This may have played a role in our survey since the reported rates of cannabis use and DUIC were a lot higher than in previous literature. The role of recall bias might have had an influence on survey data, as it is often evident among student drug use surveys (Boak et al., 2017). Since past cannabis use and DUIC were self-reported, there is potential for inaccurate reports caused by intentional (e.g., underreporting) or unintentional errors (e.g., memory or recollection errors). Therefore, self-reported data may not be representative of their actual behavior. A unique area of bias with online surveys that assess drug use, is inflated perceptions if the subjects were using drugs at time of survey completion. Evidence has shown that individuals who were using cannabis at the time of survey completion (more likely to be female) had higher odds of agreeing with statements on perceived safety of DUIC behavior (Allen et al., 2016). Since this survey was administered online, it was not possible to determine the

number of individuals currently under the influence of cannabis. Therefore, we must be aware that this influence may overestimate the perceptions on safety of DUIC.

Several limitations are noteworthy in relation to the design of the survey instrument. First, while participants were screened to be between 18 to 24 years of age, we did not assess their specific age. This limited the comparisons we could make between younger and more experienced drivers, since there could be six years difference between the youngest and oldest participant. Recent studies have showed age to be associated with driving following drug use (Armstrong et al., 2018) and future DUIC (Aston et al., 2016; Cuttler et al., 2018; Le Strat et al., 2015). However, specific age was not asked in an effort to limit identifiable information and comply with the Tri-Council Policy Statement (TCPS-2) on confidentiality (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada, 2014). At the time of the survey, cannabis use was still illegal (along with DUIC remaining illegal) and asking participant's age could deter participation and increase the amount of identifiable information available to the researchers regarding individuals who would be potentially admitting to criminal behavior. This presents an ethical tension, as studies like this are susceptible of requiring disclosure by law enforcement (e.g., through the IP address of survey participants). Along with age, location was not obtained for similar confidentiality reasons, although this would have provided an interesting variable for comparison between rural and urban settings. For example, focus group participants suggested DUIC is more common in rural areas, although we cannot compare this belief with any survey data. Another limitation was including only drivers who have a G or G2 license. This limits the generalizability of our findings and excludes those who may soon become drivers, or who have G1 licenses. While G1 drivers were excluded due to a number of restrictions associated with this license, DUIC behaviour among these drivers would have provided an interesting variable to explore, especially since G1 drivers must always be accompanied by a passenger with a full G license.

Further, the survey instrument could be improved by refining the choices and wording of specific questions. For the questions assessing gender and ethnicity, an alternative option

was provided with an open field to comment. However, we noticed some participants used this comment box as means for providing unsolicited and unrelated responses. Others provided responses that were very broad (e.g., writing "European", instead of specifying where in Europe they are from). Therefore, some of these participants were not included in the chi-squares (i.e., the "other" category in gender), in an effort to reduce the number of cells with expected cell counts under five. On another note, the question that asked if cannabis use was for medical or recreational purposes could have been more specific. Over 30% reported they used cannabis for "both" purposes, however this seems incorrect since the Ontario Medical Association (2019) reports patients under the age of 25 should not be prescribed any cannabis. Therefore, participants likely reported using cannabis they obtained recreationally for self-medication purposes (e.g., help sleep, anxiety, etc.). Other limitations included: some survey questions were negatively worded, such as question 16 which said, "doesn't affect driving". There were also two double-barreled questions, such as the statement in question 16 "I regularly drive after using cannabis and don't get caught" and the vicarious punishment avoidance question asking agreement with "my friends often use cannabis and drive without being caught". These statements addressed more than one topic, but allowed for only one answer. For instance, participants could have disagreed with the first section of the question (e.g., "I regularly drive after using cannabis" or "my friends often use cannabis and drive") and felt differently about the second (e.g., I/ they haven't been caught). Since these statements were shown to predict future DUIC likelihood (Armstrong et al., 2018; Watling et al., 2010), the wording was kept the same to preserve the integrity of the question, although we acknowledge that double barrelled questions are problematic and may not be representative of the comprehensive view of the person.

Another limitation pertains to the cells with zero frequencies identified in our analysis. Most cells (78.4%) in the 6 IV model had zero frequencies (i.e., DV levels by observed combinations of predictor variable values), which means our goodness of fit statistics should be interpreted with caution. These were present even though we combined categories among several variables (described in Section 4.2) in an effort to reduce zero cells. If our sample size was larger and more responses were obtained, then there may

have been more responses for these categories. Additionally, this may have been caused from the distribution of responses over the DV. Since over half of the participants selected "No chance" of DUIC expectancy, it decreases the overall variability in that question, including the other four response options, and the number of unique covariate patterns.

Finally, a limitation known to be common in focus groups (Smithson, 2000) and we experienced, was dealing with members that were dominant in the discussion (i.e., dominant voices). Prior to conducting the focus groups, it was decided to cluster groups by user status, since previous research suggests group homogeneity is a common method to hinder dominant voices that may otherwise be problematic (Smithson, 2000). In addition, I made an effort to ensure each participant had a chance to state their opinion before moving on to the next topic and had to interject on a few occasions (e.g., when someone was dominating the conversation, I interjected to redirect open discussion to others in the focus group). However, during data analysis it was noticed that some participants did not provide opinions for a few discussions, while others spoke frequently and on some occasions, were repetitive. Therefore, some of the opinions may not have been voiced by participants. In addition, since the non-user group only had one male, perceptions and attitudes from other male non-users may have been missed. Although, majority of non-users in our survey were female (66.7%).

6 Conclusion

Overall, our findings suggest the prevalence of cannabis use among young drivers in Ontario (ages 18 to 24) is remarkably high, with almost half of past-year cannabis users indicating a prior history of DUIC. These rates may be a factor youths' knowledge, perceptions and attitudes towards cannabis use and DUIC. While many know that DUIC is illegal and could identify the associated penalties, very few perceived these penalties as likely to be incurred and believed that law enforcement does not have the capacity to effectively detect if a driver is using cannabis. In addition, many did not view the effects of cannabis as significant risks to driving. Six significant predictors of future DUIC expectancy emerged from our analysis and can be emphasized in prevention. These include past DUIC, minor accident risk, dangerousness, perceptions on those convicted actually receiving penalties, experiences of others avoiding punishment, and moral awareness. Therefore, prevention efforts should consider educating on the dangers and risk of a MVC, that law enforcement has the capacity to apprehend and appropriately punish individuals DUIC, and that DUIC is wrong and socially unacceptable.

References

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In *Action Control* (pp. 11–39). https://doi.org/10.1007/978-3-642-69746-3_2

Allen, J. A., Davis, K. C., Duke, J. C., Nonnemaker, J. M., Bradfield, B. R., Farrelly, M. C., … Zarkin, G. A. (2016). Association between self-reports of being high and perceptions about the safety of drugged and drunk driving. *Health Education Research*, *31*(4), 535–541. https://doi.org/10.1093/her/cyw023

Anderson, B. M., Rizzo, M., Block, R. I., Pearlson, G. D., & O'Leary, D. S. (2010). Sex, drugs, and cognition: Effects of marijuana. *Journal of Psychoactive Drugs*. https://doi.org/10.1080/02791072.2010.10400704

Armstrong, K. A., Watling, C. N., & Davey, J. D. (2018). Deterrence of drug driving: The impact of the ACT drug driving legislation and detection techniques. *Transportation Research Part F: Traffic Psychology and Behaviour*, *54*, 138–147. https://doi.org/10.1016/j.trf.2018.01.014

Arterberry, B. J., Treloar, H. R., & McCarthy, D. M. (2017). Empirical Profiles of Alcohol and Marijuana Use, Drugged Driving, and Risk Perceptions. *Journal of Studies on Alcohol and Drugs*, *78*(6), 889–898. https://doi.org/10.15288/jsad.2017.78.889

Arterberry, B. J., Treloar, H. R., Smith, A. E., Martens, M. P., Pedersen, S. L., & McCarthy, D. M. (2013). Marijuana use, driving, and related cognitions. *Psychology of Addictive Behaviors*, *27*(3), 854–860. https://doi.org/10.1037/a0030877

Asbridge, M., Hayden, J. A., & Cartwright, J. L. (2012). Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis. *BMJ*, *344*(feb09 2), e536–e536. https://doi.org/10.1136/bmj.e536

Ashton, H. (2001). Pharmacology and effects of cannabis a brief review. *British Journal of Psychiatry*, *178*, 101–106. https://doi.org/10.1192/bjp.178.2.101

Aston, E. R., Merrill, J. E., McCarthy, D. M., & Metrik, J. (2016). Risk Factors for Driving After and During Marijuana Use. *Journal of Studies on Alcohol and Drugs*, *77*(2), 309–316. https://doi.org/10.15288/jsad.2016.77.309

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. *Prentice-Hall Series in Social Learning Theory.*, *xiii*, 617. Retrieved from http://psycnet.apa.org/psycinfo/1985-98423-000/

Beirness, D. J., & Beasley, E. E. (2010). A Roadside Survey of Alcohol and Drug Use Among Drivers in British Columbia. *Traffic Injury Prevention*, *11*(3), 215–221. https://doi.org/10.1080/15389581003735626

Benschop, A., Liebregts, N., van der Pol, P., Schaap, R., Buisman, R., van Laar, M., … Korf, D. J. (2015). Reliability and validity of the Marijuana Motives Measure among young adult frequent cannabis users and associations with cannabis dependence. *Addictive Behaviors*, *40*, 91–95. https://doi.org/10.1016/j.addbeh.2014.09.003

Berger, D. E., & Marelich, W. D. (1997). Legal and social control of alcohol-impaired driving in California: 1983-1994. *Journal of Studies on Alcohol*, *58*(5), 518–523. https://doi.org/10.15288/jsa.1997.58.518

Berger, D. E., Snortum, J. R., Homel, R. J., Hauge, R., & Loxley, W. (1990). Deterrence and prevention of alcohol-impaired driving in Australia, the United States, and Norway. *Justice Quarterly*, *7*(3), 453–465.

https://doi.org/10.1080/07418829000090681

Bergeron, J., & Paquette, M. (2014). Relationships between frequency of driving under the influence of cannabis, self-reported reckless driving and risk-taking behavior observed in a driving simulator. *Journal of Safety Research*, *49*(February), 19.e1-24. https://doi.org/10.1016/j.jsr.2014.02.002

Bertrand, J., Brown, J., & Ward, V. (1992). Techniques for Analyzing Focus Group Data. Evaluation Review. *Evaluation Review*, *16*(2), 198–209.

Boak, A., Hamilton, H. A., Adlaf, E. M., & Mann, R. E. (2017). *Drug use among Ontario students, 1977-2017: Detailed findings from the Ontario Student Drug Use and Health Survey (OSDUHS) (CAMH Research Document Series No. 46)*. Retrieved from http://www.camh.ca/en/research/news_and_publications/ontario-student-drug-use-and-health-survey/Documents/2017 OSDUHS Documents/Detailed_DrugUseReport_2017OSDUHS.pdf

Bondallaz, P., Favrat, B., Chtioui, H., Fornari, E., Maeder, P., & Giroud, C. (2016). Cannabis and its effects on driving skills. *Forensic Science International*, *268*, 92–102. https://doi.org/10.1016/j.forsciint.2016.09.007

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide For Beginners*. Sage.

Buckner, J. D. (2013). College Cannabis Use: The Unique Roles of Social Norms, Motives, and Expectancies. *Journal of Studies on Alcohol and Drugs*, *74*(5), 720–726. https://doi.org/10.15288/jsad.2013.74.720

Busardo, F. P., Pichini, S., Pellegrini, M., Montana, A., Lo Faro, A. F., Zaami, S., & Graziano, S. (2017). Correlation between Blood and Oral Fluid Psychoactive Drug Concentrations and Cognitive Impairment in Driving under the Influence of Drugs. *Current Neuropharmacology*, *16*(1), 84–96. https://doi.org/10.2174/1570159X15666170828162057

Canadian Automobile Association. (2017). Cannabis Impaired Driving. Retrieved from https://www.caa.ca/cannabisimpaireddriving/

Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & and Social Sciences and Humanities Research Council of Canada. (2014). *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*. Retrieved from http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/Default/

Cannabis Act. *S.C, c. 16.* , (2018).

Capler, R., Bilsker, D., Van Pelt, K., & MacPherson, D. (2017). *Cannabis use and Driving: Evidence Review*. Retrieved from https://drugpolicy.ca/wp-content/uploads/2017/02/CDPC_Cannabis-and-Driving_Evidence-Review_FINALV2_March27-2017.pdf%0Ahttp://drugpolicy.ca/wp-content/uploads/2017/02/CDPC_Cannabis-and-Driving_Evidence-Review_FINALV2_March27-2017.pdf

Carlsen, B., & Glenton, C. (2011). What about N? A methodological study of sample-size reporting in focus group studies. *BMC Medical Research Methodology*, *11*(1), 26. https://doi.org/10.1186/1471-2288-11-26

Cerdá, M., Wall, M., Feng, T., Keyes, K. M., Sarvet, A., Schulenberg, J., … Hasin, D. S.

(2017). Association of state recreational marijuana laws with adolescent marijuana use. *JAMA Pediatrics*, *171*(2), 142–149. https://doi.org/10.1001/jamapediatrics.2016.3624

Cleary, M., Horsfall, J., & Hayter, M. (2014). Data collection and sampling in qualitative research: does size matter? *Journal of Advanced Nursing*, *70*(3), 473–475. https://doi.org/10.1111/jan.12163

Cochran, W. G. (1954). Some Methods for Strengthening the Common χ 2 Tests. *Biometrics*, *10*(4), 417. https://doi.org/10.2307/3001616

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Hillsdale, NJ, NJ: Erlbaum.

Colorado Department of Public Health and Environment. (2016). *Monitoring Changes in Marijuana Use Patterns: 2016, Section 1: Monitoring Changes in Marijuana Use Patterns in Colorado*.

Colorado Department of Transportation. (2017). *Data File: Fatality Analysis Reporting System, (2013–16)([Dataset])*.

Conrod, P. J., Pihl, R. O., Stewart, S. H., & Dongier, M. (2000). Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors for substance abuse. *Psychology of Addictive Behaviors*, *14*(3), 243–256. https://doi.org/10.1037//0893-164X.14.3.243

Controlled Drugs and Substances Act. *S.C, c. 19.* , (1996).

Creswell, J. W. (2014). Research design: qualitative, quantitative, and mixed methods approaches. In *Research design Qualitative quantitative and mixed methods approaches* (4th ed.).

Criminal Code. *R.S.C., c. C-46, S. 320.* , (1985).

Cuttler, C., Sexton, M., & Mischley, L. (2018). Driving Under the Influence of Cannabis: An Examination of Driving Beliefs and Practices of Medical and Recreational Cannabis Users across the United States. *Cannabis*, *1*(2), 1–13. https://doi.org/10.26828/cannabis.2018.02.001

Danton, K., Misselke, L., Bacon, R., & Done, J. (2003). Attitudes of young people toward driving after smoking cannabis or after drinking alcohol. *Health Education Journal*, *62*(1), 50–60. https://doi.org/10.1177/001789690306200106

Davis, K. C., Allen, J. A., Duke, J. C., Nonnemaker, J. M., Bradfield, B. R., Farrelly, M. C., … Novak, S. P. (2016). Correlates of Marijuana Drugged Driving and Openness to Driving While High: Evidence from Colorado and Washington. *PLOS ONE*, *11*(1), e0146853. https://doi.org/10.1371/journal.pone.0146853

Deutskens, E., de Ruyter, K., Wetzels, M., & Oosterveld, P. (2004). Response Rate and Response Quality of Internet-Based Surveys: An Experimental Study. *Marketing Letters*, *15*(1), 21–36. https://doi.org/10.1023/B:MARK.0000021968.86465.00

ElSohly, M. A., Mehmedic, Z., Foster, S., Gon, C., Chandra, S., & Church, J. C. (2016). Changes in cannabis potency over the last 2 decades (1995-2014): Analysis of current data in the United States. *Biological Psychiatry*. https://doi.org/10.1016/j.biopsych.2016.01.004

Fischer, B., Ivsins, A., Rehm, J., Webster, C., Rudzinski, K., Rodopoulos, J., & Patra, J. (2014). Factors Associated with High-Frequency Cannabis Use and Driving among a Multi-site Sample of University Students in Ontario. *Canadian Journal of Criminology and Criminal Justice*, *56*(2), 185–200.

https://doi.org/10.3138/cjccj.2014.ES03

Fishbein, M. (1979). A theory of reasoned action: Some applications and implications. *Nebraska Symposium on Motivation*, *27*, 65–116. Retrieved from http://psycnet.apa.org/psycinfo/1982-21121-001

Fishbein, M., & Ajzen, I. (1975). Attitude formation. In *Belief, Attitude, Intention, and Behavior, An Introduction to Theory and Research* (pp. 216–287). https://doi.org/10.1016/B978-0-12-375000-6.00041-0

Gabrys, R., & Porath, A. J. (2019). Clearing the Smoke on Cannabis, Regular Use and Cognitive Fucntioning. In *Canadian Center on Substance Use and Addiction*.

Ghosh, T. S., Vigil, D. I., Maffey, A., Tolliver, R., Van Dyke, M., Kattari, L., … Wolk, L. (2017). Lessons learned after three years of legalized, recreational marijuana: The Colorado experience. *Preventive Medicine*, *104*, 4–6. https://doi.org/10.1016/j.ypmed.2017.02.021

Gossop, M., Best, D., Marsden, J., & Strang, J. (1997). Test-retest reliability of the Severity of Dependence Scale. *Addiction*, *92*(3), 353–353. https://doi.org/10.1111/j.1360-0443.1997.tb03205.x

Gossop, M., Darke, S., Griffiths, P., Hando, J., Powis, B., Hall, W., & Strang, J. (1995). The Severity of Dependence Scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction*, *90*(5), 607–614. https://doi.org/10.1111/j.1360-0443.1995.tb02199.x

Government of Canada. (n.d.). What you need to know about cannabis. Retrieved April 13, 2019, from https://www.canada.ca/en/services/health/campaigns/cannabis/canadians.html

Government of Canada. (2016). Toward the legalization, regulation and restriction of access to marijuana. In *Government of Canada*. Retrieved from https://www.canada.ca/en/health-canada/programs/consultation-toward-legalization-regulation-restriction-access-marijuana/discussion-paper-introduction.html

Government of Canada. (2017). *Legislative Background: reforms to the Transportation Provisions of the Criminal Code (Bill C-46)*. Retrieved from www.justice.gc.ca.

Grant, C., & Bélanger, R. (2017). Cannabis and Canada's children and youth. *Paediatrics & Child Health*, Vol. 22, pp. 98–102. https://doi.org/10.1093/pch/pxx017

Green, B., Kavanagh, D., & Young, R. (2003). Being stoned: A review of self-reported cannabis effects. *Drug and Alcohol Review*, *22*(4), 453–460. https://doi.org/10.1080/09595230310001613976

Guest, G., Namey, E., & McKenna, K. (2017). How Many Focus Groups Are Enough? Building an Evidence Base for Nonprobability Sample Sizes. *Field Methods*, *29*(1), 3–22. https://doi.org/10.1177/1525822X16639015

Hartman, R. L., Brown, T. L., Milavetz, G., Spurgin, A., Gorelick, D. A., Gaffney, G., & Huestis, M. A. (2016). A Framework for the Legalization and Regulation of Cannabis in Canada. In *Drug Testing and Analysis* (Vol. 8). Retrieved from http://doi.wiley.com/10.1002/dta.1839

Hartman, R. L., & Huestis, M. A. (2013). Cannabis Effects on Driving Skills. *Clinical Chemistry*, *59*(3), 478–492. https://doi.org/10.1373/clinchem.2012.194381

Health Canada. (2013). *Canadian Alcohol and Drug Use Monitoring Survey (CADUMS): Summary of Results for 2012*. Retrieved from https://www.canada.ca/en/health-canada/services/health-concerns/drug-prevention-treatment/drug-alcohol-use-

statistics/canadian-alcohol-drug-use-monitoring-survey-summary-results-2012.html

Health Canada. (2017a). *Canadian Cannabis Survey (CCS) (questionnaire)*. Retrieved from https://www.canada.ca/en/health-canada/services/publications/drugs-health-products/canadian-cannabis-survey-2017-summary.html

Health Canada. (2017b). *Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS)*. Retrieved from https://uwaterloo.ca/canadian-student-tobacco-alcohol-drugs-survey/reports-and-results/20162017-english-questionnaire

Health Canada. (2017c). *Canadian Tobacco, Alcohol and Drugs Survey (CTADS) (questionnaire)*. Retrieved from http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=333871

Health Canada. (2017d). *Legalizing and strictly regulating cannabis: the facts*. Retrieved from https://www.canada.ca/en/services/health/campaigns/legalizing-strictly-regulating-cannabis-facts.html

Health Canada. (2019). *Canadian Tobacco, Alcohol and Drugs Survey (CTADS): summary of results for 2017*. Retrieved from https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t9 (diakses tanggal 1 Februari 2019)

Hecimovic, K., Barrett, S. P., Darredeau, C., & Stewart, S. H. (2014). Cannabis use motives and personality risk factors. *Addictive Behaviors*, *39*(3), 729–732. https://doi.org/10.1016/j.addbeh.2013.11.025

Heck, R. H., Scott, T. L., & Tabata, L. N. (2014). Multilevel Modeling of Categorical Outcomes Using IBM SPSS. In *Multilevel Modeling of Categorical Outcomes Using IBM SPSS*. https://doi.org/10.4324/9780203808986

Holmes, E., Vanlaar, W. G. M., & Robertson, R. D. (2014). The Problem of Youth Drugged Driving and Approaches to Prevention : A Systematic Literature Review. In *Canadian Centre on Substance Use and Addiction*. Retrieved from http://www.ccsa.ca/Resource Library/CCSA-Youth-Drugged-Driving-technical-report-2014-en.pdf

Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied Logistic Regression* (Third Edit). John Wiley & Sons, Inc.

Hunt, S. D., Sparkman Jr., R. D., & Wilcox, J. B. (1982). The pretest in survey research: Issues and preliminary findings. *Journal of Marketing Research*, *XIX*(May), 269–274. https://doi.org/10.2307/3151627

IPSOS. (2018). *Consumption of Marijuana Likely to Increase in Canada with Many Saying They'll Light Up After Legalization (press release)*. Retrieved from https://www.ipsos.com/sites/default/files/ct/news/documents/2017-09/consumption-of-marijuana-increase-PR-2017-9-16v1.pdf

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods*, *18*(1), 3–20. https://doi.org/10.1177/1525822X05282260

Joffe, A., & Yancy, W. S. (2004). Legalization of Marijuana: Potential Impact on Youth. *PEDIATRICS*, *113*(6), e632–e638. https://doi.org/10.1542/peds.113.6.e632

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189x033007014

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a Definition of

Mixed Methods Research. *Journal of Mixed Methods Research*, *1*(2), 112–133. https://doi.org/10.1177/1558689806298224

Jonah, B. (2013). CCMTA Public Opinion Survey of Drugs and Driving in Canada, Summary Report. In *Canadian Council of Motor Transport Administrators*. Retrieved from http://ccmta.ca/images/publications/pdf/CCMTA_Public_Opinion_Survey_of_Drugs_and_Driving_in_Canada_revised_2014_04_14_FINAL_ENGLISH.pdf

Jones, C. G. A., Swift, W., Donnelly, N. J., & Weatherburn, D. J. (2007). Correlates of driving under the influence of cannabis. *Drug and Alcohol Dependence*, *88*(1), 83–86. https://doi.org/10.1016/j.drugalcdep.2006.09.005

Kalant, H. (2016). A critique of cannabis legalization proposals in Canada. *International Journal of Drug Policy*, *34*, 5–10. https://doi.org/10.1016/j.drugpo.2016.05.002

Kalant, H., & Porath-Waller, A. J. (2016). Clearing the Smoke on Cannabis: Medical Use of Cannabis and Cannabinoids. In *Canadian Centre on Substance Abuse*.

Kelly, E., Darke, S., & Ross, J. (2004). A review of drug use and driving: epidemiology, impairment, risk factors and risk perceptions. *Drug and Alcohol Review*, *23*(3), 319–344. https://doi.org/10.1080/09595230412331289482

Kerr, D. C. R., Bae, H., Phibbs, S., & Kern, A. C. (2017). Changes in undergraduates' marijuana, heavy alcohol and cigarette use following legalization of recreational marijuana use in Oregon. *Addiction*, *112*(11), 1992–2001. https://doi.org/10.1111/add.13906

Kidd, P. S., & Parshall, M. B. (2000). Getting the focus and the group: enhancing analytical rigor in focus group research. *Qualitative Health Research*, *10*(3), 293–308.

Kielhofner, G. (2006). *Research in occupational therapy: Methods of inquiry for enhancing practice*. Philadelphia [Pa.]: F.A. Davis Co.

Kitzinger, J. (1994). The methodology of Focus Groups: the importance of interaction between research participants. *Sociology of Health and Illness*, *16*(1), 103–121. https://doi.org/10.1111/1467-9566.ep11347023

Knibbe, R. A., Joosten, J., Derickx, M., Choquet, M., Morin, D., Monshouwer, K., & Vollebergh, W. (2005). Perceived availability of substances, substance use and substance-related problems: a cross national study among French and Dutch adolescents. *Journal of Substance Use*, *10*(2–3), 151–163. https://doi.org/10.1080/14659805123513441101

Krueger, R. A., & Casey, M. A. (2015). Focus groups: A practical guide for applied research. In *Sage Publications*.

Le Strat, Y., Dubertret, C., & Le Foll, B. (2015). Impact of age at onset of cannabis use on cannabis dependence and driving under the influence in the United States. *Accident Analysis & Prevention*, *76*, 1–5. https://doi.org/10.1016/j.aap.2014.12.015

Leadbeater, B. J., Foran, K., & Grove-White, A. (2008). How much can you drink before driving? The influence of riding with impaired adults and peers on the driving behaviors of urban and rural youth. *Addiction*, *103*(4), 629–637. https://doi.org/10.1111/j.1360-0443.2008.02139.x

Lee, C. M., Neighbors, C., & Woods, B. A. (2007). Marijuana motives: Young adults' reasons for using marijuana. *Addictive Behaviors*, *32*(7), 1384–1394. https://doi.org/10.1016/j.addbeh.2006.09.010

Lee, J., Abdel-Aty, A., & Park, J. (2018). Investigation of associations between marijuana law changes and marijuana-involved fatal traffic crashes: A state-level analysis. *Journal of Transport and Health*, *10*(October 2017), 194–202. https://doi.org/10.1016/j.jth.2018.05.017

Li, M. C., Brady, J. E., DiMaggio, C. J., Lusardi, A. R., Tzong, K. Y., & Li, G. (2012). Marijuana Use and Motor Vehicle Crashes. *Epidemiologic Reviews*, *34*(1), 65–72. https://doi.org/10.1093/epirev/mxr017

Mayhew, D. R., Simpson, H. M., & Singhal, D. (2005). Best practices for graduated driver licensing in Canada. In *Traffic Injury Research Foundation*. Retrieved from http://assets.ibc.ca/Documents/Auto Insurance/road_safety/Best_Practices_Driver_Distraction_Study_Oct2005.pdf

McCarthy, D. M., Lynch, A. M., & Pedersen, S. L. (2007). Driving after use of alcohol and marijuana in college students. *Psychology of Addictive Behaviors*, *21*(3), 425–430. https://doi.org/10.1037/0893-164X.21.3.425

McKiernan, A., & Fleming, K. (2017). Canadian Youth Perceptions on Cannabis. In *Canadian Centre on Substance Use and Addiction*. Retrieved from http://www.ccsa.ca/Resource Library/CCSA-Canadian-Youth-Perceptions-on-Cannabis-Report-2017-en.pdf

Miller, A. M., Rosenman, R., & Cowan, B. W. (2017). Recreational marijuana legalization and college student use: Early evidence. *SSM - Population Health*, *3*(August), 649–657. https://doi.org/10.1016/j.ssmph.2017.08.001

Minaker, L. M., Bonham, A., Elton-Marshall, T., Leos-Toro, C., Wild, T. C., & Hammond, D. (2017). Under the influence: examination of prevalence and correlates of alcohol and marijuana consumption in relation to youth driving and passenger behaviours in Canada. A cross-sectional study. *CMAJ Open*, *5*(2), E386–E394. https://doi.org/10.9778/cmajo.20160168

Ministry of Transportation Ontario. (2012). *Ontario Road Safety Annual Report 2012*. Retrieved from http://www.mto.gov.on.ca/english/publications/ontario-road-safety-annual-report.shtml

Ministry of Transportation Ontario. (2013a). *Ontario Road Safety Annual Report 2013*. Retrieved from http://www.mto.gov.on.ca/english/publications/ontario-road-safety-annual-report.shtml

Ministry of Transportation Ontario. (2013b). *The Official MTO Driver's Handbook*. Road User Safety Division of the Ministry of Transportation of Ontario.

Ministry of Transportation Ontario. (2014). *Ontario Road Safety Annual Report 2014*. Retrieved from http://www.mto.gov.on.ca/english/publications/pdfs/ontario-road-safety-annual-report-2014.pdf

Ministry of Transportation Ontario. (2016). *Preliminary 2016 Ontario Road Safety Annual Report Selected Statistics*. Retrieved from http://www.mto.gov.on.ca/english/publications/pdfs/preliminary-2016-orsar-selected-statistics.pdf

Morgan, D. (1996). Focus Groups. *Annual Review of Sociology*, *22*(1), 129–152. https://doi.org/10.1146/annurev.soc.22.1.129

Morgan, D. (1997). Focus Groups as Qualitative Research. In *Qualitative research methods series* (Vol. 16). https://doi.org/10.4135/9781412984287

Morgan, D. (2012). Focus groups and social interaction. In *The SAGE Handbook of*

Interview Research: The Complexity of the Craft (pp. 161–176).
https://doi.org/10.4135/9781452218403.n11

Morse, J., & Niehaus, L. (2016). Mixed Method Design, Principals and Procedures. In *Taylor & Francis Group*.

Muro i Rodríguez, A. (2015). Age, sex and personality in early cannabis use. *European Psychiatry*, *30*(4), 469–473. https://doi.org/10.1016/j.eurpsy.2015.02.008

National Science Foundation. (1997). Appendix C: Sample Focus Group Topic Guide. In *User-Friendly Handbook for Mixed Method Evaluations*. Retrieved from https://www.nsf.gov/pubs/1997/nsf97153/c3app_c.htm

Neale, J., Mckeganey, N., Oliver, J., & Hay, G. (2000). Recreational Drug Use and Driving : a Qualitative Study. *Scottish Executive Central Research Unit*.

Neighbors, C., Geisner, I. M., & Lee, C. M. (2008). Perceived marijuana norms and social expectancies among entering college student marijuana users. *Psychology of Addictive Behaviors*, *22*(3), 433–438. https://doi.org/10.1037/0893-164X.22.3.433

O'Brien, R. M. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity*, *41*(5), 673–690. https://doi.org/10.1007/s11135-006-9018-6

Ogourtsova, T., Kalaba, M., Gelinas, I., Korner-Bitensky, N., & Ware, M. A. (2018). Cannabis use and driving-related performance in young recreational users: a within-subject randomized clinical trial. *CMAJ Open*, *6*(4), E453–E462. https://doi.org/10.9778/cmajo.20180164

Ontario Medical Association. (2019). *Cannabis and Special Risk Populations*. Retrieved from https://www.oma.org/sections/managing-your-practice/cannabis-resource-centre/cannabis-and-special-risk-populations/

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A Qualitative Framework for Collecting and Analyzing Data in Focus Group Research. *International Journal of Qualitative Methods*, *8*(3), 1–21. https://doi.org/10.1177/160940690900800301

Palali, A., & van Ours, J. C. (2017). Cannabis use and support for cannabis legalization. *Empirical Economics*, *53*(4), 1747–1770. https://doi.org/10.1007/s00181-016-1172-7

Palamar, J. J., Ompad, D. C., & Petkova, E. (2014). Correlates of intentions to use cannabis among US high school seniors in the case of cannabis legalization. *International Journal of Drug Policy*, *25*(3), 424–435. https://doi.org/10.1016/j.drugpo.2014.01.017

Papinczak, Z. E., Connor, J. P., Harnett, P., & Gullo, M. J. (2018). A biosocial cognitive model of cannabis use in emerging adulthood. *Addictive Behaviors*, *76*(March 2017), 229–235. https://doi.org/10.1016/j.addbeh.2017.08.011

Parachute Canada. (n.d.). Motor Vehicle Collisions - What Can be Done ? *Canadian.D*. Retrieved from http://www.parachutecanada.org/injury-topics/topic/C21

Parnes, J. E., Bravo, A. J., Conner, B. T., & Pearson, M. R. (2018). A burning problem: cannabis lessons learned from Colorado. *Addiction Research & Theory*, *26*(1), 3–10. https://doi.org/10.1080/16066359.2017.1315410

Pearce, D. D., Mitsouras, K., & Irizarry, K. J. (2014). Discriminating the Effects of Cannabis sativa and Cannabis indica: A Web Survey of Medical Cannabis Users . *The Journal of Alternative and Complementary Medicine*, *20*(10), 787–791.

https://doi.org/10.1089/acm.2013.0190

Pearson, M. R., Hustad, J. T. P., Neighbors, C., Conner, B. T., & Bravo, A. J. (2018). Personality, marijuana norms, and marijuana outcomes among college students. *Addictive Behaviors*, *76*(August 2017), 291–297. https://doi.org/10.1016/j.addbeh.2017.08.012

Pinsky, I., Labouvie, E., Pandina, R., & Laranjeira, R. (2001). Drinking and driving: pre-driving attitudes and perceptions among Brazilian youth. *Drug and Alcohol Dependence*, *62*(3), 231–237. https://doi.org/10.1016/S0376-8716(00)00173-3

Piontek, D., Kraus, L., Bjarnason, T., Demetrovics, Z., & Ramstedt, M. (2013). Individual and Country-Level Effects of Cannabis-Related Perceptions on Cannabis Use. A Multilevel Study Among Adolescents in 32 European Countries. *Journal of Adolescent Health*, *52*(4), 473–479. https://doi.org/10.1016/j.jadohealth.2012.07.010

Portney, L. G., & Watkins, M. P. (2009). Validity in Experimental Design. In *Foundations of Clinical Research: Application to Practice* (3rd ed., pp. 184–185). Pearson Prentice Hall.

Ramo, D. E., Liu, H., & Prochaska, J. J. (2012). Reliability and validity of young adults' anonymous online reports of marijuana use and thoughts about use. *Psychology of Addictive Behaviors*, *26*(4), 801–811. https://doi.org/10.1037/a0026201

Riedel, G., & Davies, S. N. (2005). Cannabinoid function in learning, memory and plasticity. *Handbook of Experimental Pharmacology*. https://doi.org/10.1007/3-540-26573-2-15

Robertson, R. D., Mainegra Hing, M., Pashley, C. R., Brown, S. W., & Vanlaar, W. G. M. (2017). Prevalence and trends of drugged driving in Canada. *Accident Analysis & Prevention*, *99*, 236–241. https://doi.org/10.1016/j.aap.2016.12.008

Rogeberg, O., & Elvik, R. (2016). The effects of cannabis intoxication on motor vehicle collision revisited and revised. *Addiction*, *111*(8), 1348–1359. https://doi.org/10.1111/add.13347

Rosenstock, I. M. (1974). The Health Belief Model and Preventive Health Behavior. *Health Education Monographs*, *2*(4), 354–386. https://doi.org/10.1177/109019817400200405

Royal Canadian Mounted Police. (2018). Impaired driving investigations.

Schuermeyer, J., Salomonsen-Sautel, S., Price, R. K., Balan, S., Thurstone, C., Min, S.-J., & Sakai, J. T. (2014). Temporal trends in marijuana attitudes, availability and use in Colorado compared to non-medical marijuana states: 2003–11. *Drug and Alcohol Dependence*, *140*, 145–155. https://doi.org/10.1016/j.drugalcdep.2014.04.016

Simons, J., Correia, C. J., Carey, K. B., & Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, *45*(3), 265–273. https://doi.org/10.1037/0022-0167.45.3.265

Smart, R., Caulkins, J. P., Kilmer, B., Davenport, S., & Midgette, G. (2017). Variation in cannabis potency and prices in a newly legal market: evidence from 30 million cannabis sales in Washington state. *Addiction*, *112*(12), 2167–2177. https://doi.org/10.1111/add.13886

Smithson, J. (2000). Using and analysing focus groups: Limitations and possibilities. *International Journal of Social Research Methodology*, *3*(2), 103–119. https://doi.org/10.1080/136455700405172

Snortum, J. R., & Berger, D. E. (1989). Drinking-driving compliance in the United States: perceptions and behavior in 1983 and 1986. *Journal of Studies on Alcohol*, *50*(4), 306–319. https://doi.org/10.15288/jsa.1989.50.306

Snortum, J. R., Hauge, R., & Berger, D. E. (1986). Deterring alcohol-impaired driving: A comparative analysis of compliance in Norway and the United States. *Justice Quarterly*, *3*(2), 140–165. https://doi.org/10.1080/07418828600088861

Snortum, J. R., Hauge, R., & Berger, D. E. (1988). Legal knowledge and compliance: Drinking and driving in Norway and the United States. *Alcohol, Drugs and Driving*, *4*(3–4), 251–263.

Spriggens, L., & Hides, L. (2015). Patterns of cannabis use, psychotic-like experiences and personality styles in young cannabis users. *Schizophrenia Research*, *165*(1), 3–8. https://doi.org/10.1016/j.schres.2015.03.023

Stafford, M., & Warr, M. (1993). A Reconceptualization of General and Specific Deterrence. *Journal of Research in Crime and Delinquency*, *30*(2), 123–135. https://doi.org/10.1177/0022427893030002001

Statistics Canada. (2016a). Impaired driving in Canada, 2015. In *Juristat Article*. Retrieved from https://www150.statcan.gc.ca/n1/pub/85-002-x/2016001/article/14679-eng.htm

Statistics Canada. (2016b). *Visible Minority and Population Group Reference Guide, Census of Population, 2016*. Retrieved from https://www12.statcan.gc.ca/census-recensement/2016/ref/guides/006/98-500-x2016006-eng.cfm

Statutes of Canada. *Bill C-46, an Act to amend the Criminal Code (offences relating to conveyances) and to make consequential amendments to other Acts*. , (2018).

Substance Abuse and Mental Health Services Administration. (n.d.). *National Survey on Drug Use and Health: Comparison of 2014-2015 and 2015-2016 Population Percentages*. Retrieved from https://www.samhsa.gov/data/sites/default/files/NSDUHsaeShortTermCHG2016/NSDUHsaeShortTermCHG2016.htm

Substance Abuse and Mental Health Services Administration. (2016). *Key Substance Use and Mental Health Indicators in the United States: Results from the 2015 National Survey on Drug Use and Health*. Retrieved from https://www.samhsa.gov/data/sites/default/files/NSDUH-FFR1-2015/NSDUH-FFR1-2015/NSDUH-FFR1-2015.pdf

Sweedler, B. M., Biecheler, M.-B., Laurell, H., Kroj, G., Lerner, M., Mathijssen, M. P. M., … Tunbridge, R. J. (2004). Worldwide trends in alcohol and drug impaired driving. *Taffic Injury Prevention*.

Taxman, F. S., & Piquero, A. (1998). On preventing drunk driving recidivism: an examination of rehabilitation and punishment approaches. *Journal of Criminal Justice*, *26*(2), 129–143. https://doi.org/10.1016/S0047-2352(97)00075-5

Tefft, B. C., Arnold, L. S., & Grabowski, J. G. (2016). Prevalence of Marijuana Involvement in Fatal Crashes: Washington, 2010-2014 (May 2016). In *AAA Foundation for Traffic Safety*. Retrieved from https://aaafoundation.org/wp-content/uploads/2017/12/PrevalenceOfMarijuanaInvolvement.pdf

ter Bogt, T. F. M., de Looze, M., Molcho, M., Godeau, E., Hublet, A., Kokkevi, A., … Pickett, W. (2014). Do societal wealth, family affluence and gender account for trends in adolescent cannabis use? A 30 country cross-national study. *Addiction*,

109(2), 273–283. https://doi.org/10.1111/add.12373

Traffic Injury Research Foundation. (2017). *MARIJUANA USE AMONG DRIVERS IN CANADA, 2000-2014*.

Trevino, R. A., & Richard, A. J. (2002). Attitudes towards drug legalization among drug users. *The American Journal of Drug and Alcohol Abuse*, *28*(1), 91–108. https://doi.org/10.1081/ADA-120001283

Twohig, P. L., & Putnam, W. (2002). Group interviews in primary care research: advancing the state of the art or ritualized research? *Family Practice*, *19*(3), 278–284. https://doi.org/10.1093/fampra/19.3.278

Ulleberg, P., & Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science*, *41*(5), 427–443. https://doi.org/10.1016/S0925-7535(01)00077-7

UNICEF. (2011). Child well-being in rich countries: a comparative overview. In *Unicef* (Vol. 683). Retrieved from https://www.unicef.org.uk/Images/Campaigns/Report card briefing2b.pdf

Vandekerckhove, J., Matzke, D., & Wagenmakers, E.-J. (2015). *Model Comparison and the Principle of Parsimony* (Vol. 1; J. R. Busemeyer, Z. Wang, J. T. Townsend, & A. Eidels, Eds.). https://doi.org/10.1093/oxfordhb/9780199957996.013.14

Vanlaar, W. G. M., Robertson, R. D., Marcoux, K., Mayhew, D. R., Brown, S. W., & Boase, P. (2012). Trends in alcohol-impaired driving in Canada. *Accident Analysis and Prevention*. https://doi.org/10.1016/j.aap.2012.01.030

Vogler, J. (2017). State Marijuana Policies and Vehicle Fatalities. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3013701

Ward, N. J., Otto, J., Schell, W., Finley, K., Kelley-Baker, T., & Lacey, J. H. (2017). Cultural predictors of future intention to drive under the influence of cannabis (DUIC). *Transportation Research Part F: Traffic Psychology and Behaviour*, *49*, 215–225. https://doi.org/10.1016/j.trf.2017.06.013

Ward, N. J., Schell, W., Kelley-Baker, T., Otto, J., & Finley, K. (2018). Developing a theoretical foundation to change road user behavior and improve traffic safety: Driving under the influence of cannabis (DUIC). *Traffic Injury Prevention*, *19*(4), 358–363. https://doi.org/10.1080/15389588.2018.1425548

Washington Traffic Safety Commission. (2016). *Driver Toxicology Testing and the Involvement of Marijuana in Fatal Crashes, 2010-2014*. Retrieved from http://wtsc.wa.gov/wp-content/uploads/dlm_uploads/2015/10/Driver-Toxicology-Testing-and-the-Involvement-of-Marijuana-in-Fatal-Crashes_REVFeb2016.pdf

Watling, C. N., Palk, G. R., Freeman, J. E., & Davey, J. D. (2010). Applying Stafford and Warr's reconceptualization of deterrence theory to drug driving: Can it predict those likely to offend? *Accident Analysis & Prevention*, *42*(2), 452–458. https://doi.org/10.1016/j.aap.2009.09.007

Watson, T. M., & Mann, R. E. (2016). International approaches to driving under the influence of cannabis: A review of evidence on impact. *Drug and Alcohol Dependence*, *169*, 148–155. https://doi.org/10.1016/j.drugalcdep.2016.10.023

Wettlaufer, A., Florica, R. O., Asbridge, M., Beirness, D. J., Brubacher, J., Callaghan, R., … Rehm, J. (2017). Estimating the harms and costs of cannabis-attributable collisions in the Canadian provinces. *Drug and Alcohol Dependence*, *173*, 185–190. https://doi.org/10.1016/j.drugalcdep.2016.12.024

Williams, A. F. (2006). Alcohol-impaired driving and its consequences in the United States: The past 25 years. *Journal of Safety Research*. https://doi.org/10.1016/j.jsr.2006.01.001

Williams, J., van Ours, J. C., & Grossman, M. (2016). Attitudes to legalizing cannabis use. *Health Economics*, *25*(9), 1201–1216. https://doi.org/10.1002/hec.3340

Woicik, P. A., Stewart, S. H., Pihl, R. O., & Conrod, P. J. (2009). The substance use risk profile scale: A scale measuring traits linked to reinforcement-specific substance use profiles. *Addictive Behaviors*, *34*(12), 1042–1055. https://doi.org/10.1016/j.addbeh.2009.07.001

World Health Organization. (2016). *The health and social effects of nonmedical cannabis use cannabis*. Retrieved from https://www.who.int/substance_abuse/publications/msbcannabis.pdf

Appendices

Appendix A: NMREB Approval Letter

Western Research

Date: 4 September 2018

To: Dr. Liliana Alvarez Jaramillo

Project ID: 112219

Study Title: Cannabis Legalization and Driving: Exploring Young Canadians' Knowledge, Perceptions and Attitudes

Application Type: NMREB Initial Application

Review Type: Delegated

Full Board Reporting Date: October 5 2018

Date Approval Issued: 04/Sep/2018

REB Approval Expiry Date: 04/Sep/2019

_____

Dear Dr. Liliana Alvarez Jaramillo

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the WREM application form for the above mentioned study, as of the date noted above. NMREB approval for this study remains valid until the expiry date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date	Document Version
RC Focus group guide_31Jul2018	Focus Group(s) Guide	02/Aug/2018	
RC Focus group LOI and Consent	Written Consent/Assent	27/Aug/2018	
RC Focus group Recruitment Email	Recruitment Materials	27/Aug/2018	
RC Online survey LOI and Consent	Implied Consent/Assent	27/Aug/2018	
RC Online survey template	Online Survey	27/Aug/2018	
RC Online survey Website, social media ad	Recruitment Materials	27/Aug/2018	

Documents Acknowledged:

Document Name	Document Type	Document Date	Document Version
Figure 1- Sequential explanatory design	Supplementary Tables/Figures	01/Aug/2018	
TranscriptHeroes-ConfidentialityAgreement2017	Supplementary Tables/Figures	01/Aug/2018	

No deviations from, or changes to the protocol should be initiated without prior written approval from the NMREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario. Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Kelly Patterson, Research Ethics Officer on behalf of Dr. Randal Graham, NMREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix B: Online Survey

LETTER OF INFORMATION AND CONSENT
Project Title
Cannabis Legalization and Driving: Exploring Young Canadians' Knowledge, Perceptions and Attitudes

Principal Investigator

School of Occupational Therapy
Western University

Additional Research Staff and Contact Information

Research Assistant:

School of Occupational Therapy
Western University

1.   Invitation to Participate

You are being invited to participate in this research study, which aims to explore the knowledge, perceptions and attitudes of young drivers towards cannabis use and driving under the influence of cannabis. You have been invited because you are a young Ontarian driver between the ages of 18 to 24 years.

2.   Why is this study being done?
Driving under the influence of cannabis has been increasing in prevalence across Canada, especially in young drivers. This behavior can pose a public health and safety risk to all road users. With the upcoming recreational cannabis legalization in Canada, there may be an increase in cannabis use among youth and instances of driving under the influence of cannabis. However, there is a lack of evidence on young drivers' knowledge, perceptions and attitudes around the interaction of cannabis use and driving. Understanding such information is critical to lay the foundation for the development of targeted cannabis-impaired driving education and intervention strategies for young Ontarian drivers. Thus, this study aims to explore these factors among young drivers between the ages of 18 to 24, in the province of Ontario.

3.   How long will you be in this study?
This study only consists of an online survey which will take approximately 15 minutes to complete. You will then be asked if you would like to be contacted to participate in a future focus group. The focus groups will have a separate letter of information and consent form that will be available at a later date. You then have the option to participate or not. Participation in future focus groups will not affect any involvement in this survey.

4.   What are the study procedures?
If you agree to participate, you will be asked to complete a completely anonymous online questionnaire to share your knowledge, perceptions and attitudes around cannabis use and driving. The questionnaire will ask about your perceptions around cannabis use, driving under the influence of cannabis as well as perceptions around the upcoming legalization.

5.   What are the risks and harms of participating in this study?

Participants in this study are at a low risk to experience harm resulting from this study. All responses will remain anonymous and participants can choose to skip any question at any point.

6.   What are the benefits of participating in this study?

This study will not result in any direct benefits to you. Participants will provide their insights to help explore and understand the factors that influence driving under the influence of cannabis. Possible benefits to the society includes information that is critical to the development of targeted interventions that can address the underlying issues related to cannabis impaired driving prevention.

7.   Can participants choose to leave the study?

Your participation in this study is voluntary. You are free to refuse to participate, or to withdraw from the study at any time without giving a reason and without negative consequences. If you choose to withdraw from this study, the anonymous information that was collected prior to you leaving the study will still be used as we will not be able to remove anonymous answers. No new information will be collected without your permission.

8.   How will participants' information be kept confidential?

The survey is completely anonymous. In addition, all responses will remain accessible only to the investigators of this study. Unidentifiable data resulting from the survey responses may be shared for purposes of secondary data analysis or during the dissemination of this research (e.g., journal publication). Electronic data will be stored in a password protected computer and server network according to the privacy and confidentiality policies of Western University. Representatives of The University of Western Ontario Non-Medical Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

9.   Are participants compensated to be in this study?

As a token of appreciation for your time, you can be entered into a draw (by providing your email address) to win one (1) of twenty (20) gift cards for Amazon.ca that are worth $20 each. An email address is only collected as a method to indicate the winner of the draw and will be kept separate from the data, thus your email address will not be linked to your survey responses nor will it make identification possible. The chances of winning depend on the number of individuals who respond to the survey.

10.   What are the rights of participants?

Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time, this will have no negative consequence to you. You do not waive any legal right by consenting to this study.

11.   Whom do participants contact for questions?

If you have questions about this research study please contact:

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics (519) 661-3036, email: ethics@uwo.ca.

This letter is yours to keep for future reference.

ONLINE CONSENT FORM (IMPLIED)
Project Title: Cannabis Legalization and Driving: Exploring Young Canadians' Knowledge, Perceptions and Attitudes
Study Investigator's Name:

Having read the information above, I understand that by clicking "I agree to participate" below, I declare that I have received and read the Letter of Information, have had the nature of the study explained to me and I agree to participate.

"I agree to participate."
"I do not agree to participate."

SCREENING QUESTIONS
Q1) License status (G1, G2, G, Other)
Q2) How old are you? ___ ___ Years old
Q3) Are you competent in reading and writing English (yes/no)

INTRODUCTION
Thank you for agreeing to participate in this survey. Your participation is greatly appreciated, and it will allow us to gain a better understanding on cannabis use and driving under the influence of cannabis. Remember that the questionnaire is anonymous, so try to answer as honestly as possible.

DEMOGRAPHICS
Q4) Please identify your gender (male/ female/ other)

Q5) How would you describe yourself? Mark all that apply (in accordance with Statistics Canada Population Group standards)
1- White
2- Black
3- West Asian/Arab
4- South Asian (Indian, Pakistani...)
5- East/Southeast Asian (Chinese, Filipino...)
6- Latin American/Hispanic
7- Aboriginal (First Nations, Métis, Inuit, ...)
8- Other:

Q6) What is the highest certificate, diploma or degree that you have completed?
1- Less than high school diploma or its equivalent
2- High school diploma or equivalent
3- Trade certificate or diploma
5- College or University certificate or diploma below the bachelor's level
6- Bachelor's degree (e.g. B.A., B.Sc., …)
7- University degree above the bachelor's level (e.g., M.Sc., Master of Arts, etc.)

Q7) What is your main occupation right now?
1- Unemployed
2- Employed part time
3- Employed full time
4- Student only (unemployed)
5- Student and employed

CANNABIS CONSUMPTION & DRIVING UNDER THE INFLUENCE OF CANNABIS

Q8) In your opinion, approximately how many hours after smoking cannabis is it safe for someone of your age and gender to drive a vehicle?
1- Input number of hours (enter number)

Q9) During your lifetime have you ever used cannabis (marijuana, a joint, pot, weed, hash, or hash oil)? 0- No
1- Yes

IF YES TO Q9, ANSWER Q10-Q13:

Q10) In the last 12 months, how often did you use cannabis?
0- I don't know
1- I have not used cannabis in the last 12 months
2- Less than once a month
3- Once a month
4- 2 or 3 times a month
5- Once a week
6- 2 or 3 times a week
7- 4 to 6 times a week
8- Every day

Q11) In the last 30 days, how often did you use cannabis?
0- I don't know
1- I have not used cannabis in the last 30 days
2- Once or twice
3- Once or twice a week
4- 3 or 4 times a week
5- 5 or 6 times a week
6- Every day

Q12) Did you use cannabis for medical purposes, recreational, or both?
1- Medical purposes
2- Recreational
3- Both

Q13) Have you ever driven a vehicle within two hours of using cannabis?
0- I don't know
1- No
2- Yes- within the past 30 days
3- Yes- within the past 12 months
4- Yes- more than 12 months ago

IF YES TO Q13, ANSWER Q14- Q16

Q14) Have you ever driven a vehicle within two hours of using cannabis in combination with alcohol?
0- I don't know
1- No
2- Yes- within the past 30 days
3- Yes- within the past 12 months
4- Yes- more than 12 months ago

Q15) Have you ever driven a vehicle within two hours of using cannabis in combination with other drugs (other than alcohol or tobacco)?
0- I don't know
1- No
2- Yes- within the past 30 days
3- Yes- within the past 12 months
4- Yes- more than 12 months ago

Q16) To what extent do you agree or disagree with the following statements:
a) I can safely drive within 2 hours of cannabis use
0- I don't know
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

b) It is safer driving under the influence of cannabis than under the influence of alcohol
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

c) If I am just a little bit high, I don't think my ability to drive is impaired
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

d) Being high on cannabis doesn't affect my driving
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree

5- Strongly agree

e) Driving high is not a big deal
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

f) I regularly drive after using cannabis and don't get caught
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

IF NO TO Q9, SKIP Q10-Q16, ANSWER Q17 & Q18:

Q17) Have you ever wanted to try cannabis?
0- I don't know
1- Yes
2- No
Why or why not? (Add comment box)

Q18) Once cannabis becomes legal across Canada for recreational use, do you think at least once you may try cannabis?
1- Definitively no
2- Slight chance
3- Moderate chance
4- Large chance
5- Definitively yes

DRIVING UNDER THE INFLUENCE OF CANNABIS
Q19) Do you think that you are going to drive sometime during the next year?
1- No
2- Maybe
3- Yes

Q20) During the next year, do you think that at least once you will drive within 2 hours of using cannabis?
1- Definitively no
2- Slight chance
3- Moderate chance
4- Large chance
5- Definitively yes

Q21) Do you think that the legalization of cannabis might change the number of youth driving under the influence of cannabis?
1- I think it will decrease the number of youth driving under the influence of cannabis
2- I do not think it will change
3- I think it will increase the number of youth driving under the influence of cannabis

RIDING WITH SOMEONE UNDER THE INFLUENCE OF CANNABIS

Q22) Have you ever been a passenger in a motor vehicle driven by a young driver (ages 16–24) who you thought might have consumed too much cannabis to drive safely?
0- I don't know
1- Never
2- Yes- within the past 30 days
3- Yes- within the past 12 months
4- Yes- more than 12 months ago

Q23) Have you ever been a passenger in a motor vehicle driven by a parent or adult over 25 who you thought might have consumed too much cannabis to drive safely?
0- I don't know
1- Never
2- Yes- within the past 30 days
3- Yes- within the past 12 months
4- Yes- more than 12 months ago

Q24) Have you ever decided not to be a passenger in a motor vehicle because you thought the driver had consumed too much cannabis to drive safely?
0- I don't know
1- I've never been in a situation like that
2- No, I still got in the car with someone driving under the influence of cannabis
3- Yes, I decided not to be a passenger

KNOWLEDGE OF THE LAW

Now we are going to ask you some questions on what you know about the Canadian laws related to cannabis impaired driving. Remember, again, that this is not a test and we are interested in your honest answer. If you don't know the answer to a question, use the alternative: "I don't know".

Q25) In Canada, is it legal (permissible) to drive after using cannabis (for either medical or recreational purposes)?
0- I don't know
1- No
2- No, but it will be when cannabis is legalized
3- Yes

Q26) In Canada, is it legal (permissible) to consume cannabis while driving (for either medical and recreational purposes)?
0- I don't know
1- No
2- No, but it will be when cannabis is legalized

3- Yes

Q27) In Canada, a person convicted for cannabis impaired driving can …
a) Be charged with a criminal offence under the Criminal Code of Canada?
0- I don't know
1- No
2- Yes

b) Be subjected to financial penalties (i.e., fines)?
0- I don't know
1- No
2- Yes

c) Have his/her driver's license suspended?
0- I don't know
1- No
2- Yes

d) Be incarcerated (i.e., sent to jail)?
0- I don't know
1- No
2- Yes

e) Be subjected to periods of probationary sentences and/or mandatory substance abuse education or treatment?
0- I don't know
1- No
2- Yes

f) Have his/her vehicle impounded?
0- I don't know
1- No
2- Yes

g) Receive demerit points?
0- I don't know
1- No
2- Yes

CREDIBILITY OF THE LAW
Here we would like to know to what extent you think that laws about cannabis impaired driving are really enforced in Canada.

Q28) Do you, personally, know someone in Canada:
a) Who was stopped by police to check for cannabis impaired driving?
0- No
1- Yes

b) Who was arrested for cannabis impaired driving?

0- No
1- Yes

c) Whose driver's license was suspended due to cannabis impaired driving?
0- No
1- Yes

d) Who paid fines due to cannabis impaired driving?
0- No
1- Yes

Q29) In your opinion, what is the chance in Canada, that an individual driving after using cannabis will:
a) Be stopped and administered a drug test by the police?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

b) Be sentenced to pay fines?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

c) Have his/her license suspended?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

d) Be sent to jail?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

Q30) What percent of people convicted for cannabis impaired driving in Canada, do you think actually receive the penalties required by law (e.g., fines, license suspension, etc.)?
1- 0% to 20%
2- 21% to 40%
3- 41% to 60%
4- 61% to 80%
5- 81% to 100%

ATTITUDES TOWARDS CANNABIS IMPAIRED DRIVING

Q31) To your knowledge, what are some of the effects, if any, of using cannabis on the following driving performance characteristics?

0- I don't know, 1- Negative effect, 2- No effect, 3- Positive effect

a) Reaction times and reflexes

b) Short term memory (e.g., remembering directions)

c) Attention

d) Thinking/ decision making in rapidly-changing situations

e) Maintaining lane position (e.g., not veering into other lanes)

f) Impulsivity

g) Overall driving ability/ performance

Q32) In your opinion, an individual detected to be driving under the influence of cannabis:

a) Should have to serve some jail time?

1- Never

2- In a few specific situations

3- In several situations

4- In most situations

5- Always

b) Should have his/her driver's license suspended?

1- Never

2- In a few specific situations

3- In several situations

4- In most situations

5- Always

c) Should have to pay fines?

1- Never

2- In a few specific situations

3- In several situations

4- In most situations

5- Always

Q33) In your opinion, is driving under the influence of cannabis wrong?

1- I don't think it is wrong

2- Wrong only in a few specific situations

3- Wrong in several situations

4- Wrong in most situations

5- Always wrong

Q34) In your opinion, how dangerous do you believe it is to drive within 2 hours after consuming cannabis?

1- Not at all dangerous

2- Slightly dangerous

3- Moderately dangerous

4- Very dangerous

Q35) In your opinion, what is the average chance in Canada, that an individual driving under the influence of cannabis would get involved in:

a) A minor accident (only economic damages)?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

b) A serious accident, resulting in fatalities and/or serious injuries?
1- No chance
2- Slight chance
3- Moderate chance
4- Large chance
5- 100% chance

SOCIAL CONTEXTS

Q36) How many of your friends would disapprove of driving under the influence of cannabis?
1- None
2- A few friends
3- Several friends
4- Most of them
5- All

Q37) How many of your friends would disapprove of using cannabis while driving?
1- None
2- A few friends
3- Several friends
4- Most of them
5- All

Q38) How many of your friends do you think drive under the influence of cannabis?
1- None
2- A few friends
3- Several friends
4- Most of them
5- All

Q39) To what extent do you agree or disagree with the following statement: "My friends often use cannabis and drive without being caught"
0- I don't know/ no opinion
1- Strongly disagree
2- Somewhat disagree
3- Neither agree nor disagree
4- Somewhat agree
5- Strongly agree

Q40) How many people your age do you think drive under the influence of cannabis?
1- None
2- A few
3- Several

4- Most of them
5- All

Q41) From your experience in recent years, about how many drivers avoid using cannabis at a social event because they are responsible for driving?
1- None
2- A few
3- Several
4- Most of them
5- All

This ends our questionnaire. Please, make sure you answered all the questions.
If you want to produce any commentary, write in the space below:

(Add comment box)

Once submitted participants will be directed to this new survey page

---

Amazon.ca Draw

Thank you again for your assistance! As a token of appreciation for your time, we are conducting a draw of 20 individual $20 gift cards for Amazon.ca. If you would like to be entered into the draw, please enter your email below. You do not have to enter the draw, it is totally up to you.

An email address is only collected as a method to indicate the winner of the draw and will be kept separate from the data, thus your email address will not be linked to your survey responses nor will it make identification possible.
By providing your email, you are providing consent to being contacted in the event that you win.

E1) Email (optional): _____

Once submitted participants will be directed to this new survey page

---

Interest in future focus groups
Thank you for submitting the survey.

As a future step in this study, a number of focus groups will be conducted in London, Ontario starting in November 2018 until February 2019 to gain a better understanding on your perceptions and beliefs.

If you are interested in participating in a future focus group, please provide your contact information below.

To ensure confidentiality, your contact information will be saved separately from the survey and will not be matched to any of your responses. By providing your email, you are providing consent to being contacted.

First Name (optional): _____
Email _____

If you are NOT interested, you can close this page or flick Finish. This will have no effect on your survey responses or you chances of winning the draw.

Thank you again

Appendix C: Focus Group Interviewer Guide

Cannabis Legalization and Driving: Exploring Young Canadians' Knowledge, Perceptions and Attitudes

Date of Interview: _____   Interviewer's Initials: _____

Introduction

Good evening, my name is RC. Thank you for coming. We are here today to talk about your opinions regarding cannabis use, driving under the influence of cannabis, and the recent legalization. You were invited because you are a young Ontarian driver between the ages of 18 to 24 years and indicated your willingness to participate in this study.

I am not here to share information, or to give you my opinions. Your perceptions are what matters. There are no right or wrong, or desirable or undesirable answers. You can disagree with each other, and you can change your mind. I would like you to feel comfortable saying what you really think and how you really feel.

I will be taking notes and tape recording the discussion so that I do not miss anything you have to say. As you know, will take every precaution to maintain confidentiality. No one will know who said what, except for the people in this room. That being said, we would like to remind you to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

I want this to be a group discussion, so feel free to respond to me and to other members in the group without waiting to be called on. However, I would appreciate it if only one person did talk at a time. The discussion will last approximately 60 to 90 minutes. There is a lot I want to discuss, so at times I may move us along a bit.

Does anyone have any questions before we get started?

General Questions

We conducted a survey to explore young Ontarian drivers perceptions around DUIC. The questions that follow will help us get a better sense of what your thoughts and perceptions are.

1. What does it mean to be high?
    - Prompts: What are the signs? How do you know you are high? What about if others are high?
    - How do you know/judge when it's safe to drive after using cannabis?
    - In our survey, 40.3% indicated they have been a passenger in a vehicle with a young driver they thought had consumed too much cannabis to drive safely. Why do you think people get in a car if they know someone else is high?
        - Prompts: Are there factors to judge (e.g. older vs. younger; OR regular user vs. new user; recreational vs. medical)?

2. How does recreational cannabis differ from medical?
    - Do you think youth use cannabis for purposes they deem medical (e.g., improving their sleep, decreasing anxiety, etc.) even when not prescribed?

- o Prompt: Does medical cannabis affect perceptions of recreational use? Do they affect driving differently?;

3. Why do youth DUIC?
    - o Prompt: Are there any specific situations that increase the chances of use? (e.g., if they are the designated driver)
  - Do you think there is a difference between you doing it, your friends doing it, or others in your same age group?
    - o Prompts: Differences between their driving skills and those of others? How does cannabis affect you vs. your friends?

4. To what extend to you agree with the statement 'My friends often use cannabis and drive without being caught"?

5. What would deter DUIC?
  - What are the most effective legal repercussions? (i.e., fines/ license suspension/ jail- why most select fines)
  - If legal repercussions can't deter it, what can? (i.e., moral wrongness/ dangerousness – how to connect these)
  - What methods/modes of education would be useful?
  - If you just hear/are told its risky/wrong/dangerous, do you believe it?

6. 80.9% of survey respondents who have driven under the influence of cannabis indicated that DUIC is safer than DUIA. Do you think one is safer than the other? Which one?
  - How is cannabis different than alcohol?
    - o Prompts: How do they each affect your body?; How do they each affect your driving? (THC vs CBD vs alcohol) (+ vs - effects)
  - Do you believe there a stigma associated with cannabis and/or with alcohol?
    - o Prompt: Do you think there is a generational difference
  - How do you think the media portrays them both?
    - o Prompts: news vs social media that continues today? Entertainment (films, series, music).

7. What do you think about roadside testing?
    - o Prompts: How does alcohol vs cannabis testing differ?; Are the limits clear?; Do you think the limits are enforced? How strongly?

Targeted questions for non-users
8. Which do you think is the most common use method? (i.e., smoking, vaping, edibles)
  - Do you think different modes of cannabis use affect people differently?
    - o Prompt: In regards to impairment? In regards to driving?
9. What are the primary reasons why you do not use cannabis?
    - o Prompt: Does legalization change any of that?

Targeted questions for users
10. How do you normally use cannabis? (i.e., smoking, vaping, edibles)
  - Do different modes of cannabis use affect you differently?
    - o Prompt: In regards to impairment? In regards to driving?
  - Would you use a different method if you knew you were driving?
    - o Prompt: Would you use a different kinds (strains)?

Curriculum Vitae

Name: Robert Colonna

Post-secondary Education and Degrees

2017- Present   MSc. Health and Rehabilitation Sciences
                       Supervisor: Liliana Alvarez, PhD
                       Faculty of Health Sciences
                       Western University, London, ON

2013- 2017   Bachelor's degree in Health Science (BHSc.)
                       Specialization in Health Promotion, Minor in Economics
                       Faculty of Health Sciences
                       Western University, London, ON

Honors and Awards

2019   Student Poster Competition Finalist, Canadian Association of Road Safety Professionals
        (CARSP)
        Total Award: Complementary day registration (value: $425) to 2019 CARSP Conference

2018   Faculty of Health Sciences (FHS) & Health and Rehabilitation Sciences (HRS) Graduate
        Conference Travel Awards, Western University
        Total Award(s): $750

2017   Faculty of Health Sciences (FHS) Graduate Tri-Council Scholarship Incentive
        (Distinction awarded to the top four competitive applications to the Canada Graduate
        Scholarship- Master's applications), Western University
        Total Award: $1,000

2017   Dean's Honour List (Distinction awarded to graduates who achieved over an 80% average),
        Western University

Related Work Experience

Feb. 2018- Present   Research Assistant
                            Study Title: Using advanced driver assistance systems (ADAS)
                            as an intervention strategy for drivers with Parkinson's disease
                            PI: Liliana Alvarez, PhD, School of Occupational Therapy
                            Western University, London, ON

Nov. 2017- Apr. 2019   Research Assistant
                            Study Title: Stakeholders' expert opinions on a technology-based
                            intervention for young drivers' hazard perception
                            PI: Liliana Alvarez, PhD, School of Occupational Therapy,
                            Western University, London, ON

Sep. 2018 - Dec. 2018   Teaching Assistant
HS 2300; Health Issues in Childhood and Adolescence
Instructor: Treena Orchard, PhD, School of Health Studies
Western University, London, ON

Peer-reviewed Articles- In preparation

Colonna, R., Hand, C., Holmes, J., Alvarez, L. (2019). Cannabis and driving: Establishing young drivers' risk profiles. Manuscript in Preparation for Journal of Adolescence Health.

Colonna, R., Hand, C., Holmes, J., Alvarez, L. (2019). Perspectives of young drivers regarding driving under the influence of cannabis: A mixed methods study. Manuscript in Preparation for Journal of Adolescence Health.

Alvarez, L., **Colonna, R**., Chen, C., Chippure, K., Grewal, J., Kimm, C., Randell, T. (2019). The impact of cannabis on the fitness to drive and driving performance of youth: An evidence-based review. Manuscript in Preparation for Traffic Injury Prevention.

Alvarez, L., **Colonna, R**., Fehrer, A., Moulin, M., (2019). Personality and Driving Performance: An analysis of young drivers' profiles. Manuscript in Preparation for Accident Analysis and Prevention.

Alvarez, L., Wilson, J., **Colonna, R**. (2019). DriveFocus intervention on the simulated driving performance of a teen with ADHD: A case study. Manuscript in Preparation for Archives of Physical Medicine and Rehabilitation.

Alvarez, L., **Colonna, R** (2019). Dynamic display interventions for hazard anticipation in young drivers: A Delphi study. Manuscript in Preparation for Injury Prevention.

Colonna, R., Hawkins-Hayashi, A., Lauryssen, R., Drys, N., Othman, S., Vitaterna, L., Zecevic, A. (2019). Exceeding expectations: Student empowerment through partnerships in teaching and learning. Manuscript in preparation for International Journal for Students as Partners.

Professional Presentations

Knott, M., **Colonna, R**., & Alvarez, L. (2019). Current Evidence on Impaired Driving via Cannabis, Alcohol and Insufficient Sleep. Mini-Seminar. The Association for Driver Rehabilitation Specialists Annual Conference. Lexington, KY, August 11-13, 2019. Accepted.

Colonna, R., Hand, C., Holmes, J., Alvarez, L. (2019). Cannabis and driving: Exploring young Ontarians knowledge, perceptions and attitudes. Oral presentation. Canadian Association of Occupational Therapists Conference. Niagara Falls, ON, May 29- June 1, 2019. Accepted.

Colonna, R., Hand, C., Holmes, J., Alvarez, L. (2019). Cannabis legalization and driving: Exploring young Ontarians knowledge, perceptions and attitudes. Oral presentation. Canadian Association of Road Safety Professionals Conference. Calgary, AB, May 26-29, 2019. Accepted.

Colonna, R., Alvarez, L. (2019). Cannabis Legalization and Driving: Perspectives of Young Ontario Drivers. Poster presentation. Canadian Association of Road Safety Professionals Conference. Calgary, AB, May 26-29, 2019. Accepted.

Colonna, R., Alvarez, L. (2019). Driving under the influence of cannabis among young Ontarian drivers. Oral presentation. Ontario Road Safety Forum. University of Toronto, Toronto, ON, March 27, 2019.

Colonna, R (2019). Why Drive High: Perceptions from Ontario Youth. Oral presentation. 3 Minute Thesis (3MT). Western University, London, ON, March 5, 2019.

Colonna, R., Alvarez, L. (2019). Cannabis legalization and young drivers: An exploration of knowledge, perceptions and attitudes in Ontario survey data. Oral presentation. Health and Rehabilitation Sciences Graduate Research Conference, Western University, London, ON, February 5-6, 2019.

Colonna, R., Alvarez, L. (2018). Cannabis legalization and driving: Exploring young Canadians' knowledge, perceptions and attitudes. Poster presentation. The Association for Driver Rehabilitation Specialists Annual Conference. Richmond, VA. August 10-14, 2018.

Colonna, R. (2018). Perceptions and attitudes of young drivers towards the legalization of cannabis in Canada. Poster presentation. Health and Rehabilitation Sciences Graduate Research Conference, Western University, London, ON, January 31- February 1, 2018.

Invited Presentations

Colonna, R. (2019). Invited Speaker for Innovation in Motion: Faculty of Health Sciences and the School of Biomedical Engineering (FHS-BME) Research Day. Brescia University College, London ON, June 3, 2019.

Colonna, R. (2017). Health and Rehabilitation Sciences Program. Invited Panel Speaker for GradsHelpingU event. Health Studies Student Association (HSSA), Western University, London, ON, November 15, 2017.

Colonna, R., Hawkins-Hayashi, A., Lauryssen, R., Drys, N., Othman, S., Vitaterna, L (2017). Fostering Empathy: A Caregiver's Experience Community Conference. Invited Lab Demonstrator, Community Caregiver Conference (n= 18), Hutton House, London, ON, March 30, 2017.

Colonna, R. (2017) How to Run the Evoking Empathy Lab Workshop, Invited Lab Demonstrator for Station 8: Respiratory, Aging Body (HS 3701; n=79), Western University, January 24, 2017.

Colonna, R., Hawkins-Hayashi, A., Lauryssen, R., Drys, N., Othman, S., Vitaterna, L (2017). Empathy and Aging Simulations. Invited Guest Lecturer, Aging Body (HS 3701; n=79), Western University, January 12, 2017.

Bice, N., **Colonna, R**., Gallant, C., Kane, A., Song, Y. (2016). Evoking Empathy: An Aging Simulation Showcase, Invited Lab Demonstrator for Station 1: Skin, Hair and Nails. Western's March Break Open House (included: future students and their families, faculty members, and community organizations [n>100]), Western University, March 8, 2016.

Teaching Experience

2018   **Tutorial Facilitator** (weekly, 2 sections)
Western University, London, ON
Health Issues in Childhood and Adolescence (HS 2700; n=39 & n=37)

2017   **Guest Lecturer**
Western University, London, ON
Empathy and Aging Simulations. Aging Body (HS 3701; n=79)

Scholarly & Professional Academic Activities

Executive Roles

2019- Present   Treasurer, Young Professionals Committee (part of CARSP)

Mentorship Professional Associations/ Memberships

2018- Present   Member of the Canadian Association of Road Safety Professionals (CARSP)
2018- Present   Member of the Association for Driver Rehabilitation Specialists (ADED)

Conference/ Workshop Co-Organizer/Host

Fostering Empathy: A Caregiver's Experience Community Conference (included organizations: Hutton House, Participation House Support Services- London and Area, and L'Arche London [n= 18]), Hutton House, London, ON, March 30, 2017

Fostering Empathy: A Caregiver's Experience Pilot Workshop (included: caregivers and senior coordinators at Participation House Support Services – London and Area), Participation House, London, ON, November 10, 2016