Identifying Cannabis Use Motives and their Association with Problematic Cannabis Use

by

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ABSTRACT

Cannabis is amongst the most frequently used substances worldwide (United Nations Office on Drugs and Crime, 2015). Motivations for use are predictive of the quantity and frequency of cannabis consumed, as well as the severity of cannabis-related consequences (Lee, Neighbors, & Woods, 2007; Lee, Neighbors, Hendershot, & Grossbard, 2009). Research on cannabis-related motivations has been limited by being modeled from the alcohol literature and by the samples used (e.g., university population). The current study aimed to comprehensively assess cannabis motives in a more diverse group of cannabis users than previous studies. Past-year cannabis users from the general population (*n*=262) and a university student community (*n*=103) completed an online survey assessing cannabis use motivations, use patterns, and misuse risk factors (e.g., age, gender, personality). Five distinct motivations (i.e., positive reinforcement, coping with negative affect, health enhancement, social cohesion, and secondary substance) emerged, which were uniquely associated with frequency of cannabis use and use-related problems. Understanding motives behind cannabis use may inform the development of more effective prevention and intervention programs for cannabis misusers (Benschop et al., 2015).

Keywords: cannabis, motivations, frequency of use, use-related problems

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List of Nomenclature or Abbreviations

AS – Anxiety Sensitivity

CBD – Cannabidiol

CBT – Cognitive Behavioural Therapy

CMMQ – Comprehensive Marijuana Motives Questionnaire

COMT – Catechol-O-Methyltransferase

CUD – Cannabis Use Disorder

CUDIT – Cannabis Use Disorders Identification Test

DMQ – Drinking Motives Questionnaire

EFA – Exploratory Factor Analysis

H – Hopelessness

IMP – Impulsivity

MET – Motivational Enhancement Therapy

MMM – Marijuana Motives Measure

SS – Sensation Seeking

SURPS – Substance Use Risk Profile Scale

SUD – Substance Use Disorder

THC – Tetrahydrocannabinol

Identifying Cannabis Use Motives and their Association with Problematic Cannabis Use

On a global scale, cannabis is the most commonly used illicit substance (American Psychiatric Association [APA], 2013, Asbridge, Hayden, & Cartwright, 2012; United Nations Office on Drugs and Crime, 2015). Global prevalence rates for cannabis use across countries is estimated at 4%, accounting for approximately 180 million cannabis users worldwide (United Nations Office on Drugs and Crime, 2013). When comparing the cannabis use prevalence estimates across countries, Canada's are among the highest in the world. Prevalence for past year cannabis use in Canada is 13-15% for the general population and 20-30% amongst the 15 to 24-year-old population (Canadian Centre on Substance Abuse, 2018; Fischer, Imtiaz, Rudzinski, & Rehm, 2015; Hajizadeh, 2016; Phillips, Phillips, Lalonde, & Tormohlen, 2015). In 2012, Statistics Canada reported that 12.3% of Canadians over the age of 15 had used Cannabis in some form within the past year (Canadian Centre on Substance Abuse, 2014), making cannabis the most prevalently used drug in Canada. More recently, it has been reported that 33% of 18-24 year olds reported cannabis use in the past 3 months (Statistics Canada, 2018).

Cannabis use estimates vary across the provinces, with provincial prevalence estimates for past 3-month use ranging from 13 to 21% (Statistics Canada, 2018). Specifically, Quebec currently has the lowest prevalence rate among the provinces—at approximately 13.6%, whereas Nova Scotia reports the highest at 21.6% (Statistics Canada, 2018). New Brunswick falls in the upper half of the provincial prevalence distribution, with 18.9%, and Ontario falls in the lower half of the distribution, with 14%, of adults reporting use in the past 3-month period. In addition, rates of cannabis use within the past year have remained highest amongst youth and young adults aged from 15

to 25, showing prevalence estimates at 26-27% in 2018 (Statistics Canada, 2018; Wettlaufer et al., 2017). Given that Canada is dispersed across an expansive geographic area, and the recent legislative changes permitting access to and use of cannabis for recreational purposes are mandated and regulated at the provincial level, it is important to examine cannabis use across provinces to develop a comprehensive understanding of cannabis use and misuse rates in Canada.

Cannabis Use Disorder

The majority of those who use cannabis will not develop problematic cannabis use behaviours (Chowdhury, Kevorkian, Sheerin, Zvolensky, & Berenz, 2016). However, approximately 1-2% of adult users (Fischer et al., 2015; Stinson, Ruan, Pickering, & Grant, 2006), and close to 5% of adolescents (Phillips, Lalonde, Phillips, & Schneider, 2017), will develop Cannabis Use Disorder (CUD) as defined by the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5; APA, 2013).

The DSM-5 (APA, 2013) defines a CUD as a problematic pattern of cannabis use leading an individual to experience clinically significant impairment or distress in one or more areas of life. A CUD diagnosis requires at least two of the following symptoms to occur over a 12-month period: (1) Cannabis is often taken in larger quantities or over longer periods of time than intended; (2) There is persistent desire or unsuccessful efforts to cut down on or control cannabis use; (3) Significant quantity of time is spent on activities surrounding the acquisition or administration of cannabis; (4) There is a strong craving or desire to use cannabis; (5) Recurrent cannabis use results in a failure to fulfill role obligations in one or more areas of life (i.e., employment responsibilities, social roles); (6) There is persistent use of cannabis despite the presence of negative social or

physical consequences that are a result of or exacerbated by cannabis use; (7) Recurrent cannabis use during times in which it is physically hazardous to do so; (8) Increased need for markedly higher quantities of cannabis to achieve the same desired effect (tolerance); (9) Increased experience of physiological withdrawal symptoms when not engaging in cannabis use behaviours; and (10) Important social or occupational activities are reduced or abandoned in favour of cannabis-related activities. Additionally, these symptoms cannot be the result of another medical condition. The severity of a given CUD is categorized by the number of aforementioned symptoms present for the individual. Individuals exhibiting 2-3 symptoms are classified as experiencing Mild CUD, those with 4-5 symptoms are classified as Moderate CUD, and those with greater than 6 symptoms are classified as Severe CUD (APA, 2013; see Appendix A).

Development and Course of Cannabis Use and CUDs

Cannabis use initiation can occur at any point in the lifespan, but most commonly occurs in adolescence (Gruber, Dahlgren, Sagar, Gonec, & Lukas, 2013; Gruber, Sagar, Dahlgren, & Racine, 2012; Padovano & Miranda, 2018). The transition from initiation to problematic cannabis use generally develops over an extended period of time (APA, 2013), but risk for CUD development is highest in the first 5-year period of use (Padovano & Miranda, 2018). The psychopharmacological effects of cannabis on affect and cognition (i.e., neurophysiological effects, positive subjective effects) contribute to perpetuating cannabis use behaviours, in which individuals with greater positive perceptions of the effects of cannabis are more likely to continue cannabis use behaviours (Padovano & Miranda, 2018; Scherrer et al., 2009). Furthermore, those using to reduce

negative sensations or those experiencing greater withdrawal or craving symptoms are at greater risk for continued use behaviours (Padovano & Miranda, 2018).

Literature assessing cannabis use trajectories and the development of CUD has identified three predominant trajectory patterns; a maturing-out class, a persistent increasing risk of CUD class, and a stable low risk CUD class (Kosty, Seeley, Farmer, Stevens, & Lewinsohn, 2016). The maturing-out class demonstrated higher trajectories of use during adolescence that then decreases to minimal use by early adulthood, without intervention (i.e., ages 27-30; Kosty et al., 2016; Rodriguez, 2015; Rudzinski et al., 2013). The cessation of cannabis use into early adulthood, in part, reflects the occurrence of many significant life events (i.e., initiation into employment, cohabitation, parenthood) that are incompatible with cannabis use (Rudzinski et al., 2013). Many cannabis users experience this maturation process and do not continue to develop cannabis use or misuse behaviours into adulthood. In contrast to the maturing out class, the persistent increasing risk class demonstrates trajectories of use that increase in frequency over time and subsequently increase risk of CUD over time (Kosty et al., 2016). Unlike the persistent increasing risk and maturing out classes, the stable low risk CUD class displays stable and low cannabis use over time with an associated low risk of CUD. In addition to the three predominantly identified trajectories of CUD development, characteristics of more rapid transitions from initiation to problematic use—termed telescoping—have been demonstrated in populations of adolescents and women (APA, 2013; Cooper & Haney, 2014; Cooper & Haney, 2016; Fogel, Kelly, Westgate, & Lile, 2017). A contributing factor to an individual's risk of continued cannabis use behaviours, and trajectory of risk

for CUD, comes, in part, from the physiological impact cannabis has on the reward pathways of the brain.

There is an abundance of cannabinoid receptors in the dopaminergic pathways of the brain, including mesolimbic pathways (i.e., the reward pathways), that contribute to the development of addictive behaviours and CUD (Gonzalez, 2007). THC exposure has been associated with alterations to the dopaminergic and glutamatergic signalling systems through CB1 receptors (Colizzi, McGuire, Pertwee, & Bhattacharyya, 2016; Sami, Rabiner, & Bhattacharyya, 2015). Specifically, the THC molecule binds to the cannabinoid receptors, preventing the binding of endogenous cannabinoids, evoking a burst firing of dopamine that increases overall levels of dopamine in the prefrontal striatum and nucleus accumbens (Colizzi et al., 2016; Sami et al., 2015; Wright, Scerpella, & Lisdahl, 2016). In response to chronic cannabis administration and the overabundance of THC activating the receptors, the brain downregulates endocannabinoid receptors (i.e., decreases the number of receptors available). The down-regulation of dopamine in the brain contributes to an overall dampening of the endocannabinoid system and the development of tolerance in the individual, where increased quantities of THC are required to achieve the same sensations (Colizzi et al., 2016; Gonzalez, 2007). In sum, chronic administration of cannabis has been associated with altered neural morphology in systems involved in reward and goal processing (Cousijn et al, 2012; Gonzalez, 2007; Lichenstein, Musselman, Shaw, Sitnick, & Forbes, 2017; Wright et al., 2016). Furthermore, cannabis users demonstrate increased neural activation patterns in the nucleus accumbens in response to cannabis-based rewards in comparison to monetarily based rewards (Cousijn et al., 2012), suggesting risk for

development of a cyclical reinforcement pattern over the course of cannabis use. As a consequence, those who chronically misuse cannabis display lower reward sensitivity and motivation, with a corresponding increase in negative emotionality (Volkow et al., 2014). Moreover, gender differences are identified at the neurological level, with females reporting greater decreases in reward processing than males with prolonged use of cannabis (Wright et al., 2016). As a result of these biological alterations, CUD is associated with many significant consequences.

Consequences of Cannabis Use and Misuse

Cannabis use and misuse can have substantial negative impacts at both the individual (i.e., social, physical) and societal levels (i.e., motor vehicle accidents, hospitalizations; Fischer et al., 2015). At the individual level, cannabis users can experience acute or recurring negative social-interpersonal consequences (i.e., familial relationship tension; failure to fulfill role obligations, withdraw from social activities, etc.), impairments in cognitive functioning (i.e., executive functioning, memory, attention, reward processing), psychomotor functioning (i.e., delayed reaction time), negative self-perception, decrease in self-care behaviours, decrease in motivations or aspirations (i.e., educational attainment), and negative health consequences (i.e., neurological functional connectivity changes, psychotic symptoms, chronic bronchitis in smokers etc.; Aldington et al., 2007; APA, 2013; Cooper & Craft, 2018; Dougherty et al., 2013; Hall, 2014; Jouanjus, Leymarie, Tubery, & Lapeyre-Mestre, 2011; Kalant, 2004; Kempker, Honig, & Martin, 2015; Lichenstein et al., 2017; Pearson, Liese, Dvorak, & the Marijuana Outcomes Study Team, 2017; Phillips et al., 2015; Pletcher et al., 2012; Ribeiro & Ind, 2016; Sherif, Radharkrishnan, D'Souza, & Ranganathan, 2016).

Furthermore, cannabis use consequences at the individual level can be pervasive and have significant associated societal costs.

Societal costs associated with cannabis use can be found at the global and local community levels. Substance Use Disorders (SUDs) are a leading contributor to the burden of disease globally (Whiteford et al., 2013). In North America, the overall measure of the disease burden associated with CUD is high (Degenhardt et al., 2013). In 2012, Statistics Canada reported that 55, 000 total years of life are lost as a result of disability associated with cannabis use in Canada. Disability can result from long term chronic use symptoms (e.g., dependence, chronic cough in smokers, failure to fulfill role obligations due to cannabis use resulting in unemployment) or single use events (e.g., cannabis-related motor vehicle accidents). The risk of negative health consequences of CUDs (i.e., schizophrenia, lung disease in smokers, etc.) and motor-vehicle accident injuries and deaths comprise a substantial proportion of disability, burden, and costs associated with cannabis use (Calabria, Degenhardt, Hall, & Lynskey, 2010; Degenhardt et al., 2013; Fischer, Murphy, Rudzinski, & Macpherson, 2016; Imtiaz et al., 2015). The burden of disease attributable to cannabis is significant; however, it is comparatively lower than for other substances due to its reduced associated mortality rate (Fischer et al., 2016; Gable, 2004; Imtiaz et al., 2015). Although cannabis use has not demonstrated direct association with acute mortality (e.g., overdose), there are significant costs associated with indirect mortality related to cannabis (e.g., cannabis-attributable motor vehicle fatalities, which was estimated at 75 deaths across Canada in 2012; Canadian Centre on Substance Use and Addiction, 2017; Fischer, Imtiaz, et al., 2015).

Of specific concern, cannabis is the most commonly detected illicit drug in drivers (Hartman, Richman, Hayes, & Huestis, 2016). Estimates indicate between 2.5% and 5.5% of licensed Canadian drivers report at least one experience of driving under the influence of cannabis (Asbridge et al., 2012; Beasley, Beirness, & Boase, 2013; Bedard, Dubois, & Weaver, 2007; Fischer, Imtiaz, et al., 2015; Health Canada, 2012). Cannabis use impairs an individual's psychomotor and cognitive faculties, affecting their ability to drive and their overall driving performance (Asbridge et al., 2012; Bondallaz et al., 2016; Downey et al., 2013; Hartman et al., 2016; Kalant, 2004), particularly road positioning, reaction time, and time to brake (Bondallaz et al., 2016; Fischer et al., 2015; Hartman et al., 2016; Kalant, 2004; Lenne et al., 2010). As a result, it is estimated that cannabis impaired driving results in a twofold increase in risk of involvement in motor vehicle collisions (Asbridge et al., 2012; Fischer et al., 2015; Lenne et al., 2010; Wettlaufer et al., 2017). Following the same pattern as cannabis use prevalence rates, higher rates of cannabis-impaired driving occurs amongst adolescent and young adult drivers (Health Canada, 2012). Rates of cannabis-impaired driving have risen in recent years (Canadian Department of Justice, 2016) and the harms and costs associated with cannabis-attributable collisions are likely to follow the same ascending trajectory (Asbridge et al., 2012; Wettlaufer et al., 2017). In 2016, there were 8 reported cannabis-impaired driving deaths and 22 cannabis-impaired driving collisions resulting in bodily injury in Canada. In contrast, in the same year there were 100 alcohol-impaired driving related deaths and 541 alcohol-related collisions resulting in bodily injury in Canada (Statistics Canada, 2016). Although cannabis-impaired driving rates are climbing, with associated potential

for injury, estimates for injury and death attributable to alcohol-related collisions are significantly higher.

In congruence with the increase in cannabis-attributable motor vehicle accidents, costs associated with cannabis-related hospitalizations have also grown (Canadian Centre on Substance Use, 2011; Chatters et al., 2016). Rates of cannabis-related hospitalizations rose by approximately 40% between 2006 and 2011 (Canadian Centre on Substance Use, 2011), with adolescent and young adult users (15-24 years) having a higher prevalence of cannabis-related hospital stays and longer durations of hospitalizations (Canadian Centre on Substance Abuse, 2014). Similar trends have been reported in the U.S., with a total of 300,000 cannabis-related admissions in 2012 that accounted for 17.5% of substance abuse-related hospitalizations in the U.S. (Chatters et al., 2016). Given that cannabis use and misuse account for such significant individual, societal, and economic costs, it is important to understand the factors that contribute to susceptibility for developing a CUD, misuse behaviours, and cannabis-related negative consequences.

Risk Factors and Associated Consequences for Cannabis Use and Misuse

Although cannabis research is in its relative infancy, some key risk factors for cannabis misuse have emerged in the literature. In particular, pre-existing biological susceptibilities, gender, age, and personality factors have been associated with problematic cannabis use or the development of negative consequences as a result of use.

Biological susceptibilities. Functions of the endocannabinoid system have only recently been identified, and these include but are not limited to: synaptic pruning; myelination of neurons; cognitive regulation; motor control; and, metabolizing neurotransmitters—particularly dopamine (Ashton, Dowie, & Glass, 2017; Colizzi et al.,

2016; James, James, & Thwaites, 2013). Individual differences in the endocannabinoid systems (i.e., rate of metabolic processing, density of receptors) contribute to the intra-individual variability in the physiological experience of cannabis and the development of CUD (James et al., 2013; Silveira et al., 2017).

The relationship between an individual's genetics and susceptibility for CUD development is polygenic and complex; there is no one gene to account for the differential susceptibility, rather, numerous genes contribute (Agrawal & Lynskey, 2009; Silveira et al., 2017). Individual genetic variations in endocannabinoid and dopaminergic processing contribute to differential susceptibility for CUD. Genes associated with cannabinoid receptors, CNR1 (CB1 encoding gene) and CNR2 (CB2 encoding gene), contribute to vulnerabilities in SUDs. In particular, variations in the CNR1 gene are associated with the development of CUD (Adedeji, Akinniyi, Abiola, & Abayomi, 2014; Agrawal & Lynskey, 2009). It appears, however, that the CRN1 gene is associated with disordered use across several substances (i.e., nicotine, alcohol, and cannabis), suggesting an impact of the gene on overall propensity to develop SUDs or substance misuse behaviours (Agrawal & Lynskey, 2009). In addition, the dopaminergic receptor gene DRD2 has been associated with cannabis use at earlier ages, a risk factor for the development of cannabis misuse behaviours (Agrawal & Lynskey, 2009). The A1 variant of the DRD2 allele is associated with a hypodopaminergic state in contrast to other allele variants, resulting in 30-40% fewer dopamine receptors (Adedeji et al., 2014), and thereby producing a much higher need for dopamine. As a result, the A1 allelic variant is associated with impulsive, compulsive and addictive behaviours as a mechanism to increase dopamine levels (Adedeji et al., 2014).

A genetic component for the differential susceptibility in the development of psychotic symptoms in those who engage in cannabis use has been identified (Caspi et al., 2015). The genetic component in the risk for development of psychotic symptoms stems, in part, from the variants of the Catechol-O-methyltransferase (COMT) gene (i.e., associated with faster or slower dopamine metabolic rates; Caspi et al., 2015). Slower dopamine processing variants appear to increase the likelihood of psychotic symptom development, especially when combined with cannabis use behaviours (Caspi et al., 2015; Gothelf et al., 2005; Williams, Owen, & O'Donovan, 2007), with a reported fourfold increased likelihood in risk for psychotic symptom development (National Institute on Drug Abuse, 2018). Individuals possessing the COMT allelic variant are no more likely to engage in cannabis use behaviours than others, but carry an increased risk of psychotic symptom development if they do engage in cannabis use.

In sum, there are genomic and neurobiological differences in susceptibility for cannabis misuse and for reinforcing neurological alterations that occur as a result of cannabis use. These factors provide insight into differential susceptibility of CUD development at the biological level (Agrawal & Lynskey, 2009; Ashton et al., 2017). Furthermore, neural changes as a result of cannabis use may be related to age of first use, as adolescence is a critical developmental period.

Age-related risk factors. Adolescence is a critical period of neurobiological and physiological development, particularly for the executive cognitive functioning system, with the development of grey and white matter and changes in synaptic connectivity (Lisdahl, Wright, Medina-Kirchner, Maple, & Shollenbarger, 2014; Wright et al., 2016). Grey matter is associated with cognitive processing mechanisms, containing the cortical

neurons, whereas white matter functions to form neural interconnections and insulate neurons through the process of myelination, both necessary for effective and efficient cognitive function (Gruber et al., 2013; James et al., 2013).

In humans, brain development is sexually dimorphic, meaning that the female and male brain undergo the neurological developmental changes at different rates (Lisdahl & Price, 2012). Given that the female brain develops earlier and at a faster rate than the male brain, females can reach peak grey and white matter development up to 2 years sooner than males (James et al., 2013; Lisdahl & Price, 2012). Grey matter and white matter development occur at different rates and different stages across different regions of the brain, with grey matter development occurring in a curvilinear pattern with age and white matter development steadily increasing with age (Lenroot & Geidd, 2006). The female brain reaches peak gray matter development in the frontal lobes between ages 9-12 years, in the temporal lobes between the ages of 16-17 years, and in the parietal lobes between the ages of 9-10 years. In contrast, the male brain reaches peak gray matter development in the frontal lobes between the ages of 11-13 years, in the temporal lobes between the ages of 15-16 years, and in the parietal lobes between the ages of 11-12 years (James et al., 2013; Lenroot & Geidd, 2006; Lenroot et al., 2007). Unlike grey matter development, white matter steadily increases over time continuing to develop into early adulthood (i.e., 25-30 years old) with initial decline being demonstrated in the late 30s (Lenroot & Geidd, 2006). As a result of the slower development in males, the critical period for the developing brain in males can be longer than the critical developmental period for females (James et al., 2013). In light of these neurological changes, the adolescent brain is at increased vulnerability to the risks of cannabis use and to the

development of CUD (Gruber et al., 2013; Hanson et al., 2010). Exposing the developing brain to exogenous cannabinoids may detrimentally disrupt and alter healthy neurological development (Lisdahl & Price, 2012), potentially resulting in significant negative consequences. Although there does not appear to be a gender-related difference in age of first use of cannabis, the sexually dimorphic development of the brain may explain some gender-related differences in cannabis use problems experienced (Khan et al., 2013).

Given the developmental vulnerabilities of young people, current research demonstrates that earlier age of onset for cannabis use is a significant risk factor for the development of cannabis use-related consequences (Gruber et al., 2013; Hanson et al., 2010; Lisdahl & Price, 2012). When comparing early onset (i.e., prior to the age of 16) and late onset (i.e., above age 18) cannabis users, early onset users demonstrated greater neurological and neurocognitive deficits (Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015). Specifically, early onset of cannabis use increases risk of reductions in, and alterations to, white matter microstructure (Gruber et al., 2013), grey matter (i.e., reduced dendritic branching, abnormal signalling patterns, and reduced interhemispheric functional connectivity; Lisdahl & Price, 2012; Orr et al., 2013), and alterations to hippocampal volumes (Lisdahl & Price, 2012) which is an important structure involved in long term potentiation of memory (Gonzalez, 2007).

In congruence with neural physiological research on risks of early cannabis use, neurocognitive impairments in verbal memory, attention, executive functioning, processing speed, and psychomotor function have been identified in individuals using cannabis, with worse outcomes for individuals using prior to the age of 16 (Gruber et al., 2012; Gruber et al., 2013; Lisdahl et al., 2014; Lisdahl & Price, 2012; Mahu et al., 2015).

Reductions in IQ have been documented from adolescence to adulthood in individuals who engaged in chronic adolescent cannabis use (Lisdahl et al., 2014; Meier et al., 2012). Specifically, cannabis users who initiated and persisted in cannabis use behaviours in adolescence decreased an average of six IQ points from adolescence to adulthood (Lisdahl et al., 2014; Meier et al., 2012). The reduction in IQ scores as a result of cannabis use does not appear to recover after periods of abstinence (Meier et al., 2012). Additionally, earlier onset cannabis use has been implicated in increased risk for the development of psychotic symptoms, thought to be as a result of alterations to frontal lobe connectivity and alterations of the dopaminergic system (Sami et al., 2015).

Unfortunately, current cannabis use patterns illustrate that many individuals begin using cannabis during adolescence, with the highest prevalence rates amongst the adolescent/young adult populations (Degenhardt et al., 2008; Lisdahl & Price, 2012). Over a five-year period, the average age of first use has decreased slightly from almost 18 (17.8) years of age in 2008 (Substance Abuse and Mental Health Services Administration, 2009) to approximately 17 years of age (Gruber et al., 2012; Gruber et al., 2013). A further decline in age of first use has been more recently observed by the Canadian Centre on Substance Use (2018), with youth (15-19 years) reporting an average age of first use at 15.4 years and young adults (20-24 years) reporting an average age of first use at 16.5. Those who initiate cannabis during adolescence are at increased risk of developing CUD (Hanson et al., 2010). Hence, age of onset is a significant risk factor for the development of cannabis misuse behaviours and the experience of negative cannabis-related consequences (Gruber et al., 2013; Lisdahl et al., 2014; Meier et al., 2012).

Gender-related risk factors. Gender serves as a contributing factor in producing individual differences in the susceptibility to developing cannabis misuse behaviours and experiencing various cannabis use consequences (Ali et al., 2016; Cooper & Haney, 2014; Cooper & Haney, 2016; Fogel et al., 2017). Specifically, cannabis use prevalence estimates for both past 30-day and lifetime use are higher among men than women (Canadian Centre on Substance Abuse, 2014). In 2014, past-year cannabis use prevalence estimates were 14.9% among men and 9.7% among women (Canadian Centre on Substance Abuse, 2014; Substance Abuse and Mental Health Services Administration, 2014), increasing from 2013 rates of 13.9% and 7.4%, respectively. Following this trend, CUD estimates were also higher for males than for females, 11% and 5%, respectively (Khan et al., 2013).

Interestingly, although there are a greater number of males diagnosed with a CUD, females are much more likely to experience telescoping (i.e., rapid progression in use; Cooper & Haney, 2016; Fogel et al., 2017). In addition to telescoping, females are faster to seek treatment for their CUD, although this does not translate to superior treatment outcomes (Fogel et al., 2017). In fact, research demonstrates that women have a tendency to relapse from CUD at higher rates than males, perhaps due to their increased experience of withdrawal symptoms and greater anxiety associated with these symptoms (Fogel et al., 2017). Indeed, women report experiencing greater severity of withdrawal symptoms (Cooper & Haney, 2016) and greater anxiety symptoms associated with the experience of withdrawal symptoms (Cooper & Haney, 2014; Cooper & Haney, 2016). In addition, males and females appear to be differentially susceptible to anxiety symptoms as a consequence of cannabis use. Specifically, at high doses of THC, females report

increased anxiogenic effects in comparison to males (Cooper & Haney, 2014; Wright et al., 2016)

In addition to women reporting more subjective experiences of the negative effects of cannabis, women also express more positive subjective feelings of the active effects of THC (Cooper & Haney, 2014). Women have consistently higher ratings for the positive effects of cannabis (i.e., "I like the effects of cannabis" and "I would take cannabis again"), which are predictive of subsequent cannabis use behaviours (Cooper & Haney, 2014). Hence, although CUD affects more men than women, women are also at risk of experiencing adverse cannabis-related consequences. Some of the gender differences in the subjective experience of cannabis may be associated with personality factors, with gender serving as a contributing mechanism to our understanding of the role of personality in substance misuse (Ali et al., 2016).

Personality risk factors. A wealth of research has revealed the crucial role of personality traits in the development and maintenance of addictive behaviours (Conrod, Stewart, Comeau, & MacLean, 2006; Finn, Sharkansky, Brandt, & Turcotte, 2000, Krank et al., 2011). Personality traits are an individual difference factor, which may serve as a potential risk factor for the development of substance misuse, in that they contribute to the type of substances individuals use and their motivations for use (i.e., seeking stimulation, arousal dampening; Krank et al., 2011; Mahu et al., 2015; Schlauch et al., 2014). Indeed, personality factors have proven an effective tool in differentiating types of substance used (Krank et al., 2011), motivations for use (Comeau, Stewart, & Loba, 2001), and patterns of responses (i.e., behavioural and neurophysiological) to the effects

of substance use (Brunelle et al., 2004; Conrod, Pihl, & Vassileva, 1998; Krank et al., 2011).

Woicik, Stewart, Pihl, and Conrod (2009) developed a psychometric assessment tool, the Substance Use Risk Profile Scale (SURPS), to aid in the assessment of individuals at risk for the development of substance misuse behaviours, based on the personality risk model of substance misuse proposed by Conrod, Pihl, Stewart, and Dongier (2000). The four-factor model for personality traits, which is associated with distinct preferred substance of use and motivations for use (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Conrod et al., 2000; Woicik et al., 2009), identifies the traits: (1) Hopelessness, (2) Anxiety Sensitivity, (3) Sensation Seeking, and (4) Impulsivity.

The Hopelessness (H) personality trait of the SURPS typology represents an individuals' predisposition to experience negative and depressive thoughts (Conrod et al., 2000; Woicik et al., 2009). Individuals high in H have an increased likelihood of experiencing depressive or anxiety-related disorders, often with heightened sensitivity to negative physiological arousal (i.e., as a result of or fear of punishment) that leads to a decline in goal-directed behaviour (Conrod et al., 2000; Hecimovic, Barrett, Darredeau, & Stewart, 2014; Woicik et al., 2009). As such, individuals high in H more commonly report using substances for negative reinforcement purposes, particularly using to cope (i.e., to alleviate a low mood; Conrod et al., 2000; Hecimovic et al., 2014; Woicik et al., 2009), and preference for substances with analgesic properties (i.e., alcohol, opioids). Analgesics are a class of drug that functions to suppress nociceptive symptoms, which may also function to attenuate the effects of punishment or other forms of negative affect

and arousal (Hecimovic et al., 2014; Pihl & Peterson, 1995). It follows then, that individuals high in H may seek substances with analgesic properties as a way of temporarily reducing their experience of negative affective symptoms. In terms of cannabis use, research using the SURPS has found that H is positively associated with coping motives (i.e., "to forget about problems / to escape"), a significant predictor of problematic use, and younger age of initiation (Hecimovic et al., 2014; Malmberg et al., 2010). Additionally, using the SURPS, Spriggens and Hides (2015) found high trait H presented as a significant positive predictor of frequency of psychotic like experiences in cannabis users. Those with high levels of trait H who choose to use cannabis may be at increased risk of psychotic like experiences (Spriggens & Hides, 2015). Overall, the limited literature using the SURPS supports trait H as a risk factor for cannabis misuse and cannabis related-consequences (Ali et al., 2016; Malmberg et al., 2010; Malmberg et al., 2013).

The Anxiety Sensitivity (AS) personality trait of the SURPS typology represents an individuals' degree of sensitivity to anxiety and anxiety-related physiological sensations (i.e., to alleviate a low mood; Conrod et al., 2000; Hecimovic et al., 2014; Woicik et al., 2009). Individuals high in AS hold a fear of the arousal-based physiological sensations that correspond with anxiety, often holding the perception that these sensations signify impending harm (Conrod et al., 2000; Hecimovic et al., 2014; Reiss, 1991). Similar to H, individuals with high AS tend to use substances for coping motives, centred upon a desire to reduce and alleviate the negatively perceived arousal-based physiological sensations (Conrod et al., 2000; Schlauch et al., 2014). As a result of these motivations, individuals high in AS preferentially use substances with anxiolytic

and sedative effects (e.g., alcohol). In contrast to H, AS is also associated with conformity motives and use of substances to cope with social anxiety symptoms (Buckner, Heimberg, & Schmidt, 2011), in which substances are used to dampen the anxiety-related sensations to allow the individual to continue to engage in the anxiety-provoking environment (e.g., social situations), which contributes to continued use patterns. Cannabis use may serve to dampen or reduce anxiogenic sensations, functionally enabling the individual to regulate the associated cognitive-affective anxiety-related processes (Zvolensky et al., 2018).

Furthermore, high AS individuals also report more intense withdrawal (Bonn-Miller, Zvolensky, & Bernstein, 2007) and craving symptoms (Buckner et al., 2011; Elkader, Brands, Callaghan, & Sproule, 2009), contributing to the persistence of substance misuse behaviours and the development of a substance use disorder (Schmidt, Buckner, & Keough 2007). In addition to being a risk factor for substance misuse (Stewart, Samoluk, & MacDonald,1999), high trait AS is associated with risk for other psychopathologies such as a major depressive episode (Naragon-Gainey, 2010) and anxiety disorders (Olatunji & Wolitzky-Taylor, 2009). The relationship between AS and cannabis use is mixed; some research suggests AS is a risk factor for misuse of cannabis and the experience of cannabis-related problems (Dean, Ecker, & Buckner, 2017), whereas other research on AS and cannabis use suggests AS may serve as a protective factor against initiating cannabis use (Ali et al., 2016; Castellanos-Ryan et al., 2013; Malmberg et al., 2010; Woicik et al., 2009). Using the SURPS, Ali et al. (2016) identified a protective effect of high AS for cannabis experimentation and cannabis use for females only, supporting the gender differences in personality traits and their relationship with

cannabis misuse. Once cannabis use has been initiated, however, the protective element of AS becomes a risk factor for continued use and misuse of cannabis. The dampening of anxiety symptoms through cannabis use may become a motivation for continued use, where previously AS was preventing an individual from initiating use.

The Sensation Seeking (SS) personality trait of the SURPS typology characterizes individuals with a predilection for novel, stimulating experiences, with an associated high aversion for boredom (Castellanos-Ryan, Rubia, & Conrod, 2011; Conrod et al., 2000). In accordance with seeking stimulating sensations, as well as to avoid boredom, individuals high in SS report enhancement motivations centred around experiencing the stimulating and euphoric ("high") effects produced by substances with psychostimulant properties (Conrod, Peterson, & Pihl, 1997), such as alcohol or cannabis (Conrod et al., 2000; Hecimovic et al., 2014). Individuals high in SS experience increased activity in the mesolimbic dopaminergic pathway that contributes to their desire for stimulation (Castellanos-Ryan et al., 2011). The combination of desire for stimulation and diminished behavioural inhibition are characteristic of individuals high in SS, serving as a risk factor for the development of substance misuse behaviours and early substance use, especially alcohol use disorder (Conrod et al., 2006; Rodriguez, 2015). The link between the SS personality trait and cannabis use is such that individuals high in SS tend to report expansion or creative motives for cannabis use (Hecimovic et al., 2014), and motives centred around the psychotropic effects of cannabis (i.e., use for the "high"). Arnett (1994) and Woicik et al. (2009) identified a positive relationship between SS and cannabis use related to stimulation and mood enhancement. Furthermore, Rodriguez (2015), using the Junior-Sensation Seeking Scale, reported high SS as a strong predictor

of early cannabis use (Rodriguez, 2015) and continued misuse behaviours (Castellanos-Ryan et al., 2013; Comeau et al., 2001; Schlauch et al., 2014).

The final typology of the SURPS model is the Impulsivity (IMP) personality trait, which represents an individuals' inability to inhibit and control behaviour when immediately rewarding stimuli is accessible, regardless of the resulting potentially negative consequences (Castellanos-Ryan et al., 2011). The IMP personality profile has been identified as a risk factor and a predictor of substance misuse behaviours (Gruber et al., 2013). The serotonergic and dopaminergic systems have both been implicated in the literature as potential sources of influence for individuals with self-regulatory and response inhibitory challenges (Dally & Roiser, 2012). High IMP is a risk factor for use of substances with immediate reinforcement properties (i.e., stimulants; Conrod et al., 2000), and an earlier age of onset of substance use behaviours (Gruber et al., 2013; Tarter et al., 2003). Following from deficits in behavioural regulation, research identifies a significant relationship between high IMP and behavioural control disorders, including single and polysubstance use disorders (Conrod et al., 2000), conduct disorder (Castellanos-Ryan et al., 2011), and antisocial personality disorder (Conrod et al., 2000). Moreover, it appears that levels of IMP serve as a mediating factor for stimulant use disorder in those with high antisocial traits, demonstrating the importance of the role of IMP in the development and maintenance of substance misuse behaviours (Hopley & Brunelle, 2012). In relation to cannabis use, individuals high in IMP report fewer negative consequences associated with their cannabis use and, as a result, tend to report increased cannabis use in comparison to low IMP individuals (Gruber et al., 2013). High trait IMP is also related to motives of cannabis associated with accessibility (i.e., ease of

access to cannabis) and self-medication (Hecimovic et al., 2014), which may be in part due to the inability to inhibit behaviour in the face of immediate rewards, resulting in negative consequences (Hecimovic et al., 2014). Thus, for individuals with high trait IMP, cannabis may be initiated at a younger age and also serve as a negatively reinforcing substance. Individuals may use cannabis as a short-term remediation strategy, without full appreciation or consideration of the resulting long-term consequences (Hecimovic et al., 2014).

In sum, the SURPS has demonstrated validity in predicting substance preference (e.g., stimulants) and risk for the development of substance misuse and comorbid psychopathologies across normative and various clinical populations (Ali et al., 2016; Brunelle, Douglas, Pihl, & Stewart, 2009; Conrod et al., 2000; Hopley & Brunelle, 2012; Newton et al., 2016), with less research focusing on cannabis specifically. In addition to personality risk factors for substance misuse, motivations for substance use (in both alcohol and drug use populations) is an important factor in the development and continuation of substance misuse behaviours (Blevins, Banes, Stephens, Walker, & Roffman, 2016a; Bonar et al., 2017). Thus, motivations are an important individual difference factor to examine (Blevins, Banes, Stephens, Walker, & Roffman, 2016a; Bonar et al., 2017).

Motivational Theory of Addiction

A substantial body of research has emphasized the importance of motivations in substance use behaviours, positing that motivations for use can provide information about an individual's substance use patterns and risk of problematic use (Kuntsche, Knibbe, Gmel, & Engels, 2005). Overall, differences in motives are predictive of quantity of

substance consumed, frequency of use, as well as the experience and severity of substance-related consequences (Benschop et al., 2015; Blevins, Banes, Stephens, Walker, & Roffman, 2016b; Cooper, 1994; Lee, Neighbors, & Woods, 2007; Schlossarek, Klempkensteffen, Reimer, & Verthein, 2016). In addition, understanding the motives behind substance use behaviours may better elucidate factors that maintain the behaviour, which further informs the development of effective prevention and intervention programs (Benschop et al., 2015; Cooper, 1994; Lee et al., 2007).

Motivations for use can be conceptualized as contextual reasons for engaging in substance use, which may change over time (Cooper, 1994). Motivations for behaviour are divided into two types of reinforcement: positive or negative. Positive reinforcement is characterized by a desire to repeat a behaviour because it enhances positive experiences (i.e., the "high" euphoric sensations or positive affect), whereas negative reinforcement is characterized by a desire to repeat a behaviour because it alleviates negative affective experiences (i.e., avoidance of withdrawal symptoms or coping with negative emotional states; Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995; Lee et al., 2007).

Based on these learning principles, Cooper (1994) established a motivational model of alcohol use behaviours, which was further broken down into two distinct dimensions (source and type of reinforcement, see Figure 1). Specifically, the source of the motive dimension reflects internally (i.e., self) or externally (i.e., others) generated motives, whereas the type of reinforcement motives dimension is positive or negative in reinforcement quality. The cross-over of the two dimensions creates a distinct four-factor model for motivations of alcohol use behaviours (see Figure 1), consisting of: (a)

Enhancement motives (internally generated, positive reinforcement motives), which are centred upon seeking enjoyment or enhancement of one's mood via alcohol consumption (Bonar et al., 2017; Cooper, 1994); (b) Social motives (externally generated, positive reinforcement motives), which are centred on using alcohol to improve the experience of social events, enhance social relationships, or receive positive social rewards (Bonar et al., 2017; Buckner & Zvolensky, 2014; Cooper, 1994; Simons, Correia, Carey, & Borsari, 1998); (c) Coping motives (internally generated, negative reinforcement motives), which are centred on the use of alcohol to reduce or alleviate negative sensations (i.e., alleviate negative mood, reduce anxiety-related symptoms; Bonar et al., 2017; Cooper, 1994); and (d) Conformity motives (externally generated, negative reinforcement motives), which are centred on the use of alcohol to fit in and alleviate negative external social pressures (Bonar et al., 2017; Cooper, 1994; Simons et al., 1998). Cooper's (1994) four factor motivational theory of alcohol use can be assessed using the Drinking Motives Questionnaire (DMQ), a reliable psychometric tool frequently used for measuring motives underlying alcohol use behaviours (Blevins et al., 2016a; Gilson et al., 2013; Lee et al., 2007).

Using the DMQ, several distinct relationships between motivations and alcohol use behaviours have been identified. Enhancement, coping, and social motivations have been most predominantly associated with alcohol misuse behaviours and the resultant negative consequences (Blevins et al., 2016a; Cooper, Kuntsche, Levitt, Barber, & Wolf, 2016; Lee et al., 2007). Enhancement motives for alcohol use positively predict greater number of alcoholic beverages consumed per drinking episode, higher peak blood alcohol concentrations within a drinking episode, and more binge drinking behaviours (Hauck-

Filho, Teixeira, & Cooper, 2012; Piasecki et al., 2014). Additionally, individuals endorsing enhancement motives tend to experience greater alcohol-related problems (e.g., fear of dependence on alcohol, a loss of control when drinking, or social conflicts as a result of use), but not non-alcohol-related problems, such as poor academic performance (Kuntsche, Knibbe, Gmel, & Engels, 2006).

The relationship between coping motives and alcohol use patterns is similar to enhancement motives in that coping motives positively predict heavy alcohol use (Kuntsche et al., 2006); however, in contrast to enhancement motives, coping motives are associated with a greater experience of both alcohol and non-alcohol-related problems (Hauck-Filho et al., 2012; Kuntsche et al., 2006). Social motives are amongst the most highly endorsed motives globally, particularly amongst young adult populations (MacKinnon et al., 2017). Social motives are positively related to frequency of drinking, quantity of alcohol consumed, and binge drinking behaviours (Hauck-Filho et al., 2012). In contrast, conformity motives for alcohol use have demonstrated negative relationships with frequency of use and quantity consumed (Hauck-Filho et al., 2012; Kuntsche et al., 2006). In sum, internally generated motives for use are typically associated with more negative consequences than externally generated motives for use (Kuntsche et al., 2006). Furthermore, drinking motives under negative reinforcement principles are more strongly related to problematic alcohol use than positive reinforcement principles (Bonar et al., 2017; Buckner et al., 2015). Ultimately, the four-factor motivational theory developed by Cooper, and the derived DMQ instrument used to measure it, has served as a foundational model for research focusing on motives underlying use of other types of substances, including cannabis use.

Cannabis Use Motives

Similar to alcohol, motivations for cannabis use are an important individual difference factor that contribute to susceptibility to negative use consequences (Bonar et al., 2017). When comparing unique variance contributed by alcohol and cannabis use motives on substance use-related problems, Simons and colleagues (1998) found that cannabis motives accounted for a greater degree of variance in use-related problems than alcohol motives (59% compared to 46% of variance accounted for, respectively). This finding suggests that cannabis motives may better predict cannabis use-related problems than alcohol motives predict negative alcohol-related consequences (Simons et al., 1998). Cannabis use motives have demonstrated relationships with quantities of cannabis consumed, recency of cannabis use, severity of experienced cannabis-attributable consequences, and poor psychosocial outcomes (Benschop et al., 2015; Bonar et al., 2017; Bonn-Miller & Zvolensky, 2009; Fox, Towe, Stephens, Walker, & Roffman, 2011; Schlossarek et al., 2016).

Notably, individuals are not always guided by a single motive for use, but may be guided by multiple motives simultaneously (Buckner et al., 2015). Motivations are also vulnerable to change over time and through the course of treatment (Blevins et al., 2016a; Fox et al., 2011). The use of therapies targeted at motivations and the modification of behavioural motivations, such as Motivational Enhancement Therapy (MET) and Cognitive Behavioural Therapy (CBT), are associated with reductions in consumption rates and cannabis-related problems and improved post-treatment outcomes (Blevins et al., 2016a; Bonar et al., 2017). In particular, reductions in coping motivations is a robust predictor of decreased cannabis-related problems, even at relatively low levels of initial

endorsement (Blevins et al., 2016a). Collectively, this research highlights the necessity of assessing cannabis use motivations and to understand their relationship with patterns of use.

Cannabis Motives Measures Derived from Alcohol Research

The assessment of cannabis use motives has largely relied on Cooper's (1994) motivational model of alcohol use, using scales adapted from the DMQ (Blevins et al., 2016a; Bohnert et al., 2018; Bonar et al., 2017). The Marijuana Motives Measure (MMM), developed by Simons and colleagues (1998), is one such scale. The MMM follows Cooper's (1994) original four factor motivational model (i.e., Coping, Conformity, Enhancement, Social) with the addition of an Expansion motive (i.e., altered perceptions) to capture use for the unique psychotropic effects of cannabis produced by THC (Blevins et al., 2016a; Simons et al., 1998). Research based on these five primary motivations has uncovered several relationships with patterns of cannabis use and misuse.

First, enhancement motives, in addition to coping motives, have some of the strongest associations with problematic behaviours in alcohol research (Comeau et al., 2001; Conrod, Castellanos-Ryan, & Mackie, 2011). Similarly, enhancement motives for cannabis use are associated with increased quantity, frequency, and recency of cannabis use (Bonar et al., 2017; Bravo, Anthenien, Prince, Pearson, & The Marijuana Outcomes Study Team, 2017; Zvolensky et al., 2007) in samples of young adults from both university and general populations. Endorsement of enhancement motives has produced positive associations with recency of use (Zvolensky et al., 2007), specifically with past 30-day use (Bonn-Miller et al., 2007), and greater frequency of cannabis use (Bonn-Miller & Zvolensky 2009; Chabrol, Duconge, Casas, Roura, & Carey, 2005).

Endorsement of enhancement motives is negatively associated with anxious arousal and depressive symptoms (Bonar et al., 2017). Enhancement motives are also predictive of cannabis use consequences and dependence symptoms, although to a lesser degree than coping motives (Fox et al., 2011). In addition, Bonn-Miller and Zvolensky (2009) found greater endorsement of enhancement motives for individuals with CUD. Together, research suggests that enhancement motives represent a significant contributing factor to cannabis use and the potential development of disordered cannabis use.

Second, increased endorsement of social motives is associated with recency of cannabis use and greater frequency of use (Bohnert et al., 2018; Bonar et al., 2017; Buckner & Zvolensky, 2014; Fox et al., 2011), specifically past-month frequency of use and larger quantities of use (Bonar et al., 2017; Bravo et al., 2017; Zvolensky et al., 2007). Younger individuals appear especially prone to reporting social cannabis use motives, with 77% of adolescents reporting enhancement or socially centred motives for use (Benschop et al., 2015; Bonar et al., 2017; Bonn-Miller, Boden, Bucossi, & Babson, 2014; Bonn-Miller & Zvolensky, 2009; Buckner et al., 2015). Thus, social motives appear to be particularly important among adolescent cannabis users.

Similar to alcohol research (Comeau et al., 2001; Conrod et al., 2011), coping motives are among the most strongly associated with cannabis use problems (Blevins & Stephens, 2016; Buckner & Zvolensky, 2014; Chowdhury et al., 2016; Johnson, Mullin, Marshall, Bonn-Miller, & Zvolensky, 2010). Coping motivated cannabis use is associated with a greater risk of increased frequency of use, increased use-related impairment, and development of disordered behaviours (Buckner & Zvolensky, 2014; Dean et al., 2017; Haug et al., 2017). Greater endorsement of coping motives is associated with decreased

positive affect, increased negative affect, experience of depressive symptoms, and increased anxiety sensitivity (Bonar et al., 2017; Zvolensky et al., 2007). Bohnert and colleagues (2018) found that individuals endorsing greater levels of coping motivations had poorer mental health functioning than individuals endorsing other motivations for cannabis use. Individuals using cannabis to cope may have decreased distress tolerance and turn to cannabis use as a mechanism to alleviate these negative sensations, given that the relationship between distress tolerance and cannabis use is, at least in part, mediated by coping motivations for use (Bujarski, Norberg, & Copeland, 2012). In addition, coping motivations are predictive of treatment outcomes. Research demonstrates that coping motives can account for the presence of disordered use, and additional problems following treatment interventions, and correspondingly, that reductions in coping motivations over the course of treatment sessions contribute significantly to improvements in 12-month post-treatment outcomes (Blevins et al., 2016c; Fox et al., 2011). Hence, coping motives are a pertinent influence in the development and maintenance of CUDs.

When assessed in relation to cannabis, conformity motives have been found to be positively correlated with negative affect, but negatively related to cannabis consumption (Bonar et al., 2017; Zvolensky et al., 2007), frequency of use, and use-related impairment (Buckner et al., 2014). The directionality of the conformity motives on cannabis consumption may be explained by the fact that social acceptance minimizes the likelihood that individuals with conformity motivations will seek out cannabis independently. Although conformity motivations are statistically significant in adolescent samples, the same pattern does not emerge in adult samples. This finding suggests that

peer pressure and subsequent conformity motives are significantly more influential in the initiation of cannabis use in youth, as opposed to contributing to continued use behaviours (Benschop et al., 2015; Blevins et al., 2016; Blevins et al., 2016b; Simons et al., 1998; Vervaeke, Van Deursen, & Korf, 2008).

Finally, expansion motives, centred upon gaining an altered perceptual experience as a result of the psychotropic effects of cannabis, encapsulate some of the unique properties of cannabis in contrast to alcohol (Lee et al., 2007). Expansion motives have been significantly associated with more frequent cannabis use, past-month cannabis use, and more cannabis-related consequences (Bravo et al., 2017; Simons et al., 1998). Bohnert and colleagues (2018) further supported the relationship between higher rates of cannabis use and expansion or perceptual modification motives.

Given that cannabis and alcohol are different substances with distinct neurophysiological effects (i.e., distinct symptom profiles and associated sensations), it follows that motives for alcohol and cannabis use may be unique (Lee et al., 2007). Despite being derived from the alcohol literature, the five factor structure of the MMM has demonstrated predictive validity in numerous studies of cannabis use (Bonn-Miller & Zvolensky, 2009; Bonn-Miller et al., 2007; Bonn-Miller, Zvolensky, Bernstein, & Stickle, 2008; Buckner, Bonn-Miller, Zvolensky, & Schmidt, 2007; Bujarski et al., 2012; Chabrol et al., 2005; Fox et al., 2011; Johnson et al., 2010; Mitchell, Zvolensky, Marshall, Bonn-Miller, & Vujanovic, 2007; Simons, Correia, & Carey, 2000). The vast majority of studies using the MMM to assess cannabis use motives have sampled homogenous populations (i.e., predominantly Caucasian university-based populations). In more heterogeneous samples (i.e., varying ages, races, and gender), conformity motives

do not emerge as a significant motive for predicting patterns of cannabis use or misuse. The change in the significance of conformity motives in more heterogeneous samples provides additional evidence for conformity motives as an age-related factor stemming from the younger samples used in many of these other studies. In contrast, an additional factor identifying routine motives (i.e., habit, boredom) for cannabis use was found to be a significant factor in non-high school/university samples (Benschop et al., 2015; Lin, Ilgen, Jannausch, & Bohnert, 2016). Given the discrepancy in the literature surrounding the factor structure of the MMM across populations, and its adaptation from alcohol motive research, the five-factor structure of the MMM may not be an adequate model to capture all of the significant motives underlying cannabis misuse. It is unclear whether the MMM fully captures the large number of reasons individuals report using cannabis (Bohnert et al., 2018). Therefore, in addition to examining the traditional motives for use captured by the MMM, it is important to examine whether other latent motives for cannabis use exist and how they may be associated with problematic use.

Comprehensive Assessment of Cannabis Motives

More recent research suggests that in addition to those motives captured by the MMM (Simons et al., 1998), motives specific to cannabis use exist (Lee et al., 2007; Lee, Neighbors, Hendershot, & Grossbard, 2009). In contrast to the motive assessment tools derived from alcohol research, Lee and colleagues (2007, 2009) proposed a bottom up approach to identifying the motives associated with cannabis use. Lee and colleagues (2007) asked first year university students about motivations for cannabis use through open-ended questions (i.e., “think about what motivates you to use cannabis and briefly list the top 5 reasons in rank order”). From their study, they identified 19 initial motives

associated with cannabis use: Enjoyment (i.e., using cannabis to increase positive affect and experience); Conformity (i.e., using cannabis to reduce negative external pressure); Coping (i.e., using cannabis to alleviate negative experiences or sensations); Celebration (i.e., using cannabis to celebrate an accomplishment or holiday, usually with friends); Altered Perception (i.e., using cannabis to explore different ways to thinking); Experimentation (i.e., using cannabis to try new things); Boredom (i.e., using cannabis to alleviate boredom); Alcohol Use (i.e., using cannabis when using alcohol); Social Anxiety (i.e., using cannabis to alleviate anxiety in social situations); Relative Low Risk (i.e., cannabis is used because it is perceived as less risky than alcohol); Sleep/Rest (i.e., using cannabis as a sleep aid); Availability (i.e., using cannabis because it is easy to access); Habit (i.e., using cannabis out of developed habit); Medical use (i.e., using cannabis to alleviate or manage symptoms of a medical condition); Food Enhancement (i.e., using cannabis to enhance the taste of food); Image Enhancement (i.e., using cannabis to increase others' perceptions of oneself and one's image); and Activity Enhancement (i.e., using cannabis during activities to enhance experiences).

Despite the qualitative diversity of motives, not all of Lee et al.'s (2007) motives produced significant factor loadings in their study's university sample; thus, the motives were further refined, resulting in 12 motives which were compiled to establish the Comprehensive Marijuana Motives Questionnaire (CMMQ; Blevins et al., 2016a; Lee et al., 2007, 2009). The 12 proposed motives of the CMMQ included: Enjoyment; Conformity; Coping; Celebration; Altered Perception; Experimentation; Boredom; Alcohol Use; Social Anxiety; Relative Low Risk; Sleep/Rest; and Availability. Notably, the motives of habit, medical use, food enhancement, image enhancement, and activity

enhancement were removed from the list. The first 5 of the 12 listed motives are most similar to the MMM scale proposed by Simons et al. (1998). Apart from the 5 MMM motives, some of the most commonly endorsed motives for cannabis use were experimentation, boredom, celebration, relative low risk, and relaxation/sleep, which are less well studied motives for substance use (Lee et al., 2007).

Experimentation motives are consistently associated with less cannabis use and fewer reported cannabis use problems (Lee et al., 2007; Phillips et al., 2017). Experimentation motives, similar to conformity motives, appear to have a more significant influence on adolescent and young adult populations with diminishing effect with age (Lee et al., 2007; 2009). Use associated with viewing cannabis as low risk was positively associated with greater cannabis use and cannabis use problems (Phillips et al., 2017). This motive may be, in part, a reflection of the increasing normalization of cannabis in society (Osborne & Fogel, 2016). There are few studies examining the motive of boredom and its relation to cannabis use consequences; however, boredom centred motives appear to be a unique predictor of cannabis use problems (Blevins et al., 2016). Phillips and colleagues (2017) identified a positive association between boredom motives and greater scores on measures of cannabis-associated problems (Phillips et al., 2017); however, Lee and colleagues (2009) reported associations between boredom motives and frequency of use, but not consequences associated with use (Lee et al., 2009). Additional research is necessary to fully elucidate the relationship between boredom motives and cannabis misuse behaviours.

There are emerging studies emphasizing motivations for using cannabis as a sleep aid. Individuals may use cannabis to promote sleep because of the sedative effects some

strains can produce (Metrik et al., 2016), namely the *C. Indica* species. However, cannabis, especially at high concentrations of THC, can disturb sleep waves and decrease REM sleep (Metrik et al., 2016). Unsurprisingly, sleep motives are positively related to the number of days of cannabis use (Blevins et al., 2016). Indeed, sleep has one of the strongest associations with frequency of use among all motives (Blevins et al., 2016; Metrik et al., 2016), given that sleep motivated users may use cannabis for chronic sleep disturbances, which increases frequency of use. Endorsing sleep motives for cannabis use is associated with poorer mental and physical health functioning (Bohnert et al., 2018). Sleep motivations appear to be particularly salient in medical use populations, whether using for mental or physical health purposes (Bohnert et al., 2018; Lin et al., 2016; Metrik et al., 2016). Recreational and medical cannabis users may share some commonalities in their motivations, but motives for use amongst medical users and recreational users are not synonymous (Bonn-Miller et al., 2014; Metrik et al., 2016). Indeed, medical cannabis users endorse sleep and coping with medical symptoms to a much greater extent than recreational users (Bohnert et al., 2018). Sleep motives were correlated with increased frequency of cannabis use in individuals suffering from medical and psychiatric conditions (i.e., cancer, PTSD, or major depression), a pattern not reproduced in recreational users (Bohnert et al., 2018; Metrik et al., 2016). Although recreational and medical cannabis users demonstrate similar prevalence rates for CUD (Bonn-Miller et al., 2014; Lin et al., 2016), medical users appear to fare better in substance misuse treatment programs, partly as a result of motivational differences (Haug et al., 2017). This finding suggests that there is a need to screen individuals for motives

underlying their cannabis usage, regardless of whether they are recreational or medical users.

The CMMQ has demonstrated validity in recreational cannabis users but appears to require further expansion to incorporate motives for medical cannabis use (Blevins et al., 2016; Blevins et al., 2016b; Bohnert et al., 2018). Although medical motivations for cannabis use were present in the initial 19 motivations identified by Lee and colleagues (2007), further refinement of the instrument lead to the removal of medical use from the final list of 12 CMMQ motivations. Importantly, the CMMQ was developed using a university sample, with limited demographic variability. Consequently, only 1.3% of the sample endorsed medical use motives (Lee et al., 2007). Given the significant changes made to medical cannabis legislation in Canada and the shifting perception of cannabis as a viable medical treatment option (Goldenberg, Reid, IsHak, & Danovitch, 2017), assessment of medical motivations for use in a more diverse sample is critical.

Generally, further research is needed on cannabis use motives to clarify the number of core motives underlying cannabis usage and their relationship with the development of misuse behaviours. Currently, there is uncertainty in the literature surrounding the core number of underlying cannabis use motives. Specifically, there is a need to identify the core motivations behind cannabis use that most significantly contribute to problematic use. Although there is research in support of some shared motivations between cannabis and alcohol use, these substances are distinctly different, with unique physiological and psychological effects (Blevins et al., 2016; Bohnert et al., 2018; Lee et al., 2007; Metrik et al., 2016) suggesting some differences in underlying motives. Although the tools for assessing motives that are adapted from alcohol research

have demonstrated some utility in predicting problematic use, they do not appear to fully encapsulate all motivations underlying cannabis use. Using a bottom-up approach (similar to that used for the CMMQ) and using a broader population of cannabis users, will provide a more comprehensive assessment of cannabis use motives. Notably, problems with the generalizability of the samples (i.e., limited age range, university population, no medical users) has been a noted limitation of previous cannabis motives research (Bohnert et al., 2018).

The Current Study

Given the discrepancies in the literature on the motivations underlying cannabis use, the present study aimed to develop a comprehensive model of the motives for using cannabis in a diverse sample of cannabis users to address weaknesses in the existing cannabis motives assessment measures (e.g., MMM and CMMQ; Bohnert et al., 2018; Lee et al., 2007). Hence, the first goal of the current study was to identify the core number of cannabis use motivations that underlie cannabis use, which was done using Exploratory Factory Analysis (EFA). Specifically, the current study used a similar bottom up approach to that of Lee et al. (2007, 2009), who developed the CMMQ, to assess endorsement of use motives from a cannabis using population. Cannabis use motivations were derived from motives identified in the current literature, including those, but not limited to, the MMM and CMMQ (for full description of the identification, derivation, and inclusion of motives in the final list of motives items, see the development of cannabis motives procedure section). Given that this analysis is exploratory, no formal hypotheses were formulated prior to performing statistical analyses, other than to state that additional core motives for cannabis use were expected

to emerge beyond those already comprised in the MMM and CMMQ (2009), such as medical use motivations.

The second goal of the current study was to assess the convergent validity of the resulting motive factor structure with previously developed instruments. To assess the validity of the resulting motives model, relationships between the emerging motivational model of cannabis use and the SURPS personality model were explored. Specifically, it was hypothesized that a) H and AS would be associated with coping motivations, including motives for medical cannabis use and conformity motives; b) SS would be correlated with expansion and enhancement motives; and c) IMP would be associated with a large number of motives, including positive and negative reinforcement motives.

The final goal of the current study was to assess the associations of the resulting motives model with cannabis use patterns, including frequency of use and problematic cannabis use. It was hypothesized that cannabis use motives would be associated with cannabis use patterns over and above the variance accounted for by personality dimensions identified in the SURPS typology. Specifically, negative reinforcement motivations (i.e., use to cope, medicinal use) are expected to be most strongly associated with a greater frequency of cannabis use and cannabis use problems.

Method

Participants

Data collected for the present study were drawn from a broader research survey investigating patterns of cannabis use in Canada and perspectives on legalization for both cannabis users and non-users. Data collection occurred over a four-month time-period from January 2018 to April 2018; the survey was accessible online via Qualtrics™, a

web-based survey administration platform. During the four-month recruitment period, a total of 909 individuals participated in the survey. Participants included Canadians over 18 years of age, originating from 10 provinces, as well as students specifically recruited from the University of New Brunswick, Saint John. Both cannabis users and non-users were included in the larger survey; however, for the purposes of the present study, only current and past year users from the general population (n=262) and from the university student community (n=103) were retained in the sample, resulting in a total of N=365 participants. The sample consisted of 261 female and 102 male participants (n=1 other, n=1 missing; 71.5% female) and an average age of M_{age} = 31.76 years (SD = 13.31, range = 18 to 77). Participants of the study primarily identified as Caucasian (89.2%, n = 321) and mostly originated from the provinces of New Brunswick and Ontario (68%, n = 234 and 19.5%, n = 67, respectively). Further demographic information is provided in Table 1.

Materials

Demographics Questionnaire (author-developed, see Appendix B). All participants completed an author-developed questionnaire focusing on demographic characteristics. Participants reported their age, gender, ethnicity, marital status, highest attained level of education, province of residence, occupation, employment status, and income brackets.

Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009; see Appendix C). The SURPS is a self-report questionnaire measuring the four personality dimensions associated with substance use: (1) H (e.g., “I have faith that my future holds great promise”, reverse coded), (2) AS (e.g., “I get scared when I experience unusual bodily

sensations"), (3) SS ("I am interested in experience for its own sake, even if it's illegal"), (4) IMP ("I usually act without stopping to think"). The SURPS assesses these four personality dimensions with 23-items measured on a 4-point Likert scale, ranging from 1 (*Strongly Disagree)* to 4 (*Strongly Agree*). Higher scores reflect greater endorsement of the personality dimension being assessed.

Good internal consistency has been demonstrated for all four of the SURPS subscales (Woicik et al., 2009): H (α = .80 - .90), AS (α = .70 - .80), SS (α = .70 - .80), and IMP (α = .70). Research assessing the SURPS has demonstrated its predictive validity, with AUC values ranging from .59 to .74 for predicting substance misuse rates (Castellanos-Ryan et al., 2013). Furthermore, the SURPS has demonstrated good specificity in the identification of those not experiencing substance misuse, with accurate identification rates ranging from 72% to 91%. Importantly, the SURPS subscales are all independently correlated with similar clinical and personality constructs on other measures, showing good convergent validity for each subscale. For example, the H subscale positively correlates with the Beck Hopelessness Scale (r = .73) and the SS subscale positively correlates with Zuckerman's Sensation Seeking Scale (r = .72). The SURPS has been used in a variety of populations, including adolescent, adult, and forensic populations (Hopley & Brunelle. 2012; Krank et al., 2011; Woicik et al., 2009). In the present study, reliability scores for each subscale were adequate (H Cronbach's α = .88, AS Cronbach's α = .72, SS Cronbach's α = .71, IMP Cronbach's α = .73).

Addiction Severity Index-Adapted (ASI; McLellan et al., 1992; see Appendix D). The ASI is one of the most widely used tools for measuring the severity of substance misuse behaviours (McLellan, Luborsky, O'Brien, & Woody, 1980). The original ASI is

a semi-structured interview that assesses the severity of alcohol and substance use across 6 domains (i.e., employment patterns, medical issues, legal problems, family/social problems, psychiatric problems, alcohol and drug use patterns). The ASI has been adapted from an interview into a 47 item self-report questionnaire that assesses current (i.e., past 30 days) and lifetime substance use in each of the 6 domains (Rosen, Henson, Finney & Moos, 2000). Considerable research has been conducted on the properties of the interview and self-report ASI instrument across diverse populations, including those suffering with mental illness, homeless individuals, pregnant women suffering from addiction, and incarcerated individuals (Alterman, Zaballero, & McKay, 1994; Hodgins & Guebaly, 1992; Joyner, Wright, & Devine, 1996; Leonhard, Mulvey, Gastfriend, & Shwartz, 2000). The ASI instrument has produced good to excellent reliability (Cronbach α = .69 - .89; Leonhard et al., 2000; Weisner, McLellan, & Hunkeler, 2000), even when administered online (Butler et al., 2001). Additionally, the ASI demonstrates good discriminant and convergent validity properties; constructs of the ASI demonstrate low correlations with unrelated instruments, such as between the ASI legal and medical subscales (r = -.04) and higher correlations with similar constructs such as between the ASI psychological subscale and the Beck Depression Inventory (r > .66; Zanis, McLellan, Cnaan, & Randall, 1994). The ASI also has demonstrated good construct validity with similar substance abuse screening scales, producing strong significant correlations with the Drug Abuse Screening Test (DAST; r =.73) and the Clinical Use, Abuse, and Dependence Scale for both alcohol (r =.72) and drugs (r =.70; Appleby, Dyson, Altman, & Luchins, 1997). Based on its properties, the ASI is a standard instrument for the assessment of substance misusing populations (Leonhard et al., 2000).

In the current study, the ASI was adapted to focus solely on patterns of cannabis use and misuse. Specifically, in the current study, the ASI questionnaire included 11 items, using a combination of open-ended and Likert-scale questions, including items to assess the frequency of cannabis use, the experience of cannabis use problems, and polysubstance use within the past 30-day period. Open-ended questions were used to assess frequency of use (e.g., "How many days did you use cannabis in the past 30 days?" and "How many days did you use cannabis to intoxication in the past 30 days?") and number of days experiencing cannabis use problems (e.g., "In the past 30 days, how many days have you experienced problems due to cannabis?"). Next, a 5-point Likert scale ranging from 1 (*Not at all*) to 5 (*Extremely*) was used to assess level of distress experienced from cannabis problems (e.g., "How troubled or bothered have you been by these cannabis problems in the past 30 days?") and the respondents' view of the importance of treatment for cannabis problems (e.g., "How important to you now is treatment for these cannabis problems?"). To assess the frequency of polysubstance use behaviour, 10 different substances were presented (i.e., Tobacco, Heroin, Methadone, Other Opiates and Narcotics, Barbiturates, Sedatives/Hypnotics/Tranquilizers, Cocaine, Amphetamines, Alcohol, and Hallucinogens), each with an 8-point scale ranging from 1 (*Never Use*) to 8 (*Once a day*).

Cannabis Problems Questionnaire (CPQ; Copeland, Gilmour, Gates, & Swift, 2005; see Appendix E). Cannabis problems were assessed using the CPQ. The CPQ uses 21 items to assess the presence and number of cannabis-associated problems, whether physical, behavioural, or social, over the course of a three-month period (e.g., "In the last three months, have you usually used cannabis in the morning to get yourself going?", "In

the last three months, have you been physically sick after using cannabis?"). All items use a binary response coding in which 1 = "Yes" and 0 = "No" to indicate the presence or absence of cannabis use problems, respectively. A total score for cannabis use problems is generated, with a range from 0 to 21 and higher scores representing experiencing a greater number of and more pervasive cannabis use problems. The CPQ has been effective in classifying individuals with CUD, with 84% specificity, daily cannabis use with 83% specificity, and has excellent one-week test-retest reliability (r = .92 – 1.00; Copeland et al., 2005; European Monitoring Centre for Drugs and Drug Addiction, 2008). Furthermore, the CPQ has demonstrated reliability across diverse populations. The CPQ has demonstrated satisfactory reliability in adult populations (Cronbach α = .78; Copeland et al., 2005), adolescent populations (Cronbach's α = .88; Martin, Copeland, Gilmour, Gates, & Swift, 2006) and when adapted for other languages (Cronbach's α = .86; Fernandez-Artamendi et al., 2012). The CPQ also produced good test-retest reliability in adult (r = .92 – 1.00; Copeland et al., 2005) and adolescent (r = .91) populations (Martin et al., 2006). The internal reliability of the CPQ for the current study was excellent (α = .93 for the CPQ total score).

Procedure

Development of the Cannabis Motives Items

To develop the cannabis motives model, items were generated (see Appendix F) to assess motivations for cannabis use. To capture cannabis use motives comprehensively, numerous sources of information were accessed. First, a literature review was performed using research databases, such as 'Medline' and 'PsycInfo', including key words such as "cannabis", 'marijuana", "motives", and "reasons for use".

Through the literature review, motivations identified in the literature or included in previously developed instruments, including but not limited to the MMM and CMMQ, were captured. In addition to the literature review, other sources (e.g., cannabis use blogs, social media groups for cannabis users) were consulted to identify additional motives in a similar bottom-up approach to that used by Lee et al. (2007; 2009).

A total of 54 items were generated through this item development process. All items were reviewed for content and quality in consultation with a substance use researcher. To develop a parsimonious model, items with redundant content were merged with similarly worded items or removed. After review of the items, a total of 40 items were retained to assess cannabis motives.

The final 40 items were measured on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*), with increased scores representing greater endorsement of the respective motive the items conceptualized to represent. The conceptually organized motives include: Enhancement (e.g., "I use cannabis to heighten emotions"), Social, (e.g., I use cannabis to make me more fun socially"), Conformity (e.g., "I use cannabis only because my friends do"), Coping (e.g., "I use cannabis to numb feelings"), Expansion (e.g., "I use cannabis for the alternative thought processes I experience"), Sleep (e.g., "I use cannabis to help me get to sleep"), Medical (e.g., "I use cannabis to help with pain symptoms", "I use cannabis for seizure control"), Boredom (e.g., "I use cannabis when bored"), Enjoyment (e.g., "I use cannabis to get more joy out of things"), Celebration/Reward ("I use cannabis to celebrate things", "I use cannabis as a reward for completing tasks"), Altered Perception ("I use cannabis to explore deeper conceptual ideas"), Experimentation (e.g., "I use cannabis to try to understand why others

use it"), Social Anxiety (e.g., "I use cannabis to make me less nervous socially"), Relative Low Risk (e.g., "I use cannabis because I feel it is a safer method of intoxication"), Activity Enhancement (e.g., "I use cannabis to make activities more fun"), Image Enhancement (e.g., "I use cannabis to make me more popular socially), Spiritual (e.g., "I use cannabis as part of a spiritual or religious practice", "I use cannabis to feel closer to nature"), Relaxation (e.g., "I use cannabis to help me relax"), Personal Improvement ("I use cannabis to improve my motivation", "I use cannabis to improve my creativity"), Physical or Sexual Enhancement (e.g., "I use cannabis to heighten physical sensations", "I use cannabis to heighten sexual sensations"), Preference over other substances (e.g., "I use cannabis because I feel I have better control over myself than if I use other methods of intoxication such as alcohol"), and Secondary Substance (e.g., I use cannabis as a detoxing method to help me reduce my use of other substances", "I use cannabis to help with the symptoms of another drug"). Use of these items to evaluate the proposed model of cannabis use motives and the internal reliability of the resulting factor structure is discussed in the statistical analysis section. The motive items were assessed on a 5-point Likert scale format and administered online to participants with the other measures.

Data Collection

The data for the present thesis was collected as part of a larger study. Participants included Canadians from the general population, as well as from the student population at the University of New Brunswick, Saint John campus. Different methods of recruitment and compensation were used for these respective populations. For the general population (*n*=262), participants were recruited through social networking sites (i.e., Facebook,

Reddit, etc.), community advertisements (i.e., posters), and word of mouth (i.e., snowballing). Advertisements for the study included information about the study's purpose (i.e., to learn more about cannabis use patterns, motives for use, and perspectives on cannabis legalization), types of questions queried, and form of compensation. Those interested in participating were presented a link in the advertisement that directed them to the Qualtrics™ survey platform to anonymously participate in the study. In total, the study took approximately 30 minutes to complete. As compensation for participating, general population participants were given the opportunity to enter a draw to win one of two $25.00 Amazon gift cards.

For the University of New Brunswick student population (*n*=103), participants were recruited through course announcements, campus bulletin boards, and the student research recruitment system (SONA). Students signed into the SONA system through their university personal access accounts to register for the study. Once registered, students were given a link that redirected them to the Qualtrics™ survey platform to anonymously participate in the study. As compensation for participating, students were awarded one bonus point towards their course credit. Students participating in the study who did not wish to receive course credit (e.g., graduate students) were offered the opportunity to enter the draw for one of two $25.00 Amazon gift cards.

Regardless of sample source, once participants were redirected to Qualtrics™, all participants were presented with a consent form (see Appendix G), clearly outlining the content and purpose of the study, the age restriction requiring participants be over the age of 18, the participant's rights to withdraw from the study at any time without penalty, and contact information for the study's investigators should participants have questions or

concerns. Participants were asked to click a box presented at the end of the consent form to clearly indicate consent to participate. Participation in the study was voluntary and consent was attained from all participants prior to the presentation of study materials. After consenting, participants were presented with the demographics questionnaire, followed by all other instruments presented in a counterbalanced order. Text entry format was used for questions on the demographics ("Age in years?") and ASI-Adapted measure (e.g., "How many days did you use cannabis in the past 30 days?") as a precautionary feature to ensure that responses were not generated from computerized sources. All measures and information for the present study were presented in English. Ethical approval for the broader study was granted by the Research Ethics Board of the University of New Brunswick, Saint John (see Appendix H).

Results

Several statistical analyses were conducted to test the aforementioned hypotheses. All data analyses were conducted using SPSS 25 and tested at the $p < .05$ level, unless otherwise specified. Prior to statistical analyses, the dataset was cleaned and conditioned using the recommendations of Tabachnick and Fidell (2019) to ensure necessary procedure-specific statistical assumptions (e.g., multivariate normality) were met.

Data Cleaning and Conditioning

As previously mentioned, data was drawn from a broader study assessing cannabis use patterns in Canada prior to legalization and perspectives on legalization (N=795), incorporating both cannabis users and nonusers. For the purposes of the present study, only current and past year cannabis users were retained in the sample, a restriction that resulted in a total of N=398 participants. Further assessment of the data resulted in

removal of several participants from the dataset. Specifically, participants that were missing 70% of data or greater (*n*=22), with unrealistic completion times (i.e., less than 5 minutes; *n*=8), or responding with nonsensical answers (e.g., *n*=1 participant produced responses of 'Human' for Ethnicity and '100 days' of use out of past 30 days illustrating a nonsensical response pattern), were removed from the dataset (*N*=367). For considerations of power in EFA, Tabachnick and Fidell (2019) suggest a minimum sample size of 300 participants or 5 participants per variable included in the study. The inclusion of 5 participants per variable in the current study produces a minimum suggested sample size of *N*=270 participants. The sample size of the current study surpasses both power recommendations (i.e., *N*=300 and a minimum of 5 participants per variable), suggesting adequate power to conduct factor analysis.

Following the removal of missing and uninterpretable data, adjustments were made to any interpretable but incorrect participant entries, resulting in alterations to entries for participant ages (*n*=2) and ethnicities (*n*=23). Specifically, year of birth (e.g., 1962) was altered to reflect the equivalent value of age in years (e.g., 1962 adjusted to reflect 57) and participant ethnicity entries of 'Other – White' or 'Other – Caucasian' (*n*=23) were adjusted to reflect the provided option for Caucasian.

All variables were then assessed for univariate outliers, missing data, skewness, kurtosis, and normality. To test for univariate outliers, z-scores were assessed for all variables. Variables that produced outliers with scores exceeding 3 standard deviations from the mean, included: age, six of the cannabis motives items, the CPQ total score, and the H, AS, and IMP subscales scores of the SURPS.

Of the demographics variables, the variable age produced two values outside of the designated +/- 3 SD range. Given that the values for age do not reflect discontinuous values, no adjustments were made. The cannabis motives items with z-score ranges indicating outliers included: 'I use cannabis to make me more popular socially' (two outliers), 'I use cannabis as part of a religious or spiritual practice' (two outliers), 'I use cannabis to help with the symptoms of another drug' (four outliers), 'I use cannabis for seizure control' (five outliers), 'I use cannabis to help me reduce my use of other substances' (13 outliers), and 'I use cannabis to try and determine why others use cannabis' (three outliers). The specific cannabis motives items that produced outlying z-score values are items that are expected to be endorsed strongly by small subsets of the sample (e.g., "I use cannabis for seizure control" or "I use cannabis to help me reduce my use of other substances"). This response pattern may produce an expected pattern of outliers (i.e., 10 participants indicated 'strongly agree' and more than 340 others in the sample indicated 'disagree' or 'strongly disagree'), that, in reality, may reflect a low incidence rate for certain diseases or symptoms (i.e., seizures) in a given population. As a result, adjustments to scores on these items would be a deviation from the data and may have a statistical impact on accurately identifying all motivational factors underlying cannabis use. Moreover, given that z-scores are estimates of variation from the mean, they may not be as accurate for ordinal variables (i.e., the cannabis motives items are in Likert format; Tabachnick & Fidell, 2019). Hence, to prevent adjustments resulting in an inaccurate reflection of the data, winsorizing of z-scores was not performed. Three of the SURPS subscales and the CPQ total score also produced out of range z-score values: H (three outliers), AS (two outliers), IMP (two outliers), and CPQ total score (eight

outliers). These variables were adjusted using winsorizing (i.e., scores were adjusted to represent the next highest value that is not an outlier).

Multivariate outliers were assessed using Mahalanobis distances for the variables used in the regressions, namely, the variables of age, age of first use, the four SURPS subscales, the CPQ total, and number of days using cannabis in past 30 days. The generated Mahalanobis distances produced two scores that were discontinuous. With only a few multivariate outliers (i.e., less than 5), Tabachnick and Fidell (2019) suggest the outliers are removed individually and the Mahalanobis distances are re-evaluated after the removal of each outlier. After removal of the most extreme outlier, one discontinuous score remained, thus the outlying value was once again removed and no further multivariate outliers were found. The final sample following data cleaning and conditioning resulted in the retention of N=365 participants.

All variables in the current study were assessed for missing data prior to statistical analyses. Of all variables included in the study, three were missing greater than 5% of data. The item 'I use cannabis as part of a religious or spiritual practice' from the cannabis motives items was missing 57.5% of data, a significant discrepancy from the other motives items, which were missing under 5% of the data. For those who provided a response for the item, 69% indicated 'Strongly Disagree'. Given that item is missing such a substantial portion of responses with a lack of missing responses from neighbouring items, it appears participants elected to intentionally provide no response for the item. There are several reasons for which someone may not have provided a response to the item (e.g., participants may not be religious and felt the item was not applicable,

participants wanted to keep their religiosity private, etc.). Due to the substantial lack of provided data for the item, it was removed from the analysis.

Values of skew and kurtosis were assessed for all variables included in the analyses. Skew for each variable was assessed based on deviations from 0.00, where a score of +/-1.00 represents a highly skewed distribution (Tabachnick & Fidell, 2019). The values revealed mild to significant skew for several variables, including age and several of the motives items. Some skewness deviations were due to their lower prevalence of endorsement (e.g., I use cannabis for seizure control). Other skewness, however, may be attributable to an increased sample size, which decreases the impact and accuracy of skew metrics (Tabachnick & Fidell, 2019). Similarly, the assessment of kurtosis identified abnormal values for all cannabis motive items, with the exception of three items. Given that motives with a lower prevalence of endorsement will cause abnormal values for skewness or kurtosis while not necessarily reflecting inaccurate data, and that the EFA extraction method used is robust to violations of normality (Costello & Osborne, 2005), no adjustments were made to address these issues. Similarly, Probability Plots (P-P) were used to identify normality of the variables. Visual inspection of the P-P plots also suggested a lack of normality for some motives variables. Tabachnick and Fidell (2019) suggest that large sample sizes (i.e., greater than 200) help to ensure that violations of skew and kurtosis do not result in an underestimation of variance.

When using EFA techniques, meeting assumptions of univariate normality is ideal but not a statistical necessity. In contrast to univariate normality, however, most methods of EFA do necessitate that the statistical assumption of multivariate normality is met (Tabachnick & Fidell, 2019). In accordance with this requirement, the Mardia's test for

multinormality (Yap & Sim, 2011; Zygmont & Smith, 2014) was used to assess the presence of multivariate normality in the dataset. Results of the Mardia's test indicated non-normality in the cannabis motives items ($\chi^2 = 1811.80,\ p < .001$). Given that there are violations of assumptions of normality at both the univariate and multivariate levels, the present study used principal axis factor analysis, as opposed to the proposed maximum likelihood factor analysis, as it is robust in the face of significant violations to normality (Costello & Osborne, 2005; Treiblmaier & Filzmoser, 2010). For this reason, no transformations were performed on the data to adjust for normality prior to analysis.

Personality Descriptive Statistics

All participants were assessed for personality risk factors for substance misuse using the four subscales of the SURPS instrument (Woicik et al., 2009). Endorsement on the respective subscales were similar to those reported in previous studies examining personality characteristics in alcohol and cannabis users in the general population and across cultures (Jurk et al., 2015; Spriggens et al., 2015; Woicik et al., 2009). Such studies report mean range scores of 12.00-14.00 for H, 10.00-12.00 for AS, 15.00-18.00 for SS, and 9.00-13.00 for IMP (Jurk et al., 2015; Spriggens et al., 2015; Woicik et al., 2009). In the current study, mean ranges were similar (M_H=12.98, M_{AS} =12.73, M_{SS}= 15.89, M_{IMP} =10.15, see Table 2).

Cannabis Use Patterns

Participants reported on patterns of cannabis use (see Table 3). All participants included in the study were cannabis users, with the majority of participants reporting having used for a period of more than 6 years (*Median*=7.00, median provided as variable responses were ordinal). Self-reported average age of first use was 17.12 years

(*SD*=5.73), with a range extending from '9.00' to '62.00' years of age. Among all participants, including those reporting use in the past 30 days and those who reported no use in the past 30 days, cannabis use in the past month among the sample averaged M_{Days}=12.76 days (SD=13.02, *n*=365), with a minimum of 0 days used and a maximum of 30 days used. When examining only participants who reported use in the past 30 days, which encompassed almost three quarters of participants (*n*=271, 73.8%), the average number of days used in the past 30 rose to 17.3 days (*SD*=12.31), with a minimum of 1 day used and a maximum of 30 days used. Furthermore, participants who reported use in the past 30 days reported reaching feelings of intoxication on 9.05 days on average (*SD*=11.50), suggesting that participants are not using to self-perceived intoxication on every occasion. Mean total score on the CPQ was low (*M*=2.14, *SD*=2.64), with a total possible range from 0 to 21 problems and with participants' reporting a range of 0 to 12 problems endorsed.

Self-reported frequency of cannabis use produced a range of infrequent to daily cannabis use spread across four quartiles. The first quartile is comprised of participants reporting infrequent cannabis use ('6 times a year or less', *n*=98, 26.9%), the second quartile of participants reporting low-moderate cannabis use ('1 to 4 times per month, *n*=73, 20.1%), the third is comprised of participants reporting moderate-high cannabis use ('2-6 times a week or almost every day', *n*=98, 26.9%). Finally, 26.1% (*n*=95) of participants reported cannabis use 'several times a day'. The distribution of frequencies suggests that a diverse population of cannabis users are present in the sample.

Factor Structure of the Cannabis Motives Model and Internal Properties

An EFA was used to identify the number of core motives for cannabis use. EFA is a data reduction technique, which helps to identify meaningful relationships in datasets by indicating items that respond in similar and predictable ways. EFA partition out the unique and error variance, producing a solution of only common variance (Costello & Osborne, 2005). The aim of EFA is to identify the groups of items that, taken together, parsimoniously account for the greatest amount of variance.

In preparation for EFA, the presence and proportion of common variance among cannabis motives items was assessed to determine the factorability of the data using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of Sphericity. Guidelines for KMO values, which can range between 0 and 1, stipulate that they should be at least greater than .5 and ideally above .7 (Tabachnick & Fidell, 2019). The results of the KMO test indicated that the sample was adequate for factoring, producing a KMO value of .940, $p<.05$. The statistically significant result from Bartlett's test of Sphericity ($\chi^2=9199.05$; $p < .001$) further corroborates the results of the KMO test, indicating adequate factorability of the data.

Although there are several methods of factor extraction in EFA, the current study used Principal Axis Factoring. Principal Axis factor analysis, as opposed to the proposed maximum likelihood factor analysis, does not necessitate that the assumption of multivariate normality is met (Costello & Osborne, 2005). Further, it is a more robust statistical method in the face of significant violations to normality (Costello & Osborne, 2005; Treiblmaier & Filzmoser, 2010), which were identified for some variables in the present study.

The number of factors that were retained in the model following extraction was, in part, determined using eigenvalues. Eigenvalues represent the magnitude of the factor, a measure of the variance in all of the variables that is accounted for by that factor (Tabachnick & Fidell, 2019). Field (2000) recommends that only factors with eigenvalues over 1.00 be retained. The EFA generated 5 eigenvalues above this value (i.e., 14.31, 3.14, 2.11, 1.31, and 1.02). These five eigenvalues accounted for 36.64%, 7.99%, 5.37%, 3.31%, and 2.54% of the variance, respectively.

Although examination of the eigenvalues provides evidence for a 5 factor model, there is criticism in the literature that retaining factors with eigenvalues greater than 1.00 can lead to an overinclusion of factors (Costello & Osborne, 2005). For this reason, scree plots were also examined. The scree plot provides a graph of the extracted eigenvalues, where the factors that appear prior to the natural elbow are retained in the model. The scree plot for the resulting factor structure produced more than one elbow, providing additional, but not definitive, information about the number of factors to retain. The scree plot can be found in Figure 2.

Since the scree plot was difficult to interpret given the multiple elbowing, the number of factors to retain was further tested by running multiple factor analyses, setting the number of factors manually with consecutive numbers (i.e., 3, 4, and 5). The rotated factor solutions for each manually set factor analysis were then compared to discern the cleanest factor structure (Costello & Osborne, 2005). An ideal factor structure would generate item loadings of above .30, with minimal to no cross loading of items and factors accounting for around 60-70% of total variance (Costello & Osborne, 2005). Tabachnick and Fidell (2019) identify .32 as a sufficient minimum loading for an item to

load onto a factor and suggest that no item should load at or above that value on more than one factor. However, factor structures with no item cross-loadings are uncommon in EFA, especially given their exploratory nature. Comparison of factor loadings for the fixed factor analyses revealed statistical support for both a four or five factor model. Assessment of item loadings for the four and five factor structure revealed a greater number of cross-loading items for the four factor structure than for the five factor structure (i.e., 16 compared to 13), with the four factor model accounting for 52.93% of the overall variance and the five factor model accounting for 55.85% of the overall variance. The resulting factor loadings for three, four, and five fixed factor solutions are included in Table 4, Table 5, and Table 6 respectively, for further reference.

To provide further support for the factor structure of the cannabis motives items, a parallel analysis was conducted on the data. Results of the parallel analysis indicate four factors exceed the corresponding criterion values for randomly generated datasets with a matrix of equal size (i.e., 39 variables x 365 participants), with a fifth factor nearing criterion values. Results of the parallel analysis corroborate the results of the fixed factor analyses, providing support for both the four and five factor solutions. Considering the exploratory nature of the study, a more liberal approach to factor retention was taken, with future confirmatory measures allowing for refinement if necessary. Additionally, given that there is both statistical and theoretical support (Lau et al., 2015; Sloan et al., 2017; Soaris et al., 2017) to suggest the presence and retention of a fifth factor in the model, a five factor model for cannabis use motives was selected. However, the emerging fifth factor necessitates a more cautious interpretation than the other factors, given that it

did not present with an eigenvalue above 1.00 in the 5 fixed factor analysis and did not reach the 95% confidence threshold in the parallel analysis, as the other factors did.

To improve interpretability of the extracted factors, a rotation was conducted. Specifically, a varimax rotation was used, which simplifies factors by maximizing the variance of item loadings within factors, allowing small item loadings to be reduced and larger item loadings to be enhanced (Tabachnick & Fidell, 2019). A rotation does not alter the amount of variance accounted for by the model, it strictly provides a mechanism for data simplification (Costello & Osborne, 2005). There are two forms of rotation, orthogonal and oblique rotations. The varimax rotation is a form of orthogonal rotation that produces factors that are uncorrelated. To ensure the rotation used did not have significant impact on the factor model, an oblimin rotation was also conducted to assess for correlations between variables. The pattern matrix generated from the oblimin rotation further confirmed the 5 factor structure of the varimax rotation and the correlations matrix between factors demonstrated small to moderate correlations, which will be discussed further below. The pattern matrix for the oblimin rotation can be found in Table 7 for further reference. Considering both analyses generated a five factor model with similar item loading structures, and that correlations between factors were in the low to moderate range, the varimax rotation is reported below.

The varimax rotation resulted in a factor structure with 13 complex items (i.e., items loading on more than one factor). To examine the impact of the complex items on the factor structure, a factor analysis was conducted with and without the inclusion of the complex items. Comparison of the factor analyses showed a slight reduction in the factorability of the data, indicated by a minimal reduction in the KMO value (from .940

to .930), and a decrease in the total variance explained by the data (from 57.8% to 52.4%), when complex items were removed. For these reasons, the complex items were retained in the factor structure, with each item being placed within the factor on which it had the highest loading value. The final factor solution had five fixed factors that explained 55.85% of the variance, with factors contributing 36.64%, 7.99%, 5.37%, 3.31%, and 2.54% of the variance, respectively.

Factor Composition and Item Loadings

Considering the statistical and research evidence to support a 5 factor motives model for cannabis use, all further discussion of the factor composition and item loadings will be based on results from the 5 fixed factor EFA (see Table 6). Of note, given that the reported eigenvalues and factor loadings for each of the following factors are derived from the 5 fixed factor EFA model, they do not directly correspond with the previously reported eigenvalues or factor loadings derived from the initial EFA. The fixed factor EFA results in a slight reduction to the initially observed eigenvalues for each factor, as well as the factor loadings.

The first of the five factors had an eigenvalue of 14.31 and accounted for the most significant proportion of variance (i.e., 36.64%). The first factor also contained the largest number of items, with 18 items loading onto the factor and demonstrated excellent internal consistency, with an alpha value of .945. Items loading onto the first factor had factor loading values ranging from .492 to .734 and included items such as: ‘I use cannabis for the alternative thought processes I experience’ (loading .734), ‘I use cannabis to heighten physical sensations’ (loading .732), ‘I use cannabis as a way to celebrate things’ (loading .704); ‘I use cannabis to become more self-aware’ (loading

.697); ‘I use cannabis for the euphoric sensations it gives me’ (loading .694); and ‘I use cannabis to make events or activities more fun’ (loading .690). Items loading onto the first factor share the fundamental commonality of positive reinforcement, where individuals use cannabis as a method of internal (i.e., enhancement, expansion, creativity) and external (i.e., social, celebration) positive reinforcement. In accordance with the underlying positively rewarding aspects of the collective items on this factor, the first factor has been entitled ‘Positive Reinforcement Motives’.

The second factor has an eigenvalue of 3.10, accounting for 7.99% of the variance, with 9 items loading onto the factor. Items loading onto the second factor had item loading values ranging from .436 to .704, and included items such as; ‘I use cannabis to improve concentration’ (loading .646); ‘I use cannabis to control muscle spasms or cramping associated with a medical condition’ (loading .581); ‘I use cannabis to improve my quality of life’ (loading .568); ‘I use cannabis to help with pain symptoms’ (loading .555); ‘I use cannabis to reduce symptoms of nausea’ (loading .530); and ‘I use cannabis to help me get to sleep at night’ (loading .461). Items demonstrated excellent internal consistency, with an alpha value of .902. The clustering of items loading onto the second factor are indicative of medical motives, functional enhancement motives, or quality of life improvement motives and as such, the second factor has been entitled ‘Health Enhancement Motives’.

The third factor has an eigenvalue of 2.10, accounting for 5.37% of the variance, with 6 items loading onto the factor. Items loading onto the third factor had item loading values ranging from .476 to .703, and included statements such as: ‘I use cannabis to feel less down emotionally’ (loading .703); ‘I use cannabis to numb feelings’ (loading .669);

‘I use cannabis to help reduce anxious feelings’ (loading .647). Items demonstrated excellent internal consistency, with an alpha value of .877. Items loading onto the third factor are characteristic of internal negative reinforcement (e.g., alleviate negative emotions or internal negative sensations) motives. Given the underlying feature of coping amongst the items, particularly for affective purposes, the third factor has been entitled ‘Coping with Negative Affect Motives’.

The fourth factor has an eigenvalue of 1.29, accounting for 3.31% of the variance, with 3 items loading onto the factor. Items loading onto the fourth factor had item loading values ranging from .550 to .707 and included items such as: ‘I use cannabis only because my friends use cannabis’ (loading .707), ‘I use cannabis to make me more popular socially’ (loading .558), and ‘I use cannabis to try to understand why others use cannabis’ (loading .550). Items also demonstrated adequate internal consistency, with an alpha value of .690. The items on the fourth factor are descriptive of using cannabis to improve social standing, to emulate friends, or to gain insight into why others use. As such, items are representative of cannabis use to improve group cohesion as the primary motive for use. Following this, the fourth factor has been entitled ‘Social Cohesion Motives’.

The fifth and final factor had an eigenvalue of .991, accounting for 2.54% of the variance, with 3 items loading onto the factor. Items loading onto the fifth factor had item loading values ranging from .513 to .839, and included items such as: ‘I use cannabis to help me reduce my use of other substances (e.g., cocaine; loading .839), ‘I use cannabis to help with the symptoms of another drug’ (e.g., ‘calm down’ from cocaine, loading .707), and ‘I use cannabis for seizure control’ (i.e., a potential negative consequence of

the abuse of some substances, such as alcohol; loading .513). Items demonstrated good internal consistency, with an alpha value of .762. The items loading onto the fifth factor depict motivations for cannabis use as secondary to another substance, whether using to reduce or modulate use of another substance, as well as use to reduce negative effects associated with another substance, and as such, the fifth factor has been entitled 'Secondary Substance Motives'.

Relationships Between Motive Factors

To assess the independence of cannabis motivation factors, correlations were performed between factors using Pearson correlations. A table containing the correlations between factors are provided in Table 8 for further reference. A Bonferroni correction was used to reduce the potential for Type 1 errors with a corrected statistical significance threshold of $p < .001$ (.05/10=.005). Although the Bonferroni correction suggested a cut off criteria of .005, all statistically significant correlations emerged at or below the .001 level. The correlational analysis revealed predominantly small to moderate correlations between factors with a range of *rs*=.175 to .272, except for three strong correlations. The largest correlation occurred between Health Enhancement and Coping with Negative Affect factors, r=.677, p <.001, followed by a strong correlation between Positive Reinforcement and Coping with Negative Affect motives, r=.622, p <.001, and a strong correlation between Positive Reinforcement and Health Enhancement motives, r=.573, p <.001. Considering that the strong correlations between factors account for under 50% of shared variance ($.622^2$ = 38.7% shared variance between the strongest correlated factors), the significant correlations between factors do not appear to warrant the amalgamation of factors. In addition to these strong correlations, only the Secondary Substance motive

factor produced moderate to small correlations with each of the other factors; specifically, Secondary Substance motives produced a moderate positive correlation with Positive Reinforcement motives, r=.272, p <.001; Health Enhancement motives, r=-.300, p <.001; and Coping with Negative Affect motives, r=.316, p <.001; as well as a weak positive correlation with social cohesion motives, r=.175, p=.001. All other correlations did not reach statistical significance with the Bonferroni adjustment.

Relationships Between the SURPS Personality Model and Cannabis Use Motives

The second goal of the current study was to establish the convergent validity of the new model using a previously established model for substance misuse. In particular, Pearson's *r* correlations were conducted between the motives derived from the EFA and the previously established personality risk model of substance misuse of the SURPS. Expected relationships included: an association between the H and AS subscales of the SURPS and Coping with Negative Affect motives; an association between the SS subscale and positive reinforcement centered motive; and correlations between the IMP subscale and several of the cannabis motives. To reduce the risk of inflated Type 1 error, a Bonferroni correction was made (p < .05/20= .002).

Although the Bonferroni correction suggested a cut off criteria of .002, all statistically significant correlations emerged at or below the p < .001 level. All correlations are reported in Table 9. The largest positive correlation emerged between the Coping with Negative Affect factor and the H subscale, r= .404, p < .001. Coping with negative affect motivations were also positively correlated with the IMP, r= .320, p < .001, and SS, r= .225, p < .001, subscales. Positive Reinforcement motives were moderately correlated with the SS subscale, r= .346, p < .001, and produced a small

negative correlation with the AS subscale, r= -.188, p < .001. Health Enhancement motives produced a small positive correlation with the H subscale, r= .187, p < .001, but were negatively associated with the AS subscale, r= -.176, p = .001. Finally, a small correlation was found between the IMP subscale of the SURPS and both social cohesion motives and secondary substance motives (rs= .257, p < .001, and .228, p < .001, respectively).

The Role of Cannabis Motives in Cannabis Use and Misuse

Two hierarchical regressions were performed to test the third goal of the study, which was to assess the ability of the resulting new cannabis motives model to identify associations with patterns of cannabis use. The associated hypotheses stipulated that the cannabis motives retained in the model would be meaningfully associated with 1) frequency of use and 2) the experience of cannabis-related problems.

Past 30 Day Use

The first hierarchical multiple regression tested whether the motives derived from the EFA were associated with an individual's frequency of cannabis use, as measured by the number of self-reported days using cannabis in the previous 30 days. The regression model included age, gender, and age of first use on the first step and the SURPS personality subscales (i.e., H, AS, SS, IMP) on the second step of the regression to control for previously established and research supported risk factors. The resulting motives of the EFA (i.e., positive reinforcement, health enhancement, coping with negative affect, social cohesion, and secondary substance motives) were entered in the last step of the regression to assess the overall contribution of motives to past 30-day use, over and above other risk factors. The overall regression model produced a statistically

significant result, $F(12, 344) = 35.21$, $p < .001$; accounting for 56% of the variance in frequency of cannabis use. A table summarizing the regression model can be found in Table 10.

To control for previously identified risk factors, demographic variables including age, gender, and age of first use of cannabis, were entered on the first step of the regression, generating a significant result and accounting for 12.9% of the variance in frequency of use. Of the variables in the first step of the regression, age (β=.316, $p <$ .001), gender (β=-.110, p=.034), and age of first use (β=-.126, p=.015) emerged as significant contributing variables. These results indicate that older age, being of male gender, and younger age of first use are associated with a higher frequencies of cannabis use in the past 30 days.

The SURPS personality variables were entered on the second step of the regression to control for previously identified risk factors. The second step of the regression also produced a statistically significant result, accounting for 5.0% of additional variance. Of the personality variables in the second step of the regression, the H subscale (β= .165, p = .02) and the AS subscale (β= -.150, p = .004) emerged as significant. The results suggest that greater endorsement of H and less endorsement of AS are associated with more frequent cannabis use in the past 30 days.

Finally, the derived motives from the EFA were entered on the last step of the regression predicting past 30-day cannabis use frequency, accounting for the largest proportion of additional variance (38%). Of the variables in the final step of the regression, motive factors, beta weights identify the Health Enhancement factor (β=

.487, $p < .001$) and the Social Cohesion factor ($\beta = -.233$, $p < .001$) as significant independent contributors to the model. Thus, greater endorsement of health enhancement motives and lesser endorsement of social cohesion motives were associated with more frequent past 30-day cannabis use.

Cannabis Problems

A second hierarchical multiple regression was run to test whether the derived motives from the EFA were associated with cannabis problems, as measured by the CPQ total score. Similar to the first regression model, the previously identified demographic risk factors of age, gender, and age of first use were entered on the first step and the SURPS personality subscales were entered on the second step of the regression. The resulting EFA motives (i.e., positive reinforcement, health enhancement, coping with negative affect, social cohesion, and secondary substance motives) were entered in the last step of the regression to identify the unique contributions of motives in cannabis use problems. The overall model was statistically significant, $F(11, 364) = 14.93$; $p < .001$, with the included variables accounting for 33.7% of the overall variance in cannabis use problems.

To control for previously identified risk factors, the demographic variables of age, gender, and age of first use were entered in the first step of the regression. The first block of the regression was statistically significant, accounting for 4.1% of the variance in cannabis use problems. Of the variables in the first step of the regression, the standardized beta weights identified younger age as the only variable significantly contributing to cannabis use problems ($\beta = -.197$, $p < .001$).

On the second step of the regression, the four SURPS personality subscales were entered to control for the contribution of personality in cannabis use problems. Of the personality variables entered in the second step of the regression, only the H subscale was significant (β= .421, $p < .001$), accounting for an added 21.2% of the variance. Thus, greater endorsement of the H personality trait uniquely contributed to more serious cannabis use problems.

The five derived motives identified from the EFA analysis were entered in the third step of the regression to determine whether motives accounted for unique variance in cannabis problems above the variance contributed by demographic and personality variables. This step was also statistically significant, accounting for an additional 8.1% of the variance. Coping with Negative Affect (β = .183, p= .028) and Positive Reinforcement (β =.173, p= .014) motivations emerged as significant unique contributors. Hence, greater endorsement of these motives is associated with a greater severity of cannabis use problems. A table containing results of the regression model can be found in Table 10.

Discussion

The goals of the present study were threefold: 1) the first goal was to establish a comprehensive model of motivations for cannabis use by using a more representative sample of Canadian adult cannabis users; 2) the second goal was to then test the convergent validity of the resulting motivations model relative to a previously established model of personality risk for substance misuse; and 3) the final goal was to assess the postdictive validity of the resulting motives model with regard to the frequency of cannabis use and severity of cannabis use problems.

Goal 1: Establish a Comprehensive Cannabis Use Motives Model

The first goal of the current study was to explore the core motives underlying cannabis use to help clarify some discrepancies in the literature regarding the number of existing motives underlying cannabis use. Given that cannabis research is in its relative infancy, motive models for cannabis use have largely been adapted from those developed for other substances (Cooper, 1994; Simons et al., 1998). Previous literature adapted from alcohol use research suggests that there may be five core motives for cannabis use (i.e., the MMM model), which include: Enhancement, Coping, Social, Conformity, and Expansion motives (Simons et al., 1998). However, given that different substances produce unique neuropsychological effects that can contribute to distinct motivations for use, there is some contention in the research regarding the accuracy of using motive models adapted from other substances (Bohnert et al., 2018; Lee et al., 2007). As a result, Lee and colleagues used a bottom up-approach to determine underlying motives for cannabis users, which included the five core motives derived from alcohol research (Simons et al., 1998) along with several additional cannabis use motives (e.g., sleep, habit/routine, boredom, etc.; Lee et al., 2007). Although several additional motives were included in Lee and colleagues' study, medical motives for cannabis use did not emerge in the model, possibly because of the nature of the sample used (i.e., university sample). Considering recent legislative changes regarding cannabis use in Canada and increased prescribing practices for medical conditions (Health Canada, 2018; Health Canada, 2019; Hurd et al., 2015; Labigalini et al., 1999; Lau et al., 2015; Socias et al., 2017; Sloan et al., 2017), there was a need to further examine motives for cannabis use in a more diverse sample of users.

Results of the EFA in the current study supported a five factor model for cannabis use motives in adult users. Despite the identification of a five factor model, the factors that emerged in the current study were not completely consistent with the MMM model derived from alcohol research (i.e., enhancement, coping, social, conformity, expansion; Simons et al., 1998). In particular, the EFA revealed support for Positive Reinforcement, Health Enhancement, Coping with Negative Affect, Social Cohesion, and Secondary Substance motive factors. Hence, health enhancement and secondary substance motives uniquely emerged from the current study, whereas the previously reported enhancement, expansion, as well as positive social and celebration motives appeared to load primarily onto one single dimension of positive reinforcement motives. Each of these factors were labeled based on the underlying commonalities between the collective items loading onto each respective motive, which are discussed individually below.

Positive reinforcement motives. In accordance with previous research, the motivations characterized by the pursuit of emotional, physical, or situational enhancement and altered perception as a result of the psychotropic effects of cannabis (i.e., expansion) emerged in the present study as core motives underlying cannabis use. Interestingly, in contrast to the previously established motive models of the MMM and CMMQ that identified these motivations as independent (Lee et al., 2007; Lee et al., 2009; Simons et al., 1998; Zvolensky et al., 2007), these elements loaded onto a singular factor in the present study. This is not the first study to find expansion and enhancement motives emerging as one factor. Specifically, Newcomb, Chou, Bentler, and Huba (1988) identified a factor 'Enhance Positive Affect and Creativity', which combined both expansion and enhancement motivations when assessing motivations for alcohol and

cannabis use. They argued these elements functioned through a mechanism of positive reinforcement (Newcomb et al., 1988). Similarly, positive reinforcement mechanisms appear to underlie the items that emerged on the Positive Reinforcement factor of the current study: adding to or enhancing perceptual experiences (i.e., enhancement), experiencing psychotropic effects that influence cognitive thought processes (i.e., expansion), augmenting celebratory experiences (i.e., celebration), or providing added stimulation to reduce the experience of boredom (i.e., boredom). Thus, there is underlying commonalities in the mechanism of these motives to correspond with the statistical inclusion of positive reinforcement based motives into one factor.

The singular Positive Reinforcement motives factor identified in the current sample fits with Cooper's motivational model for alcohol use, as that model distinguishes positive from negative reinforcement motives (Cooper et al., 1994). Unlike Cooper's motivational model, however, the Positive Reinforcement motives factor of the current study combines external (e.g., making social events more fun) and internal (e.g., heighten physical sensations) sources of positive reinforcement. The resulting factor explained the greatest amount of variance in motives and produced excellent internal consistency (Cronbach's α = .945) in the current sample, supporting a singular factor representing the positive reinforcement motives of enhancement, expansion, boredom, and celebratory motivations. Although the items share the underlying commonality of positive reinforcement properties, the identification of these motivations as separate in previous literature (Lee et al., 2007; Lee et al., 2009; Simons et al., 1998) suggest the necessity of further research. Use of confirmatory analysis could test whether this singular factor structure holds in subsequent research with other diverse adult samples.

Health enhancement motives. In contrast to previous research that has failed to include medical or health-focused motive items (Simons et al., 1998), or did not retain these types of motives in finalized models (Lee et al., 2007; Lee et al., 2009), results of the current EFA suggested a health enhancement centred cannabis motives factor. In 2019, Health Canada (2019) reported 369,614 active registered medical cannabis users (i.e., federal medical cannabis licence holder), a significant increase from the previous year registered at 345,520 (Health Canada, 2019). Cannabis is often used to alleviate or provide symptom relief in patients with a diagnosed medical condition (i.e., cannabis to treat nausea associated with chemotherapy; Bohnert et al., 2018; Bonn-Miller et al., 2014; Haug et al., 2017). Several items loaded onto the Health Enhancement factor, including medical motives such as: 'I use cannabis to reduce symptoms of nausea', 'I use cannabis to help with pain symptoms', 'but also broader health enhancement motives such as 'I use cannabis to improve my motivation', and 'I use cannabis because it improves my quality of life'. Overall, the resulting factor had excellent internal consistency (Cronbach's α = .902) and participant endorsement of health enhancement motive items ranged from 20.1-46.3%, providing further support for cannabis use to promote perceived functionality and physical health.

The emergence of health, and partly medically, centred motivations for cannabis use is in congruence with literature reporting the use of cannabis for the improvement or alleviation of symptoms associated with various medical conditions (Bonn-Miller et al., 2014; Bridgeman & Abazia, 2017). In 2001, legislation was passed allowing the use of cannabis for medical purposes (Health Canada, 2018). The government of Canada has approved the use of cannabis as a medical treatment for the remediation of a variety of

medical conditions, including: pain associated with cancer or neuropathic origins; nausea and lack of appetite symptoms associated with chemotherapy; and tics in patients with Parkinson's or Tourette's disease (Bridgeman & Abazia, 2017; Gloss & Vickrey, 2014; Health Canada, 2018; Lynch, & Campbell, 2011; Smith, Azariah, Lavender, Stoner, & Bettiol, 2015). Although there is research supporting the efficacy of cannabis for symptom improvement, the use of cannabis for medical symptom management remains controversial on a global scale and the long-term effects remain unclear (Bridgeman & Abazia, 2017; Hill, Palastro, & George, 2019). However, since the legalization of cannabis for medical use in Canada in 2001, there has been a parallel decrease in the perceived risks associated with cannabis use amongst the general population that then may contribute to increased perceptions of cannabis as a viable medical treatment (Lin, Ilgen, Jannausch, & Bohner, 2016).

In addition to medically-based motivations for cannabis use, the Health Enhancement factor in the current study included items that assessed cannabis use for personal functional health enhancement (i.e., "I use cannabis to improve my motivation", "I use cannabis to improve my productivity", and "I use cannabis because it improves my quality of life"). Considering cannabis research is in its relative infancy, there are few studies that examine the use of cannabis for personal functional health enhancement. A qualitative study by Chapkis (2007) reported participant's impressions of increased motivation, concentration, and productivity with cannabis use, supporting the items endorsement in the current study. There are, however, studies that suggest lower reported quality of life is associated with increased cannabis use (Goldenberg, IsHak, & Danovitch, 2017). In contrast to the research evidence, the current study indicated

endorsement of motivations for improved quality of life. The endorsement of these items may be explained by an individual's perceptions of the effects of cannabis. Indeed, Simons, Clark, Simons, and Spelman (2016) reported that an individual's perception of cannabis' role or personal utility (e.g., to improve concentration, or to do well academically) was inversely associated with problem recognition, perceived benefits of change, and steps toward change. Thus, it may be that individuals perceive cannabis to have personal utility (i.e., improve quality of life or productivity), which results in the perception of a positive contribution of cannabis, but does not necessarily equate to a corresponding functional improvement.

Hence, the current study has identified a subset of cannabis users endorsing health enhancement centred motivations, but the existence of health enhancement motives does not necessarily equate with effectiveness of cannabis. Rather, some individuals may seek symptom remediation and functional recovery assistance through cannabis use; whether this perceived benefit is through actual symptom management or placebo effects remains to be determined. Regardless, findings of the current study appear to support health enhancement and functional recovery as motivations for cannabis use.

Coping with negative affect motives. Whether separated into coping with depressive affect and coping with anxiety or represented singularly by an overarching negative affect motivation, coping motives for substance use have consistently emerged in previous literature as an important motivation for use across substances (Cooper, 1994; Lee et al., 2007; Lee et al., 2009; Newcomb et al., 1988). Coping motivations capture the use of substances to alleviate aversive sensations, particularly affective processes (Colder, Lee, Frndak, Read, & Wieczorek, 2019). The temporary alleviation of negative

affect produces a negative reinforcement loop that reinforces further substance use (Colder et al., 2019). Coping motivations are identified in both the MMM (Simons et al., 1998) and the CMMQ (Lee et al., 2007; 2009) models of cannabis use. The Coping with Negative Affect factor in the current study included several items, such as 'I use cannabis to get through events that are emotionally painful', 'I use cannabis to numb feelings', 'I use cannabis to make me less nervous socially', and 'I use cannabis to reduce anxious feelings'. Thus, the coping motives represented on this factor in the current study captured negative affect coping motivations. The strong alpha consistency values (Cronbach's α = .877) of the coping with negative affect items suggests that the items are endorsed in a consistent manner. Reliance on coping motivations in substance use can interfere with the development of adaptive coping strategies and can lead to significant consequences. Coping motives for substance use have often been associated with greater substance use-related problems, attributed, in part, to the development of a circular negative reinforcement pattern (Colder et al., 2019; Cooper et al., 2016).

Social cohesion motives. Social cohesion motivations, or motivations for substance use rooted in conformity or increasing social standing, have consistently emerged as a unique factor across substances (Cooper et al., 1994; Lee et al., 2007; Lee et al., 2009). In the present study, social cohesion motives also emerged, albeit accounting for only 3.31% of the variance in cannabis use. The Social Cohesion factor of the current study included items such as 'I use cannabis to make me more popular socially', 'I use cannabis to understand why others use', and 'I use cannabis because my friends use cannabis', which produced acceptable alpha consistency values (Cronbach's α = .690). The present study identified a factor for social cohesion using a sample with a greater

diversity in age. The emergence of a Social Cohesion factor in the current study's adult sample suggests that the social cohesion component of cannabis use exists in some adult users, which is a motive that has not been consistently been found across studies (Simons et al., 1998) or has been demonstrated to be influential only during adolescent ages (Benschop et al., 2015; Blevins et al., 2016a; Blevins et al., 2016b). Social cohesion and conformity related motives appear to have greater influence in younger populations (i.e., adolescents aged 12-15; Cooper et al., 1994; Blevins et al., 2016a; Vervaeke et al., 2008), a population not examined in the current study, which may explain why this factor explained a smaller proportion of the variance. Approximately a third of the sample were young adults (i.e., aged 18-24; n=130), ages at which conformity motives may be less prominent compared to adolescents (i.e., 12-15 year olds). Furthermore, Simons and colleagues (1998) suggest that conformity motives may be less prominent for substances that are less socially accepted and normalized in society, which also may explain the lower amount of variance explained by social cohesion motives in the current study. Since cannabis is now legal across Canada, normalization may increase and social cohesion motives may become more significant but future research is needed. Nevertheless, the findings of the current study support the presence of a social cohesion based motivation for cannabis use.

Secondary substance motives. A novel finding that emerged in the present study was a fifth factor identifying secondary substance use motives for cannabis use. Some caution is warranted when interpreting this finding due to conflicting statistical evidence in favour of retaining this factor. This factor produced good internal consistency (Cronbach's α = .762) and emerged with 3 items, which included: 'I use cannabis to

reduce my use of other substances'; 'I use cannabis to help with the symptoms of another drug'; and 'I use cannabis for seizure control'. Although a similar factor has not emerged in previous substance use motivation research, this may be because previous substance use motivation research has failed to include items that assess the use of cannabis to alleviate/reduce use of other substances (Lee et al., 2007; Lee et al., 2009; Simons et al., 1998). Recent developments in cannabis research have highlighted the practice of using cannabis to address use of other substances, including alcohol (Caille, Alvarez-Jaimes, Polis, Stouffer, & Parsons, 2007), nicotine (Morgan, Das, Joye, Curran, & Kamboj, 2013), heroin (Hurd et al., 2015), and crack-cocaine (Lau et al., 2015). Cannabis as a secondary substance appears to have two predominant functions: cannabis serves to decrease the frequency of use of other substances (Morgan et al., 2013) and decrease the severity of experienced withdrawal symptoms from other substances (Sloan, Gowin, Ramchandani, Hurd, & Le Foll, 2017).

Recent literature is emerging that proposes the use of cannabis as a potential therapeutic tool for other substance use. Given that the endocannabinoid system plays such a pivotal role in reward processing and that the CB1 receptors associated with the endocannabinoid system are densely concentrated in regions of the brain associated with habit-forming behaviours (i.e., ventral striatum, dorsal striatum, and amygdala; Sloan et al., 2017), cannabis has been suggested as a substitution drug in substance use disorders that function along similar pathways (i.e., crack/cocaine, opioids, nicotine; Labigalini, Rodrigues, & Da Silveira, 1999; Lau et al., 2015; Morgan, Das, Joye, Curran, & Kamboj, 2013; Sloan et al., 2017; Socias et al., 2017). Given that the primary mechanism for THC is to act as a CB1 agonist, it may function similarly to methadone in replacing a

potentially more harmful substance (Sloan et al., 2017). Intentional substitution of other substances with cannabis may decrease frequency of use and the experience of withdrawal symptoms from the other substance, serving as harm reduction strategy (Lau et al., 2015). Indeed, in a Jamaican sample of illicit crack-users, cannabis was perceived by users as an effective and readily available tool for reducing crack-cocaine use (Dreher, 2002).

In addition to providing a mechanism for reducing use of other substances, cannabis appears to dampen the aversive physiological symptoms associated with the use of other substances. Studies on opioid use has suggested that cannabis may aid in reducing the intoxicating effects of opioids and can reduce symptoms of opioid withdrawal (Katsidoni, Anagnostou, & Panagis, 2013; Ren, Whittard, Higuera-Matas, Morris, & Hurd, 2009). Cannabis was also found to be effective in reducing the craving symptoms associated with drug use in crack-cocaine users (Lanigalini et al., 1999), with several studies reporting the use of cannabis as a 'survival strategy' to reduce negative crack-cocaine-related experiences, such as aggression and symptoms of withdrawal (Chaves, Sanchez, Ribeiro, & Nappo, 2011; Goncalves & Nappo, 2015; Ribeiro, Sanchez, & Nappo, 2010). There is further evidence to suggest that some negative substance-related experiences can include seizures (Chen, Albertson, & Olson, 2016). Abuse of some substances (e.g., Alcohol) can result in withdrawal symptoms that include seizure-like brain activity, as observed on an EEG, which in some cases can also include generalized motor activity (i.e., convulsions) as well (Chen et al., 2016). As a result of its characteristic sedative effects, cannabis also may help to reduce undesired drug effects and thereby lead to self-medication with cannabis (Fischer et al., 2015; Lau et al., 2015;

Palamar, Griffin-Tomas, & Kamboukos, 2015). Although not amongst the most highly endorsed reasons for cannabis use, the use of cannabis to regulate the effects of other substances has, unsurprisingly, significant associations with the number of recent substances used (Palamar et al., 2015). Overall, the identification of a Secondary Substance factor suggests that some cannabis users may be using to decrease use of potentially more dangerous substances or as a self-medicating mechanism for alleviating negative drug-related experiences.

Correlations between motive factors. The present study found several significant correlations between the identified cannabis use motivational factors. Specifically, there was significant overlap in variance between the Coping with Negative Affect and Health Enhancement motive factors (r=.677). Given the underlying commonality of symptom alleviation between these motives, a positive association was expected. Moreover, many who use cannabis medically are treating chronic conditions that are often comorbid with negative affect, which also are characteristic of using to cope (Kissane, Clarke, & Street, 2001). The experience of hopelessness, existential distress, or negative affect in the physical disease process are generally associated with more severe symptoms associated with the medical condition and a significant degree of disruption in function (Cannella, Lobel, Glass, Lokshina, & Graham, 2007; Nail, King, & Johnson, 1986). Another explanation for the strong correlation between Coping with Negative Affect and Health Enhancement motives is that there were also complex items that loaded onto both factors (e.g., "I use cannabis to help me get to sleep at night", "I use cannabis to reduce anger"), which were retained in the model on the factor with the higher loading. Although correlations were performed with and without complex items

and no significant differences emerged, their retention in the model may have contributed, in part, to the correlation between factors.

Positive Reinforcement motives were found to share variance with two other motives. First, Coping with Negative Affect and Positive Reinforcement motives were strongly positively correlated (r= .622). In the current study, the expansion and enhancement categories loaded onto a single category, which resulted in the inclusion of items related to expansion or altered perception on the Positive Reinforcement factor. Motives centred around altered perception demonstrated moderate positive correlations with coping motivations in previous literature (Hecimovic et al., 2015), which may explain the positive correlation between Coping with Negative Affect and Positive Reinforcement motives in the present study. Specifically, both Coping with Negative Affect and Positive Reinforcement factor motives alter affect or personal experience, with positive reinforcement working to enhance perception and affective experience and coping with negative affect motives working to alleviate or reduce negative affective experiences. Second, Positive Reinforcement and Health Enhancement motives were strongly positively correlated (r=.573). Given that positive reinforcement motives encompassed expansion and enhancement motivations, and health enhancement motives are newly emerging in the present study, this relationship could not be compared with the findings in previous literature. Although the cause of the association is unclear, it is possible that those who are using cannabis for medical or health improvement reasons may receive additional benefits from their cannabis use that they perceive to be additive in nature or that contribute to the experience of or enhancement of further coping benefits. In addition to symptom alleviation, individuals using cannabis for medical or

health enhancement purposes may experience the additive benefits of an increased ability to engage in daily activities, the ability to experience more joy during activities, or have an improved quality of life (Fiz, Duran, Capella, Carbonell, & Farre, 2011). Indeed, these additive properties have been identified in patients using cannabis medicinally to alleviate fibromyalgia pain. Fibromyalgia patients who use medicinal cannabis have demonstrated better mental health scores, reported greater relief of pain and stiffness symptoms, and reported greater reduction in sleep disturbances in comparison to non-cannabis using fibromyalgia patients (Fiz et al., 2011). It appears that by alleviating some of the pervasive and disruptive aspects of the disease, cannabis may also serve to provide improvements to an individual's overall perceived quality of life and positive affective experiences.

In addition to these correlations, several moderate correlations were identified. A moderate negative correlation between the Secondary Substance and Health Enhancement motive factors was found (r= -.300). Considering that these motives represent different aspects of a similar mechanism (i.e., representing positive and negative reinforcement mechanisms for functional improvement), the moderate negative correlation makes theoretical sense. Individuals using cannabis for medical purposes are using cannabis for symptom management of medical conditions (Bonn-Miller et al., 2014; Lin et al., 2016), a form of positive reinforcement, whereas those using for secondary substance motives are using cannabis to decrease use or alleviate effects of another substance (Caille et al., 2007; Hurd et al., 2015; Morgan et al., 2013), a form of negative reinforcement. The negative relationship between Secondary Substance and Health Enhancement motive factors also may be explained by previous research findings

that indicate individuals using cannabis for medical purposes report a lower use of other substances than individuals using for recreational purposes (Richmond et al., 2015) and demonstrate lower prevalence of alcohol or drug disorders when compared to recreational cannabis users (Lin et al., 2016; Zvolensky et al., 2007). Thus, medical or health enhancement motivated users may be less likely than recreational users to concurrently endorse using cannabis for secondary substance motives (e.g., as a detoxification method). As such, the negative correlation is likely reflecting an association with a third variable (e.g., polysubstance use) or healthy coping strategies.

The Secondary Substance motivation factor also produced a moderate positive correlation with the Coping with Negative Affect motivation factor (r=.316). Although there are no previous studies reporting an association between the newly identified secondary substance and previously identified coping motivations in cannabis use, there is other research evidence to support this association. In particular, research suggests that similar mechanisms of self-medication for symptom alleviation could underlie both coping and secondary substance use motives (Colder et al., 2019; Lau et al., 2015), albeit for different reasons. Despite both being influenced by negative reinforcement processes, these factors represent distinct motivations for use that may necessitate different forms of intervention. Thus, although Coping with Negative Affect and Secondary Substance motivation factors share commonalities, the current study suggests that they should be conceptualized as independent factors.

Goal 2: Determine the Convergent Validity of the Motives Model with the Established SURPS Personality Model

Correlations were conducted between the cannabis use motives derived from the EFA and the previously established personality risk model of substance misuse (i.e., SURPS) to examine the convergent validity of the EFA identified model. From this analysis, several significant correlations emerged, providing convergent validity for the factor model.

The largest of the correlations occurred between the Coping with Negative Affect motivations factor and the H subscale of the SURPS (r=.404). This correlation was expected given that the H subscale is characterized by a greater likelihood of experiencing low mood (Conrod et al., 2000; Hecimovic et al., 2014; Woicik et al., 2009), increasing the likelihood of using substances to alleviate negative affect. Previous literature has found similar relationships between coping centred substance use motivations and the H subscale of the SURPS (Hecimovic et al., 2014). The significant correlation between the Coping with Negative Affect motivation factor and H subscale provides confirmatory evidence for the validity of a coping factor for cannabis use.

Another significant positive correlation emerged between the Positive Reinforcement motives factor and the SS subscale of the SURPS (r=.346). Given that the SS subscale is characterized by a proclivity for activities that produce exciting or stimulating sensations (Woicik et al., 2009), and that the positive reinforcement motives are characterized by the use of substances for enhancement or expansion purposes, it follows that there would be a positive association between these variables. Previous literature also supports this relationship, identifying positive associations between

elevations in SS and the use of cannabis for expansion and enhancement motives (Conrod, 2016; Hecimovic et al., 2014; Woicik et al., 2009). Hence, the current findings support the convergent validity of the Positive Reinforcement factor.

As predicted, the IMP subscale produced significant correlations with several different motive factors (i.e., coping with negative affect, social cohesion, secondary substance). Given that the IMP subscale is characterized by an inability to inhibit behaviour in the face of immediately rewarding stimuli which can lead to negative consequences, it follows that IMP would correlate with several motivations for use. Indeed, several significant associations have been identified in previous literature between the IMP subscale and motives for use, including enhancement, conformity, social, accessibility, coping, and self-medication (Hecimovic et al., 2014; Woicik et al., 2009). The current study identified three significant correlations between the IMP subscale and the resulting EFA motive factors. First, a significant positive correlation was identified between the IMP subscale and Coping with Negative Affect motives factor for use (r=.320). It may be that individuals higher in IMP use cannabis to cope with consequences that result from their inability to appropriately weigh immediate rewards against long-term consequences (Conrod et al, 2000; Hecimovic et al., 2014), leading to an increased likelihood of experiencing negative affect. Second, a significant correlation was identified between the IMP subscale and the Social Cohesion motives factor (r=.257). Although there is minimal research assessing the SURPS and motives for use in cannabis, previous alcohol research has identified associations between the IMP subscale and conformity motives (Woicik et al., 2009). Individuals high in IMP may be more vulnerable to using cannabis when pressured in a social situation. Lastly, the IMP

subscale was associated (r=.228) with Secondary Substance motives factor. No previous studies have included secondary substance motives in their models of cannabis use to corroborate these findings. This relationship is intuitive, however, given that individuals high in IMP have higher rates of polysubstance use (Conrod, 2016; Woicik et al., 2009) and are more likely to use substances for self-medicating purposes (Hecimovic et al., 2014). Secondary substance motives are, in part, characterized by using cannabis to self-medicate symptoms associated with use of another drug (i.e., "I use cannabis to 'come down' from cocaine").

In sum, the correlations that emerged between the cannabis motives and the SURPS are in line with formulated hypotheses supporting links between theoretically relevant personality and substance use motives. However, there was an expected association based on previous literature that did not emerge as significant in the present study. Specifically, the Coping with Negative Affect motive factor did not produce a significant correlation with the AS subscale of the SURPS, which is surprising given that the factor included some items addressing cannabis use for anxiety. Although the use of cannabis to reduce anxiety is one of the most common reasons for use (Hathaway, 2003), the acute administration of cannabis can cause relaxation for some people and symptoms of paranoia or increased anxiety in others (Temple, Driver, & Brown, 2014). Furthermore, the chronic use of cannabis appears to have an exacerbated anxiogenic effect (Crippa et al., 2009). Thus, some people who use cannabis initially experience anxiolytic or relaxing effects, but continued chronic use may generate greater levels of anxiety. Research demonstrates that regular cannabis users exhibit greater levels of anxiety than irregular cannabis users or non-users, with increased severity of anxiety

symptoms correlating positively with cannabis consumption (Crippa et al., 2009). Therefore, it may be that chronic cannabis users experience anxiogenic effects of cannabis, as opposed to anxiolytic effects, and are less likely to report the use cannabis to reduce anxiety. Given that the sample of the current study was composed largely of chronic or regular cannabis users, these heavy use characteristics may explain why AS did not significantly correlate with the Coping with Negative Affect motive factor in the current sample. Despite the fact that most correlations between the SURPS model and the cannabis motives model were in expected directions, a confirmatory examination of the five proposed factors and their relationship with the SURPS is needed to further verify the convergent validity of the model.

Goal 3: Establish the Contribution of Cannabis Motives in Cannabis Use Patterns

Two regressions were conducted to assess the third goal of the current study, which was to assess the relationship between the extracted motives and patterns of cannabis use. Specifically, two multiple hierarchical regressions were run to assess the relationship between the extracted motives for cannabis use with both the 1) frequency of use and 2) problems associated with use.

Frequency of use. Results of the first hierarchical regression revealed several contributing factors to the frequency of cannabis use. Of the demographic variables, being of older age, male gender, and initiating cannabis use at younger ages were significantly predictive of use in the past 30 days, accounting for 12.9% of the variance in the model. These findings are consistent with previous literature associating these variables with increased cannabis use (Canadian Centre on Substance Abuse, 2014;

Gruber et al., 2013; Hanson et al., 2010; Meier et al., 2012; Rodriguez, 2015; Substance Abuse and Mental Health Services Administration, 2014).

A possible explanation for the significant association between older age and increased past 30-day use of cannabis may come from the health enhancement users in the study. Although there was no question included in the study to ask participants to specify whether their use was medical or recreational, evaluation of the endorsement levels of health enhancement items reveals a significant number of users identifying medical or health enhancement motivations. Specifically, a proxy estimate of medical and health enhancement users was created by summing participants who answered '*agree'* or *'strongly agree*' to any of the items on the health enhancement factor (*n*=261, 71.5%). However, considering that this factor also included the item 'I use cannabis to help me get to sleep at night', which was positively endorsed by 197 participants, this estimate is likely an inflated estimate of the actual number of health enhancement motivated users in the study as the use of cannabis for sleep may not be of medical necessity in some cases. Regardless, participant endorsement of health enhancement items suggests adequate representation of potential medical users that may account for some of the significant relationship with older age. In fact, medical and health enhancement users of cannabis are more likely to be older than recreational users (Lin et al., 2016). Given that cannabis is now medically used to treat several chronic health symptoms (Health Canada, 2018), for which cannabis may be consumed daily (e.g., insomnia), older participants may be more likely to report higher use due to medicinal or health enhancement-related motives. Medicinal users tend to report increased rates of use relative to non-medical users (Lin et al., 2016). For example, research has identified some

of the strongest associations between frequency of cannabis use and sleep centred motivations (Bohnert et al., 2018; Lin et al., 2016), which received upwards of 40% endorsement in the current study.

In addition to user age, the present study also identified male gender as a significant contributor in the frequency of cannabis use. There is consistent evidence to support a greater prevalence of consumption of cannabis use for males than for females (Rodriguez, 2015). Studies have demonstrated that males exhibit greater rates of current and past 30-day use compared to female users (Fogel et al., 2017; Johnson et al., 2015). Moreover, Statistics Canada consistently reported higher rates of consumption and frequency of use for males (Statistics Canada, 2015; Statistics Canada; 2018). The pattern of greater use for males may have several contributing factors, including different gender-related social norms, differences in propensity for risk-taking behaviours, difference in peer group use, and differences in perceived risks associated with cannabis use (Carliner et al., 2017).

Finally, younger age of first use emerged as a significant predictor in past 30-day cannabis use, a finding that replicates previous literature (Hanson et al., 2010; Richmond-Rakerd, Slutske, Wood, 2017). The average age of first use of cannabis is typically between 15 and 17 years of age (Canadian Centre on Substance Use, 2018; Gruber et al., 2012; Gruber et al., 2013; Substance Abuse and Mental Health Services Administration, 2009). Earlier ages of first use are associated with heavier use in adolescence and a slower rate of decline for substance use when compared to those who began using at a later age (Richmond-Rakerd et al., 2017). Moreover, those who initiate cannabis use at an earlier age are at greater risk for the development of higher frequency of use and CUD

(Hanson et al., 2010). Individuals who initiate cannabis use at younger ages are at an increased risk of experiencing cognitive impairments (Mahu et al., 2015), alterations to neurological development (Gruber et al., 2012, 2013; Sami et al., 2015), and developing symptoms of CUD (Hanson et al., 2010) due to the neurological structural and functional changes occurring during adolescence.

Regarding the contribution of the SURPS personality factors, which accounted for 5% of the overall variance in cannabis use frequency, higher Hopelessness (H) was associated with a greater number of days used in the past 30 days but higher Anxiety Sensitivity (AS) scores were associated with a lower frequency of use in the past 30 days. These findings emulate previous reports indicating that individuals scoring higher on H tend to report greater frequency of use, whereas individuals with greater AS engage in a lower frequency of substance use (Conrod et al., 2000a; Woicik et al., 2009). Indeed, the positive association between the SURPS H subscale and frequency of use is amongst the most consistent relation to emerge (Ali et al., 2016; Hecimovic et al., 2014; Krank et al., 2011; Malmberg et al., 2010; Malmberg et al., 2012). Higher H scores are often associated with an increased risk of experimentation across substances (Ali et al., 2016) and a higher frequency of current cannabis use (Hecimovic et al., 2014; Krank et al., 2011; Malmberg et al., 2010; Malmberg et al., 2012). In contrast, Ali and colleagues (2016) reported a negative association between AS and substance use across different substances, including cannabis. Although there are some studies that identify AS as a risk factor for cannabis misuse and the development of cannabis problems (Dean et al., 2017), other studies identify AS as a protective factor against the initiation and development of cannabis use and misuse (Ali et al., 2016; Castellanos-Ryan et al., 2013; Malmberg et al.,

2010; Woicik et al., 2009). The study by Dean and colleages (2017) identifying AS as a significant risk factor for cannabis misuse examined the impact of race and reported significant findings of AS for black participants but not white participants. It appears that some research suggests a differential impact of AS associated with race; however, given that the current study sample was primarily Caucasian, further research is necessary to explore this possibility. The present study appears to provide support for AS as a protective factor against more frequent cannabis use, corresponding with previous research (Ali et al., 2016; Castellanos-Ryan et al., 2013; Malmberg et al., 2010; Woicik et al., 2009). It appears that greater AS (i.e., greater levels of anxiety surrounding particular physiological sensations) may serve as an inhibiting mechanism that reduces an individual's desire to engage in cannabis use.

Contrary to previous literature, IMP did not emerge as contributing to frequency of cannabis use. Woicik and colleagues identified a unique relationship with IMP and frequency and severity of substance use consumption across several substances, particularly stimulants (Woicik et al., 2009). Although there are stimulant effects of cannabis (i.e., the psychotropic effects; Centre for Substance Abuse Research, 2018), the depressive effects of cannabis make it distinctly different from stimulants such as cocaine (Centre for Substance Abuse Research, 2018). As such, IMP may be more related to increased use of primarily stimulant drugs and less directly relevant to cannabis use.

Central to the current thesis, the contribution of cannabis motives factors to the frequency of use of cannabis was also examined. Motivation factors for cannabis use accounted for 38% of the overall variance in past 30-day cannabis use. Only Health Enhancement motives and Social Cohesion motives were significantly associated with

frequency of cannabis use above and beyond demographic factors, use onset, and SURPS personality factors. There is minimal research assessing the association between Health Enhancement motives and frequency of cannabis use; however, medically centred cannabis use appears to be predominantly for chronic conditions, such as neuropathic pain, cancer symptoms, and tics associated with Tourette's or Parkinson's disease (Bridgeman & Abazia, 2017; Gloss & Vickrey, 2014; Health Canada, 2018; Lynch, & Campbell, 2011; Smith, Azariah, Lavender, Stoner, & Bettiol, 2015). Individuals using cannabis for chronic medical conditions may regularly use cannabis as part of a medical treatment regimen (i.e., regular use of cannabis for pain management). Thus, it follows that medical or health-centred use of cannabis would be associated with an increased frequency of use. Blevins and colleagues (2016) found that medical users reported using on more days compared to recreational users (Blevins et al., 2016). The association between Health Enhancement motives and greater frequency of use does not necessarily equate to a greater number of use-related problems. Medical and recreational cannabis users demonstrate relatively equal rates of CUD (Bonn-Miller et al., 2014; Lin et al., 2016).

Social Cohesion motives also emerged as significant in explaining the frequency of cannabis use. In contrast to Health Enhancement motives, however, Social Cohesion motives were associated with reduced frequency of cannabis use. A similar motive, conformity, has been associated in the literature with a lower frequency of cannabis use (Bonar et al., 2017; Buckner et al., 2014; Zvolensky et al., 2007). This negative relation may be explained, in part, by individuals only engaging in cannabis use when socially pressured to do so as opposed to seeking out cannabis independently for its effects. Some

research has suggested that conformity motives for cannabis use are present only in adolescence and young adulthood (Benschop et al., 2015). Based on our findings (i.e., conducting a post-hoc correlational analysis between age and social cohesion motives, r=-.218, $p < .001$), younger participants in the current study appear to endorse Social Cohesion motives more strongly than older participants.

Overall, results of the regression model suggest that motives for cannabis use are an important factor for recent cannabis use (i.e., past 30-day use), explaining a significant portion of variance when controlling for previously identified demographic and personality risk factors. Thus, examining motivations for use may provide important information to clinicians and provide a good target for therapeutic intervention for frequent cannabis users.

Use-related problems. A regression examined the impact of demographic, personality, and cannabis motives on the likelihood of experiencing cannabis-related problems (i.e., CPQ total score). Of the demographic variables included in the model (i.e., age, gender, age of first use), younger age was the only one to emerge as significant, accounting for 4.4% of the overall variance. Younger age is typically associated with increased cannabis problems in previous literature (Bashford, Flett, & Copeland, 2010; Haug et al., 2017). Younger cannabis users tend to display greater rates of problematic cannabis use than their older counterparts, as well as more subsequent use-related problems (Haug et al., 2017). For example, misuse rates are consistently higher for adolescents aged 15-19 years than for any other age category, followed by young adults aged 20-24 years (Canadian Centre on Substance Abuse. 2018; Durham Region Health Department, 2018). Moreover, the number of days spent in hospital as a result of

cannabis misuse has reportedly increased by 40%, which has been largely attributed to the adolescent and young adult age groups (15-24 years of age; Canadian Centre on Substance Abuse, 2018). Furthermore, in 2018, the Canadian Institute for Health Information reported the greatest rates of hospitalizations associated with cannabis use were among males aged 19-24 years, with estimates between 500-650 hospitalizations per 100,000 people, further supporting the relationship between younger age and increased risk associated with cannabis use.

Interestingly, neither gender nor age of first use emerged as significant in use-related problems in the current study. This finding comes in contrast with previous literature that identifies both male gender and younger age of first use as predictive of cannabis use problems. Males typically experience greater frequency of use, misuse, and hospitalizations as a result of cannabis use (Canadian Centre on Substance Abuse, 2018; Durham Region Health Department, 2018; Fogel et al., 2017; Johnson et al., 2015). Females have been found to demonstrate lower rates of misuse and hospitalization in contrast to males, but also tend to experience greater rates of telescoping, withdrawal symptoms, and anxiety associated with withdrawal symptoms relating to a greater tendency to relapse (Cooper & Haney, 2014; Cooper & Haney; 2016; Fogel et al., 2017; Johnson et al., 2015). The differential representation of males and females in the sample may partly explain the lack of gender identification in problems. Moreover, given that the current study did not differentiate the type of problems experienced (i.e., social-interpersonal, physiological, emotional, etc.), the different forms of cannabis-attributable consequences experienced by males and females may be presenting as similar

quantitatively, but not qualitatively. Further research is needed to examine this possibility.

Although age of first use has emerged consistently in previous research as a contributing factor for the experience of cannabis-related problems (Gruber et al., 2012; Lisdahl et al., 2014; Mahu et al., 2015), it did not emerge as such in the current study. This null finding may be due to the nature of the sample. Closer examination of the sample reveals that just under half of the study participants (*n*=151) reported using cannabis for the first time at or before the age of 16 years, and far fewer reported use before the age of 14 years (*n*=51). The average age of first use for the overall sample was 17.12 years, which is a later onset than typical of most studies. Moreover, younger age of onset generally refers to substance use initiation around the age of 13 or 14 (Gruber et al., 2013). Hence, it is possible that age of first use did not emerge as associated with cannabis problems because, overall, the sample only initiated cannabis use in later adolescence.

Of the SURPS personality subscales included in the regression model predicting cannabis use problems, only the H subscale emerged as significant, which accounted for 21.2% of the overall variance. The H subscale has previously been associated with problematic cannabis use (Hecimovic et al., 2014; Malmberg et al., 2010), as well as with the emergence of cannabis-related problems, including psychotic-like experiences (Spriggens & Hides, 2015). Individuals higher in H may be using substances to self-medicate aversive depressive symptoms, which may contribute to more problems. The mechanism underlying the role of H in cannabis use problems is still unknown; however,

individuals higher in H may have a sensitivity to the negatively reinforcing properties of certain substances, like cannabis (Woicik et al., 2009).

Regarding the five motive factors from the EFA entered on the final step of the regression predicting cannabis use problems, both Coping with Negative Affect and Positive Reinforcement motives emerged as uniquely contributing to increased cannabis-related problems, which accounted for 8.1% of the overall variance. It had been hypothesized that coping with negative affect would be predictive of cannabis problems because coping motives typically have been tied to substance use-related problems, such as DSM-IV cannabis dependence (Fox et al., 2011; Johnson et al., 2010), poorer mental health functioning (Blevins et al., 2016b; Bohnert et al., 2018; Brodbeck, Matter, Page, & Moggi, 2007), and greater psychosocial distress (Brodbeck et al., 2007). Individuals using cannabis to cope may seek to reduce negative affect (Mitchell et al., 2007). Coping with Negative Affect motives appear to be a particularly risky motive for cannabis use, demonstrating the greatest association with use-related problems among motive factors (Blevins et al., 2016b; Brodbeck et al., 2007; Buckner & Zvolensky, 2014; Chowdhury et al., 2016; Johnson et al., 2010). Not all studies have reported a large impact of motives on the propensity of developing use-related problems, however. For example, Simons and colleagues (1998) found a significant relationship between coping motives and alcohol use problems, but found motives were less important for cannabis problems (Simons et al., 1998). Interestingly, Simons and colleagues also identified only a small increase in explained variance for cannabis use problems when adding motives into a regression model (8%), similar to the current study, with lifetime use emerging as a more significant risk factor. This finding lends support to the results of the current study, suggesting that

motives may be less important in the development of cannabis use problems than other previously identified risk factors, such as lifetime use and personality factors (Simons et al., 1998).

Endorsement of Positive Enhancement motives factor also predicted greater presence of cannabis use problems in the present study, albeit to a slightly lesser degree than Coping with Negative Affect. Although not hypothesized, this finding is consistent with the findings of Fox and colleagues (2011), who found that endorsement of enhancement motives was predictive of greater cannabis-related use consequences, including DSM-IV dependence symptoms (Fox et al., 2011). Moreover, Enhancement motives are also more commonly endorsed in individuals with CUD than other use motives (Bonn-Miller & Zvolensky, 2009). In addition to enhancement motives, positive reinforcement motives in the present study included alternative perception motivated cannabis use, which also has demonstrated significant associations with increased cannabis-related consequences (Bravo et al., 2017; Simons et al., 1998). Given that positive reinforcement motives in the current study are representative of both enhancement and altered perception motives that are each associated with cannabis use problems, the current results are consistent with previous findings on the relationship between coping, enhancement, and expansion-related motives and cannabis use problems (Bonn-Miller & Zvolensky, 2009; Bravo et al., 2017; Fox et al., 2011).

Overall, the regression model predicting cannabis use problems demonstrated that Coping with Negative Affect and Positive Reinforcement motives factors were related to more cannabis use-related problems even after considering the influence of demographics, age of onset, and SURPS personality factors. Interestingly, the regression

also identified a significant contribution of the H personality trait, accounting for the largest proportion of variance in cannabis use problems, suggesting a more significant role of personality in the development of cannabis use problems. Screening individuals for cannabis misuse by including an assessment of whether or not they possess personality risk factors (i.e., H) and are using cannabis for these reasons will help practitioners identify cannabis users at higher risk of frequent cannabis use or cannabis-related consequences and provide greater opportunities for early intervention.

Limitations

Although a strength of the current research was the inclusion of a more generalizable sample than used in previous research (i.e., recruitment beyond a university population, diverse patterns of cannabis use), some limitations of the present study include the sample demographics (i.e., it was a largely female, Caucasian, over the age of 18, and predominantly New Brunswick/Ontario sample). Thus, these factors limit the generalizability of the current study. Furthermore, the current sample has a greater prevalence of frequent cannabis use than has been reported in previous literature. Given that the current study was conducted online through voluntary participation, a potential self-selection bias based on the subject matter of the present study may have contributed to the inclusion of heavier cannabis users. The cannabis use patterns reported by participants, however, suggested a relatively diverse sample with respect to cannabis usage, from recreational to more significant use. Random stratification would require significant national level resources, such as those afforded to Statistics Canada, which were outside the scope of the current project. Moreover, there was no question in the current study that asked participants to indicate whether their cannabis use was

recreational or medical. Although the current study was not focused on the differentiation of motives between recreational and medical, not including a question to distinguish between self-reported medical or recreational users creates a limitation in the current study's ability to report on the amount of health motivated users present in the study. A proxy measure of health motivated users was generated using endorsement levels of health enhancement items, however, this may have resulted in an overestimation of health motivated users so caution should be used when using this number for interpretation or extrapolation.

The present study was exploratory and, as such, no formal hypotheses were made regarding the expected number of factors underlying cannabis use motives. Given that there were no a priori expectations for the number of motives that would emerge, items were not generated for a specific set of motives and, as a result, not all factors were represented by a similar number of items. Factors emerging with a more significant number of items, for example the positive reinforcement factor (18 items), may generate more robust factor structures, however, having significant discrepancies in the number of items between motives subscales impacts the strength of the overall model the motive scale was attempting to represent. Thus, a limitation of the present study is that some motive factors were represented by a large number of items (e.g., 18 items), whereas others were represented by much fewer items (e.g., 3 items). It is a general rule of factor analysis to include a minimum of 5-10 items per factor. Although this issue represents a limitation of the present study, the emergence of the Secondary Substance factor in the present study provides support for future examination of the factor structure and potential inclusion of additional items to be tested to more effectively represent these identified

motive constructs. Moreover, despite the small number of items for the Secondary Substance factor, the internal consistency of the factor yielded reliable measurement.

In addition, due to the exploratory nature of the study, an orthogonal EFA was used to discern the fundamental factors associated with problematic cannabis use. Results of the factor analysis reveal some significant correlations between factors. Although an oblique rotation was run to further test the factor structure produced for correlated factors and a parallel analysis was run to confirm statistical significance of the factor structure, the significant correlations between factors are a limitation of the current study. Given that the shared variance between the most correlated factors was under 40%, individual factors were retained in the present study, however, a confirmatory factor analysis should be conducted to affirm the factor structure proposed in the current study.

Lastly, the cross-sectional research design of the present study removed the ability to make causal inferences between cannabis motivations and patterns of use. A longitudinal research design would have been necessary to elucidate any causal mechanisms between the identified cannabis use motives and the frequency of cannabis use or experience of negative cannabis-related consequences. Although favourable, longitudinal research designs are temporally and financially expensive, requiring resources that far exceeded those afforded to the current project.

Conclusions and Implications

The current study found support for several previously established motivations for cannabis use including coping, social cohesion, and enhancement/altered expansion, as well as the additional motives of health enhancement and secondary substance motivated use. Notably, in the current study, the previously established motives of enhancement and

altered expansion emerged together, labeled positive reinforcement motives for cannabis use, similar to the model presented by Newcomb and colleagues (Newcomb et al., 1988). Although they are sometimes presented individually in other cannabis motive models (Lee et al., 2007; Lee et al., 2009; Simons et al., 1998), the current study supports a singular Positive Reinforcement factor in cannabis use. In addition, positive reinforcement motives and coping with negative affect motives significantly predicted use-related consequences, suggesting that both of these motives are important in assessing risk of cannabis misuse. Lastly, social cohesion motives emerged, consistent with previous conformity motives (Simons et al., 1998), and were significantly associated with lower past 30-day cannabis use. In addition to confirming previously identified motives, the current study expanded upon current literature, with the emergence of health enhancement and secondary substance motives. The present study suggests that there is a subset of cannabis users who are using for medical or health enhancement purposes and some who are using for secondary substance motivations, which have been only recently identified in the literature. Interestingly, results of the present study identified a significant contribution of motivations and a smaller contribution of personality characteristics for recency of cannabis use, but identified the opposite pattern for the development of cannabis use problems. This finding suggests that motivations may significantly impact frequency of cannabis use behaviours, whereas personality characteristics may have more of a significant impact on the development of cannabis use problems, a similar finding to Simons and colleagues (Simons et al., 1998). Further research is needed to confirm the present motives structure; however, the present study provides support for the significance of motivations in cannabis use behaviours.

Considering that the prevalence rates for cannabis use in Canada were amongst the highest in the world prior to the legislative changes made in October 2018 (Canadian Centre on Substance Abuse, 2014, Fischer et al., 2016; United Nations Office on Drugs and Crime, 2013), that the legalization of cannabis increased accessibility to cannabis, and may have contributed to the societal normalization of cannabis use (Osborne & Fogel, 2016), understanding the factors contributing to cannabis use and misuse behaviours is imperative. Motivations for use have consistently emerged across substances as an important individual difference factor that contributes significantly to susceptibility to continued use and the experience of associated negative substance use consequences (Benschop et al., 2015; Bonn-miller et al., 2009; Fox et al., 2011; Schlossarek et al., 2016). As with Cooper's motivational model (1994), motivations can be divided into positive and negative reinforcement motivations, with negative reinforcement motivations (i.e., substance use to alleviate negative affect or sensations) being more strongly associated with problematic use and negative use-related outcomes (Blevins et al., 2016; Cooper, 1994; Fox et al., 2011). Although decreases in all motivations for use, as assessed by the CMMQ, typically contribute to reductions in frequency of use and use consequences, some motivations appear to significantly predict changes to cannabis use patterns, consequences, and treatment outcomes more than others (Blevins et al., 2016b). In particular, reductions to coping motivations have been most strongly and consistently linked to reductions in cannabis use consequences, over and above changes in other motivations (Blevins et al., 2016b). Results of the current study correspond with this, with motivations centred on the alleviation of negative sensations (i.e., coping with negative affect motivations) being significantly associated

with use-related problems. Cannabis-related harm is most likely to occur in weekly or daily cannabis users (Chatters et al., 2016); however, frequency of use does not necessarily predict greater cannabis use-related problems, as seen with health enhancement motivations in the current study. Thus, motivations contributing to quantity of cannabis consumed, as well as consequences related to cannabis use, need to be examined for effective prevention and treatment of cannabis misuse.

Interestingly, and contrary to the past 30-day use outcome, the SURPS personality risk factors emerged as the most significant contributor to cannabis use problems, explaining a greater proportion of variance than motivations. It appears that an individual's inherent personality traits are more important for the development of cannabis use problems, whereas motivations are more significant for cannabis use behaviours. It may be that personality traits (i.e., Hopelessness, Anxiety Sensitivity, Sensation Seeking, and Impulsivity) increase an individual's risk for problematic use and motivations serve as a mechanism to reinforce or maintain cannabis misuse behaviours. Although this finding requires replication, it provides an interesting potential insight into the importance of personality in the development of cannabis-related problems and the role of motivations in behaviour. Thus, personality traits and motivations are individual risk factors that contribute significantly and independently to the development of cannabis use patterns and associated problems. While personality traits are relatively stable over time, motivations are susceptible to change over time and, therefore, when targeted, can be altered and subsequently improve treatment outcomes (Blevins et al., 2016), the examination of motivations in the context of prevention and intervention is crucial.

Clinical therapies targeting substance use motivations have demonstrated efficacy in reducing use behaviours (i.e., frequency of use) in cannabis using populations and associated cannabis use-related problems, including symptoms of DSM-IV cannabis dependence (Banes, Stephens, Blevins, Walker, & Roffman, 2014; Blevins et al., 2016b; Blevins, Walker, Stephens, Banes, & Roffman, 2018; Walker et al., 2016). CBT and MET target cognitions and motivations that contribute to the maintenance of substance misuse behaviours. CBT and MET are collaborative therapies that allow individuals to acknowledge a problematic behaviour (i.e., problematic cannabis use), understand the behaviour's maladaptive role (i.e., using cannabis to reduce negative emotions), identify ways in which the maladaptive behaviour may be incompatible with future goals (i.e., excessive cannabis use may be incongruent with future career or relationship goals), and strengthen an individual's motivations for behavioural change (Blevins et al., 2018; de Gee, Verdurman, Bransen, de Jonge, & Schippers, 2014).

CBT and MET therapies have demonstrated efficacy when used individually or concurrently. Three studies have reported significant differences between those who receive MET for their cannabis misuse in comparison to wait-listed controls. Cannabis use outcomes were largely improved for the MET participants, reporting a minimum of at least one significant improvement in use-related outcomes and significant improvements in dependence symptoms across studies (Babor et al., 2004; Stephens, Roffman, & Curtin, 2000; Stephens, Roffman, Fearer, Williams, & Burke, 2007). Research on the efficacy of CBT interventions for cannabis cessation has revealed similar results to MET, with five studies reporting significantly better outcomes for participants in CBT-based therapies compared to wait-list controls on all primary measures of cannabis-related

outcomes (i.e., frequency of cannabis use, presence and severity of DSM-IV cannabis dependence symptoms, and presence and severity of cannabis-related problems; Babor et al., 2014; Hoch et al., 2012; Hoch et al., 2014; Jungerman, Andreoni, & Laranjeira, 2007; Stephens et al., 2000). Additionally, interventions that have concurrently used MET and CBT have demonstrated success in reducing post-intervention coping motives for drinking (Blevins & Stephens, 2016), reductions in several different motivations for cannabis use (Banes et al., 2014; Blevins et al., 2016b), and contributed to reductions in cannabis use frequency and DSM-IV cannabis dependence symptoms, post-intervention (Blevins et al., 2016b). Changes to and reductions in motivations for cannabis use and cannabis use patterns were maintained at 15-month follow up periods, suggesting that changes to motivations for substance use through motivational and cognitively-based interventions can lead to long-term therapeutic improvements (Blevins et al., 2016b). Based on the findings reported in the current thesis, individuals who use cannabis for positive reinforcement or coping with negative affect motivations may be most likely to benefit from CBT and/or MET-based therapeutic interventions (Walker et al., 2016).

Inclusion of motivations into tools for screening cannabis misuse may also serve to help mitigate the development of potential misuse and use-related consequences in the future. Screening tools in cannabis use, such as the Cannabis Use Disorders Identification Test (Spilka, Janssen, & Legleye, 2013) and the Cannabis Abuse Screening Test (Adamson & Sellman, 2003) focus on risk for problematic use based on consumption rates, presence and severity of cannabis use-related problems, and disordered use (Adamson et al., 2010). Interestingly, the aforementioned screening tools do not address motivations behind cannabis use as a risk for the development of misuse and cannabis-

related problems. Given the significant contribution of motivations for use in the development of problematic misuse and the experience of use-related consequences, it may be worth examining whether the inclusion of motivations in screening tools may add sensitivity in identifying individuals that are at increased risk for misuse.

In sum, the present study provides evidence for differential motives underlying cannabis use than those found in alcohol research, and further affirms the significance of motivations in cannabis use and related consequences. Although only coping and positive reinforcement motivations were associated with greater cannabis-related problems, health enhancement and social cohesion motives were predictive of frequency of use, providing crucial information about cannabis use patterns and misuse. By elucidating the motivations behind cannabis use and their associations with use-related outcomes, a more comprehensive understanding of cannabis behaviours can be developed and used towards the advancement of more effective tools for cannabis prevention, screening, and intervention.

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Table 1

Demographic Information

Variable	*M* (*SD*)	*n* (%)
Age	31.76 (13.31)	
Gender		
Male		102 (28)
Female		261 (71.5)
Other		1 (0.3)
Ethnicity		
European Origin / Caucasian		321 (89.2)
Asian-Canadian / Asian Origin		9 (2.5)
Indigenous Peoples		8 (2.2)
Bi-Racial / Multi-Racial		10 (2.8)
African-Canadian / Caribbean or African Origin		6 (1.7)
Middle Eastern		2 (0.5)
Latino(a) / Hispanic		1 (0.3)
Other		3 (0.8)
Province of Residence		
New Brunswick		234 (68.0)
Ontario		67 (19.5)
Alberta		12 (3.5)
British Columbia		10 (2.9)
Nova Scotia		5 (1.5)
Quebec		5 (1.5)
Manitoba		4 (1.2)
Saskatchewan		3 (0.9)
Newfoundland and Labrador		2 (0.6)
Prince Edward Island		2 (0.5)
Highest Level of Education		
Middle School (Grades 6-8)		3 (0.8)
High School (Grades 9-12)		61 (16.8)
Some Community College		22 (6.0)
Completed Community College		83 (22.8)
Some University		103 (28.3)
University Degree		65 (17.9)
Post Graduate Studies or Specialized Degree (MA, Ph.D., LLB)		27 (7.4)
Marital Status		
Single (Never Married)		190 (52.2)
Common Law / Married		152 (41.7)
Separated / Divorced / Widowed		22 (6.0)

Note. *N*=365. Totals for all variables are not equal to *N*=365 due to missing values Gender (*n*=1), Ethnicity (*n*=5), Province (*n*=21), Education (*n*=1).

Table 2

SURPS Descriptive Statistics

SURPS Subscale	Minimum	Maximum	*M*	*SD*
H	7.00	25.00	12.98	3.45
AS	6.00	20.00	12.73	2.47
SS	7.00	24.00	15.89	3.02
IMP	5.00	18.00	10.15	2.37

Note. *N*=365; H = Hopelessness; AS = Anxiety Sensitivity; SS = Sensation Seeking; IMP = Impulsivity.

Table 3

Cannabis Use Descriptives

Variable	*M* (*SD*)	*n* (%)
Age of First Use	17.12 (5.73)	
Length of Cannabis Use		
Tried It a Few Times		35 (9.7)
Between 6 Months and 1 Year of Using		55 (15.2)
Between 2 and 5 Years of Using		82 (22.6)
Between 6 and 10 Years		57 (15.7)
Over 10 Years		133 (36.7)
Frequency of Use		
6 Times a Year or Less		98 (26.9)
1 to 4 Times a Month		73 (20.1)
2 to 6 Times a Week or Almost Everyday		98 (26.9)
Several Times a Day		95 (26.1)
Recency of Use		
Used Cannabis in Past 30 Days		271 (73.8)
Average # of Days Used in Past 30 (if reporting past 30-day use)	17.3 (12.31)	
Average Number of Days Reaching Intoxication in Past 30	9.05 (11.50)	
Cannabis Use Problems (CPQ) Total Score	2.14 (2.64)	

Note. *N*=365.

Table 4

3 Fixed Factor EFA Item Loadings

	Factors		
Items	1	2	3
I use cannabis to help me get to sleep at night		**.695**	-.316
I use cannabis to help reduce anxious feelings	.297	**.626**	
I use cannabis to relax	**.536**	.476	-.297
I use cannabis as a reward for completing tasks	**.653**		
I use cannabis at the end of the week to unwind	**.605**		
I use cannabis to make me more popular socially			**.553**
I use cannabis to help with pain symptoms		**.711**	
I use cannabis to improve my appetite	.339	**.599**	
I use cannabis to reduce symptoms of nausea		**.687**	
I use cannabis because it improves my quality of life	.391	**.648**	
I use cannabis only because my friends use cannabis		-.314	**.605**
I use cannabis to improve my motivation	.400	**.621**	
I use cannabis to get through events that are emotionally painful	.392	**.544**	
I use cannabis to make events or activities more fun	**.709**		
I use cannabis to get more joy out of things	**.724**		
I use cannabis to make me less nervous socially	.371	**.459**	
I use cannabis to numb feelings	.406	**.425**	
I use cannabis to feel less down emotionally	.390	**.533**	
I use cannabis as a way to celebrate things	**.715**		
I use cannabis to feel closer to nature	**.505**	.334	
I use cannabis to heighten emotions	**.692**		
I use cannabis to heighten physical sensations	**.742**		
I use cannabis to heighten sexual experiences	**.674**		
I use cannabis to improve concentration	.404	**.549**	
I use cannabis to reduce stress	**.585**	.469	
I use cannabis to improve my creativity	**.668**	.435	
I use cannabis to become more self-aware (introspection)	**.716**	.351	
I use cannabis for the alternative thought processes I experience	**.739**		
I use cannabis because I believe it is a safer method of intoxication	**.611**		
I use cannabis to improve productivity	.443	**.598**	
I use cannabis to reduce anger	.418	**.590**	

I use cannabis because I feel I have better control over myself than if I use other methods of intoxication	**.548**	.341	
I use cannabis to help with the symptoms of another drug (i.e., calm down from cocaine)		.329	**.397**
I use cannabis to control muscle spasms and cramping associated with a medical condition		**.674**	
I use cannabis for seizure control		**.530**	.347
I use cannabis to help me reduce my use of other substances—detoxing method (i.e., use cannabis to reduce cocaine use)		.457	**.461**
I use cannabis when I am bored	**.606**		
I use cannabis to try to understand why others use cannabis			**.544**
I use cannabis for the euphoric sensations it gives me	**.691**		

Note. *N*=365. Item loading values below .295 have not been reported in the table for improved interpretability.

Table 5

4 Fixed Factor EFA Item Loadings

Items	Factors 1	2	3	4
I use cannabis to help me get to sleep at night		.449	**.459**	-.420
I use cannabis to help reduce anxious feelings			**.660**	
I use cannabis to relax	.487		**.491**	-.331
I use cannabis as a reward for completing tasks	**.642**			
I use cannabis at the end of the week to unwind	**.596**			
I use cannabis to make me more popular socially				**.562**
I use cannabis to help with pain symptoms		**.567**	.335	-.326
I use cannabis to improve my appetite	.319	**.560**	.406	
I use cannabis to reduce symptoms of nausea		**.557**	.364	
I use cannabis because it improves my quality of life	.404	**.514**	.328	
I use cannabis only because my friends use cannabis				**.681**
I use cannabis to improve my motivation	.424	**.565**		
I use cannabis to get through events that are emotionally painful	.302		**.630**	
I use cannabis to make events or activities more fun	**.665**			
I use cannabis to get more joy out of things	**.677**		.306	
I use cannabis to make me less nervous socially	.302		**.509**	
I use cannabis to numb feelings			**.668**	
I use cannabis to feel less down emotionally			**.691**	
I use cannabis as a way to celebrate things	**.691**			
I use cannabis to feel closer to nature	**.566**	.427		
I use cannabis to heighten emotions	**.677**			
I use cannabis to heighten physical sensations	**.738**			
I use cannabis to heighten sexual experiences	**.671**			
I use cannabis to improve concentration	.438	**.527**		
I use cannabis to reduce stress	**.532**		.498	
I use cannabis to improve my creativity	**.706**	.411		
I use cannabis to become more self-aware (introspection)	**.747**	.338		
I use cannabis for the alternative thought processes I experience	**.772**			
I use cannabis because I believe it is a safer method of intoxication	**.616**			

I use cannabis to improve productivity	.489	**.576**		
I use cannabis to reduce anger	.377	.427	**.478**	
I use cannabis because I feel I have better control over myself than if I use other methods of intoxication	**.542**			
I use cannabis to help with the symptoms of another drug (i.e., calm down from cocaine)		**.395**		.307
I use cannabis to control muscle spasms and cramping associated with a medical condition		**.676**		
I use cannabis for seizure control		**.633**		
I use cannabis to help me reduce my use of other substances—detoxing method (i.e., use cannabis to reduce cocaine use)		**.538**		.334
I use cannabis when I am bored	**.552**		.380	
I use cannabis to try to understand why others use cannabis				**.530**
I use cannabis for the euphoric sensations it gives me	**.685**			

Note. *N*=365. Correlations below .295 were not reported in the table for improved interpretability.

Table 6

Final 5 Fixed Factor EFA Item Loadings

Items	Factors 1	2	3	4	5
I use cannabis to help me get to sleep at night		**.461**	.454	-.409	
I use cannabis to help reduce anxious feelings			**.647**		
I use cannabis to relax	**.492**		.465	-.383	
I use cannabis as a reward for completing tasks	**.643**				
I use cannabis at the end of the week to unwind	**.609**				
I use cannabis to make me more popular socially				**.558**	
I use cannabis to help with pain symptoms		**.555**	.346	-.304	
I use cannabis to improve my appetite		**.436**	.412		
I use cannabis to reduce symptoms of nausea		**.530**	.372		
I use cannabis because it improves my quality of life	.348	**.568**	.330		
I use cannabis only because my friends use cannabis				**.707**	
I use cannabis to improve my motivation	.351	**.641**			
I use cannabis to get through events that are emotionally painful			**.637**		
I use cannabis to make events or activities more fun	**.690**				
I use cannabis to get more joy out of things	**.686**				
I use cannabis to make me less nervous socially		.306	**.521**		
I use cannabis to numb feelings	.306		**.669**		
I use cannabis to feel less down emotionally			**.703**		
I use cannabis as a way to celebrate things	**.704**				
I use cannabis to feel closer to nature	**.528**	.417			
I use cannabis to heighten emotions	**.667**				
I use cannabis to heighten physical sensations	**.732**				

I use cannabis to heighten sexual experiences	**.669**				
I use cannabis to improve concentration	.358	**.646**			
I use cannabis to reduce stress	**.524**		.477		
I use cannabis to improve my creativity	**.661**	.472			
I use cannabis to become more self-aware (introspection)	**.697**	.448			
I use cannabis for the alternative thought processes I experience	**.734**	.338			
I use cannabis because I believe it is a safer method of intoxication	**.593**				
I use cannabis to improve productivity	.404	**.704**			
I use cannabis to reduce anger	.370	.350	**.476**		
I use cannabis because I feel I have better control over myself than if I use other methods of intoxication	**.523**				
I use cannabis to help with the symptoms of another drug (i.e., calm down from cocaine)					**.707**
I use cannabis to control muscle spasms and cramping associated with a medical condition		**.581**			.301
I use cannabis for seizure control		.412			**.513**
I use cannabis to help me reduce my use of other substances—detoxing method (i.e., use cannabis to reduce cocaine use)					**.839**
I use cannabis when I am bored	**.586**		.358		
I use cannabis to try to understand why others use cannabis				**.550**	
I use cannabis for the euphoric sensations it gives me	**.694**				

Note. *N*= 365. Correlations below .295 were not reported in the table for improved interpretability. Factor 1 = Positive Reinforcement Motives; Factor 2 = Health Enhancement Motives; Factor 3 = Coping with Negative Affect Motives; Factor 4 = Social Cohesion Motives; Factor 5 = Secondary Substance Motives.

Table 7

Oblimin Rotation Item Loading Pattern Matrix

	Factors				
Items	1	2	3	4	5
I use cannabis to help me get to sleep at night			**-.398**	.362	
I use cannabis to help reduce anxious feelings			-.310	.**628**	
I use cannabis to relax	.302		-.**422**	.373	
I use cannabis as a reward for completing tasks	.**545**				
I use cannabis at the end of the week to unwind	.**543**		-.301		
I use cannabis to make me more popular socially			.**549**		
I use cannabis to help with pain symptoms		-.**577**			
I use cannabis to improve my appetite		-.**333**		.313	
I use cannabis to reduce symptoms of nausea		-.**458**			
I use cannabis because it improves my quality of life		-.**307**			
I use cannabis only because my friends use cannabis			.**710**		
I use cannabis to improve my motivation	.**706**				
I use cannabis to get through events that are emotionally painful				.**628**	
I use cannabis to make events or activities more fun	.**692**				
I use cannabis to get more joy out of things	.**650**				
I use cannabis to make me less nervous socially				.**524**	
I use cannabis to numb feelings				**.707**	
I use cannabis to feel less down emotionally				**.723**	
I use cannabis as a way to celebrate things	**.629**				
I use cannabis to feel closer to nature	**.577**				
I use cannabis to heighten emotions	**.606**				
I use cannabis to heighten physical sensations	**.822**				

I use cannabis to heighten sexual experiences	**.730**				
I use cannabis to improve concentration	**.679**				
I use cannabis to reduce stress				**.399**	
I use cannabis to improve my creativity	**.581**				
I use cannabis to become more self-aware (introspection)	**.622**				
I use cannabis for the alternative thought processes I experience	**.707**				
I use cannabis because I believe it is a safer method of intoxication	**.504**				
I use cannabis to improve productivity	**.794**				
I use cannabis to reduce anger				**.383**	
I use cannabis because I feel I have better control over myself than if I use other methods of intoxication	**.336**				
I use cannabis to help with the symptoms of another drug (i.e., calm down from cocaine)					**.771**
I use cannabis to control muscle spasms and cramping associated with a medical condition		**-.606**			
I use cannabis for seizure control					**.502**
I use cannabis to help me reduce my use of other substances—detoxing method (i.e., use cannabis to reduce cocaine use)					**.951**
I use cannabis when I am bored	**.477**				
I use cannabis to try to understand why others use cannabis			**.543**		
I use cannabis for the euphoric sensations it gives me	**.727**				

Note. *N*=365. Loadings below .295 are not reported in the table for improved interpretability.

Table 8

Correlations Between Motives Factors

	Factors				
Factors	Positive Reinforcement	Health Enhancement	Coping with Negative Affect	Social Cohesion	Secondary Substance
Positive Reinforcement	-				
Health Enhancement	.573*	-			
Coping with Negative Affect	.622*	.677*	-		
Social Cohesion	.101	-.101	.053	-	
Secondary Substance	.272*	-.300*	.316*	.175*	-

Note. *N*= 365; * denotes correlations reaching significance at the Bonferroni adjusted threshold of $p<.001$(surpassing Bonferroni adjustments of $p<.005$).

Table 9

Correlations Between SURPS Personality Subscale Scores and Motive Factors

	SURPS Personality Subscales			
Factors	H	AS	SS	IMP
Positive Reinforcement	.085	-.188*	.346*	.162
Health Enhancement	.187*	-.176*	.110	.031
Coping with Negative Affect	.404*	-.055	.225*	.320*
Social Cohesion	.102	.112	.072	.257*
Secondary Substance	.155	-.049	.162	.228*

Note. *N*=365; * denotes correlations that reached significance at the $p < .001$ after Bonferroni adjustments (emerged at *p* values lower than the Bonferroni adjustment of $p < .002$); H = Hopelessness; AS = Anxiety Sensitivity; SS = Sensation Seeking; IMP = Impulsivity.

Table 10

Hierarchical Regressions Assessing Demographics, Personality, and Motives on Past 30-Day Cannabis Use and Cannabis Use-Related Problems

	Past 30 Day Use		Cannabis Problems	
Predictors	ΔR^2	β	ΔR^2	β
Step 1	.129**		.041*	
Age		.316**		-.197**
Gender		-.110*		-.046
Age of First Use		-.126*		-.057
Step 2	.050**		.212**	
H		.165*		.421**
AS		-.150*		.084
SS		.091		.029
IMP		-.038		.062
Step 3	.380**		.081**	
Positive Reinforcement Motives		.060		.173*
Health Enhancement Motives		.487**		-.004
Coping with Negative Affect Motives		.120		.183*
Social Cohesion Motives		-.233**		-.009
Secondary Substance Motives		-.022		.000
Total R^2	.560**		.337**	
N	349		343	

Note. * denotes significance at $p < .05$; ** denotes significance at $p < .001$; H = Hopelessness, AS = Anxiety Sensitivity; SS = Sensation Seeking; IMP = Impulsivity. β values represented in the table are those at the point and step that variable was entered into.

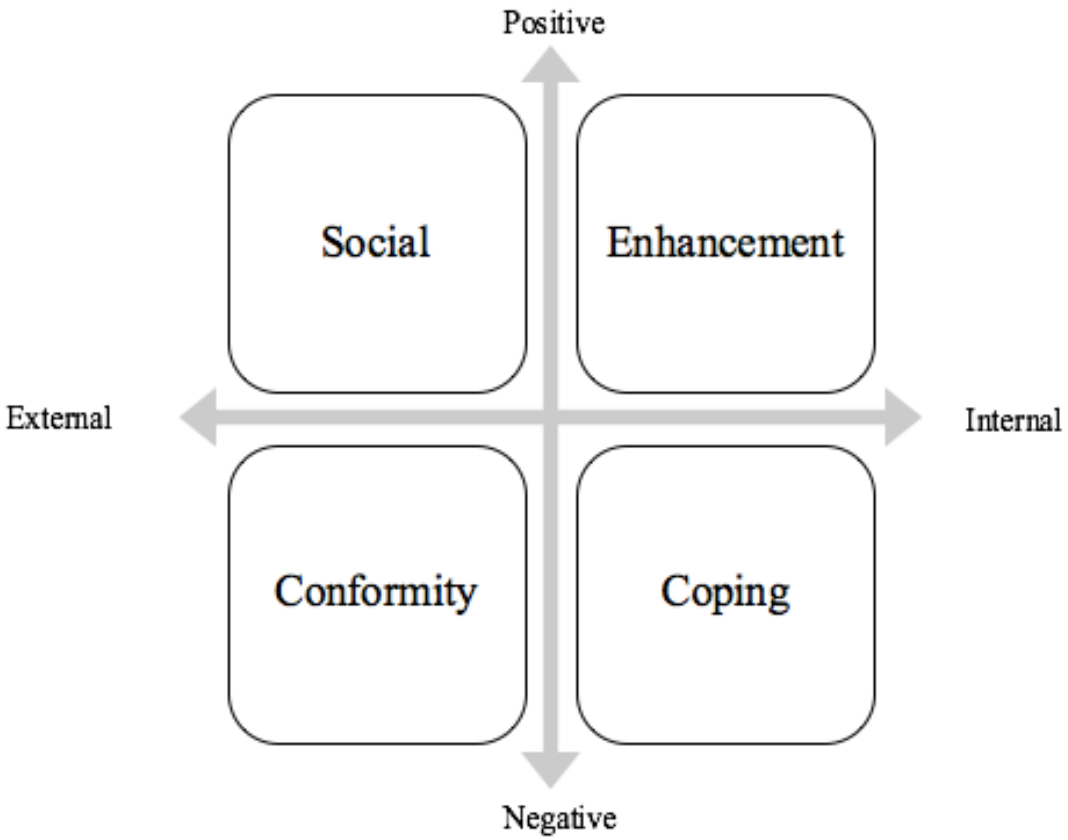

Figure 1. Cooper's Motivational Model.

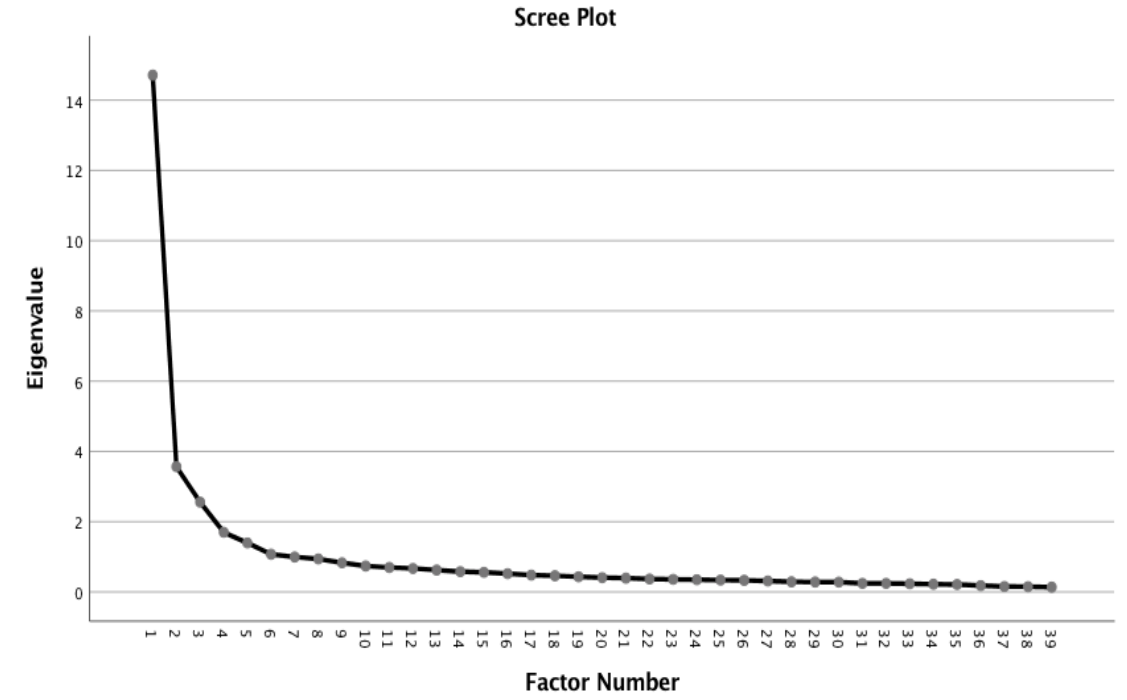

Figure 2. Exploratory Factor Analysis Scree Plot.

Appendix A

DSM-5 Cannabis Use Disorder Diagnostic Criteria

1) Cannabis is often taken in larger quantities or over longer periods of time than intended.

2) There is persistent desire or unsuccessful efforts to cut down on or control cannabis use.

3) Significant quantities of time is spent on activities surrounding the acquisition or administration of cannabis.

4) There is a strong craving or desire to use cannabis.

5) Recurrent cannabis use results in a failure to fulfill role obligations in one or more areas of life (i.e., employment responsibilities, social roles).

6) There is persistent use of cannabis despite the presence of negative social or physical consequences that are a result of or exacerbated by cannabis use.

7) Recurrent cannabis use during times in which it is physically hazardous to do so.

8) Increased need for markedly higher quantities of cannabis to achieve the same desired effect (tolerance).

9) Increased experience of physiological withdrawal symptoms when not engaging in cannabis use behaviours.

10) Important social or occupational activities are reduced or abandoned in favour of cannabis-related activities.

Note: The number of endorsed criteria indicates severity; 2-3 mild, 4-5 moderate, and 6+ severe.

Appendix B

Demographic Questionnaire

1. Age (in years): ____

2. Gender:
   Male _____
   Female _____
   Other _____

3. To which ethnic group do you most identify yourself as belonging to?

   () African-Canadian / African Origin / Caribbean Origin

   () Asian-Canadian / Asian Origin

   () Latino(a) / Hispanic

   () Indigenous Peoples

   () European Origin / Caucasian

   () Middle Eastern

   () Bi-Racial / Multi-Racial

   () Other (please specify):_____

4. What is the highest level of education that you have **completed**?

   () Elementary school (Grades 1-5)

   () Middle School (Grades 6-8)

   () High School (Grades 9-12)

   () Some Community College

() Community College

() Some University

() University (undergraduate degree)

() Post-Graduate Studies (MA or PH.D.)

5. What is your current marital status?

() Single (never married)

() Common Law

() Married

() Separated/Divorced

() Widow

6. What is your gross annual family income?

____ Less than $25,000

____ $26,000 to $40,000

____ $41,000 to 60,000

____ $61,000 to $80,000

____ $81,000 to $99,000

____ More than $100,000

7. Occupation (specify): _____

8. What has been your employment pattern in the last year?

☐ Full time (35+ hours) ☐ Military service

☐ Part time (regular hours) ☐ Retired/disability

☐ Part time (irregular hours) ☐ Unemployed

☐ Student ☐ In controlled environment

9. Do you receive money from any of the following sources? (check all that apply)

☐ Employment ☐ Pension, benefits, or social security

☐ Unemployment compensation ☐ Partner, family, or friends

☐ Welfare ☐ Illegal

10. How many people depend on you for the majority of their food, shelter, etc.?

_____

Appendix C

Substance Use Risk Profile Scale—SURPS

Rate each statement as it applies to you by choosing the appropriate number.	Strongly Disagree	Disagree	Agree	Strongly Agree
I am content.	1	2	3	4
I often don't think things through before I speak.	1	2	3	4
I would like to skydive.	1	2	3	4
I am happy.	1	2	3	4
I often involve myself in situations that I later regret being involved in.	1	2	3	4
I enjoy new and exciting experiences even if they are unconventional.	1	2	3	4
I have faith that my future holds great promise.	1	2	3	4
It's frightening to feel dizzy or faint.	1	2	3	4
I like doing things that frighten me a little.	1	2	3	4
It frightens me when I feel my heart beat change.	1	2	3	4
I usually act without stopping to think.	1	2	3	4
I would like to learn how to drive a motorcycle.	1	2	3	4
I feel proud of my accomplishments.	1	2	3	4
I get scared when I'm too nervous.	1	2	3	4

Generally, I am an impulsive person.	1	2	3	4
I am interested in experience for its own sake even if it is illegal.	1	2	3	4
I feel that I'm a failure.	1	2	3	4
I get scared when I experience unusual sensations.	1	2	3	4
I would enjoy hiking long distances in wild and uninhibited territory.	1	2	3	4
I feel pleasant.	1	2	3	4
It scared me when I'm unable to focus on a task.	1	2	3	4
I feel I have to be manipulative to get what I want.	1	2	3	4
I am very enthusiastic about my future.	1	2	3	4

Appendix D

Adapted Cannabis—ASI

1. How many days did you use Cannabis **in the past 30 days?** _____ (number of days)
2. How many days did you use Cannabis to intoxication **in the past 30 days?** _____ (number of days)
3. How much money would you say you spent on Cannabis **in the past 30 days?** _____
4. **In the past 30 days,** how many days have you experienced problems due to Cannabis? _____ (number of days)
5. How troubled or bothered have you been by these Cannabis problems **in the past 30 days?**

   ☐ Not at all ☐ Slightly ☐ Moderately ☐ Considerably ☐ Extremely
6. How important to you now is treatment for these Cannabis problems?

   ☐ Not at all ☐ Slightly ☐ Moderately ☐ Considerably ☐ Extremely
7. Please circle how frequently you have used the following substances **in the past 30 days** (<u>not</u> including drugs taken as prescribed by your doctor).

   1 = never use
   2 = less than once a month
   3 = about once a month
   4 = two or three times a month
   5 = once or twice a week
   6 = three or four times a week
   7 = nearly every day
   8 = once a day or more

1. Tobacco (cigarettes, cigars, chew)	1	2	3	4	5	6	7	8
2. Heroin	1	2	3	4	5	6	7	8
3. Methadone	1	2	3	4	5	6	7	8
4. Other opiates/narcotics (morphine; opium; Dilaudid; Demerol; Percocet; Vicodin; Oxycontin; Fentanyl; Codeine; Tylenol 2,3,4)	1	2	3	4	5	6	7	8
5. Barbiturates (Nembutal, Seconol, Amytal, Secobarbital, Phenobarbital)	1	2	3	4	5	6	7	8
6. Sedatives/Hypnotics/Tranquilizers (benzodiazepines, Valium, Xanax, Librium, Ativan, Quaaludes)	1	2	3	4	5	6	7	8
7. Cocaine (free-base, crack cocaine)	1	2	3	4	5	6	7	8
8. Amphetamines (methamphetamines, Dexedrine, Ritalin, speed, ice)	1	2	3	4	5	6	7	8
9. Alcohol	1	2	3	4	5	6	7	8
10. Hallucinogens (LSD [acid], mescaline, psilocybin [mushrooms], ecstasy, PCP [phencyclidine])	1	2	3	4	5	6	7	8

8. How many days have you used more than one substance (including Cannabis) **in the past 30 days**? _____

9. How old were you the first time you used cannabis? _____

10. How long have you been using cannabis?

☐ Within First 6 Months of Using	4 Years
☐ Within First Year of Using	5 Years
☐ 2 Years	Over 7 Years
☐ 3 Years	10+ Years

11. How often do you use cannabis?

Never use	☐ 1-3 Times a Month
☐ Once a Year	☐ Once a Week
☐ 3-5 Times a Year	☐ 1-3 Times a Week
☐ Once Every Other Month	☐ 4-6 Times a Week
☐ Once a Month	☐ Once a Day or More

Appendix E

Cannabis Problems Questionnaire—CPQ

All the questions apply to your experiences from smoking cannabis in the last 3 months.

Please answer all of the questions by indicating Yes or No

Problem	No	Yes
Have you tended to smoke more on your own than you used to?	1	2
Have you worried about meeting people you don't know when stoned?	1	2
Have you spent more time with smoking friends than other kinds of friends?	1	2
Have your friends criticized you for smoking too much?	1	2
Have you sold any of your belongings to buy cannabis?	1	2
Do you find yourself making excuses about money?	1	2
Have you been in trouble with the police due to your smoking?	1	2
Have you been physically sick after smoking?	1	2
Have you passed out after a smoking session?	1	2
Have you had pains in your chest or lungs after a smoking session?	1	2
Have you been neglecting yourself physically?	1	2
Have you failed to wash for several days at a time?	1	2
Have you felt depressed for more than a week?	1	2

Have you been so depressed you felt like doing away with yourself?	1	2
Have you given up recreational activities you once enjoyed for smoking?	1	2
Do you find it hard to get the same enjoyment from your usual interests?	1	2
Has your general health been poorer than usual?	1	2
Have you felt more antisocial after smoking?	1	2
Have you been concerned about a lack of motivation?	1	2
Have you worried about feelings of personal isolations or detachment?	1	2
Do you usually have a smoke in the morning, to get yourself going?	1	2

Appendix F

Cannabis Motives

Motive	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
I use cannabis to help me get to sleep at night	1	2	3	4	5
I use cannabis to help reduce anxious feelings	1	2	3	4	5
I use cannabis to relax	1	2	3	4	5
I use cannabis as a reward for completing tasks	1	2	3	4	5
I use cannabis at the end of the week to unwind	1	2	3	4	5
I use cannabis to make me more popular socially	1	2	3	4	5
I use cannabis to help with pain symptoms	1	2	3	4	5
I use cannabis to improve my appetite	1	2	3	4	5
I use cannabis to reduce symptoms of nausea	1	2	3	4	5
I use cannabis because it improves my quality of life	1	2	3	4	5
I use cannabis only because my friends use cannabis	1	2	3	4	5
I use cannabis to improve my motivation	1	2	3	4	5

I use cannabis to get through events that are emotionally painful	1	2	3	4	5
I use cannabis to make events or activities more fun	1	2	3	4	5
I use cannabis to get more joy out of things	1	2	3	4	5
I use cannabis to make me less nervous socially	1	2	3	4	5
I use cannabis to numb feelings	1	2	3	4	5
I use cannabis to feel less down emotionally	1	2	3	4	5
I use cannabis as a way to celebrate things	1	2	3	4	5
I use cannabis as part of a religious or spiritual practice	1	2	3	4	5
I use cannabis to feel closer to nature	1	2	3	4	5
I use cannabis to heighten emotions	1	2	3	4	5
I use cannabis to heighten physical sensations	1	2	3	4	5
I use cannabis to heighten sexual experiences	1	2	3	4	5
I use cannabis to improve concentration	1	2	3	4	5
I use cannabis to reduce stress	1	2	3	4	5
I use cannabis to improve creativity	1	2	3	4	5

I use cannabis to become more self-aware (introspection)	1	2	3	4	5
I use cannabis for the alternative thought processes I experience	1	2	3	4	5
I use cannabis because I believe it is a safer method of intoxication	1	2	3	4	5
I use cannabis to improve productivity	1	2	3	4	5
I use cannabis to reduce anger	1	2	3	4	5
I use cannabis because I feel I have better control over myself than if I use other methods of intoxication (i.e., alcohol or other drugs)	1	2	3	4	5
I use cannabis to help with the symptoms of another drug (i.e., using cannabis to calm down from cocaine)	1	2	3	4	5
I use cannabis to control muscle spasms and cramping associated with a medical condition	1	2	3	4	5
I use cannabis for seizure control	1	2	3	4	5
I use cannabis as a detoxification method to help reduce my use of other substances (i.e., using cannabis to stop using cocaine as regularly)	1	2	3	4	5

I use cannabis to understand why others use cannabis	1	2	3	4	5
I use cannabis for the euphoric sensations it gives me	1	2	3	4	5

Appendix G

Study Consent Form

PROJECT NAME: Current Cannabis Use Patterns and Perspectives on Legalization in Canada

Please read the following information carefully before agreeing to participate in this research study.

Introduction: You are invited to participate in a study which will investigate the current patterns of use of Cannabis in Canada, motives for use, perspectives on Cannabis, knowledge about Cannabis, and perspectives on the legalization of Cannabis in Canada. The study aims to contribute to the creation of a more comprehensive understanding of the current patterns of use for Cannabis, perspectives of Cannabis, and how those patterns may be impacted by the legalization of Cannabis in Canada in 2018.

Researcher Information: This study is conducted by graduate student Catherine McDonald, cmcdona2@unb.ca, under the supervision of Dr. Caroline Brunelle from the Department of Psychology at the University of New Brunswick- Saint John. In the event that you wish to contact Dr. Caroline Brunelle, you may contact her at **(506) 648-5797** or cbrunell@unb.ca (this information will be provided to you again after the study is completed).

Procedure: You will first be asked for some basic information about yourself including age, gender, ethnicity, and employment status. Then you will be asked to complete a series of questionnaires asking about your experiences with Cannabis, age of first use, motivations for using Cannabis, perspectives on Cannabis, health risk awareness of Cannabis, and your perspectives on the legalization of Cannabis.

Participation Information: The study will take approximately 15-30 minutes to complete. If you are completing this study via UNB student access services (MyUNBportal, SONA, etc) you will be awarded 0.5 course credit for participation. If you are completing this study via social media or forum advertisements, you will have the option of entering into a draw to win one of 2 $25.00 Amazon gift cards. Please note that your participation is voluntary and you may withdraw at any time without loss of compensation. It is not expected that you will face any risks or discomfort during your participation. The benefit of participating in this research is that you will gain firsthand experience with psychological research in general.

Confidentiality: We will make every reasonable attempt to ensure that the information you provide is kept confidential. However, because the data is collected over the internet, complete anonymity and confidentiality cannot be guaranteed. Given that this website is based out of the USA, it is possible that this survey data may be reviewed under provisions of the PATRIOT Act. Specifically, the United States Department of Homeland Security has the right to access survey information if it is believed to be a threat to national security. However, given the nature of this study, it is very unlikely that this would happen. You will not be asked for any personally identifying information. Data will be stored securely in a password protected file and on an encrypted USB that will be kept in the locked office of the primary researcher. Results of this study will only be reported in combined form, so your individual responses will not be shared.

Additional Contact Information: If you have ethical concerns about your participation in this study and would like to discuss this study with someone not directly involved in

this research, you may contact Dr. Lisa Best, Chair Research Ethics Board, UNB- Saint John (648-5908; reb@unb.ca).

By clicking "Continue," I confirm that I have read the information on the INFORMED CONSENT FORM and volunteer to participate in this study. I am aware that all records are entirely confidential, and that I may discontinue my participation at any point in the study without loss of compensation.

Appendix H

University of New Brunswick Saint John
PO Box 5050 Saint John, NB E2L 4L5

Research Ethics Board

UNIVERSITY OF NEW BRUNSWICK
PO BOX 4040 FREDERICTON, NB CANADA E2L 4L5
TEL 506 453 5189 FAX 506 453 3522 WWW.UNB.CA/RESEARCH
OFFICE OF THE VICE-PRESIDENT (RESEARCH)

December 19, 2017

Name: Catherine McDonald
Department of Psychology
UNBSJ

Project Title: **"Current Cannabis Use Patterns and Perspectives on Legalization in Canada"**

REB File Number: 049-2017
Date Application Received – **December 18, 2017**
Date Application Approved – **December 19, 2017**

Dear Catherine,

This is to inform you that the above – named protocol has been approved as submitted.

The period of approval is from December 19, 2017 – December 19, 2021.

Please inform me of any changes made to your protocol during the approval period.

Annual Reports for this project are due on the 15th. January of each year, provided that this date is at least six months after the date of project approval. **Final reports** are due 90 days after project completion.

Although your application was processed via Delegated Review, for your information we are providing a list of current Research Ethics Board members.

Good luck with your research.

Sincerely,

Lisi Best.

Dr. Lisa Best
Chair
UNBSJ Research Ethics Board

REB Members:
Lisa Best, Department of Psychology (Chair)
Signe Gurholt, New Brunswick Community College Rep.
Beth Keyes, Department of Social Sciences
Rebecca Atkinson, Community Representative, Legal
Rose McCloskey, Department of Nursing
Denise LeBlanc-Duchin, ad hoc member, Horizon Health
Caroline Brunelle, Department of Psychology
Bryn Robinson, Community Representative

Curriculum Vitae

Candidate's Full Name:

Catherine Alicia McDonald

Universities Attended

McMaster University, Hamilton

Bachelor of Arts in Sociology, 2012

McMaster University, Hamilton

Bachelor of Arts Honors in Psychology, Neuroscience and Behaviour, 2016

Publications Submissions

McDonald, C., & Brunelle, C. (Submitted). Canadian cannabis use patterns and perspectives regarding legalization. *Canadian Journal of Behavioural Science*.

Conference Presentations

Tang, A., Lahat, A., **McDonald, C**., Stead, V., Crowley, M.J., & Schmidt, L.A. (March 2015). *Shyness, Sociability and social rejection in children and adolescents.* Poster presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, United States.

McDonald, C., McKinnon, M., & Boyd, J. (2018). *Gains with goals: Assessing efficacy of Goal Management Training for cognitive remediation in Major Depressive Disorder.* Gimme-5 presentation at the 29th International Congress of Applied Psychology (CPA), Montreal, Canada.

Brunelle, C., & **McDonald, C**. (2018). *Canadian patterns of cannabis use prior to legalization and perspectives on legalization.* Presentation and Panel Discussion at the 29th Atlantic Crime Prevention Conference, Saint John, Canada.

Gallagher, C. E., **McDonald, C**., & Brunelle, C. (2019). *Daily cannabis use and drug-related problems: Understanding motivations for use matters!* Gimme-5 presentation at the 30th International Congress of Applied Psychology Convention (CPA), Halifax, Canada.

McDonald, C., & Brunelle, C. (2019). *Cannabis in Canada: How are people using and what do they think of it?* Gimme-5 presentation at the 30th International Congress of Applied Psychology Convention (CPA), Halifax, Canada.

McDonald, C., Brunelle, C. (Nov, 2019). *Identifying Cannabis Use Motives and their Association with Problematic Cannabis Use*. Poster presentation at the third annual Canadian Research Initiative in Substance Misuse (CRISM) convention, Charlottetown, Canada.

Brunelle, C., **McDonald, C.** (Accepted, 2020). *Psychological risk factors for cannabis misuse : Use motives and internalizing/externalizing symptoms.* 12 minute talk at the Canadian Psychological Association Annual National Conference 2020 (CPA), Montreal, Canada.