Examining the Associations Between Social Anxiety and Cannabis Outcomes in Emerging Adulthood

by

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A Thesis submitted to the Faculty of Graduate Studies of
The University of Manitoba
in partial fulfilment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

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Abstract

Emerging adulthood is a developmental period where cannabis is used at higher rates compared to other age groups. Social anxiety, a condition defined as being fearful of negative evaluation from others, is also prevalent in emerging adulthood and may be related to cannabis outcomes. Tension reduction theory posits that individuals with social anxiety use cannabis to reduce unpleasant emotions from perceived negative interactions. Research demonstrates that social anxiety and cannabis are related in adulthood; however, the literature in emerging adulthood is mixed. The overarching goal of this dissertation was to elucidate the association between social anxiety and cannabis outcomes in emerging adulthood by (a) quantifying the strength of the association between social anxiety and cannabis outcomes in the extant literature and (b) examining contributing factors to this association. Study 1 (k = 18) used meta-analytic methods to establish the magnitude of the associations between social anxiety and cannabis-related variables. Results supported a small significant (but negligible) positive association between social anxiety and cannabis problems, but not cannabis use frequency, in emerging adulthood. Study 2 (N = 5,194) used epidemiological data from a nationally representative sample in the United States to explore what sociodemographics and psychiatric disorders may be associated with co-occurring social anxiety disorder (SAD) and cannabis use in emerging adults. Results revealed that being White, a part-time student, or not a student were associated with increased odds of having co-occurring lifetime cannabis use and SAD. Additionally, having major depressive disorder, bipolar I disorder, generalized anxiety disorder, specific phobia, agoraphobia, and panic disorder were associated with increased odds of having co-occurring lifetime cannabis use and SAD. Study 3 (N = 269) used a mediated moderation to test negative urgency and sex as moderators that may strengthen the associations between social anxiety and cannabis outcomes in emerging adults. Results revealed that higher social anxiety predicted elevated cannabis use and problems via coping motives, but only for males higher in negative urgency. Overall, this work expanded our understanding of the associations between social anxiety and cannabis outcomes among emerging adults. Results have implications for informing screening approaches in this population.

Keywords: emerging adulthood, social anxiety, cannabis use, meta-analysis, epidemiological, mediated moderation

Acknowledgements

First and foremost, I would like to extend my deepest gratitude to my co-advisors, Matt and Natalie. I can only imagine that my graduate school journey would have been fraught with much more stress had I not been continually uplifted and encouraged by your words of kindness and care. Your unending support has not gone unnoticed; thank you both so much. I would also like to thank my committee members, Dr. Johnson Li, Dr. Jennifer Theule, and Dr. Gillian Alcolado for providing valuable feedback and guidance at various points throughout this process.

To my graduate school companions – it has been an absolute pleasure getting to celebrate many milestones, both academic and personal, throughout our time together in this program. A special shout out is in order to the "silent Zoom.ca crew" for enabling accountability and harbouring connectedness while working on our research during a global pandemic. This dissertation would be incomplete if not for our virtual work sessions that were riddled with progress updates, check-ins, and many laughs. To my friends and family – you have given relentless encouragement since the outset of my graduate studies. You have made me feel like a superstar during times when I believed to be stuck in the doldrums. Thank you for continuing to remain attentive to and interested in my academic life since the beginning. To my partner – thank you for understanding and sharing my appreciation of the Oxford comma, among many other things. Your dependableness and unwavering patience has provided me with stability that I am so grateful for.

Lastly, I would like to thank the various funding sources that supported my dissertation research: a Joseph-Armand Bombardier Canada Graduate Doctoral Scholarship from the Social Sciences and Humanities Research Council; a Graduate Doctoral Scholarship from the Liquor, Gaming and Cannabis Authority of Manitoba; and a Research Completion Scholarship from the Faculty of Graduate Studies. Without your generous financial support, this work would not have been possible.

Contributions of Authors

Study 1

In collaboration with my co-supervisors, Drs. Keough and Mota, I created the research question, assisted with search and study selection, analyzed and interpreted the data, wrote the final manuscript, and submitted the manuscript for publication. Ms. Ho completed the literature search. Dr. Bilevicius assisted with search and study selection. Drs. Theule, Buckner, Mota, and Keough provided feedback on the manuscript and gave valuable conceptual input. The final manuscript represents a substantial combined effort from all authors. I secured funding from the Joseph-Armand Bombardier Canada Graduate Scholarship – Social Sciences and Humanities Research Council.

Study 2

In collaboration with my co-supervisors, Drs. Keough and Mota, I created the research question, obtained ethics approval, conducted statistical analyses, wrote the final manuscript, and submitted the manuscript for publication. Drs. Alcolado, Keough, and Mota provided feedback on the manuscript and gave valuable conceptual input. The final manuscript represents a substantial combined effort from all authors. I secured funding from the Joseph-Armand Bombardier Canada Graduate Scholarship – Social Sciences and Humanities Research Council.

Study 3

In collaboration with my co-supervisors, Drs. Keough and Mota, I created the research question, obtained ethics approval, designed the study protocol, conducted data cleaning and statistical analyses, wrote the final manuscript, and submitted the manuscript for publication. Drs. Mota and Keough provided feedback on the manuscript and gave valuable conceptual input. The final manuscript represents a substantial combined effort from all authors. I secured funding from the Joseph-Armand Bombardier Canada Graduate Scholarship – Social Sciences and Humanities Research Council.

Table of Contents

List of Tables

Study 1

Study 2

Study 3

List of Figures

Study 1

Study 3

List of Appendices

Chapter 1: General Introduction

Scope of the Problem

Emerging adulthood, which begins in the late teens and continues throughout the twenties, is a developmental period associated with instability and experimentation as there are numerous changes in identity, life structure, and goal pursuits that occur during this time (Arnett, 2000). Substance use typically begins in adolescence but reaches its peak in emerging adulthood (Chen & Kandel, 1995). Cannabis is widely used during emerging adulthood and is the most frequently used substance second to alcohol, with approximately 30% of emerging adults reporting past year use (Center for Behavioral Health Statistics and Quality, 2016). Additionally, emerging adults use cannabis at rates higher than any other developmental age group (Stone et al., 2012). Emerging adults also have the highest prevalence rates of cannabis use disorders (CUDs) compared to other age groups (Hasin et al., 2016). Though substance use experimentation is widely considered normalized during this stage, heavy and frequent cannabis use can be harmful as it is associated with numerous negative outcomes, such as physical health problems (Ames et al., 2020), lower educational and occupational attainment (Thompson et al., 2019), and mental health difficulties (Looby & Earlywine, 2007). Additionally, emerging adulthood marks a period of habit formation in which engaging in maladaptive behaviours during this stage may have implications for continuing behaviours or problems once adulthood commences (Sussman et al., 2011). Ultimately, this highlights the necessity to understand more about cannabis outcomes during emerging adulthood.

Social anxiety, a psychiatric condition characterized by marked fear or distress of social situations (American Psychiatric Association [APA], 2013), is also prevalent in emerging adulthood. Persons with social anxiety attempt to avoid a number of social situations, or if unavoidable, they endure them with intense anxiety. Prevalence estimates suggest that approximately 3% of emerging adults meet clinical levels of social anxiety disorder (SAD; Hasin & Grant, 2015), although other research has documented prevalence estimates for emerging adults meeting the threshold criteria for clinically elevated social anxiety symptoms to be as high as 36-42% (Jefferies & Ungar, 2020; Walukevich-Dienst et al., 2022). Social anxiety is linked to lower quality of life and poor educational and occupational attainment (Stein & Kean, 2000), and

is comorbid with other psychiatric disorders (e.g., substance use disorders; major depressive disorder; Ruscio et al., 2008).

The co-occurrence of cannabis use and social anxiety can be best understood through theories which propose that cannabis is used as a method to quell social anxiety symptoms. Tension reduction theory (Conger, 1956) posits that substance use may be motivated by reducing negative affect. In individuals with social anxiety, we might expect that cannabis use increases as a method to alleviate any unwanted, negative feelings associated with social anxiety as a manner to cope with such distress. Though providing immediate relief, this negatively reinforces cannabis use as a means to relieve unpleasant symptoms and increases the likelihood of relying on cannabis to manage social anxiety longer-term. Indeed, there appears to be a relation between social anxiety and cannabis outcomes in adult populations. For example, in adulthood, research has supported that those who experience social anxiety are more likely to use cannabis (Blanco et al., 2018). Epidemiologic literature has identified that approximately one third of individuals who have cannabis dependence meet criteria for social phobia (Agosti et al., 2002). Additional epidemiologic work has documented that SAD significantly predicts cannabis dependence approximately 16 years later (Buckner et al., 2008). Additionally, cross-sectional nationally representative work has found that SAD is related to cannabis dependence in adults (Buckner, Heimberg, Schneier, et al., 2012).

Despite there being a known connection between social anxiety and cannabis use outcomes in adults, the literature in emerging adulthood is less clear, with work finding inconsistent results. For instance, research has found there to be robust positive associations between cannabis problems and social anxiety (Ecker & Buckner, 2014; Morris & Buckner, 2023), whereas cannabis use frequency is unrelated to social anxiety (Cloutier et al., 2021; Buckner & Schmidt, 2008; Ecker et al., 2014). One possibility for this discrepancy may be the lack of consideration of other moderating factors. For example, epidemiological research has supported that differences exist in adult populations, such as the severity and presentation of social anxiety being dependent on sex differences (Asher & Aderka, 2018), income earnings (Carliner et al., 2017), and experience of a psychiatric disorder being related to having co-occurring social anxiety and cannabis use (Buckner, Heimberg, Schneier, et al., 2012). Given the inconclusive results in the literature, more research is needed to solidify our understanding of these links in emerging adulthood.

The overall goal of this dissertation was to better understand the complexities in the associations between social anxiety and cannabis outcomes in emerging adulthood. Following theory (Conger, 1956), which suggests that cannabis is used as a means for individuals to rid themselves of their uncomfortable internal experiences which are driven by social anxiety symptoms, this dissertation advances our current understanding of the extant literature and provides novel findings which contribute to our conceptual knowledge during this developmental stage. Despite emerging adulthood being linked with high rates of cannabis use (Center for Behavioral Health Statistics and Quality, 2016; Substance Abuse and Mental Health Services Administration [SAMHSA], 2016) and cannabis related-problems (Volkow et al., 2014), there remains a lack of information dedicated to knowing specific contributing factors that may be related to co-occurring cannabis and social anxiety in emerging adults. The aim of this dissertation was to elucidate the association between social anxiety and cannabis outcomes in emerging adulthood by first quantifying the strength of the association between social anxiety and cannabis use outcomes in the extant literature, and second by examining contributing factors to this association.

Theoretical Background

Emerging Adulthood

In contemporary westernized societies, the progression from adolescence into full-fledged adulthood is often prolonged. Various cultural and social trends in recent decades have contributed to this prolongment, such as there being a delay in emerging adults moving out or away from home or spending more years in postsecondary education (Beaujot, 2004). Thus, the time between adolescence and adulthood is largely transitional and is commonly referred to as emerging adulthood, which begins in the late teens and lasts up until the late twenties (Arnett, 2000). Often, emerging adults navigate unfamiliar and challenging experiences such as finding alternate living arrangements, the pursual of intimate relationships, first-time parenthood, moving away from home, and novel employment or educational opportunities (Arnett & Schwab, 2012). Further, distinct markers characterize this developmental period between adolescence and adulthood, which include instability, identity exploration, feeling ‘in-between’, self-focused time, and possibility (Arnett, 2000). Therefore, the emerging adulthood period is marked with many lifestyle changes, making this a critical time to lay the foundation for future interests and to capitalize on new-found freedom.

Although emerging adulthood is often viewed as an exciting life stage due to the possibility of engaging in multiple new opportunities, these circumstances can sometimes be accompanied with risk for negative experiences. It has been documented that risk-taking behaviours, such as substance use, tend to emerge in and peak during emerging adulthood (Steinberg et al., 2008). These risky behaviours seem to compliment the typical scenarios that are present in emerging adulthood. For instance, the change of context such as less monitoring from parental figures or increased freedom to explore different and new opportunities during emerging adulthood may inherently be a risk factor for substance use (Stone et al., 2012). Additionally, some of the defining markers of the emerging adulthood era might also be uniquely linked to greater substance use. Supporting this, emerging adults who endorse strong feelings of being "in-between" tend to experience more substance-related problems (Smith et al., 2014). Alternatively, assuming an adult identity and having greater individual perceptions of adulthood is associated with less substance use (Blevins et al., 2021; Schulenberg et al., 2004); therefore, how an emerging adult navigates life during this time and the choices one makes can have repercussions for risky substance use behaviour and patterns of use.

Cannabis Use

Emerging adults appear to be at greater risk for substance use and related problems as a function of the new-found freedom and lessened responsibilities that are typically observed during emerging adulthood. Accordingly, research has observed the trend that substance use tends to peak during emerging adulthood (Arnett, 2005; Sussman & Arnett, 2014) and then begins to decrease thereafter (Schulenberg et al., 2018). Secondary to alcohol use, cannabis is the second most used substance in emerging adulthood (Johnston et al., 2015; Leos-Toro et al., 2018). Compared to other developmental age groups, cannabis use is highest during emerging adulthood, with prevalence estimates ranging from 21-33% in North America in the past year (Statistics Canada, 2018; SAMHSA, 2016). Prevalence estimates suggest that approximately one third of emerging adults have used cannabis in the past-month and 10.8% of emerging adults use cannabis daily (Patrick et al., 2022). Cannabis outcomes and CUDs (i.e., a substance-related and addictive disorder in which an individual is unable to stop cannabis use despite experiencing physical or psychological impairment as a result; APA, 2013) have been well documented in emerging adulthood. For instance, research using nationally representative data from the National Epidemiologic Survey of Alcohol and Related Conditions-III (NESARC-III) found that

the 12-month prevalence of CUD among emerging adults in the United States was 6.9% (Hasin et al., 2016). The 12-month prevalence of CUD has been observed to be highest during emerging adulthood compared to other age groups (Degenhardt et al., 2013; Hasin et al., 2016). Han and colleagues (2019) examined lifetime and 12-month prevalence of cannabis use and CUD among emerging adults aged 18 to 25 years old in the United States using a cross-sectional nationally representative survey called the National Surveys on Drug Use and Health (NSDUH). Lifetime prevalence of cannabis use has been demonstrated to be 52.4%. Of those with lifetime prevalence of cannabis use, 12-month prevalence for cannabis use and CUD in emerging adults was 63.6% and 9.8%, respectively (Han et al., 2019). Additionally, among those with lifetime cannabis use, the 12-month prevalence estimate of cannabis use was consistently higher each year following the start of cannabis use: 4.2% during the first year compared to 7.1% during the second year, and 9.7% during the third year (Han et al., 2019). Further research by Hayley et al. (2017) using the NESARC-III found that individuals diagnosed with current CUD were disproportionately aged 18 to 24 years, with prevalence estimates of 43.7% compared to second highest rates of 26.9% during the ages of 25 to 34 years.

Cannabis is derived from the plant *Cannabis sativa* and is used for medical and recreational purposes (Bonini et al., 2018). Cannabis contains a number of chemically active compounds, such as cannabinoids, which act on the cannabis receptors in the brain (Le Boisselier et al., 2017). Commonly known cannabinoids include (a) delta-9-tetrahydrocannabinol (THC), which is the main pharmacologically active cannabinoid that leads to psychoactive effects, and (b) cannabidiol (CBD), which produces minimal to no psychoactive effects but produces physiological effects (Pertwee, 2005). THC acts on the central nervous system via the cannabinoid receptor type 1 (Pertwee, 2008) which releases numerous neurotransmitters that influence cognitive and psychomotor functioning (Atakan, 2012). There are a variety of ways in which cannabis can be used, such as by being smoked, vaporized, or consumed through food (i.e., edibles; World Health Organization, 2016). The level of THC in most cannabis plants is between 5 and 20% (Small, 2016), with the level of THC often being proportional to the intensity of its effects (Crippa et al., 2012). Cannabis has historically been observed to have lower levels of THC; however, there has been an increase in the potency level of THC in the past decade which raises concerns about the level of toxicity and subsequent problems from cannabis use (Chandra et al., 2019; Mahamad et al., 2020).

Many individuals experience a range of harms from both acute and chronic cannabis use, which may have a detrimental impact across health, educational, and social domains (Gilman et al., 2014; Korn et al., 2018; Shollenbarger et al., 2015; Tait et al., 2011; Volkow et al., 2014). In general, the risk of experiencing adverse effects from acute cannabis use is considered low, though there are reports of negative effects of acute use including slower reaction times and poorer attentional abilities (Hartman & Huestis, 2013), impaired cognitive functioning and psychomotor ability (Spindle et al., 2018), health risks (e.g., nausea, vomiting; Schmid et al., 2020), impaired driving while under the influence of cannabis (Li et al., 2016), and negative mental health experiences (e.g., inducing panic attacks or anxiety; Hall et al., 2018). Cannabis use can also exert residual impairing effects on executive functioning skills (e.g., working memory, impulsivity) in the absence of intoxication in people who have used cannabis acutely and chronically, with people who have used chronically exhibiting the most enduring deficits (Crean et al., 2011; Dahlgren et al., 2020). Negative effects of chronic use include experiencing increased anxiety over time (Davis et al., 2022), and being at greater risk of developing psychosis (McGrath et al., 2010). Regular cannabis use during emerging adulthood increases the risk of developing a CUD, and using cannabis as an emerging adult is predictive of developing a CUD in adulthood (Anthony, 2006). Further, incidence rates of CUDs peak during the ages of 18 to 25 years old and decline in years following (Farmer et al., 2015a; Perkonigg et al., 2008). Many additional factors contribute to the level of impairment experienced from cannabis use such as age of onset, years of accumulated use, and quantity of use (Grant et al., 2003). Emerging adults are at a vulnerable life stage for greater cannabis use and subsequent harms due to this developmental period being one of instability and possibilities (Stone et al., 2012); therefore, it is imperative to identify contributing factors that are associated with cannabis use during emerging adulthood.

Social Anxiety Disorder

One psychiatric diagnosis that might be related to cannabis use among emerging adults is social anxiety. SAD is defined as having a fear of being negatively judged or evaluated by others (APA, 2013). Individuals with social anxiety tend to avoid or escape situations where they may fear being humiliated or rejected, which includes eating in front of others, meeting new people, or talking to people in authority, among others (APA, 2013). Persons with social anxiety worry that their behaviour may be embarrassing, or are concerned about showing symptoms of anxiety

(e.g., shaking hands, sweating). Further, individuals with social anxiety recognize that their projected fears are disproportionate to the situation which they fear. Individuals with social anxiety may spend excessive time ruminating on events and may experience somatic symptoms such as sweating, blushing, or trembling (Heiser et al., 2009). Social anxiety can have detrimental effects on the health and well-being of individuals, resulting in lower quality of life and greater functional impairment (Kessler, 2003; Safren et al., 1996; Schneier et al., 1994; Wittchen et al., 1999).

Social anxiety has an estimated lifetime prevalence of 12.1% in the United States (Ruscio et al., 2008) and 8.1% in Canada (MacKenzie & Fowler, 2013). Statistics from a Canadian adolescent and adult sample estimate current prevalence (i.e., past 12-months) to be approximately 3% of the total population, translating to approximately 750,000 people (Statistics Canada, 2004). Additionally, approximately 2% of adults meet criteria for SAD, with emerging adults ages 18-29 years comprising the largest portion (Fehm et al., 2008). In emerging adulthood, past 12-month prevalence rates of social anxiety have been reported to be between approximately 5 and 6% (Gomes et al., 2019; Wittchen et al., 1999). Epidemiological research suggests that the onset for SAD typically occurs in adolescence (Chavira & Stein, 2005; Grant et al., 2005; Mackenzie & Fowler, 2013) with a median age of onset of 13 years (Kessler et al., 2005) and is most pervasive during adolescence and emerging adulthood (Fehm et al., 2008). The earlier the onset of SAD during adolescence, the greater social anxiety psychopathology is experienced in later life (Rapee & Spence, 2004). In addition to its early onset, SAD symptoms are often longstanding, with symptoms persisting for years if untreated (Keller, 2003; Wittchen & Fehm, 2003).

Increases in SAD and related-symptoms may be contextually unique to emerging adulthood as a discrete developmental period, as this period is conducive to many social activities such as attending academic classes, developing professional relationships with peers and coworkers, and attending parties; all of which may illuminate a heightened awareness of believing one needs to fit in, and in turn, contribute to a negative cognitive framework of those with social anxiety. Indeed, emerging adults are faced with navigating difficult transitions amongst their relations with friends, family, and partners (Padilla-Walker et al., 2017). Additionally, both non-clinical and clinical samples of university students tend to report high

levels of social anxiety (Stewart & Mandrusiak, 2007) and social anxiety often increases during the transition to college (Spokas & Heimberg, 2009).

Social Anxiety and Cannabis Use

There have been a number of studies which have documented an association between social anxiety and cannabis use in adulthood (i.e., age 18 years and older). Previous data from the National Comorbidity Survey suggests that approximately 30% of individuals with cannabis dependence also have comorbid SAD in a population of adolescents and adults (i.e., 15 to 54 years of age; Agosti et al., 2002). In another nationally representative survey of Australian adults which examined predictors of cannabis use and CUD, SAD was the only psychiatric disorder assessed that was directly related to increased risk of cannabis use, in addition to being directly associated with an increased risk of transitioning from using cannabis to developing a CUD (Butterworth et al., 2014). More cross-sectional epidemiological research using the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) has identified that SAD most often had prior onset to CUD for adults reporting co-occurring diagnoses (Buckner, Heimberg, Schneier, et al., 2012). Similarly, data from the longitudinal Oregon Adolescent Depression Project found that a reported SAD diagnosis in adolescence is significantly associated with cannabis dependence in adulthood (Buckner, Schmidt, et al., 2008). The evidence is not as clear in emerging adulthood, as studies have shown mixed associations between social anxiety with cannabis use and problems. For instance, there is robust evidence that social anxiety is positively related to cannabis problems (Buckner, Schmidt, et al., 2006; Buckner et al., 2007; Buckner et al., 2011; Buckner, Heimberg, Matthews, & Silgado, 2012; Foster et al., 2016; Mueller et al., 2021). Additionally, more work has shown small positive associations between social anxiety and cannabis use frequency (Buckner et al., 2018; Phillips et al., 2018), but other research has shown this association to be inversely related (Ecker et al., 2014; Schmits & Quertemont, 2018; Villarosa-Hurlocker et al., 2019). Yet, more research has shown that using cannabis in social situations for coping reasons was related to cannabis problems, but not to frequency of use (Buckner & Zvolensky, 2014). One study by Krygsman and Vaillancourt (2022) who followed children throughout adolescence and emerging adulthood found that those who reported high social anxiety symptoms at baseline had higher levels of cannabis use compared to those who reported moderate or low levels of social anxiety. In an Australian sample of young adult twins, reporting a history of social anxiety was a risk factor for

future cannabis dependence (Lynskey et al., 2002). Using longitudinal data from the NESARC, Feingold et al., (2016) found no association between emerging adults' daily cannabis use at baseline and incidence of social anxiety at follow-up three years later, whereas an association between CUD at baseline and incidence of social anxiety at follow-up emerged.

Tension reduction theory (Conger, 1956), which posits that people use substances to cope with negative emotions, is a useful premise for understanding how social anxiety may be related to cannabis outcomes in emerging adulthood. Specifically, tension reduction theory is comprised of two tenets which are: a) consuming substances reduces negative affect (e.g., tension, anxiety, nervousness), and b) this tension-reducing process is desirable and subsequently motivates future substance use, reinforcing substance use over time. Thus, tension reduction theory suggests that anxiety symptoms precede substance use. Much of the literature has evaluated tension reduction theory in studies examining alcohol (Kalodner et al., 1989; Kushner et al., 1994; Patock-Peckham et al., 2018) though others have investigated the utility in studies examining cannabis (Foster et al., 2015; Hayaki et al., 2010; Schafer & Brown, 1991) supporting it as an overarching framework for understanding substance use. However, critiques of tension reduction theory state that the theory might not be sufficient in postulating the motivations behind all substance use and that there may be additional individual differences that influence the association (Cappell & Greeley, 1987; Lewis & Vogeltanz-Holm, 2002; Young et al., 1990). Notwithstanding this limitation, tension reduction theory serves as a concrete foundation to understand the relation between social anxiety and cannabis outcomes.

Following a tension reduction framework social anxiety can be viewed as a risk process in the pathway to cannabis use behaviours. As a consequence, persons with social anxiety may rely on cannabis as a method to cope with social anxiety-related distress at the expense of using other adaptive strategies. Accordingly, we would expect that individuals struggling with socially anxious thoughts may use cannabis before social events to manage any anxiety-related thoughts about being scrutinized or rejected by others. Further, in social situations that are more difficult to evade or are unavoidable, using cannabis to cope with unpleasant negative emotions may feel like the only option and lead to greater use in the moment. Indeed, using cannabis to cope with social situations is positively related to cannabis problems (Buckner & Zvolensky, 2014) and coping motives for cannabis use has been endorsed in the literature (Buckner & Zvolensky, 2014; Colder et al., 2019). People with social anxiety may also use cannabis after social events to

cope with ruminative behaviours out of fear that they did something embarrassing. Supporting this, post-event processing (i.e., the tendency to review previous social scenarios) has been found to mediate the relationship between social anxiety and cannabis problems in emerging adult cannabis users (Ecker & Buckner, 2018). Context is of importance because using cannabis in solitary situations provides an opportunity for individuals with social anxiety to ruminate on previously perceived social failures and worry about upcoming anxiety-provoking events. Following this, solitary cannabis use presents as a risk factor for greater cannabis-related problems among individuals with social anxiety (Buckner et al., 2016; Tucker et al., 2006). Cannabis use is also related to tension reduction expectancies, that is, to relieve distressing anxiety-related symptoms, in young adult females (de Dios et al., 2010) and tension reduction expectancies are associated with greater cannabis use frequency (Simons & Arens, 2007). Relatedly, social anxiety is related to experiential avoidance (i.e., avoidance of internal distressing experiences; Buckner et al., 2014). Individuals with social anxiety may also be particularly motivated to use cannabis when experiencing craving for the substance (Buckner, Crosby, et al., 2012). More work has found that social anxiety is related to cannabis use for reasons such as to increase positive affect and reduce negative affect in social situations, which in turn, was associated with more cannabis problems (Walukevich-Dienst et al., 2020).

Conversely, social anxiety may be unrelated to cannabis use as understood through a buffering perspective: if individuals with social anxiety are more inclined to be avoidant of social situations out of fear of receiving potential rejection or criticism, this may limit their exposure to social opportunities where cannabis use may occur and is available (e.g., parties), leading to a decrease in overall cannabis use behaviour (Shedler & Block, 1990). Further, people with social anxiety might not attend social events if they know cannabis will be unavailable, limiting their ability to cope with unpleasant affect. Additionally, individuals with social anxiety may avoid using cannabis altogether out of fear of losing control in social situations which may exacerbate their anxiety or make them behave in ways that would involve scrutiny from others. The physiological effects of cannabis at certain doses might also be aversive to people high in social anxiety, as they tend to have high anxiety sensitivity and higher doses of cannabis have been shown to increase negative affect (Childs et al., 2017). People with social anxiety may also have a core fear that others may notice their anxiety during socially anxious moments, and avoid using for fear of being disinhibited and ultimately identified as someone who is socially anxious.

Supporting this, previous research has found that social anxiety is inversely related to cannabis use in undergraduate students (Di Blasi et al., 2017; Ecker & Buckner, 2014).

At present, little work has attempted to solidify the association between social anxiety and cannabis outcomes during emerging adulthood. A systematic review examining various types of substance use and social anxiety during adolescence generally found negative associations between social anxiety and cannabis use (Lemyre et al., 2019). Other reviews have identified a relation between cannabis and anxiety disorders more broadly (Crippa et al., 2009; Kedzior & Laeber, 2014), but research is needed to clarify the direction and strength of the association between cannabis use outcomes and social anxiety specifically during emerging adulthood. One meta-analysis investigated the relation between social anxiety and alcohol variables within a college population. Results demonstrated that social anxiety was significantly negatively associated with alcohol use frequency and quantity but was positively associated with alcohol related problems (Schry & White, 2013). Similar associations could be expected to emerge between social anxiety and cannabis use and problems in emerging adulthood given the co-occurrence of alcohol and cannabis use during this developmental period (Degenhardt et al., 2001; Duncan et al., 2015), and the evidence suggesting similar patterns with timing of first use, typical trajectories, and period of risk for developing a related substance use disorder (Flory et al., 2004; Jackson et al., 2008; Wagner & Anthony, 2002). Further complicating the association between social anxiety and cannabis outcomes stems from the makeup of cannabinoids in cannabis. The extant literature has consistently demonstrated that using cannabis with THC can trigger social anxiety whereas using cannabis with CBD is shown to reduce anxiety (Sharpe et al., 2020). In terms of whether cannabis use directly contributes to social anxiety, a large body of literature demonstrates temporal precedence in which social anxiety precedes cannabis use (Buckner, Heimberg, et al., 2013; Walukevich-Dienst et al., 2019).

Theoretical Contributing Factors

Sociodemographics. Given the complex association between social anxiety and cannabis outcomes in emerging adulthood, it is worthwhile examining if certain sociodemographics may be associated with these conditions. Prior research has explored potential sex and gender differences in the onset, development, and treatment of cannabis use and CUDs. Men tend to have higher prevalence rates of cannabis use (Carliner et al., 2017; Greaves & Hemsing, 2020) and tend to use cannabis more frequently and in greater quantities compared to women (Cuttler

et al., 2016; Khan et al., 2013). Interestingly, women tend to use cannabis at a later age but progress more quickly toward CUD compared to men (Ehlers et al., 2010). Regarding gender differences in SAD, women typically report greater experience of social anxiety than males (Turk et al., 1998) and have more severe clinical presentations (Asher & Aderka, 2018). Lifetime prevalence rates for SAD are similar for both men and women, but past 12-month prevalence rates were greater for women compared to men (McLean et al., 2011). In terms of gender differences within the SAD-CUD comorbidity, SAD is related to faster transition from age of first cannabis use to development of CUD among men but not among women (Buckner, Heimberg, Schneier, et al., 2012). In undergraduate samples, SAD symptoms are positively correlated with CUD symptoms among women, but not men (Buckner, Mallott, et al., 2006).

Regarding additional sociodemographics, such as level of achieved education, cross-sectional research has demonstrated that adults with lower education levels tend to have a higher prevalence of cannabis use or CUD (Azofeifa et al., 2016). Additionally, using cannabis for the first time in high-school is associated with not completing high-school (Bray et al., 2000). Individuals are more likely to have SAD if they had not completed secondary or postsecondary education (Statistics Canada, 2004). Another potential consideration that may influence the relation between social anxiety and cannabis is student enrollment status. In North America, approximately 80% of emerging adults attend some form of postsecondary institution (Arnett & Schwab, 2012; Shaienks et al., 2008) and the first year out of high school is associated with the highest rates of substance use, with these rates often tapering off in subsequent years (White et al., 2005). Some research has shown that cannabis use is higher among students compared to non-students given the social nature of university and the inherent normative experiences associated with this chapter (Odani et al., 2019). In terms of marital status, those who are not married, divorced, or separated are reported to have greater cannabis use (Hasin et al., 2015; Statistics Canada, 2004) and prevalence of CUD (Hasin et al., 2019). Cannabis use has also been related to postponing marriage and parenthood (Yamaguchi & Kandel, 1985). Regarding employment, both cannabis use and social anxiety have been linked to higher unemployment rates (Henkel, 2011; Statistics Canada, 2004) and unemployed individuals report higher rates of cannabis use compared to employed personnel (Compton et al., 2014). In terms of income, lower income and earnings have also been found to be related to increased cannabis use and social anxiety (Carliner et al., 2017; Hasin et al., 2015; Stein et al., 2017). Finally, racial-ethnic

minority status has been associated with lower rates of SAD compared to White individuals (Breslau et al., 2006), whereas non-White ethnicity has been found to be related to increased odds of cannabis use (Pacek et al., 2015). Though informative, it should be noted that these studies used adult samples and may not be representative of the emerging adult demographics.

Psychiatric Disorders. Additional psychiatric disorders may be important contributing factors to the social anxiety and cannabis outcome association. In the literature, we observe the co-occurrence of cannabis use with other psychiatric disorders, and the co-occurrence of SAD with other psychiatric disorders. For example, research supports that individuals who use cannabis have higher symptoms of depression (Arendt & Munk-Jørgensen, 2004). Population research has shown that individuals with a diagnosis of major depressive disorder (MDD) are more likely to have cannabis use dependence compared to those without MDD (Grant, 1995). In Canada, individuals with SAD were over six times as likely compared to the general population to have MDD (Statistics Canada, 2004). Relatedly, bipolar I disorder has been shown to have onset and be prevalent in emerging adulthood (Solmi et al., 2022) and CUD is associated with increased risk of bipolar disorder (Jefsen et al., 2023) and SAD is associated with bipolar disorder (Koyuncu et al., 2014). In terms of anxiety-related disorders, there is a high overlap between SAD and generalized anxiety disorder (Starcevic et al., 2007), SAD and panic disorder, and SAD and agoraphobia (Fehm et al., 2008). CUD have also been documented to be related to generalized anxiety disorder, panic disorder, and agoraphobia (Hasin et al., 2016).

Individual Differences. Individual differences might also help to explain the discrepant findings in the association between social anxiety and cannabis outcomes during emerging adulthood. Work has suggested that personality characteristics, such as impulsivity, may explain variations in the relation between social anxiety and cannabis use. Impulsivity has been broadly defined as engaging in premature actions which may result in poor outcomes (Durana & Barnes, 1993). Impulsivity is a personality trait well-documented in the literature associated with higher rates of substance use (DeVito et al., 2020; Mitchell & Potenza, 2014; Verdejo-García et al., 2007) and cannabis use in emerging adulthood (Ansell et al., 2015; Glowacz & Schmits, 2017; Piechatsek et al., 2009). Therefore, impulsivity may be an important variable in explaining the relation between social anxiety and cannabis outcomes. Work has found that some individuals with social anxiety have high levels of impulsivity (Nicholls et al., 2014), and individuals with high levels of social anxiety and high levels of impulsivity typically report greater overall use of

alcohol or drug use (Keough et al., 2016; Lipton et al., 2016) and risky cannabis use is also associated with impulsivity in emerging adults (Lyvers et al., 2013). It is possible that greater cannabis use and problematic outcomes in emerging adults might be observed in those who are socially anxious and impulsive.

Another factor to evaluate in cannabis use research are reasons to use cannabis. Various motives for using cannabis have been documented including, but not limited to, providing relief from chronic pain (Nugent et al., 2017), reducing stress and feeling calmer (Sexton et al., 2019), to escape from or cope with problems (Patrick et al., 2016), cope with anxiety (Ogborne et al., 2000), improving creativity (Newcomb et al., 1988), facilitate relaxation (Hathaway, 2003), and for enjoyment or pleasure (Lee et al., 2007). Notably, many of the reasons to use cannabis align with a drive to reduce negative internal experiences which is congruent with tension-reduction theory (Conger, 1956). Understanding the different reasons why people with social anxiety use cannabis sheds light on how they might be related to differential cannabis outcomes. For example, the bulk of the literature demonstrates that coping-related cannabis use tends to be associated with more frequent use (Bravo et al., 2017; Sofis et al., 2020) and greater problems (Moitra et al., 2015; Patrick et al., 2016). In a sample of college students, Glodosky and Cuttler (2020) found that coping motives were related to cannabis-problems and negative affect. In fact, cannabis use motives tend to mediate the relation between social anxiety and cannabis outcomes in emerging adulthood. For example, in a sample of emerging adults, social anxiety was positively related to cannabis problems via coping and conformity motives among men; and social anxiety was positively related to social motives among women (Buckner, Zvolensky, & Schmidt, 2012). Further, coping motives mediated the relationship between social anxiety and cannabis problems. Replicatory research found that social anxiety was positively associated with cannabis problems, coping motives, and social anxiety motives (i.e., using when feeling distressed in a social situation; Morris & Buckner, 2023). Further, gender differences emerged in which social anxiety was related to coping motives among men, and social anxiety was related to enjoyment, experimentation, boredom alleviation, altered perceptions, and relatively low risk motives among women. Coping motives have been shown to mediate the relation between social anxiety and cannabis problems (Buckner et al., 2007) and substance use problems (i.e., alcohol and cannabis; Villarosa-Hurlocker et al., 2019). Thus, understanding the reasons why individuals use cannabis use may be useful in this area of research.

Overview of the Current Research

The aim of the current research was to clarify the association between social anxiety and cannabis outcomes in emerging adulthood and address aforementioned limitations in the literature with respect to furthering our understanding of social anxiety and cannabis use in emerging adulthood. Emerging adulthood is an opportune time to examine the relation between social anxiety and cannabis outcomes given the high rates of cannabis use during this period (Schulenberg et al., 2020), the various negative repercussions that can result from acute and chronic use (Volkow et al., 2014), and the prevalence of social anxiety during this age stage (Gomes et al., 2019). Following tension reduction theory (Conger, 1956), which suggests that increased cannabis use occurs from attempting to cope with socially-anxious negative affect, emerging adults with social anxiety may experience greater problems from cannabis use. The association between social anxiety and cannabis problems has been robustly represented in the literature (Buckner, Schmidt, et al., 2006; Ecker & Buckner, 2014; Di Blasi et al., 2017), though the association between social anxiety and cannabis use has shown mixed results (Phillips et al., 2018; Schmits & Quertemont, 2018; Villarosa-Hurlocker et al., 2019). Despite previous work completed in the area of social anxiety and cannabis outcomes, our current knowledge is still in the nascent stages for better understanding additional contributing factors toward these associations.

This current dissertation is comprised of three studies. The primary goal of Study 1 was to evaluate the current status of the literature regarding the associations between social anxiety and cannabis-related variables in emerging adulthood. I used a meta-analytic framework to summarize and analyze the current literature regarding the association between cannabis outcomes and social anxiety in emerging adulthood, as the current available findings for specific cannabis behaviours (i.e., frequency of use, problems) are mixed. I also included theoretically-informed moderators in the analyses. This was an important first step to establish the current consensus in the literature, as it helped to inform Study 2 and Study 3 which were intended to examine contributing factors to the relation between social anxiety and cannabis outcomes.

The primary goal for Study 2 was to use epidemiological data from a nationally representative sample of individuals ages 18 to 25 years old in the United States of America to examine prevalence estimates of cannabis use and SAD and their co-occurrence, and to examine which sociodemographics and psychiatric disorders might predict having one or both conditions.

To my knowledge, no nationally representative data has examined prevalence of cannabis use and SAD within emerging adults nor have specific sociodemographic and psychiatric disorders of this group been explored.

Finally, the goal of Study 3 was to explore potential moderating and mediating factors that might help better explain the association between social anxiety and cannabis outcomes during emerging adulthood. I used cross-sectional data from a university student sample to examine negative urgency and sex as moderators and cannabis motives as a mediator in the relation between social anxiety and cannabis outcomes in emerging adulthood. Together, these studies contribute novel information that better informs our understanding of the association between social anxiety and cannabis outcomes during emerging adulthood.

Chapter 2: Study 1

Cannabis Use and Social Anxiety in Young Adulthood: A Meta-Analysis

This article was published in *Addictive Behaviors, 129,* Single, A., Bilevicius, E., Ho, V., Theule, J., Buckner, J. D., Mota, N., & Keough, M. T., Cannabis use and social anxiety in young adulthood: A meta-analysis, 107275, Copyright Elsevier (2022).
Link to article: https://doi.org/10.1016/j.addbeh.2022.107275

Abstract

Young adulthood (ages 18 to 30 years old), a developmental age of exploration, is marked by new experiences and transitions. Cannabis use frequency is highest in young adulthood compared to other age periods. Social anxiety (characterized by fear, shyness, and inhibition in social situations where scrutiny and judgment is possible) is also prevalent during young adulthood. Social anxiety may be a complex predictor of cannabis use frequency and problems (e.g., any negative physical, emotional, or social outcome from use). Social anxiety may act as a risk factor as individuals may use cannabis frequently to manage their fear of negative evaluation and associated unpleasant affective states. The purpose of this meta-analysis was to quantify the magnitude of the associations between social anxiety and two cannabis variables (frequency of use and problems) in young adulthood. A comprehensive literature review was conducted to identify studies that included measures of social anxiety and at least one cannabis-related variable of interest among young adults. Eighteen studies were included in the meta-analysis. Results revealed a small, statistically significant positive association between social anxiety and cannabis problems (r = .197, k = 16, p <.001), and a nonsignificant association between social anxiety and cannabis use frequency (r = .002, k = 16, p = .929). The association between social anxiety and cannabis use frequency was moderated by mean age, such that samples with older mean ages exhibited a stronger correlation. Additionally, the association between social anxiety and cannabis problems was moderated by clinically significant levels of social anxiety, such that samples with fewer participants who met clinical levels of social anxiety exhibit a stronger correlation. This meta-analysis supports the idea that there is a complex relation between social anxiety and cannabis outcomes during young adulthood.

Keywords: social anxiety, cannabis use frequency, cannabis problems, young adulthood, meta-analysis

Cannabis Use and Social Anxiety in Young Adulthood: A Meta-Analysis

Introduction

Cannabis is one of the most widely used substances among young adults in North America (Schulenberg et al., 2020). Young adulthood is a developmental period wedged between adolescence and adulthood, spanning the ages of 18 and 30 years, and is characterized by identity exploration in realms such as work, relationships, and education (Arnett, 2000). Approximately 33% of young adults in the United States have used cannabis in the past year, and 20% have used in the past month (Center for Behavioral Health Statistics and Quality, 2016). Rates of cannabis use, often defined as the frequency at which someone uses cannabis, are typically at their peak during young adulthood, and frequency of use decreases with age (Substance Abuse and Mental Health Service Administration [SAMHSA], 2016). Cannabis problems (i.e., negative outcomes resulting from cannabis use) can negatively affect a multitude of domains, such as impacting brain development, worsening school performance and subsequent lifetime achievement, and increasing chances of motor vehicle accidents resulting in injury or death (Volkow et al., 2014). Identification of malleable psychosocial factors related to cannabis use frequency and related problems may inform treatment and prevention efforts designed to target this age group.

Social Anxiety Disorder

Social anxiety disorder (SAD) affects approximately 9–14% of the young adult population (Kessler et al., 2005; MacKenzie & Fowler, 2013) and most individuals develop SAD in adolescence or young adulthood (Grant et al., 2005). SAD is defined as having a fear or anxiety of being negatively evaluated or judged by others across a variety of situations (American Psychiatric Association [APA], 2013). This anxiety of being judged leads to subsequent avoidance of or escape from situations where one fears humiliation or rejection, such as eating in front of others, public speaking, or meeting new people (McGinn & Newman, 2013). Social anxiety is associated with many negative outcomes, such as problems with interpersonal relationships with friends, family, and partners (Rapaport et al., 2005; Sparrevohn & Rapee, 2009); difficulty in educational attainment and success (Aderka et al., 2012; Stein & Kean, 2000); and employment stability and productivity (Wittchen et al., 2000). Certain pursuits that typically occur during the young adulthood period may also be conducive to experiencing social anxiety. For example, it is normative to attend postsecondary institutions or enter the workforce

during this stage, and most individuals may be cognizant of the possibility of being judged or evaluated by others.

Social Anxiety and Cannabis Use

Social anxiety may be associated with frequent cannabis use and related problems during young adulthood (Stiles-Shields et al., 2021). Further, socially anxious individuals may be at increased vulnerability of excessive cannabis use and related harms through fearfulness of being judged. Theoretical frameworks for social anxiety suggest that individuals may engage in avoidance to alleviate feelings of apprehension and reduce self-focused attention in social situations (Conger, 1956). Cannabis use, then, in response to anxiety-provoking situations, can be conceptualized as an avoidance behaviour, as a socially anxious person may use cannabis in an effort to reduce current distress (Lee et al., 2007). Conversely, an individual who feels intense negative arousal from a social event that was perceived as going poorly or who spends time ruminating on their behaviour may use cannabis to cope with their post-event anxiety (Buckner et al., 2013). Both of these reasons to use cannabis may provide short-term relief, but social anxiety in future social situations is likely to remain unchanged or perhaps worsen. Further, cannabis use to manage anxiety may lead to reliance on cannabis at the expense of more adaptive coping strategies and thus continued and more frequent use (Simons & Arens, 2007). Finally, the effects of cannabis on anxiety may function differently depending on the composition of chemical compounds. For example, cannabis with higher levels of delta- 9-tetrahydrocannabinol (THC), the psychoactive component, has been shown to increase anxiety whereas cannabis with lower levels of THC tends to decrease anxiety (Childs et al., 2017). The other main chemical compound found in cannabis is cannabidiol (CBD) which is robustly related to reducing anxiety (for a review, see Crippa et al., 2009).

Social anxiety is associated with high rates of cannabis use disorders in adults (CUDs), with prevalence research estimating that nearly 30% of individuals with cannabis dependence have SAD (Agosti et al., 2002); however, research supporting the association between cannabis use and social anxiety in young adulthood is not as clear. Although social anxiety is unrelated to cannabis use frequency among young adults (Cloutier et al., 2021), it does appear to be related to cannabis-related problems (Buckner, Zvolensky, & Schmidt, 2012; Foster et al., 2016). In young adult samples, some research fails to show significant associations between social anxiety and cannabis use frequency among undergraduate young adult samples (di Blasi et al., 2017; Ecker &

Buckner, 2014), whereas other research demonstrates a statistically significant positive association of social anxiety with cannabis problems (Ecker et al., 2014; Villarosa-Hurlocker et al., 2019). Further, motives research suggests that socially anxious persons may be at elevated risk for frequent cannabis use and related problems because of their strong coping reasons for use (Buckner et al., 2007; Walukevich-Dienst et al., 2020).

Little attention has been paid, however, to individual differences that may increase or decrease cannabis use and related problems among socially anxious persons. Characteristics, such as sex, may affect study results, considering that in males (but not females), social anxiety is related to more cannabis problems (Buckner, Zvolensky, & Schmidt, 2012) and males tend to use cannabis at greater frequencies and quantities compared to females (Khan et al., 2013). Regarding sex differences in SAD, lifetime prevalence rates for females are higher than males (Xu et al., 2012) and females tend to report greater experience of social anxiety symptoms than males (Turk et al., 1998). The average age of the sample is also important because earlier age of first cannabis use has been consistently reported to be related to higher risk of developing a CUD (Palmer et al., 2009; Wu et al., 2012). Ethnicity of the sample is also important because higher rates of cannabis use tend to occur among non-White individuals (Pacek et al., 2015). Finally, clinical levels of social anxiety may moderate the strength of the relation between social anxiety and cannabis outcomes, such that those with clinically elevated social anxiety may be more vulnerable to negative cannabis-related outcomes. As most of the research utilizes student and community samples, the number of individuals who may meet clinically significant levels of social anxiety are fewer than what would be observed in a clinical setting and the prevalence of social anxiety may have an impact on the frequency of or problems from cannabis use.

The Current Study

To the best of our knowledge, this is the first study to use a meta-analytic design to further understand the complex relations between social anxiety and cannabis use frequency and related problems. The aim of the current study was to quantify the relationship between social anxiety and cannabis use outcomes during young adulthood. Based on prior research showing mixed associations between social anxiety and cannabis use frequency in young adulthood (Buckner, Zvolensky, & Schmidt, 2012; Ecker & Buckner, 2014), we hypothesized that social anxiety would not be related to cannabis use frequency. Further, based on the robust literature supporting an association between social anxiety and cannabis problems during young adulthood

(Ecker et al., 2014; Villarosa-Hurlocker et al., 2019), we hypothesized that a positive association would emerge between social anxiety and cannabis problems. We were also interested in examining the moderating influences of study-level characteristics such as ethnicity, sex, average age of each sample, and clinical levels of social anxiety. Therefore, our moderator analyses were exploratory in nature to further understand the complexities within the cannabis and social anxiety association.

Method

Procedure

To ensure transparency in the current study, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed throughout the stages of identification, screening, and eligibility selection for the included studies in the meta-analysis (Moher et al., 2009). The PRISMA guideline is a useful tool in providing a visual understanding of the process of finding eligible studies.

Eligibility Criteria

The following criteria was used to determine inclusion in the study: the manuscript or grey literature (i.e., unpublished literature) must a) have been published in English, b) have an empirical basis (i.e., not be a systematic review), c) include an young adult sample that ranged from 18 to 30 years of age, d) have measured social anxiety and at least one cannabis-related variable of interest (i.e., use, problems), and e) have reported a correlation between social anxiety and the cannabis-related correlation to be computed.

In terms of operational definitions, *social anxiety* was defined as a fear of anxiety of being negatively judged or evaluated in social situations (APA, 2013). *Cannabis use* was defined as any measure of frequency for the consumption of cannabis. We were unable to derive a separate estimate for cannabis use quantity because it is not commonly reported in the literature due to nuances with measuring and scoring. *Cannabis problems* were defined as any physical, emotional, mental, psychological, or social outcome that was caused or exacerbated due to cannabis use, including disorder-related symptoms (APA, 2013). Finally, *young adult* was defined as a cohort of individuals between the ages of 18 and 30. Although the young adult age range is most often proposed as being between the ages of 18 and 25, the upper limit demarcation is not clearly defined, and Arnett (2000, 2004) has suggested that young adulthood is subjective and this transitional experience can occur throughout the later 20′s. Therefore, we

opted to be more inclusive in our definition of young adulthood and included studies with age ranges with an upper limit of 30 years.

Search and Study Selection

Numerous databases were searched by a social sciences librarian. The search period covered years from inception to October 8, 2021. PsycInfo, PubMed, Scopus, Google Scholar, and ProQuest were searched using a combination and variation of the following terms: emerging adult*, young adult*, college students, university students, cannabis, marijuana, weed, hashish, cannabinoids, hallucinogenic drugs, narcotic drugs, tetrahydrocannabinol, anxiety disorder, social anxiety, and social phobia. Both published and unpublished (e.g., dissertation and theses) records were included in the search. The search results were compiled and duplicates were removed using EndNote X9.

A coding manual was developed that specified the pertinent information needed to be extracted from the articles to be used in subsequent analysis (Lipsey & Wilson, 2001). For example, the self-report measures of social anxiety, cannabis use, cannabis problems, sample size, percentage of the sample that met clinically significant levels of social anxiety, mean age of the sample, and percentage of the sample that was female were included in the coding manual. A copy of the coding manual can be found in Appendix A. Pearson's correlation coefficient (*r*) was extracted for studies reporting a correlation between social anxiety and cannabis use frequency or problems. In the case of there being multiple studies using the same data, the publication with the largest sample size was chosen for inclusion to preserve independence. The search and study selection is documented by the PRISMA flow diagram (see Fig. 1), which shows the different phases of determining study inclusion from identification of records throughout the screening phase.

Data Analysis Plan

Comprehensive Meta-Analysis (CMA; Borenstein et al., 2013) software was used to compute effect sizes. One dataset was created that included all of the eligible studies and relevant study variables. Moderator analyses were conducted using meta-regression to examine the degree to which a moderator might influence the magnitude of an effect size (Card, 2012). The moderators examined in this study included mean age of the sample, percent of the sample that met clinically significant levels of social anxiety, percent of the sample that was female, and percent of the sample that was White.

Results

Study Selection

Search results of databases yielded 1306 records. After removing duplicates, 1073 studies remained. Records were then independently screened by the first and second authors, who are graduate students in the clinical psychology program at the University of Manitoba. The screening process began by screening title and abstract to see if the records met the aforementioned inclusion criteria. Nine-hundred-seventy-six records were excluded after this screening phase, leaving a total of 97 full-text articles to review for eligibility criteria. Of the 97 articles, 79 were excluded for different reasons. The screening procedure is documented using the PRISMA flow diagram (see Fig. 1; Moher et al., 2009).

For studies that met eligibility criteria but were missing pertinent information, the corresponding authors were contacted in efforts to try and retrieve the information necessary (Atkinson et al., 2015). After attempts were made to contact corresponding authors and retrieve the unreported information, it was deemed that one of the 24 studies was ineligible as it did not meet the inclusion criteria for not reporting a correlation between social anxiety and cannabis use frequency. Information was not attained for five of the 23 studies, leaving the final number of studies included in the meta-analysis to be 18.

Backward and forward reference searches of the 18 articles were conducted to ensure that there were no potentially relevant studies missing from the total (Cooper, 2017). No additional studies that met the aforementioned inclusion criteria were found using this search method. Finally, the first author coded all eligible studies, and the second author coded 25% to assess interrater reliability. There was 100% agreement between both coders.

Results of Individual Studies

Study characteristics are listed in Table 1. The included studies were published from 2006 to 2021. The most commonly used measure of social anxiety was the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998). The most common measure of cannabis use was the Marijuana Use Form (MUF; Buckner et al., 2007) and the most utilized measure of cannabis problems was the Marijuana Problems Scale (MPS; Stephens et al., 2000). All studies (100%) were from the United States and were peer-reviewed published articles. There was a total of 6,129 participants across all of the studies. The mean ages of the samples ranged from 18.74 to 23.13 years.

Study Quality

The applicability of meta-analysis outcomes are dependent on the quality of the studies included; therefore, a review of study quality is warranted. All but one of the published studies were cross-sectional in nature, and thus were arguably of lower quality. However, the majority of research examining the relation between social anxiety and cannabis outcomes in young adulthood utilizes cross-sectional designs, which continues to be a limitation in this area. Additionally, the study populations were primarily comprised of student samples. Results from studies using student samples are acceptable as many young adults attend postsecondary institutions, making this an ideal recruitment source. However, student samples are limited as they typically do not capture participants in the later part of young adulthood (i.e., 25 to 30 years of age). Another necessary item to note is that the majority of the studies included in the current meta-analysis were co-authored by Buckner. Although it may be possible that the studies co-authored by Buckner may be driving the observed effect sizes, these studies are comparable to other studies reviewed in the present meta-analysis in terms of using a correlational design, sampling from university students, etc. Finally, the use of different measures may have impacted the findings across each study. For instance, the SIAS (Mattick & Clarke, 1998) is composed of items that assess interacting and meeting other people, but social anxiety can manifest in situations also include being observed by others or when performing in front of others. Additionally, the MUF (Buckner et al., 2007) was variable in the amount of time that individuals were asked to retrospectively recall their cannabis use frequency for, which could have impacted the findings. For instance, recalling shorter timeframes may be more accurate, but also susceptible to acute cannabis use that may not accurately represent typical use. Despite these potential quality limitations, the literature included in the present meta-analysis were appropriate for the purposes of deriving a correlation between social anxiety and cannabis use frequency and cannabis problems.

Association Between Cannabis Outcomes and Social Anxiety

Using a random effects model, we observed a small nonsignificant positive correlation between social anxiety and cannabis use frequency (r = .002, p = .929, 95% CI [-.041, .045], Q(15) 29.895 (p = .012); I^2 = 49.825%; tau^2 = 0.003). We observed a small significant positive correlation between social anxiety and cannabis problems (r = .197, p <.001, 95% CI [.151, .243], Q(15) 33.945 (p = .003); I^2 = 55.811%; tau = 0.005). There was a moderate level of

variability according to the significant *Q* statistic, meaning that it was appropriate to examine potential moderators. Forest plots were generated to display confidence intervals for the individual studies and meta-analysis for the association between social anxiety and cannabis use frequency (see Figure 2) and cannabis problems (see Figure 3).

Publication Bias

Publication bias is a phenomenon where research with significant findings are more likely to be published in scientific literature than research with non-significant results (Card, 2012). Under this assumption, published manuscripts will more likely be associated with a relation between social anxiety and cannabis outcomes. To assess for publication bias, funnel plots were created and inspected for asymmetry, as asymmetry suggests the presence of bias (with smaller studies clustering on the right side of the plot as opposed to being equally distributed). Inspection of funnel plots suggested no evidence of publication bias for the association between social anxiety and cannabis use frequency (Figure 4) and cannabis problems (Figure 5).

Moderator Analyses

Four planned moderator analyses examining study-level characteristics of ethnicity, sex, average age of the sample, and percent of participants who had clinical levels of social anxiety were conducted using meta-regression for the relation between social anxiety and cannabis use frequency. The moderator analysis for the mean age of the sample was the only significant moderator in the relation between social anxiety and cannabis use frequency ($Q = 11.12$, $p < .001$, $k = 13$), meaning study samples with older mean ages of participants produced larger positive effect sizes (Figure 6). Percent of the sample with clinical levels of social anxiety ($Q = 0.20$, $p = .655$, $k = 13$), percent of the sample that was female ($Q = 1.06$, $p = .304$, $k = 13$), and percent of the sample that was White ($Q = 1.87$, $p = .172$, $k = 13$) were not significant.

Similarly, four planned moderator analyses examining the study-level characteristics of ethnicity, sex, average age of the sample, and percent of participants with clinical levels of social anxiety were conducted for the relation between social anxiety and cannabis problems. The moderator analysis for the percent of the sample that met clinical levels of social anxiety was a significant moderator of the relation between social anxiety and cannabis problems ($Q = 20.63$, $p < .001$, $k = 14$), meaning that study samples with fewer participants with clinical levels of social anxiety yielded larger effect sizes (Figure 7). Mean age of the sample ($Q = 0.48$, $p = .489$, $k =$

14), percent of the sample that was White (Q = 0.02, p = .893, k = 14), and the percent of the sample that was female (Q = 1.98, p = .160, k = 14) were not significant.

Post Hoc Analyses

We observed some variability in the strength of the association by measure for both cannabis use and problems. As previously noted, the most common measure of cannabis use was the MUF (47.06% of studies) and the most common measure of cannabis problems was the MPS (62.50% of studies). Given that the most common measure of cannabis problems was the only measure that consistently reported positive significant associations with social anxiety, we opted to run two post hoc moderator analyses. We created binary variables for the cannabis use measure (1 = MUF; 0 = other) and cannabis problems measure (1 = MPS; 0 = other). The moderator analysis for inclusion of the MUF versus all other measures was not significant in the association between social anxiety and cannabis use frequency (Q = 1.10, p = .294, k = 16). The moderator analysis for the use of MPS versus all other cannabis problems measures was significant in the association between social anxiety and cannabis problems (Q = 6.39, p = .012, k = 16), meaning that there were larger effect sizes for studies that utilized the MPS (Figure 8). Accordingly, this suggests that the strength of the correlation between social anxiety and cannabis problems depends on the measure used to assess cannabis problems, whereby the MPS is capturing something uniquely important about this association.

Discussion

This is the first known meta-analytic study of the body of research on the relations between social anxiety and cannabis use frequency and problems during young adulthood. Our findings suggest that there is a small statistically significant positive association between social anxiety and cannabis problems, but not cannabis use, cross-sectionally. The percent of the sample that had clinically significant levels of social anxiety was a significant moderator for the relation between social anxiety and cannabis problems such that samples with fewer participants with clinical levels of social anxiety demonstrated a stronger relation between social anxiety and cannabis problems. Also, the mean age of the sample was a significant moderator in the association between social anxiety and cannabis use frequency, such that samples with older mean ages (i.e., 20 years of age) exhibited a stronger relation between social anxiety and cannabis use frequency. Finally, a post hoc analysis revealed that the use of the MPS (Stephens et al., 2000) was a significant moderator in the association between social anxiety and cannabis

problems, such that studies that utilized the MPS exhibited a stronger relation between social anxiety and cannabis problems.

This meta-analysis adds to the current literature on cannabis use frequency and mental health during young adulthood as it provides a concrete correlation between social anxiety and cannabis-related problems, but indicates that social anxiety is not directly, significantly related to cannabis use frequency. This is consistent with findings reported from earlier cross-sectional studies (Buckner et al., 2007; Ecker et al., 2014; Villarosa-Hurlocker et al., 2019). Rather, these data indicate that age moderates the relation between cannabis use frequency and that among older young adults, social anxiety may be related to more frequent cannabis use. This aligns with research indicating there are certain circumstances in which social anxiety is related to more frequent cannabis use among young adults, such as more frequent solitary cannabis use (Buckner et al., 2016) and personality variables (e.g., risk-seeking tendencies; Rahm-Knigge et al., 2019). Therefore, it may be that although there is not a statistically significant direct effect of social anxiety on cannabis use frequency, certain contextual (e.g., when alone) and individual difference factors (e.g., age) could moderate this relationship. Future work may benefit from testing whether there is something particular about the young adulthood period that impacts the relationship between social anxiety and cannabis outcomes, such as examining theoretically informed moderators (e.g., other mental health conditions, peer influence, and academic or new workplace environment pressures).

The mean age of the sample was a significant moderator for the relationship between cannabis use frequency and social anxiety. This is consistent with data indicating that cannabis use tends to peak around the late teens and early twenties and then taper off in subsequent years (Coffey and Patton, 2016). Moreover, this provides some initial evidence that social anxiety may be associated with less of a likelihood to reduce cannabis use as individuals age through their 20′s. Research has typically observed a decline in cannabis use (and substance use broadly; Windle, 2020) but the findings from our moderator analysis suggest that social anxiety may impede this natural reduction of cannabis use. It is important to note that the mean age of the study samples included in this meta-analysis had a restricted range (18.74–23.13 years of age) which we acknowledge to be quite limited, so interpretations should be made with caution.

Additionally, the percentage of the sample that had clinically significant levels of social anxiety was a significant moderator for the relation between cannabis problems and social

anxiety, where we observed greater effects with lower levels of clinically significant social anxiety. It is surprising that this effect was observed as we might anticipate that as the severity of social anxiety increases, using cannabis to cope with these negative symptoms may also increase, and the literature suggests that using cannabis to cope is robustly associated with more problems among young adults (Colder et al., 2019). Other research on the heterogeneity in social anxiety presentations may help to understand this effect. This literature shows that there are two general subtypes of social anxiety. The first is a prototypical *inhibited subtype* and is characterized by shyness, behavioural inhibition, and low novelty-and risk-seeking behaviours (Kashdan and Hofmann, 2008). Most individuals with SAD (~79%) fit within this subtype and they have been shown to be a lower risk for substance misuse. The second is an atypical *impulsive subtype* and tends to be much smaller than the inhibited subtype (~21% of those with SAD). This subtype is defined by high levels of risk-taking, impulsiveness, and excessive substance use (Kashdan and Hofmann, 2008). The distinction between inhibited and impulsive subtypes of social anxiety could explain why we observed reduced correlation strength between social anxiety and cannabis problems with more clinical elevation. It is likely that the bulk of participants with clinical levels of social anxiety across studies were from the inhibited (and not the impulsive) subtype - thus having lower risk for cannabis problems. We could not differentiate between these subtypes in our study, which should be a goal of future work in this area. Alternatively, greater levels of social anxiety might dampen the effect size because they may have avoided participating in studies out of fear of being negatively evaluated by research personnel, or responded to self-report measures in such a manner to convey positive response bias. It is also possible that individuals who struggle with social anxiety may avoid using cannabis in problematic ways as doing so could result in judgment from others, or use may increase the likelihood of doing something embarrassing when under the influence.

Limitations and Future Directions

Certain limitations should be discussed. First, publication bias is an inherent limitation in most meta-analytic work. Efforts were made to search for and include unpublished theses and dissertations, but the search results did not yield any grey literature. Additionally, funnel plots were inspected for asymmetry. To the best of our knowledge, the current meta-analysis includes all pertinent literature as specified by our inclusion criteria and the funnel plots do not show asymmetry, and thus has a low level of publication bias making this a strength in our study.

Second, we observed some limited variability on some moderators, which may have precluded us from having enough power to find potential effects. For example, we examined percentage of the sample that was White; however, these percentages ranged from 43% to 79.7%. We should note that this could either be attributed to a true absence of moderation effects, or perhaps not having sufficient power to detect a result. Third, all of the studies included in the current meta-analysis were cross-sectional in design. This presents limitations as there is an inability to speak to cause-and-effect or temporal precedence of the findings as could be done with other experimental or longitudinal research designs.

The current findings from this meta-analysis may differ compared to results from epidemiological studies. It appears that the literature in young adulthood is more complex in that we observed mixed evidence for the role of social anxiety in cannabis outcomes relative to the more consistent findings from epidemiologic adult samples. Epidemiologic research in this sector has used adult samples, with findings that SAD is uniquely related to CUD (Buckner, Heimberg, Schneier, et al., 2012). Our results found that study samples with less clinical levels of social anxiety experienced greater cannabis problems, suggesting that clinical risk may only partially explain heightened risk for cannabis-related problems. The discrepancy between the association between social anxiety and cannabis variables in young adulthood relative to adulthood suggests that other factors may moderate or strengthen this association. That is, as young adults age, other variables may make the association between social anxiety and cannabis problems stronger. For example, certain personality traits like impulsivity (Rinehart & Spencer, 2021) and emotional dysregulation (Bonn-Miller et al., 2008), both of which are known antecedents to cannabis use, may moderate this association. Future longitudinal research should examine how key individual differences solidify social anxiety-cannabis use associations as people make their way through young adulthood into adulthood.

Finally, all the studies included in the current meta-analysis looked at the association between cannabis use and problems and social anxiety in university populations predominantly comprised of White females in the United States. It is important to note the limitations of the nonrepresentative samples in the current meta-analysis and how this may have impacted study findings. These results may not generalize to more diverse samples or in other countries, especially in light of data that the relations of anxiety-related variables and cannabis use outcomes could vary as a function of ethnicity (Dean et al., 2017). As well, the non-

representativeness of the samples here may reflect broader systemic biases against non-White individuals in postsecondary institutions. For instance, psychological research tends to rely on theoretical models that have been developed by White researchers and conceptualized for White populations (Settles et al., 2020). From a broader perspective, these systemic biases may have potentially impacted the studies included in the current meta-analysis, as manuscripts prepared by White researchers using primarily White populations are more likely to be published (Roberts et al., 2020). Certainly, these systemic biases may have impacted study findings. Based on prior research showing that non-White college students' experiences of discrimination are associated with greater mental health difficulties (Cokley et al., 2017) and that rates of cannabis use are higher among non-Whites broadly (Pacek et al., 2015), we could speculate that we may have observed a significant, or at least positive, association between social anxiety and cannabis use frequency. Purposeful recruitment to have racially balanced samples should be a pursuit of subsequent work.

Our results suggest that in cross-sectional research there is a small relation between social anxiety and cannabis problems during the young adulthood period, which has particular clinical relevance. Clinicians should consider providing psychoeducation to their clients about the relationship between cannabis use frequency and social anxiety to bring awareness to the potential harms that may result from use. Practitioners are encouraged to assess cannabis use and related problems among clients who demonstrate social anxiety. Recommended guidelines for screening those with social anxiety often include questions to assess for alcohol use, but broadening this to substance use (especially cannabis use) may inform whether it would be useful to teach patients more adaptive skills to manage anxiety and to reduce cannabis misuse. Typical assessments of cannabis consumption involve inquiring about frequency of use, but clarification questions regarding problems experienced across various domains (e.g., work, health, school) should be included to better elucidate the extent to which frequent cannabis use may be occurring.

Table 2.1

Characteristics of Studies Included in the Meta-Analysis

Study	Sample size	% female	% clinical level of SA	% White	Age range	Mean age (SD)	SA measure	Cannabis use measure	Cannabis problems measure	SA and use *r* (95% CI)	SA and problems *r* (95% CI)
Buckner et al., (2006)	123	59.3%	19.1%	59.3%	N/R	20.8 (4.1)	SCID-I/NP	N/A	SCID-I/NP	N/A	.23 (.06, .39)
Buckner et al., (2007)	159	54.7%	15.1%	79.9%	18-26	18.74 (1.20)	LSAS	MUF	MPS	.03 (-.13, .19)	.25 (.10, .39)
Buckner & Schmidt, (2008)	337	58.8%	18.8%	79.4%	18-26	18.8 (1.17)	SIAS	MUF	MPS	-.13 (-.23, -.02)	.17 (.07, .27)
Buckner et al., (2011)	102	43.1%	N/R	85.3%	18-22	19.13 (1.04)	LSAS	MUF	MPS	-.24 (-.42, -.05)	.33 (.15, .49)
Buckner et al., (2012)	252	63.6%	17.5%	84%	18-35	19.93 (2.17)	SIAS	MUF	MPS	N/R	.18 (.06, .30)
Buckner et al., (2016)	276	79.7%	N/R	76.1%	18-29	20.2 (2)	SIAS	MUF	MPS	.09 (-.03, .21)	.14 (.02, .25)
Buckner et al., (2018)	349	69.6%	20.7%	72.4%	N/R	19.9 (1.8)	SIAS	MUF	MPS	.05 (-.06, .15)	.16 (.06, .26)
Buckner et al., (2020)	63	84.1%	20.6%	87.3%	N/R	19.3 (1.0) - control group, 18.9 (1.8) - intervention group	SIAS	TLFB	B-MACQ	.02 (-.23, 0.27)	.05 (-.20, .29)
Buckner et al., (2021)	102	80.4%	21.6%	8.8%	18-27	19.6 (1.6)	SIAS	TLFB	B-MACQ	.06 (-.14, .25)	.27 (.08, .44)
Cloutier et al., (2021)	80	70.0%	N/R	66.1%	18-25	20.06 (1.95)	SIAS	MFS	N/A	-.15 (-.36, .07)	N/A

Ecker & Buckner (2014)	230	63%	12.7%	85.7%	18-23	19.68 (1.34)	SIAS	MUF	MPS	.02 (-.11, .15)	.29 (.17, .40)
Ecker et al., (2014)	158	75%	26%	77.2%	N/R	20.28 (2.41)	SPS	MUF	MPS	-.09 (-.24, .07)	.23 (.08, .37)
Ecker & Buckner (2018a)	244	76.2%	11.4%	74.2%	18-30	20.32 (1.7)	SIAS	TLFB	MPS	.07 (-.06, .19)	.32 (.20, .43)
Ecker & Buckner (2018b)	191	75%	12.7%	74.2%	18-30	20.40 (1.68)	SIAS	TLFB	MPS	.05 (-.09, .19)	.35 (.22, .47)
Garrison et al., (2021)	124	29.8%	28.9%	64.52%	20-25	23.13 (1.51)	SIAS	DFAQ-CU	CUDIT-R	.21 (.04, .37)	.08 (-.10, .25)
Phillips et al., (2018)	300	60%	31.5%	69%	18-25	20.32 (0.82)	SIAS	MUM	RMPI	.06 (-.05, .17)	.02 (-.09, .13)
Rahm-Knigge et al., (2019)	1005	67.6%	31.5%	83.7%	17-35	18.92 (1.69)	SIAS	RBI	N/A	-.06 (-.12, .01)	N/A
Villarosa-Hurlocker et al., (2019)	2,034	69.1%	29.6%	68%	18-N/R	20.24 (3.16)	SIAS	MUG	B-MACQ	-.00 (-.04, .04)	.14 (.10, .18)

Note: CI, confidence interval; B-MACQ, Brief Marijuana Consequences Questionnaire; CUDIT-R, Cannabis Use Disorder Identification Test – Revised; DFAQ-CU, Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory; LSAS, Liebowitz Social Anxiety Scale; MFS; select items from the Monitoring the Future Survey; MPS, Marijuana Problems Scale; MUF, Marijuana Use Form; MUG, Marijuana Use Grid; MUM; Marijuana Use Measure; N/R, not reported; N/A, not applicable; RBI, Risky Behavior Inventory; RMPI; Rutgers Marijuana Problem Index; SA, social anxiety; SCID-I/NP, Structured Clinical Interview for DSM-IV-TR Axis 1 Disorders, Research Version, Non-Patient Edition; SD, standard deviation; SIAS, Social Interaction Anxiety Scale; SPS, Social Phobia Scale; TLFB, Timeline

Figure 2.1

PRISMA Flow Diagram for the Different Phases of Determining Study Inclusion for the Meta-Analysis. The Flow Diagram is Adapted From Moher et al. (2009).

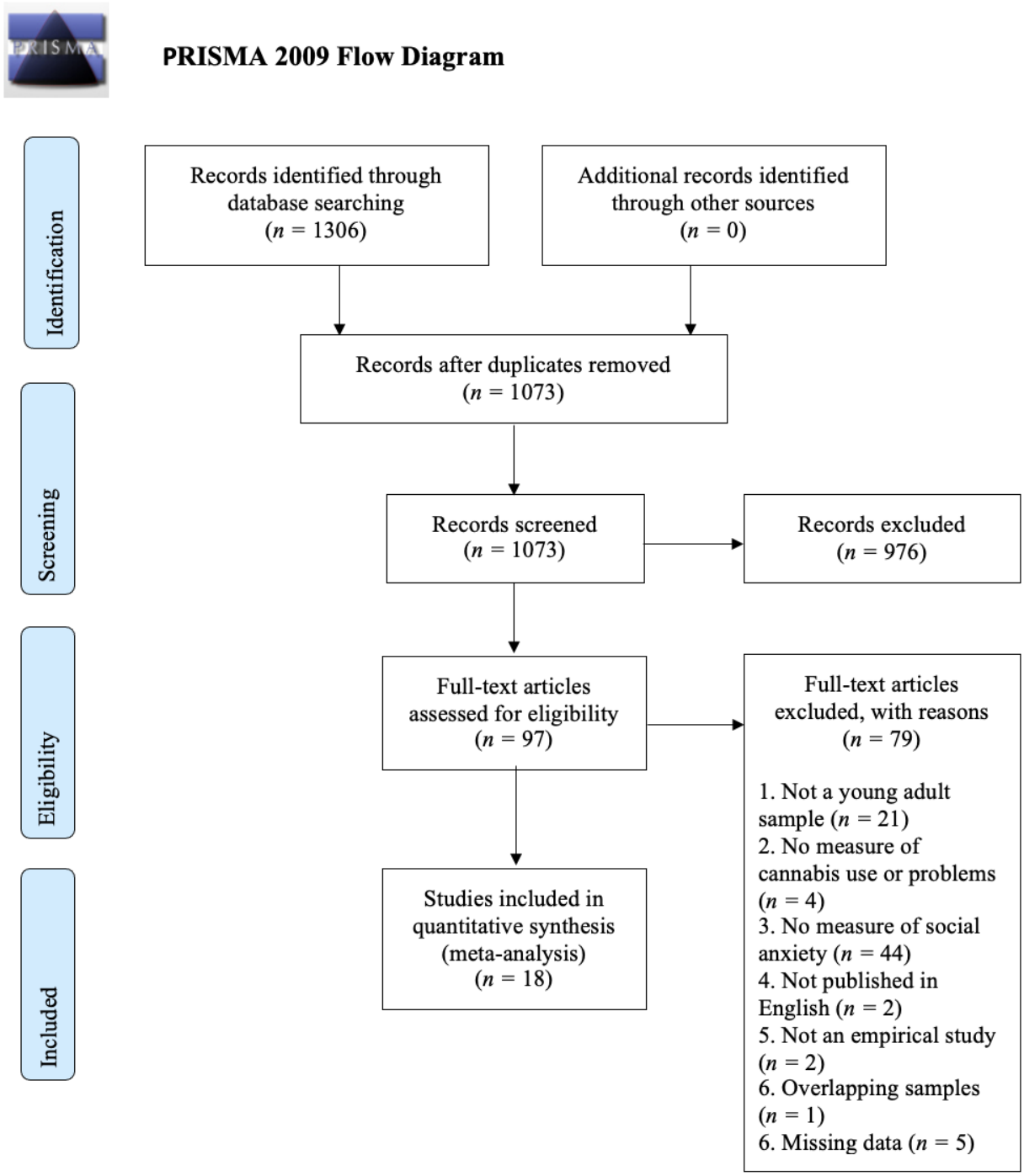
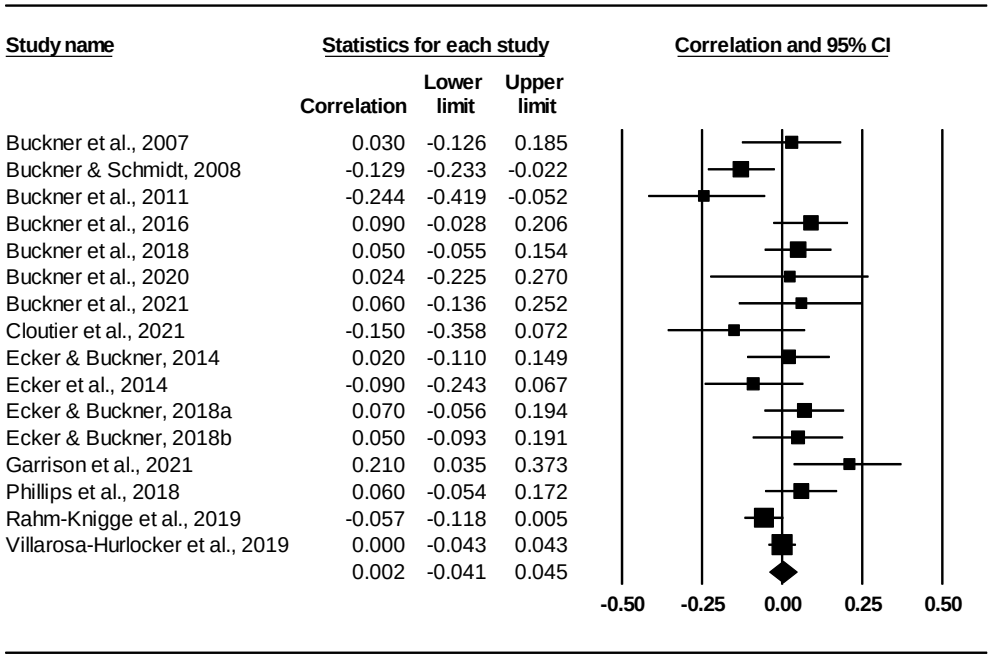


Figure 2.2

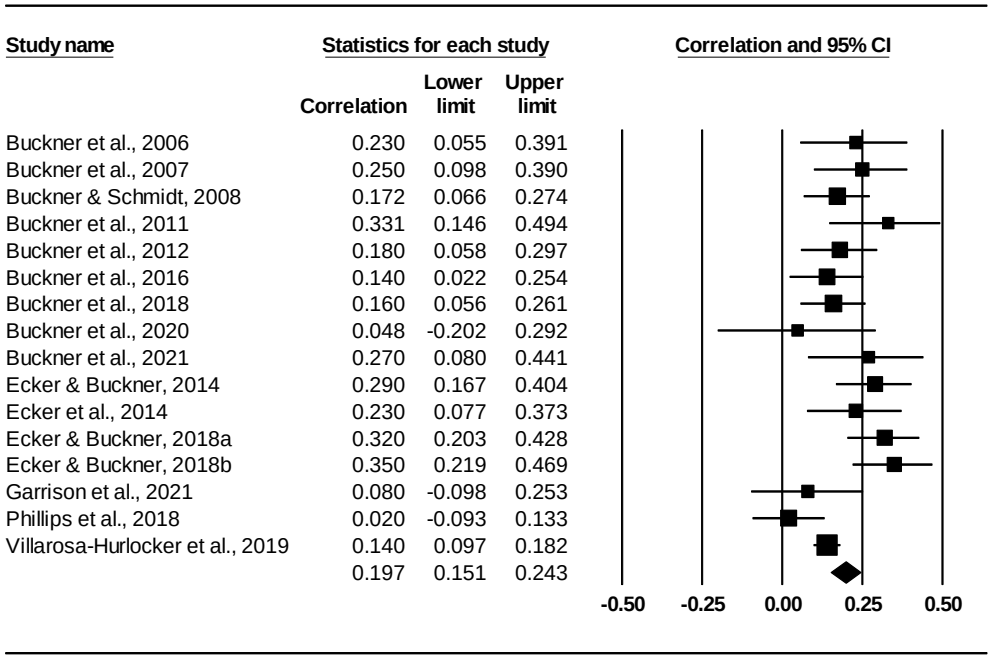
Forest Plot for the Association Between Social Anxiety and Cannabis Use.



Note. The average correlation is represented by a diamond. Individual study correlations are represented by squares, and confidence intervals are displayed as horizontal lines.

Figure 2.3

Forest Plot for the Association Between Social Anxiety and Cannabis Problems.



Note. The average correlation is represented by a diamond. Individual study correlations are represented by squares, and confidence intervals are displayed as horizontal lines.

Figure 2.4

Funnel Plot for the Association Between Social Anxiety and Cannabis Use Frequency.

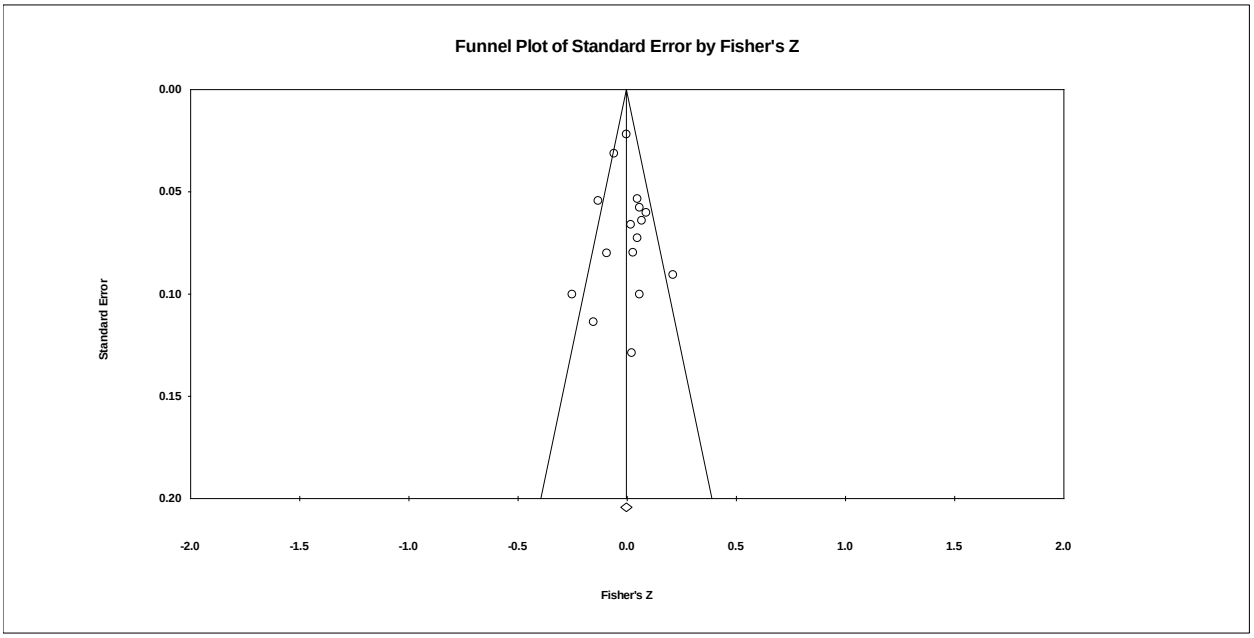


Figure 2.5

Funnel Plot for the Association Between Social Anxiety and Cannabis Problems.

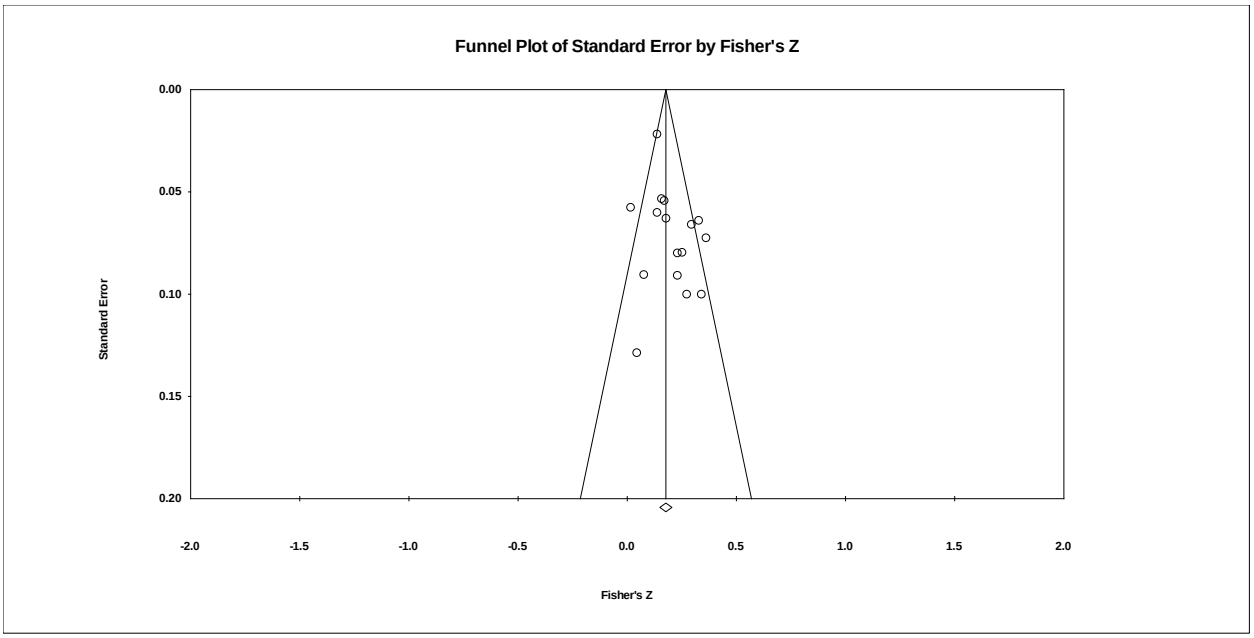


Figure 2.6

Scatterplot Depicting the Effects of Mean Age on the Association Between Social Anxiety and Cannabis Use Frequency.

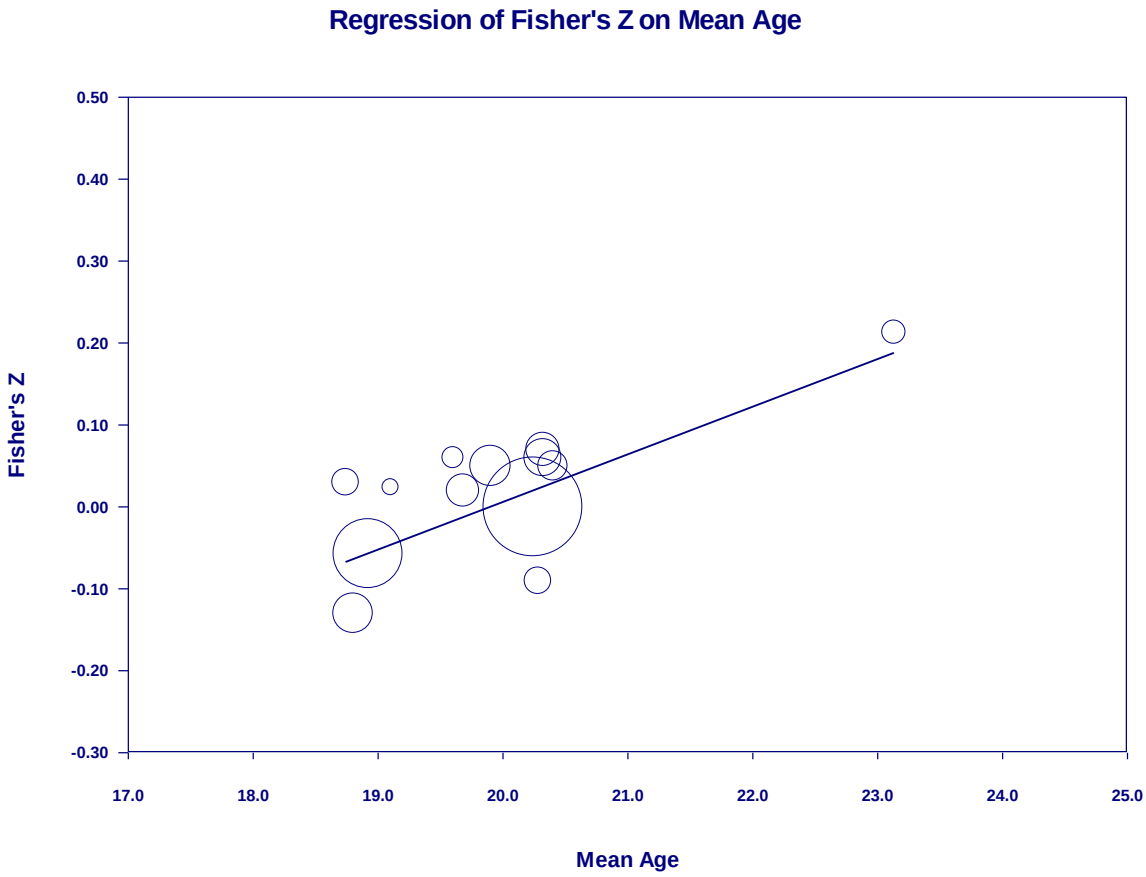
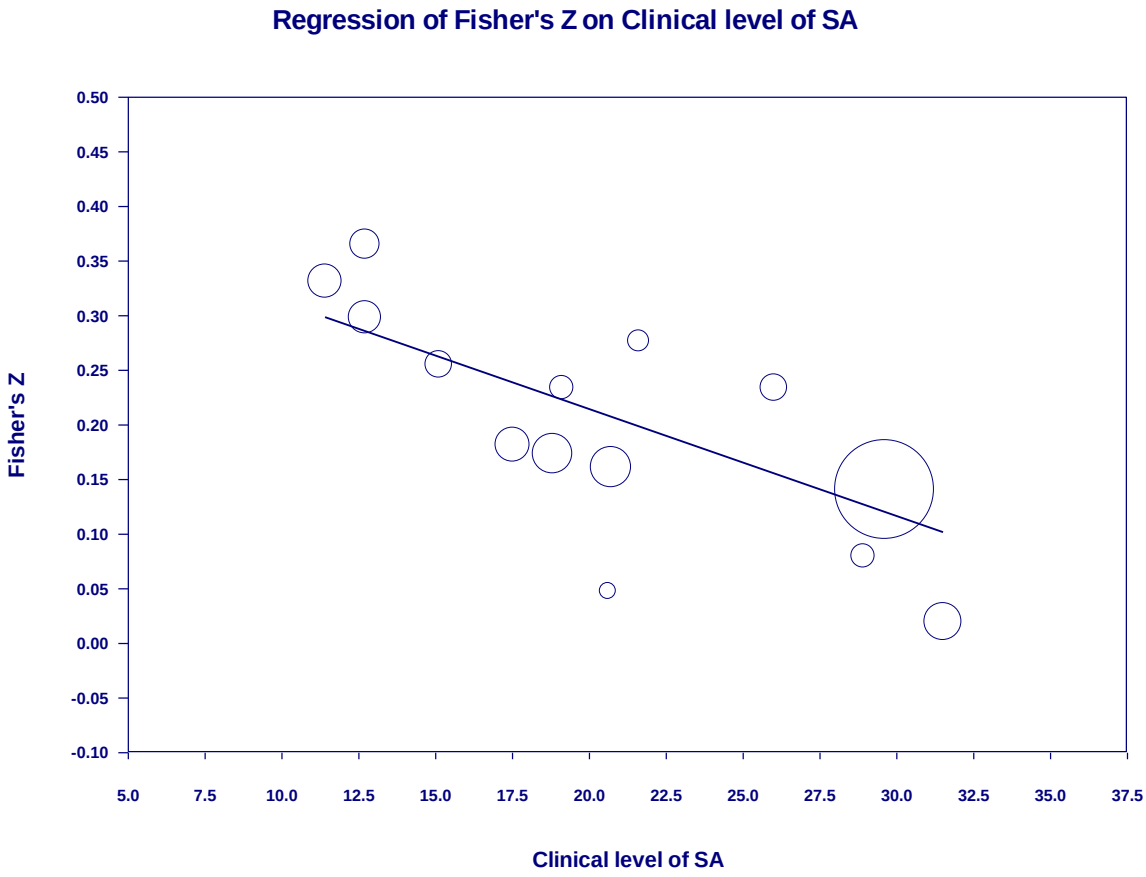


Figure 2.7

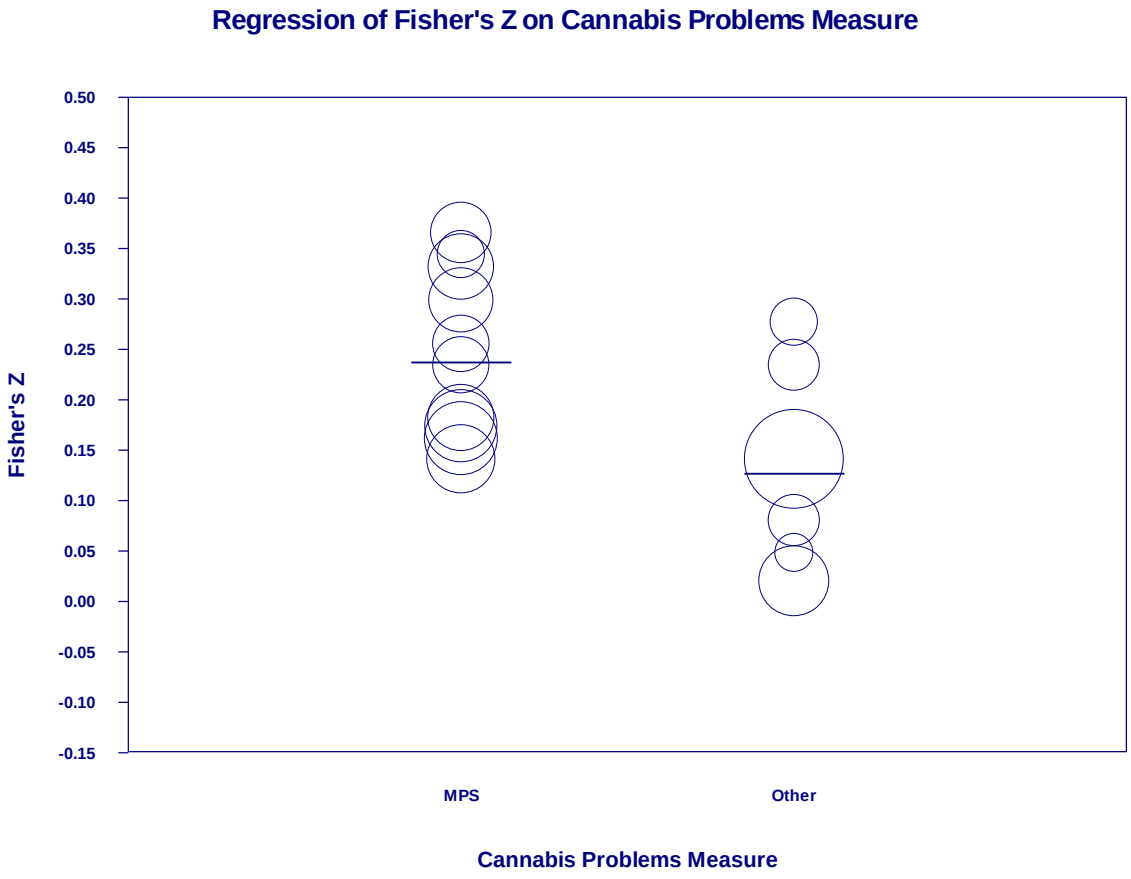
Scatterplot Depicting the Effects of Clinically Significant Levels of Social Anxiety on the Association Between Social Anxiety and Cannabis Problems.



Note. SA; social anxiety.

Figure 2.8

Scatterplot Depicting the Effects of Using the MPS (Versus Other Cannabis Problems Measures) on the Association Between Social Anxiety and Cannabis Problems.



Note. MPS; Marijuana Problems Scale (Stephens et al., 2000).

Chapter 3: Transition to Study 2

The main purpose of Study 1 was to quantify the current cross-sectional literature to better understand the association between social anxiety and cannabis outcomes (i.e., problems and frequency of use) in emerging adulthood. Given that the literature has supported positive associations between social anxiety and cannabis problems (Buckner et al., 2011; Garrison et al., 2021), it was posited that we would find support for an effect between social anxiety and cannabis problems. Based on the literature showing mixed results between social anxiety and cannabis use frequency (Phillips et al., 2018; Rahm-Knigge et al., 2019) we hypothesized that no association would be supported. The findings from the meta-analysis supported a small, statistically significant positive association between cannabis problems and social anxiety in cross-sectional emerging adult populations. Additionally, results revealed a nonsignificant association between social anxiety and cannabis use frequency in emerging adulthood. The moderator analyses also suggested that percent of the sample that had clinically significant levels of social anxiety was a moderator for the association between social anxiety and cannabis problems, and the mean age of the sample was a significant moderator in the relation between social anxiety and cannabis use frequency. Specifically, samples with older mean ages exhibited a stronger correlation in the relation between social anxiety and cannabis problems, and samples that had fewer participants who met clinical levels of social anxiety exhibited a stronger correlation in the relation between social anxiety and cannabis use frequency.

Overall, Study 1 was crucial in synthesizing the literature and providing a mean estimate of the literature on cannabis outcomes and social anxiety in emerging adulthood, given that this is a relatively newly studied area. Further, the finding of the effect size between social anxiety and cannabis problems was negligible, which suggests that there are other moderating factors that are influencing the association and might be relevant for strengthening the relation between social anxiety and cannabis problems as emerging adults make their way into adulthood. Study 1 included a limited number of moderators which were chosen solely based on their consistency across the cross-sectional work (e.g., sex, ethnicity); however, these were limited in the scope of the exploratory work. Evidence from a number of epidemiologic studies using adult populations suggests that additional moderators are worthy of exploration including sociodemographics. For instance, work has found that sex, ethnicity, income, education, and marital status are all relevant factors and are related to increased cannabis use or greater social anxiety (Ambusaidi et al.,

2022; Asher & Aderka, 2018; Breslau et al., 2006; Callaghan et al., 2019; Hasin et al., 2015; Hasin et al., 2019; Pacek et al., 2015; Stein et al., 2017). Psychiatric disorders may also be worthwhile examining as possible correlates given the known associations between psychiatric disorders with cannabis use (Hasin et al., 2016) and psychiatric disorders with social anxiety (Ruscio et al., 2018).

To the best of my knowledge, no study has examined the prevalence estimates for co-occurring SAD and cannabis use in emerging adulthood, or the sociodemographic and psychiatric disorder correlates that may be relevant in the relation between cannabis use and social anxiety using an emerging adult sample of nationally representative data. While the work to date has examined these correlates using adult populations, this hampers our understanding of whether similar estimates would exist in emerging adult populations. Therefore, the aim of Study 2 was to further the literature by exploring what other moderators may be associated with cannabis use and SAD in emerging adulthood.

Chapter 4: Study 2

Cannabis Use and Social Anxiety Disorder in Emerging Adulthood: Results From a Nationally Representative Sample

This article was published in *Journal of Anxiety Disorders*, *101*, Single, A., Alcolado, G., Keough, M. T., & Mota, N., Cannabis use and social anxiety disorder in emerging adulthood: Results from a nationally representative sample, 102808, Copyright Elsevier (2023).
Link to article: https://doi.org/10.1016/j.janxdis.2023.102808

Abstract

Cannabis use and social anxiety disorder (SAD) are prevalent during emerging adulthood. Previous work has demonstrated that SAD is related to cannabis use in adults; however, less is known about what correlates relate to this association in emerging adults. A subsample of individuals ages 18-25 years old from the NESARC-III (N = 5194) was used to (a) evaluate the association between cannabis use and SAD and (b) examine what risk correlates may be associated with cannabis use and SAD in emerging adulthood. Weighted cross-tabulations assessed sociodemographics and lifetime psychiatric disorder prevalence estimates among the emerging adult sample. Multinomial logistic regressions examined associations between sociodemographics and psychiatric disorders and four groups (i.e., no cannabis use or SAD; cannabis use only; SAD only; cannabis use + SAD). The prevalence of co-occurring cannabis use and SAD was 1.10%. Being White, a part-time student, or not a student were associated with increased odds of having co-occurring cannabis use + SAD (OR range: 2.26-3.09). Significant associations also emerged between major depressive disorder, bipolar I disorder, generalized anxiety disorder, specific phobia, agoraphobia, and panic disorder and co-occurring cannabis use + SAD (AOR range: 3.03-19.05). Results of this study may have implications for better identifying and screening emerging adults who are at risk of co-occurring cannabis use and SAD.

Keywords: emerging adulthood, social anxiety disorder, cannabis use, epidemiological

Cannabis Use and Social Anxiety Disorder in Emerging Adulthood: Results From a Nationally Representative Sample

Introduction

In the United States, emerging adults (i.e., ages 18-25 years old) have the highest prevalence of cannabis use compared to other ages, with nearly 20% reporting past-year use (Center for Behavioral Health Statistics and Quality, 2016). Prevalence rates of past-year cannabis use disorder (CUD) are also highest for emerging adults compared to other age groups (Hasin et al., 2016), with epidemiological research supporting that between the years of 2001-2002 and 2012-2013, prevalence estimates of CUD among emerging adults increased more among this age group than among all other developmental age groups (Hasin et al., 2019). Results from a recent meta-analysis found that the risk of developing a CUD among cannabis users was higher in those who used cannabis more frequently (i.e., on a daily or weekly basis) compared to those who used cannabis on a monthly basis, and in younger individuals (Leung et al., 2020). More frequent, persistent cannabis use is associated with a range of negative physical, psychosocial, and developmental outcomes such as cognitive and memory impairment (Meier et al., 2012), poor quality of life (Hasin, 2018), mental health conditions (e.g., anxiety, depression, psychosis; Leadbeater et al., 2019; Lev-Ran & Feingold, 2017), and increased risk of developing a CUD (Anthony, 2006).

One psychiatric disorder that may be related to cannabis use in emerging adulthood is social anxiety. Social anxiety disorder (SAD) is a condition characterized by fear of negative evaluation across multiple social scenarios (e.g., meeting new people, speaking in front of others; APA, 2013). Onset of SAD is early and usually occurs in childhood or adolescence (Stein, 2006). SAD has an estimated prevalence in North America of 3% and 5% for past-year and lifetime timeframes, respectively (Grant et al., 2005; Stein & Kean, 2000), with past-month and past-year prevalence estimates for emerging adults at 5% and 3.1%, respectively (Gomes et al., 2019; Hasin & Grant, 2015). Individuals with SAD often try to avoid situations that may evoke anxiety, or if unavoidable, endure situations with significant distress and discomfort. SAD is related to negative outcomes such as poor quality of life (Stein & Kean, 2000) and significant impairment in employment, educational, and social domains (Aderka et al., 2012; APA, 2013).

SAD has also been linked to higher risk of substance use (Buckner et al., 2013). Indeed, an association between cannabis use and CUD and SAD has been documented in cross-sectional

and longitudinal epidemiological literature. In the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), regular (i.e., at least weekly) cannabis use has been shown to predict increased likelihood of developing DSM-IV social phobia three years later in a nationally representative adult sample (Cougle et al., 2015) and past-year cannabis use has been reported to be associated with increased odds of SAD (Blanco et al., 2016). Further, data from Wave 1 (2001) of the NESARC supports that SAD is associated with a greater likelihood of lifetime cannabis use in adulthood (Blanco et al., 2018). In the National Comorbidity Survey, 29% of adults with lifetime DSM-III-R cannabis dependence had comorbid lifetime DSM-III-R social phobia (Agosti et al., 2002), and data from Wave 1 of the NESARC supports that the majority of individuals with comorbid SAD and CUD report initial onset of SAD before developing a CUD (Buckner et al., 2012).

Despite the extant literature supporting an association between SAD and cannabis use and CUD in adulthood, comparatively less is known about the association in emerging adulthood, and the literature is mixed. Longitudinal data from the NESARC found an association between CUD at baseline and incidence of DSM-IV social anxiety three-years later among emerging adults, but no association between daily cannabis use at baseline and incidence of DSM-IV social anxiety three-years later among emerging adults (Feingold et al., 2016). In emerging adult university sample populations, it has been documented that 11.4-31.5% of cannabis users meet clinically significant levels of social anxiety (Buckner et al., 2007; Ecker & Buckner, 2018; Phillips et al., 2018) and social anxiety is linked to greater cannabis problem severity (Villarosa-Hurlocker et al., 2019). A recent-meta-analysis found a statistically significant association between social anxiety and cannabis-related problems in young adulthood, though the effect size was small, suggesting that there may be moderating factors influencing the association (Single et al., 2022).

It is possible that certain sociodemographics and psychiatric disorders may be influencing the association between social anxiety and cannabis use in emerging adulthood. For instance, higher estimates of cannabis use and CUD are observed among individuals with low-income or lower earnings (Carliner et al., 2017), who are unmarried or divorced (Hasin et al., 2015), of racial-ethnic minority status (Pacek et al., 2015), who are students (Odani et al., 2019) and who are male (Stinson et al., 2006). Higher prevalence estimates of SAD are observed in females (Stein et al., 2017), individuals with lower income earnings (Statistics Canada, 2004), and those

with lower levels of employment (Stein et al., 2017). Certain depressive disorders (e.g., major depressive disorder; MDD), anxiety disorders (e.g., generalized anxiety disorder; GAD), and bipolar disorders typically have onset during emerging adulthood and are highly prevalent during this developmental stage (Bellivier et al., 2001; Mondin et al., 2013; Riggs & Han, 2009). Further research by Buckner et al. (2012) examined how individuals with comorbid SAD and CUD differed from those without the comorbidity with respect to psychiatric disorders, and nearly all respondents reported at least one other lifetime psychiatric disorder. Specifically examining whether sociodemographics and psychiatric disorders might be related to the co-occurrence of cannabis use and SAD in emerging adulthood would help elucidate our current understanding of potential correlates contributing to this association.

The present study aimed to expand the current literature by using nationally representative data to examine the association between cannabis use and SAD in emerging adulthood. To date, most research examining cannabis use and SAD has utilized small cross-sectional emerging adult samples (Buckner et al., 2011; Garrison et al., 2021) or has examined this co-occurrence in nationally representative adult populations (Cougle et al., 2015; Hasin et al., 2016). This is a limitation given research highlighting emerging adulthood as a discrete time period of greater cannabis use and related problems, in addition to the documented deleterious effects that are commonly experienced. Additionally, most studies using nationally representative data have analyzed cannabis use and SAD (previously known as social phobia) according to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV; APA, 1994) as opposed to the DSM-5 (APA, 2013). Modifications to many psychiatric disorders changed considerably with the DSM-5. For instance, the “generalized” specifier in SAD was replaced with a “performance only” specifier, as this subset of individuals are distinct in terms of etiology, age of onset, and response to treatment (APA, 2013). Further, studies in this realm have examined whether a relation between cannabis use and SAD exists; however, there is a lack of understanding of what factors might be relevant in the association among cannabis use and SAD. To our knowledge, this will be the first cross-sectional epidemiological study using nationally representative data to examine the prevalence estimate of co-occurring cannabis use and DSM-5 SAD, including sociodemographics and psychiatric disorder correlates with these comorbid conditions, among emerging adults. We examined sociodemographics and psychiatric disorders that might correlate with cannabis use, SAD, or both cannabis use and SAD. We

predicted that individuals with co-occurring cannabis use and SAD will differ from those with no cannabis use or SAD on sociodemographics of sex, race/ethnicity, household income, education status, marital status, and student status. Similarly, we predicted that individuals with co-occurring cannabis use and SAD will differ from those with SAD only or cannabis use only. We also predicted that individuals with both cannabis use and SAD will have at least one other comorbid psychiatric disorder compared to those with no cannabis use or SAD.

Method

The NESARC-III (Grant et al., 2014) was used for this study, sponsored by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). The NESARC-III is a nationally representative survey of civilians (n = 36,309) aged 18 years and older living in the United States. Respondents completed in-person interviews between April 2012 and June 2013. The overall response rate was 60.1%. To account for non-responsiveness and oversampling, the data were adjusted and then weighted to be representative of the United States population. Trained lay interviewers conducted the survey with the aid of computer-assisted interviews. All participants provided consent prior to their participation and received monetary compensation for participating. Ethical approval was obtained from the National Institutes of Health and Westat Institutional Board for the purposes of data collection, and ethical approval was granted at the institutional level for secondary data analysis. Additional information pertaining to methods, protocol, and data collection for the NESARC-III has been previously published elsewhere (Grant et al., 2014).

Measures

Cannabis Use, Social Anxiety Disorder, and Other Psychiatric Disorders

The Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5; Grant et al., 2011) is a diagnostic interview that was used to assess past-year and lifetime psychiatric disorders. The AUDADIS-5 followed a structured interview process in which it covered DSM-5 criteria for each psychiatric disorder. A dichotomous variable was created for each diagnosis indicating either presence or absence of such. The presence of SAD was assessed using the AUDADIS-5 based on primary symptoms of DSM-5 SAD (i.e., fear of eating or drinking in public). In the interview, respondents were asked to respond to “yes” or “no” to 16 questions about different social situations that may evoke anxiety. If participants responded “yes” to any of the 16 questions, they were then asked follow-up questions to assess if

they met DSM-5 criteria for SAD. Past-year DSM-5 SAD was used in the analyses. In terms of cannabis use, respondents were asked if they have ever used cannabis. If participants endorsed using cannabis, a follow-up question was asked pertaining to timeframe of use (e.g., "Did you use cannabis in the last 12 months only, before the last 12 months only, or during both time periods?"). We examined lifetime cannabis use for participants who endorsed using any cannabis in both time periods. DSM-5 diagnoses of past-year MDD, bipolar I disorder, GAD, specific phobia, agoraphobia, and panic disorder were assessed by the AUDADIS-5 and included in the analyses as psychiatric disorder correlates.

Sociodemographics

Sociodemographics included in the analyses were age (included as a continuous variable from ages 18 to 25 years old), sex (male, female), race/ethnicity (White, racial-ethnic minority), household income ($0-$19,999, $20,000-$34,999, $35,000-$59,999, $60,000+), marital status (married/common law, unmarried), highest level of education achieved (less than high school, completed high school, some college or higher), and student status (full-time student, part-time student, not a student). We based our categorizations of sociodemographics in accordance with previous research (Blanco et al., 2017; Geoffroy et al., 2020) and to ensure adequate sample sizes for multinomial logistic regressions.

Data Analysis Plan

All analyses were conducted using STATA Version 13 (StataCorp, 2019). The proposed study was restricted to a subsample of emerging adult participants aged 18 to 25 years old. We created a four-level categorical dependent variable to use in the multinomial logistic regression analyses: (a) no lifetime cannabis use or SAD, (b) lifetime cannabis use only, (c) SAD only, and (d) lifetime cannabis use + SAD. First, we used frequencies to examine the prevalence of lifetime cannabis use, past-year SAD, sociodemographics, and other psychiatric disorders within the emerging adult sample. Weighted prevalence estimates of sociodemographics and psychiatric disorders were obtained using cross-tabulations. Second, multinomial logistic regressions were conducted to examine associations between sociodemographics, psychiatric disorders, and the four cannabis use and SAD groups. We tested an unadjusted model when examining the associations between sociodemographics and our four-level group variable, with the reference group as no lifetime cannabis use or SAD. We then tested the same unadjusted model but used lifetime cannabis use only as the reference group, and then SAD only as the reference group, as

comparing these groups to lifetime cannabis use + SAD group gives us a sense of the impact of comorbidity. We also tested an adjusted model accounting for sociodemographics when examining the associations between sociodemographics and our four-level group variable with the reference groups as no lifetime cannabis use or SAD, lifetime cannabis use only, and SAD only. Finally, we tested an adjusted model when examining the associations between psychiatric disorders and our four-level group variable accounting for sociodemographics (i.e., sex, race/ethnicity, household income, marital status, education status, student status), with the reference groups as no lifetime cannabis use or SAD, lifetime cannabis use only, and SAD only. We used 95% confidence intervals and a *p*-value of .05 as our cut-off.

Results

Prevalence

Prevalence estimates for study sample characteristics (N = 5,194) are reported in Table 1. The sample was predominantly female (54.25%) and the majority of the sample identified with being a race/ethnicity other than White (57.80%). The majority of the sample was unmarried (78.17%), had completed some college or higher (53.89%), and were enrolled as full-time students (44.15%). Over one third of the sample reported a past-year household income of $0-$19,999 (38.64%). Of the sample, 3.47% met criteria for DSM-5 SAD, and 20.95% endorsed lifetime cannabis use. Further, 1.10% of the sample had co-occurring SAD and lifetime cannabis use.

Multinomial Logistic Regression

Table 2 describes the unadjusted associations between sociodemographics among our groups for cannabis use and SAD (i.e., no lifetime cannabis use or SAD, lifetime cannabis use only, SAD only, lifetime cannabis use + SAD). Relative to those with no lifetime cannabis use or SAD, individuals who were male, White, or were a part-time student or not a student had increased odds of having lifetime cannabis use (OR range: 1.22-1.67; all p's < .05). Individuals who had a household income of $20,000-$39,999 or were married/common law had decreased odds of having lifetime cannabis use (OR range: 0.61-0.70; all p's < .05). Relative to those with no lifetime cannabis use or SAD, individuals who were White and completed less than high school were significantly associated with increased odds of having SAD (OR range: 1.85-2.04; all p's < .05), whereas being male and having a household income of $40,000-$59,999 was associated with decreased odds of having SAD (OR range: 0.37-0.63; all p's < .05). Finally,

relative to those with no lifetime cannabis use or SAD, being White, being a part-time student or not a student had significantly increased odds of having lifetime cannabis use + SAD (OR range: 2.26-3.09; all *p*'s < .05).

We also tested an unadjusted model for the associations between sociodemographics and our four-level group variable, using lifetime cannabis use only as the reference group to examine the impact of the lifetime cannabis use + SAD comorbidity. Relative to those with lifetime cannabis use only, individuals who were White (OR: 1.85, 95% CI [1.01-3.37]; $p < .05$) had significantly increased odds of having lifetime cannabis use + SAD. Additionally, relative to those with SAD only, individuals who were part-time students (OR: 3.14, 95% CI [1.10-8.93]; $p < .05$) had significantly increased odds of having lifetime cannabis use + SAD.

In addition, we tested a multivariate model in which all sociodemographics (i.e., sex, race/ethnicity, household income, marital status, education status, student status) were controlled for to control for the possible confounding effects among the different sociodemographics. Results were comparable to the unadjusted model, in which relative to those with no lifetime cannabis use or SAD, being White, being a part-time student or not a student had significantly increased odds of having lifetime cannabis use + SAD (AOR range: 2.38-3.32).

Results from the multinomial logistic regressions examining the associations between psychiatric disorders and our four-level categorical groups for cannabis use and SAD after adjusting for sociodemographics are displayed in Table 3. Relative to those with no lifetime cannabis use or SAD, individuals with MDD, bipolar I disorder, GAD, specific phobia, agoraphobia, and panic disorder had significantly increased odds of having lifetime cannabis use + SAD (AOR range: 3.03-19.05). Relative to those with lifetime cannabis use only, those with bipolar I disorder (AOR: 3.46, 95% CI [1.15-9.86]; $p < .05$), GAD (AOR: 8.83, 95% CI [3.77-20.69]; $p < .001$), specific phobia (AOR: 13.28, 95% CI [6.53-27.01]; $p < .001$), agoraphobia (AOR: 4.95, 95% CI [1.85-13.25]; $p < .01$), and panic disorder (AOR: 6.51, 95% CI [2.29-18.46]; $p < .01$) had significantly increased odds of having lifetime cannabis use + SAD. There were no significant associations between those with lifetime cannabis use + SAD relative to those with SAD only with respect to psychiatric disorders.

Discussion

To our knowledge, this study represents the first nationally representative examination of the prevalence of and associations between sociodemographics and psychiatric disorders with

co-occurring lifetime cannabis use and SAD in emerging adulthood. One novel contribution of this work is providing prevalence estimates of DSM-5 SAD, lifetime cannabis use, and co-occurring lifetime cannabis use and SAD in emerging adulthood as this is a relatively newly studied area. Our study supported that prevalence estimates for lifetime cannabis use among emerging adults was 20.95%, which was lower than lifetime prevalence estimates of cannabis use in emerging adults which have been previously reported to be 52.4% (Han et al., 2019) using a sample from the 2015-2017 National Survey on Drug Use and Health (NSDUH). The lifetime cannabis use estimate may have been impacted by the legalization of cannabis in some states. Between the period when the NESARC-III and the NSDUH were conducted (2012-2013 and 2015-2017, respectively), seven states legalized cannabis for recreational use. Research using emerging adult samples have found greater cannabis use post-legalization (Bae & Kerr, 2020; Parnes et al., 2018). Our data were from an earlier timepoint when fewer states had legalized cannabis for recreational use, and so prevalence rates of lifetime cannabis use may have increased due to the availability and accessibility of cannabis. Regarding SAD, previous work has found that prevalence estimates in emerging adults is 5-6% (Gomes et al., 2019), and we found comparable estimates of 3.47%. The prevalence of cannabis use and SAD in our sample was 1.10%. Research using adult populations has reported the prevalence for past-year cannabis use and SAD at 4.1% (Feingold et al., 2016), and other cross-sectional work utilizing university populations with lifetime cannabis use have reported the rate of co-occurrence to be approximately 15% (Buckner et al., 2007). It is possible that our results provided different prevalence estimates for co-occurring cannabis use and SAD as past-year DSM-5 SAD was assessed using the AUDADIS-5 using DSM-5 criteria, rather than primarily assessing situations which may evoke social anxiety as used in the majority of studies examining the association between social anxiety and cannabis outcomes in emerging adulthood (see Single et al., 2022). For instance, although the Social Interaction Anxiety Scale (Mattick & Clarke, 1998) is a well-established social anxiety self-report measure, the items do not assess specific SAD criteria (e.g., inquiring if the social situations are ever avoided because of intense fear or anxiety). Additionally, it is possible that our results provided lower prevalence estimates for lifetime cannabis use as our sample was not comprised solely of college students, so this could be another reason for the differential estimates, as college students report using high amounts of cannabis (Johnston et al., 2016).

Another important outcome from this research was examining sociodemographics that were related to increased odds of having co-occurring cannabis use and SAD, with part-time student status and not a student being significantly associated with such. This is surprising, considering the literature has documented prevalence estimates of cannabis use to be nearly equivalent for college-attending and non-college-attending individuals (Schulenberg et al., 2021) and that college-attending students report high levels of social anxiety (Stewart & Mandrusiak, 2007). One possibility may be that these results reflect students who experience difficulty with academic achievement due to cannabis use (e.g., lower attendance rates; Arria et al., 2015). SAD alone is not a predictor of college persistence (Strahan, 2003) and frequent cannabis use is linked to lower educational attainment (Thompson et al., 2019) and so the combined experience of SAD with cannabis use might be a possible explanation underlying this result. Alternatively, another unmeasured correlate may be driving this association. For example, emerging adults who have dropped out of college have cited a lack of social support and lack of resources for mental health difficulties as contributing factors (Ramsdal et al., 2018). Future research should examine whether this remains true for emerging adults with co-occurring cannabis use and SAD. One other potential reason for our findings may stem from other circumstances that we did not assess that may have impacted the frequency of cannabis use in non-college attending individuals, such as being a recipient of social welfare assistance. Research supports that cannabis use is higher for those on social welfare assistance (Pedersen, 2011), and so not including this variable in our analyses may be one limitation that hampers our ability to understand why being a part-time student or not a student was associated with cannabis use and SAD; future research should explore such.

Our findings also supported that being White was related to increased odds of having co-occurring cannabis use and SAD. Prior research has found racial-ethnic minority status to be related to CUD (Stinson et al., 2006) and cannabis use (Pacek et al., 2015) in adult populations, and other work has identified that Hispanic and Black individuals had lower lifetime risk for social phobia compared to non-Hispanic White individuals (Breslau et al., 2006). More recent work with data from the NESARC-III found that Black emerging adults have higher CUD prevalence compared to White and Latino emerging adults (Vasilenko et al., 2017). It is possible that our data are capturing a unique crossover effect, where White emerging adults are observed to have higher rates of lifetime cannabis use as a function of also having SAD before a shift in

cannabis use trends occurs in later adulthood. Crossover effects have been observed in prior research examining cannabis use across racial-ethnicity status and age, in which racial-ethnic minority individuals are at lower risk of substance use in adolescence and emerging adulthood, but then trend toward higher risk as they transition into adulthood (for a review, see Banks & Zapolski, 2018). Additionally, cultural understanding and expression of social anxiety may have influenced these findings, as various cultures experience social fears differently (Hofmann et al., 2010). One framework which may help to understand these findings is through individualism and collectivism, which delineates how people think, behave, and relate to one another (Triandis, 1995). More specifically, people in individualistic cultures tend to prioritize self over others, whereas people in collectivistic cultures tend to prioritize others over self (Singelis, 1994), though individualism and collectivism exist on a continuum. Since White individuals from the United States tend to identify more strongly with individualism (Oyserman et al., 2002), we may have observed that being White was associated with increased odds of co-occurring cannabis use and SAD if these individuals experienced SAD as it is described in the DSM-5, that is, having to do with the fear of embarrassing oneself (versus fear of embarrassing others). Racial-ethnic minorities tend to identify more strongly with collectivism (Coon & Kemmelmeier, 2001), and in turn, might be more likely to have fears of embarrassing others (and less likely to have fears of embarrassing oneself); statements that the DSM-5 criteria for SAD would not adequately assess. It is important to note that variation in individualism and collectivism is based on a variety of factors and not just racial-ethnic background alone. Another possibility that may have influenced findings involves the presence of structural racism in research and clinical practice. Structural racism is the process of how systemic institutions unwittingly ascribe biased practices and policies onto health care providers which tend to de-center the individual receiving care in ways that could be racialized (Desai et al., 2022). This racialized practicing may take many forms, one result of which might be how racial-ethnic minorities are more likely to be misdiagnosed (Liang et al., 2016; Saldana et al., 2021). Therefore, our results may have emerged as an outcome of inherent bias within institutions and systems, which should be further explored in future research.

Our research also documented which psychiatric disorders were associated with co-occurring lifetime cannabis use and SAD. Compared to having neither condition, all DSM-5 psychiatric disorders included in the present study (i.e., MDD, bipolar I disorder, GAD, specific

phobia, agoraphobia, panic disorder) increased the odds of co-occurring cannabis use and SAD after adjusting for sociodemographics. Additionally, compared to lifetime cannabis use only, individuals with another DSM-5 psychiatric disorder (with the exception of MDD) had increased odds of having co-occurring cannabis use and SAD. This is unsurprising, as comorbidity is more often the rule than the exception, with previous work documenting that 23% of individuals have three or more psychiatric diagnoses (Kessler et al., 2005). As it pertains to co-occurring cannabis use and other psychiatric disorders, regular cannabis use is also related to risk of developing other psychiatric disorders aside from SAD (e.g., bipolar disorder; Cougle et al., 2015). Additionally, the vast majority (43%) of individuals with an anxiety disorder have an additional current anxiety disorder, with 37% of individuals with social phobia also meeting criteria for another anxiety disorder (Brown et al., 2001). This is concerning, given that individuals with co-occurring disorders experience greater functional impairment compared to those with only one disorder (Vida et al., 2009). Further, utilization of treatment in emerging adulthood is low (Mental Health Commission of Canada, 2017) while approximately only half of individuals with SAD seek treatment (Iza et al., 2013), and so these findings have implications for health care providers regarding selecting appropriate treatment. For example, treating one anxiety-related disorder leads to improvements in another anxiety-related disorder (e.g., GAD with social phobia; Borkovec et al., 1995; Tsao et al., 2005), though treatment outcomes with an anxiety-related disorder and other comorbidities (e.g., SAD with bipolar I disorder) are not as well known. Future research should examine if these types of comorbidities in emerging adulthood impact treatment outcomes. Another possibility for this result is that individuals may be self-medicating with cannabis to reduce any unpleasant emotional states. The self-medication hypothesis suggests that substances may be used to reduce negative affect (Khantzian, 1985), and research supports that cannabis is used to alleviate anxiety- or mood-related symptoms (Kosiba et al., 2019). Therefore, we may have observed numerous DSM-5 psychiatric disorders be related to increased odds of cannabis use and SAD for self-medication reasons.

The present findings provide information which may advance screening efforts and have implications for treatment. Our results highlight that evaluating the co-occurrence of cannabis and SAD among emerging adults with another DSM-5 psychiatric disorder should be prioritized. Since assessing the presence of more than one condition can be time and resource intensive, single-item screens for each disorder may be preferred (e.g., Matson et al., 2022). Additionally,

mental health clinics should aim to conduct routine screening of cannabis use among emerging adults who present with social anxiety symptoms to confirm whether the comorbidity is present, and vice-versa (e.g., routine screening for social anxiety among those who present with cannabis use). Regarding treatment, our findings indicate a need to provide interventions for more than one condition. Decisions about interventions are informed by patient presentation and preference, though concurrent treatment has been identified as the optimal approach (National Institute on Drug Abuse, 2010). Other research suggests that treating anxiety can have implications for reducing cannabis use in adult populations (Buckner & Carroll, 2010). At this time, further research is needed to determine what brief screening measurements would be appropriate in health care settings and which treatments are most effective for emerging adults. Overall, our results suggest SAD and cannabis use co-occur in emerging adulthood; therefore, we should continue to investigate the mechanisms contributing to this association as that will better inform treatment for this group.

Several limitations should be noted. First, the NESARC-III is based on cross-sectional data, meaning that temporal and causal relations between SAD and lifetime cannabis use cannot be explored. Relatedly, past-year SAD and lifetime cannabis use were included in the analyses, and so although there may have been some overlap captured between cannabis use and the experience of SAD, we cannot explore whether the presence of one condition happened before the other, or vice versa. Second, the data were based on self-reports from respondents, and so they may be subject to recall bias. We attempted to lessen this shortcoming by using past-year DSM-5 diagnoses and reports when applicable. Examining past-year DSM-5 diagnoses helps to reduce the possibility of inaccurate reporting due to retrospective recall, though this may have limited the number of individuals who endorsed certain psychiatric disorders. Third, although the race/ethnicity variable in the NESARC-III dataset is commonly comprised of five categories (i.e., White, Black, American Indian/Alaska Native, Asian/Native Hawaiian/Other Pacific Islander, Hispanic*)*, we opted to collapse the race/ethnicity variable into a dichotomous variable (i.e., White and Ethnic Minority). This decision was made in accordance with ethical procedures as we aimed to present only aggregate data and did not report cell sizes of less than five to preserve respondent confidentiality, though it likely resulted in the loss of valuable, nuanced information. Similarly, we also collapsed the variable marital status from three (i.e., married/common law, widowed/separated/divorced, single/never married) to two categories (i.e.,

married/common law, unmarried). We were unable to use DSM-5 CUD in our analyses for the same reasons. Further, the decision to use lifetime cannabis use (instead of past-year CUD) in our analyses because of small sample size poses another shortcoming of the current research. Broadly examining lifetime cannabis use without an understanding of possible motives or associated reasons underlying use could conflate different forms of cannabis use (e.g., non-problematic, recreational cannabis use, medical cannabis use, and problematic, disordered cannabis use) and limits our ability to make concise remarks about whether problematic cannabis use, for example, is driving the current results. The results should be considered in light of this limitation, and future research may benefit from exploring these research questions. Fourth, the NESARC-III did not collect data on whether individuals with SAD met the performance only specifier. The DSM-5 classifies a performance only specifier for individuals whose experience of social anxiety is limited for situations of public speaking, presentation delivery, or public performances (APA, 2013). Some research suggests that there are differences on factors such as clinical severity and other mental health experiences between those with performance only SAD and SAD without the performance only specifier in an adolescent population (Fuentes-Rodriguez et al., 2018). Future research should examine whether these differences exist in an emerging adult population. Fifth, the NESARC-III dataset only collected data on sex as a dichotomous variable and it did not collect data on gender, consequently limiting our ability to examine biological or socialized effects. It is imperative for all research to strive to remain sensitive and inclusive of additional ways of understanding the complexities of human behaviour by acknowledging these differences and how to best assess for them in psychological research.

In conclusion, this study provides noteworthy information about the association between lifetime cannabis use and SAD during emerging adulthood by highlighting some of the sociodemographics and psychiatric disorders that are related to greater odds of these conditions co-occurring. Emerging adulthood is a critical developmental period, so better understanding those who are at greater risk of cannabis use and SAD can provide useful information for screening and intervention strategies that aim to mitigate the risks associated with these co-occurring conditions.

Table 4.1

Characteristics of the Study Sample (*N* = 5,194)

	n (%)
Sociodemographics	
Sex	
Male	2,376 (45.75)
Female	2,818 (54.25)
Race/ethnicity	
White	2,192 (42.20)
Racial-ethnic minority	3,002 (57.80)
Household income	
$0-$19,999	2,007 (38.64)
$20,000-$39,999	1,434 (27.61)
$40,000-$59,999	723 (13.92)
$60,000+	1,030 (19.83)
Marital status	
Married/common law	1,134 (21.83)
Unmarried	4,060 (78.17)
Education	
Less than high school	744 (14.32)
Completed high school	1,651 (31.79)
Some college or higher	2,799 (53.89)
Student status	
Full-time	2,293 (44.15)
Part-time	871 (16.77)
Not a student	2,030 (39.08)
Psychiatric Conditions	
Lifetime cannabis use	1,088 (20.95)
Social anxiety disorder	180 (3.47)

Note. n-values are unweighted, percentages are weighted.

Table 4.1

Associations Between Sociodemographics Among Individuals with Lifetime Cannabis Use, SAD, and Co-occurring Lifetime Cannabis Use and SAD

	No condition		Lifetime cannabis use			SAD			Lifetime cannabis use + SAD		
	n (%)	OR (95% CI)	*n* (%)	OR (95% CI)	AOR (95% CI)	*n* (%)	OR (95% CI)	AOR (95% CI)	*n* (%)	OR (95% CI)	AOR (95% CI)
Sex											
Female	2,272 (52.30)	1.00	434 (39.67)	1.00	1.00	82 (63.53)	1.00	1.00	30 (48.66)	1.00	1.00
Male	1,711 (47.70)		597 (60.33)	1.67 (1.38-2.02)***	1.62 (1.34-1.97)***	41 (36.47)	0.63 (.40-.99)*	.62 (.40-.97)*	27 (51.34)	1.16 (.61-2.18)	1.16 (.62-2.20)
Race/ethnicity											
Racial-ethnic minority	2,383 (44.96)	1.00	546 (40.10)	1.00	1.00	52 (30.63)	1.00	1.00	21 (26.59)	1.00	1.00
White	1,600 (55.01)		485 (59.90)	1.22 (1.04-1.44)*	1.26 (1.06-1.50)**	71 (69.37)	1.85 (1.16-2.94)**	2.09 (1.26-3.46)**	36 (73.41)	2.26 (1.23-4.16)**	2.38 (1.25-4.55)**
Household income											
$0-$19,999	1,499 (30.89)	1.00	426 (36.66)	1.00	1.00	53 (40.69)	1.00	1.00	29 (45.49)	1.00	1.00
$20,000-$39,999	1,130 (26.81)		259 (22.16)	0.70 (.55-.88)*	.69 (.54-.87)**	32 (24.56)	0.70 (.42-1.14)	.71 (.41-1.22)	13 (22.49)	0.57 (.25-1.28)	.52 (.22-1.22)
$40,000-$59,999	563 (15.36)		144 (14.25)	0.78 (.60-1.01)	.77 (.59-1.00)	11 (7.44)	0.37 (.15-.89)*	.38 (.15-.98)*	5 (8.90)	0.39 (.13-1.21)	.36 (.12-1.09)
$60,000+	791 (26.93)		202 (26.93)	0.84 (.68-1.05)	.80 (.64-1.00)	27 (27.31)	0.77 (.40-1.47)	.81 (.41-1.61)	10 (23.12)	0.58 (.26-1.32)	.56 (.24-1.28)
Marital status											
Unmarried	3,053 (76.25)	1.00	867 (83.93)	1.00	1.00	93 (72.75)	1.00	1.00	47 (75.76)	1.00	1.00
Married/common law	930 (23.75)		164 (16.07)	0.61 (.48-.78)***	.61 (.48-.79)***	30 (27.25)	1.20 (.74-1.94)	1.09 (.64-1.86)	10 (24.24)	1.03 (.47-2.23)	.86 (.38-1.95)
Education											
Some college or higher	2,140 (56.26)	1.00	569 (56.82)	1.00	1.00	58 (44.34)	1.00	1.00	32 (50.56)	1.00	1.00
Less than high school	562 (13.77)		152 (13.64)	0.98 (.77-1.25)	.89 (.69-1.16)	24 (22.16)	2.04 (1.11-3.75)*	2.20 (1.11-4.39)*	6 (9.88)	0.80 (.29-2.17)	.68 (.24-1.96)
Completed high school	1,281 (29.96)		310 (29.54)	0.98 (.78-1.21)	.88 (.70-1.10)	41 (33.51)	1.42 (.87-2.32)	1.45 (.85-2.46)	19 (39.55)	1.47 (.76-2.83)	1.17 (.57-2.43)
Student status											
Full-time	1,819 (50.09)	1.00	403 (42.96)	1.00	1.00	54 (44.65)	1.00	1.00	17 (27.09)	1.00	1.00
Part-time	643 (14.24)		200 (18.17)	1.49 (1.18-1.87)**	1.61 (1.27-2.04)***	15 (12.51)	0.99 (.51-1.92)	.97 (1.92-1.96)	13 (23.84)	3.09 (1.36-7.02)**	3.32 (1.46-7.56)**
Not a student	1,521 (35.67)		428 (38.87)	1.27 (1.07-1.51)**	1.46 (1.19-1.79)***	54 (42.83)	1.35 (.84-2.17)	1.17 (.70-1.96)	27 (49.06)	2.54 (1.20-5.41)*	2.64 (1.10-6.33)*

Note. *$p < .05$ **$p < .01$ ***$p < .001$. *n*-values are unweighted, and percentages are weighted. SAD, social anxiety disorder. Sex reference group was females. Race/ethnicity reference group was racial-ethnic minority. Household income reference group was $0-$19,999. Marital status reference group was unmarried. Education reference group was some college or higher. Student status reference group was full-time.

Table 4.1

Associations Between Psychiatric Disorders Among Individuals With Lifetime Cannabis Use, SAD, and Co-Occurring Lifetime Cannabis Use and SAD

	No condition		Lifetime cannabis use		SAD		Lifetime cannabis use + SAD	
	n (%)	AOR (95% CI)	*n* (%)	AOR (95% CI)	*n* (%)	AOR (95% CI)	*n* (%)	AOR (95% CI)
MDD								
No	3,564 (89.29)	1.00	841 (80.16)	1.00	81 (67.76)	1.00	43 (74.41)	1.00
Yes	419 (10.71)		190 (19.84)	2.35 (1.83-3.03)***	42 (32.24)	3.52 (2.25-5.53)***	14 (25.59)	3.03 (1.48-6.19)**
Bipolar I disorder								
No	3,920 (98.40)	1.00	983 (95.66)	1.00	118 (94.93)	1.00	50 (86.30)	1.00
Yes	63 (1.60)		48 (4.34)	2.87 (1.75-4.71)***	5 (5.07)	3.05 (.91-10.23)	7 (13.70)	9.66 (3.52-26.52)***
GAD								
No	3,886 (97.14)	1.00	980 (94.47)	1.00	95 (72.63)	1.00	37 (64.04)	1.00
Yes	97 (2.86)		51 (5.53)	2.16 (1.32-3.52)**	28 (27.37)	12.14 (6.34-23.26)***	20 (35.96)	19.05 (8.98-40.39)***
Specific phobia								
No	3,776 (94.53)	1.00	972 (95.00)	1.00	69 (54.17)	1.00	34 (58.30)	1.00
Yes	207 (5.47)		59 (5.00)	1.03 (.72-1.48)	54 (45.83)	13.43 (8.86-20.37)***	23 (41.70)	13.71 (6.89-27.28)***
Agoraphobia								
No	3,950 (99.20)	1.00	1,012 (98.18)	1.00	103 (82.08)	1.00	51 (90.16)	1.00
Yes	33 (0.80)		19 (1.82)	2.55 (1.34-4.84)**	20 (17.92)	23.90 (10.89-52.46)***	6 (9.84)	12.61 (4.49-35.45)***
Panic disorder								
No	3,895 (97.33)	1.00	996 (96.72)	1.00	100 (78.86)	1.00	43 (79.85)	1.00
Yes	88 (2.67)		35 (3.28)	1.38 (.86-2.20)	23 (21.14)	8.59 (4.94-14.93)***	14 (20.15)	8.95 (3.42-23.44)***

Note. *$p < .05$ **$p < .01$ ***$p < .001$. *n*-values are unweighted, and percentages are weighted. AOR = adjusted odds ratio (controlling for sex, race/ethnicity, household income, marital status, education level, and student status). GAD, generalized anxiety disorder; MDD, major depressive disorder; SAD, social anxiety disorder. The reference group was the former category of the pair.

Chapter 5: Transition to Study 3

The main purpose of Study 2 was to evaluate the association between cannabis use and SAD in emerging adulthood and to examine what sociodemographics and psychiatric disorders are significant correlates associated with co-occurring cannabis use and SAD. Results from this study found that the prevalence estimate of cannabis use and SAD in emerging adulthood was 1.10%. Results also found that being White and being a part-time student or not a student was associated with increased odds of having lifetime cannabis use and SAD relative to those with no cannabis use or SAD. Additionally, having another psychiatric disorder (i.e., MDD, bipolar I disorder, specific phobia, GAD, agoraphobia, and panic disorder) increased the odds of having lifetime cannabis use and SAD relative to those with no cannabis use or SAD when adjusting for sociodemographics.

These results extend previous research by providing prevalence estimates for co-occurring cannabis use and SAD in an epidemiological emerging adult population, which had not been done yet to date given previous estimates were from cross-sectional emerging adult samples or adult epidemiologic populations (Buckner et al., 2007; Feingold et al., 2016). As evidenced from the small correlation between social anxiety and cannabis problems in Study 1, this was suggestive that there were other moderating factors influencing the association; therefore, the results from Study 2 are informative by identifying certain correlates that are associated of increased odds of cannabis use and SAD in emerging adults. Study 2 aimed to expand this area of the literature by exploring some of the relevant sociodemographics and psychiatric disorder correlates of this association in a national representative emerging adult population. These results are important in informing future clinicians about the awareness that social anxiety and cannabis use do co-occur, which could enhance screening and treatment for emerging adults.

Study 2 findings are novel contributions to the literature as they summarize overarching risk factors, but epidemiological data often neglects examining any in-the-moment factors that might be relevant in the association between cannabis and social anxiety. Therefore, the goal of Study 3 was to examine more individual differences and mechanistic factors that relate to social anxiety-driven cannabis use in emerging adulthood. For example, one such factor that has been robustly shown to be related to substance use in the literature is impulsivity (DeVito et al., 2020; Mitchell & Potenza, 2014). In emerging adulthood, impulsivity is associated with cannabis use (Lyvers et al., 2013). Work has found that individuals who are socially anxious and who report high levels of impulsivity tend to use greater levels of substances (Keough et al., 2016; Lipton et al., 2016).

One specific facet of impulsivity that may be particularly relevant in the relation between social anxiety and cannabis use is negative urgency. Defined as the tendency to act rashly when experiencing negative emotion (Whiteside & Lynam, 2001), negative urgency highlights the motivation to engage in unhelpful strategies when feeling overwhelmed. Individuals who are high in negative urgency might then use cannabis to provide relief to social anxiety-related internal experiences. Supporting this, negative urgency is related to cannabis use and problems in emerging adults (Kaiser et al., 2012; Wardell et al., 2016); however, less is known about whether negative urgency moderates the association between social anxiety and cannabis use. Therefore, the primary goal of Study 3 was to examine negative urgency as a moderator in the association between social anxiety and cannabis outcomes in emerging adults.

Chapter 6: Study 3

Negative Urgency Increases Risk for Coping-Motivated Cannabis Outcomes in Socially Anxious Male Emerging Adult Cannabis Users

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Abstract

Tension reduction theory suggests that socially anxious emerging adults use cannabis to cope with negative affect. However, the literature is mixed, indicating that the effect of social anxiety on cannabis use behaviours during emerging adulthood may depend on other moderating factors, such as negative urgency. This study aimed to clarify potential moderators that may strengthen the associations between social anxiety and cannabis outcomes among emerging adults. Emerging adult undergraduates who reported past six-month cannabis use completed an online self-report survey. Results from a mediated moderation revealed that higher social anxiety predicted elevated cannabis use and problems via coping motives, but only for males higher in negative urgency. Findings suggest that socially anxious males higher in negative urgency are at greater risk for coping-motivated cannabis use and related problems. These results may inform screening and treatment approaches aimed at reducing impulsive cannabis use and subsequent harms for these emerging adult males.

Keywords: social anxiety; cannabis problems; cannabis use; cannabis motives; negative urgency

Negative Urgency Increases Risk for Coping-Motivated Cannabis Outcomes in Socially Anxious Male Emerging Adult Cannabis Users

Introduction

Emerging adulthood is associated with the highest prevalence estimates of cannabis use compared to other age groups (Patrick et al., 2023). Additionally, emerging adulthood is associated with many mental health concerns, such as social anxiety (Gomes et al., 2019; Stewart & Mandrusiak, 2007), and many emerging adults may engage in maladaptive behaviours to cope with their social anxiety-related symptoms. Supporting this, tension reduction theory suggests that people with social anxiety may use cannabis to alleviate uncomfortable negative emotions (Conger et al., 1956). Despite the high rates of cannabis use and social anxiety during emerging adulthood, the literature on the relation between social anxiety and cannabis use is mixed. On one hand, cannabis may be used by emerging adults who are socially anxious to cope with negative affect, which would increase the frequency and risk of cannabis use. Conversely, emerging adults who are socially anxious are typically inhibited and hypersensitive to negative evaluation, and so they may abstain from cannabis use to avoid potential embarrassment. This complexity is reflective of the literature, as some studies show positive associations between social anxiety and cannabis problems (Foster et al., 2016; Walukevich-Dienst et al., 2020), whereas other research has demonstrated null findings (Buckner et al., 2021; Cloutier et al., 2021). A recent meta-analysis revealed a small significant positive correlation between social anxiety and cannabis problems (r = .197) and a non-significant negative correlation between social anxiety and cannabis use frequency (r = .002) in emerging adulthood (Single et al., 2022). Given the small effect sizes between social anxiety and cannabis use frequency and problems, this broadly suggests that moderating and/or mediating factors are influencing the association. Therefore, we aimed to clarify social anxiety as a moderating risk factor for cannabis-related outcomes among emerging adults.

Moderating Role of Negative Urgency

One factor which may be a relevant moderator in the association between social anxiety and cannabis outcomes is negative urgency. Negative urgency is a facet of impulsivity defined as having the tendency to act rashly under extreme negative emotions (Whiteside & Lynam, 2001). People who are elevated in negative urgency are intolerant of distress and more likely to use maladaptive coping strategies to get immediate relief from unwanted negative emotions (Settles et al., 2012). Accordingly, socially anxious emerging adults who have higher levels of negative urgency might

experience greater cannabis use and related problems, suggesting that negative urgency reduces the tendency to be inhibited which is characteristic of socially anxious individuals. Supporting this, work has demonstrated that individuals who are higher in social anxiety and disinhibition engage in greater amounts of substance use (Kashdan & Hofmann, 2008), and that negative urgency is associated with cannabis problems (Keough et al., 2018; Wardell et al., 2016) and cannabis use (Kaiser et al., 2012) in emerging adults. Importantly, mixed results for sex differences also emerge in work examining cannabis use, social anxiety, and negative urgency (Cuttler et al., 2016; Cyders, 2013; Xu et al., 2012); therefore, it is important to examine sex as an additional moderator.

Mediating Role of Cannabis Use Motives

Motivational models help elucidate the reasons why emerging adults with social anxiety may engage in cannabis use (Cooper, 1994; Simons et al., 1998). These include coping motives (i.e., to alleviate negative affect), conformity motives (i.e., to avoid social scrutiny), enhancement motives (i.e., to increase positive affect), social motives (i.e., to enhance social benefit), and expansion motives (i.e., to expand experiential awareness). Research has robustly shown that coping motives are associated with cannabis problems and greater cannabis use in emerging adult samples (Bonar et al., 2017; Lee et al., 2007). Coping motives have been found to mediate the relationship between distress tolerance and cannabis problems, which was stronger for adult women than men (Bujarski et al., 2012), and to mediate the relationship between social anxiety and cannabis problems in emerging adult undergraduates (Buckner et al., 2007). Although theory would suggest that social anxiety may lead to cannabis use and problems through coping motives, the research is inconclusive. Supporting theory, one study found that coping and conformity motives mediate the association between social anxiety and cannabis outcomes among men, whereas social motives mediate the relation among women (Buckner, Zvolensky, & Schmidt, 2012). In contrast, another study found that coping motives were not associated with social anxiety symptoms in a community sample (Colder et al., 2019).

The Current Study

The moderating role of negative urgency and mediating role of cannabis use motives may help clarify why some emerging adults with social anxiety use cannabis to cope with their negative affect while others do not. The present study used path modelling to explore the associations between social anxiety and cannabis outcomes (i.e., frequency, quantity, and problems) in emerging adults using cannabis motives as a mediator and sex and negative urgency as moderators. We hypothesized

that social anxiety would be associated with cannabis problems, cannabis use frequency, and cannabis use quantity at higher levels of negative urgency. We further expected this pathway to be mediated by coping motives. Finally, as the literature regarding sex differences is mixed, our hypotheses for sex differences were exploratory.

Method

Participants and Procedure

Ethical approval was granted from the University of Manitoba Psychology/Sociology Research Ethics Board prior to commencement of the study. All participants provided consent before proceeding with survey completion (see Appendix B). Data were collected between October and November 2021. A battery of questionnaires were administered through an online survey platform (i.e., Qualtrics; see Appendix C). Undergraduates from the University of Manitoba Introduction to Psychology participant pool received credit for their participation as part of their optional research-participation component in their Introduction to Psychology course (see Appendix D). Feedback pertaining to the study objectives was provided to participants following completion of the online questionnaires (see Appendix E).

The participant selection for this study is shown in Figure 1 which depicts the different phases of determining participant inclusion. 797 undergraduates completed the survey. Participants 26 years of age or older were excluded to ensure that all participants were emerging adults. We restricted the main analysis to cannabis users as we were examining cannabis use motives; therefore, those who reported past 6-month cannabis use by the Cannabis Use Disorders Identification Test-Revised (CUDIT-R) were included in this study (n = 273). We removed four of these participants had missing data on the negative urgency subscale.

The final sample consisted of 269 participants (M_{age} = 19.34, SD_{age} = 1.75). The final sample was predominantly female (77%). The racial-ethnic breakdown consisted of White (58.4%), East Asian (16%), Aboriginal (5.9%), Black (5.6%), South Asian (4.8%), Middle Eastern (3.3%), and Hispanic (1.5%) participants, with 4.5% of the sample specifying another race/ethnicity. Of the recruited sample, 87.4% of the sample were full-time students and 12.6% were part-time students. An estimated 7.1% of the sample met the cut-off (i.e., > 8 on the CUDIT-R) for harmful cannabis use, but overall CUDIT-R scores were in the non-problem use range (M = 5.63, SD = 5.34). 109 participants (40.5%) scored at the clinically significant cut-off for social anxiety based on the Social Interaction Anxiety Scale (>36; Peters, 2000). Compared to other samples utilizing Canadian

undergraduate students, our sample had similar levels of social anxiety (Auyeung & Alden, 2015) and cannabis problems (Vilhena-Churchill & Goldstein, 2013). Full demographic characteristics of the final sample can be found in Table 1.

Measures

Social Interaction Anxiety Scale

The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20-item measure that assesses social situations in which an individual with social anxiety is likely to feel fear or unease. Participants responded on a 5-point Likert scale from 0 (*Not at all characteristic or true of me*) to 4 (*Extremely characteristic or true of me*) to items asking about how true each statement is for them (e.g., "I find it difficult to mix comfortably with the people I work with"). Total scores for the SIAS range from 0 to 80, with a score of 36 or higher likely indicating presence of SAD.[27] Total sum scores were used, with higher scores meaning higher social anxiety. Cronbach's alpha in this study was .94.

UPPS-P Impulsive Behaviour Scale

The UPPS-P Behaviour Scale (Lynam et al., 2007) is a 59-item measure that assesses impulsivity. The UPPS-P is comprised of five subscales, these being negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency. We focused on negative urgency in this study because it is the most relevant theoretically, given that negative urgency involves the tendency to respond rashly to uncomfortable internal experiences, and that theory posits individuals use cannabis to cope with unpleasant affective states, suggesting that individuals who are socially anxious and higher in negative urgency are more likely to use cannabis to alleviate social-anxiety symptoms (Conger, 1956; Whiteside & Lynam, 2001). Participants responded on a 4-point Likert scale to 12 items assessing negative urgency (e.g., "I always keep my feelings under control"), with responses ranging from 1 (*agree strongly*) to 4 (*disagree strongly*). A mean score was used, with higher scores indicating higher negative urgency. The internal consistency for the negative urgency subscale was .88.

Marijuana Motives Measure

The Marijuana Motives Measure (MMM; Simons et al., 1998) is a 25-item measure that assesses reasons, or motives, for using cannabis. The MMM consists of five subscales, these being coping (e.g., "To forget about my problems"), social (e.g., "To be sociable"), enhancement (e.g., "Because I like the feeling"), conformity (e.g., "To fit in with the group I like"), and expansion (e.g.,

"To know myself better"). Participants responded on a 5-point Likert scale from 1 (*almost never/never*) to 5 (*almost always/always*) to items asking how frequently they use cannabis for different motives. Mean scores for each subscale were computed. The internal consistency for each of the subscales were as follows: coping .91; enhancement .93; conformity 84; and expansion .91.

Marijuana Problems Scale

The Marijuana Problems Scale (MPS; Stephens et al., 2000) is a 19-item measure that assesses various problems resulting from cannabis use. Participants responded on a 3-point Likert scale from 0 (*no problem*) to 2 (*serious problem*) to items asking if they have experienced problems from cannabis use in certain areas of their life (e.g., work, physical health, social relationships). Total sum scores were computed, ranging from 0 to 38, with higher scores indicating a higher likelihood of experiencing problems from cannabis use. The internal consistency in this study was .87.

Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory

The Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU; Cuttler & Spradlin, 2017) is a 31-item measure that assesses various dimensions of cannabis use including frequency of use, age of first use, and quantity of cannabis use in the form of edibles, concentrates, and pure cannabis. The DFAQ-CU is comprehensive as it asks about different methods in which one can use cannabis (e.g., joints, bongs, vaporizers, concentrates). If cannabis use is endorsed for each category (e.g., concentrates), participants complete follow-up questions that ask specifically about their use related to that category (e.g., "On a typical day you use cannabis concentrates, how many hits do you personally take?"). In this study, singular items assessing cannabis use frequency (e.g., "How many days of the week did you use cannabis?") and quantity (e.g., "In a typical week you use marijuana, how much marijuana do you personally use?") were used for cannabis use outcomes. Participants were asked to indicate the quantity of cannabis used by the number of grams.

Cannabis Use Disorder Identification Test – Revised

The Cannabis Use Disorder Identification Test – Revised (CUDIT-R; Adamson et al., 2010) is an 8-item measure used for screening for cannabis use disorder (CUD). The first item asks participants to respond 'yes' or 'no' to whether they have used cannabis over the past six months. If yes is selected, participants then responded on a 5-point scale from 0 to 4 to questions asking about cannabis use (e.g., "How often during the past six months did you find that you were not able to stop using cannabis once you had started?"). Total sum scores for the CUDIT-R range from 0 to 32, with

scores of 8 or more indicating harmful cannabis use, and scores of 12 or more indicating a possible CUD.

Demographics

Respondents were asked demographic questions regarding age, sex, gender, education, race/ethnicity, current income, and relationship status (see Appendix F).

Data Analytic Plan

All analyses were conducted in SPSS version 23 (IBM Corp, 2015) and MPlus version 8 (Muthén & Muthén, 2017). Preliminary analyses included screening the data for outliers ($\pm$ 3.29 SD above or below the mean) and excluding participants who had missing data on the negative urgency subscale (n = 4). Path analysis (specifying mediated moderation) was used to test our hypothesized model. In this model, social anxiety, negative urgency, sex, all two-way interactions (social anxiety *by* negative urgency, social anxiety *by* sex, and negative urgency *by* sex), and three-way interactions of interest (social anxiety *by* negative urgency *by* sex) were entered as predictors; cannabis use motives (excluding social motives) were entered as correlated mediators; and cannabis use frequency, quantity, and related problems were modelled as correlated outcomes. Social motives were excluded from our analyses as socially-motivated cannabis use tends to be unrelated to cannabis outcomes relative to coping-motivated cannabis use (Brodbeck et al., 2007; Buckner et al., 2007; Villarosa-Hurlocker et al., 2019). To assist with interpretability of results, continuous predictor variables were centered prior to creating interaction terms. Moderation effects were probed using simple slopes by conditioning the effect of social anxiety on cannabis outcomes at high (-1 SD) and low (+1 SD) levels of negative urgency in both males and females (Aiken & West, 1991).

Model fit was evaluated using several well-established indices. Model fit was considered excellent if the following guidelines were met: the chi-square statistic divided by degrees of freedom test (χ^2/df) was < 3.0; the root mean square error of approximation (RMSEA) was ≤ .06); the comparative fit index (CFI) was ≥ .95; and the standardized root mean residual (SRMR) was ≤ .08 (Hu & Bentler, 1999; Kline, 2010). Path and indirect effects were assessed using effect sizes with 95% confidence intervals (CIs). Bootstrapping was used to calculate CIs for the indirect effects. If the CI did not contain zero, then the mediation was supported (Fritz & MacKinnon, 2007).

Results

Data Screening, Descriptive Statistics, and Bivariate Correlations

Cannabis problems, cannabis use frequency, cannabis use quantity had non-normal distributions (skew > 3.0; kurtosis > 10; Kline, 2013), which is consistent with non-clinical undergraduate samples. MLR was used to estimate model parameters, given the non-normal outcome distributions (Muthén & Muthén, 2017). Descriptive statistics and bivariate correlations are reported in Table 2. Of note, social anxiety was correlated with coping motives (r = .27), enhancement motives (r = .17), expansion motives (r = .22), cannabis use quantity (r = .21) and cannabis use problems (r = .24), but was uncorrelated with cannabis use frequency (r = .11) and conformity motives (r = .10).

Hypothesis Testing

Mediated Moderation Analysis

The specified model fit the data well: χ^2 = 46.08, df = 21, χ^2/df = 2.19; *CFI* = 0.950; *RMSEA* = 0.067 (90% *CI* [0.040, 0.093]); *SRMR* = 0.036 (see Figure 2). When examining the front-end of the model, the three-way social anxiety *by* negative urgency *by* sex interaction was a statistically significant predictor of coping motives for cannabis use. Additionally, the two-way social anxiety *by* negative urgency was a statistically significant predictor of coping motives. The two-way interaction of social anxiety *by* sex was a statistically significant predictor of coping motives and enhancement motives.[1]

When examining the back-end of the model, results revealed that coping motives, enhancement motives, and conformity motives were significantly and positively associated with cannabis problems. Cannabis motives accounted for 30% of the variance (R^2 = .30) in cannabis problems in the model. Coping (but not conformity or enhancement) motives was the only positive predictor of cannabis use frequency. Cannabis motives accounted for 32% of the variance (R^2 = .32) in cannabis use frequency in the model. Coping and enhancement motives were positively associated with cannabis use quantity, and conformity motives were negatively associated with cannabis use quantity. Cannabis motives accounted for 18% of the variance (R^2 = .18) in cannabis use quantity in the model. Social anxiety, sex, negative urgency, and the interactions accounted for small to medium

[1]We tested alternative models to clarify the directionality of the associations between social anxiety and cannabis outcomes, and they fit the data poorly.

proportions of variance (coping motives, R^2 = .17; enhancement motives, R^2 = .12; conformity motives, R^2 = .03; expansion motives, R^2 = .10) in cannabis motives. Overall, coping motives emerged as a predictor for all facets of cannabis outcomes.

Given that the three-way interaction between social anxiety *by* negative urgency *by* sex was supported in the pathway to coping motives at average levels of negative urgency, the next step was to probe the three-way interaction using simple slope analyses at high and low levels of negative urgency in males and females. Results revealed that the indirect effects from social anxiety to cannabis problems (*b* = 0.27, 95% *CI* [0.13, 0.41]), cannabis frequency (*b* = 0.43, 95% *CI* [0.26, 0.59]), and cannabis quantity (*b* = 0.27, 95% *CI* [0.08, 0.46]) via coping motives was supported in males who are higher in negative urgency. These results demonstrate that as negative urgency increases, cannabis problems, cannabis use quantity, and cannabis use frequency increase in socially anxious males. Social anxiety was not associated with cannabis problems (*b* = 0.10, 95% *CI* [-0.03, 0.24]), cannabis frequency (*b* = 0.16, 95% *CI* [-0.04, 0.37]), or cannabis quantity (*b* = 0.10, 95% *CI* [-0.05, 0.25]) in males who were lower in negative urgency. Similarly, the indirect effect was not supported from social anxiety to cannabis problems (*b* = 0.05, 95% *CI* [-0.02, 0.11]), cannabis frequency (*b* = 0.08, 95% *CI* [-0.02, 0.18]), or cannabis quantity (*b* = 0.05, 95% *CI* [-0.02, 0.11]) in females who were higher in negative urgency, nor was it supported from social anxiety to cannabis problems (*b* = 0.05, 95% *CI* [-0.03, 0.12]), cannabis frequency (*b* = 0.08, 95% *CI* [-0.04, 0.19]), or cannabis quantity (*b* = 0.05, 95% *CI* [-0.02, 0.11]) in females who were lower in negative urgency.

Discussion

Our goal was to clarify social anxiety as a risk factor for cannabis outcomes in an emerging adult undergraduate sample of cannabis users, using cannabis motives as an informed mediator and negative urgency and sex as moderators. Using a mediated moderation model, we found that socially anxious males who were higher in negative urgency were likely to report heavier cannabis use and related problems due to their elevated coping reasons for using. Results were not supported for socially anxious males lower in negative urgency, nor for socially anxious females both high and low in negative urgency. This study advances our understanding of the association between social anxiety and cannabis outcomes in emerging adulthood by identifying negative urgency as a factor that worsens cannabis outcomes in males who are socially anxious.

These results are similar to studies that have found an association between social anxiety and cannabis problems (Ecker et al., 2014; Villarosa-Hurlocker et al., 2019), and our findings advance

the literature as we tested negative urgency as a moderator. This suggests that socially anxious males may be more inclined to use cannabis to alleviate their social anxiety symptoms, and experience greater cannabis-related problems likely due to coping reasons for use to help manage their social anxiety. Additionally, our results found social anxiety to be a significant positive predictor of cannabis use frequency and quantity. Considering that some research has found nonsignificant associations between social anxiety and cannabis use frequency (Cloutier et al., 2021), the support for an association between social anxiety and greater cannabis use frequency and quantity was likely established given our inclusion of negative urgency as a theoretically-important moderator. Although we see well-established associations between social anxiety and cannabis problems in adulthood (Agosti et al., 2002), the findings during emerging adulthood are less clear. It would be beneficial to test this moderation longitudinally as males who are socially anxious mature into adulthood to see if the association remains.

Our inclusion of theoretically-informed moderators in our model was a strength of the current study. For instance, sex and gender differences have been documented in the literature for both social anxiety and cannabis outcomes (Cuttler et al., 2016; Xu et al., 2012). It is possible that we observed this association for males and not females, as males are more likely to engage in externalizing behaviours when distressed, as opposed to internalizing behaviours (Booth & Murray, 2018), and externalizing behaviours predict CUD onset (Farmer et al., 2015b). Another strength of this study is that both cannabis use frequency and quantity were examined as correlated outcomes. Because of the nuances with scoring and reporting, cannabis use quantity often does not get reported in the literature or gets subsumed within another cannabis use variable. Our work included both, thus providing a more comprehensive understanding of cannabis outcomes. Future research should aim to continue using such measures to capture a comprehensive understanding of cannabis outcomes.

Clinical implications of the present study may help to inform intervention strategies in emerging adult populations. Given that negative urgency involves the tendency to act rashly and impulsively under distressing conditions, it is possible that this subset of individuals have difficulty tolerating internal experiences, and so learning distress tolerance skills may be of benefit. Distress tolerance involves having the ability to manage emotional distress, and poor distress tolerance has been shown to be related to greater cannabis problems (Dvorak & Day, 2014). Our results were explained uniquely through coping motives, and research supports that using cannabis to cope with negative affect is associated with heaviest and most problematic cannabis use (Hyman & Sinha,

2009). It is possible that males who are socially anxious are unaware of alternative ways to cope with their uncomfortable internal experience, thus engaging in hasty behaviours to immediately relieve distress. Intervention efforts, then, could aim to introduce adaptive ways to cope that are targeting at learning to tolerate and accept uncomfortable internal experiences without reacting to them (e.g., mindfulness).

Limitations of the current work warrant discussion. First, the study is cross-sectional, meaning that temporal precedence cannot be established, and as such, we can only speculate about the casual mechanism of coping-motivated cannabis outcomes. Future work should consider examining this pathway longitudinally, as there is some evidence that social anxiety precedes cannabis use (Buckner, Heimberg, Schneier, et al., 2012). Second, this study used a university sample; therefore, results cannot be generalized to those who may experience clinical levels of social anxiety. Though many university students do experience social anxiety (Stewart & Mandrusiak, 2007), and approximately 40% of our sample likely had clinical levels of social anxiety, additional research examining the similar pathway in individuals who have comorbid SAD and CUD would elucidate whether this association stands in clinical populations. Fourth, sample size limitations precluded us from controlling for other important moderators in the given model. For example, although race/ethnicity would be an important potential moderator to consider, a four-way interaction (i.e., social anxiety *by* negative urgency *by* sex *by* race/ethnicity) would have been too grand given our modest sample size. It would be of interest to recruit larger samples to examine these potential theoretically-informed moderators.

Despite these limitations, this novel study examined negative urgency and sex as theoretically-informed moderators in the association between social anxiety and cannabis outcomes during emerging adulthood, with cannabis use motives as an empirically-informed mediator. The findings contribute to our growing understanding of the complex relation between social anxiety and cannabis outcomes in emerging adulthood, and suggests that negative urgency as a moderating factor elucidates this relation during this developmental period.

Table 6.1

Demographic Characteristics of Participants (*n* = 269)

	n (%) or M (SD)
Age	19.34 (1.75)
Sex	
Male	62 (23%)
Female	207 (77%)
Gender	
Man	61 (22.7%)
Woman	202 (75.1%)
Transgender	1 (0.4%)
Non-binary	3 (1.1%)
Another gender specified	2 (0.7%)
Ethnicity	
East Asian, South-East Asian, Pacific Islander	43 (16%)
Middle Eastern, North African, Central Asian	9 (3.3%)
Hispanic or Latino	4 (1.5%)
Caucasian or White	157 (58.4%)
Black	15 (5.6%)
Aboriginal	16 (5.9%)
South Asian	13 (4.8%)
Another ethnicity specified	12 (4.5%)
Student Status	
Full-time	235 (87.4%)
Part-time	34 (12.6%)
Education	
High school diploma	137 (50.9%)
One- or two-year post high school but not college	9 (3.3%)
One- or two-year diploma from a trade or professional school but not college	4 (1.5%)
Some college or university education	114 (42.4%)
College or university degree (Bachelors)	4 (1.5%)
Post graduate work	1 (0.4%)
Job	
Not working	21 (7.8%)
No (enrolled as a post-secondary student)	65 (24.2%)
Yes, part-time (approximately 9 hours or less per week)	48 (17.8%)
Yes, part-time (approximately 10-19 hours per week)	94 (34.9%)
Yes, part-time (approximately 20 or more hours per week)	33 (12.3%)
Yes, full-time (approximately 40 hours per week)	8 (3.0%)

Table 6.2

Descriptive Statistics and Bivariate Correlations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Social anxiety	-	.29**	.15*	.27**	.17**	.10	.22**	.11	.21**	.24**
2. Negative urgency		-	-.04	.25**	.24**	.00	.20**	.11	.12	.19**
3. Sex			-	-.10	-.13*	-.03	-.09	-.03	-.14	-.10
4. Coping motives				-	.62**	.26**	.62**	.55**	.40**	.47**
5. Enhancement motives					-	.19**	.52**	.39**	.35**	.39**
6. Conformity motives						-	.31**	.04	-.08	.35**
7. Expansion motives							-	.31**	.16*	.31**
8. Cannabis use frequency								-	.45**	.42**
9. Cannabis use quantity									-	.27**
10. Cannabis problems										-
M	32.63	2.43	-	2.05	2.64	1.30	1.74	1.00	1.14	2.78
SD	17.26	.60	-	1.12	1.26	0.57	0.96	1.75	2.28	3.54

Note. * $p < .05$ ** $p < .01$

Figure 6.1

Flowchart for participant eligibility selection.

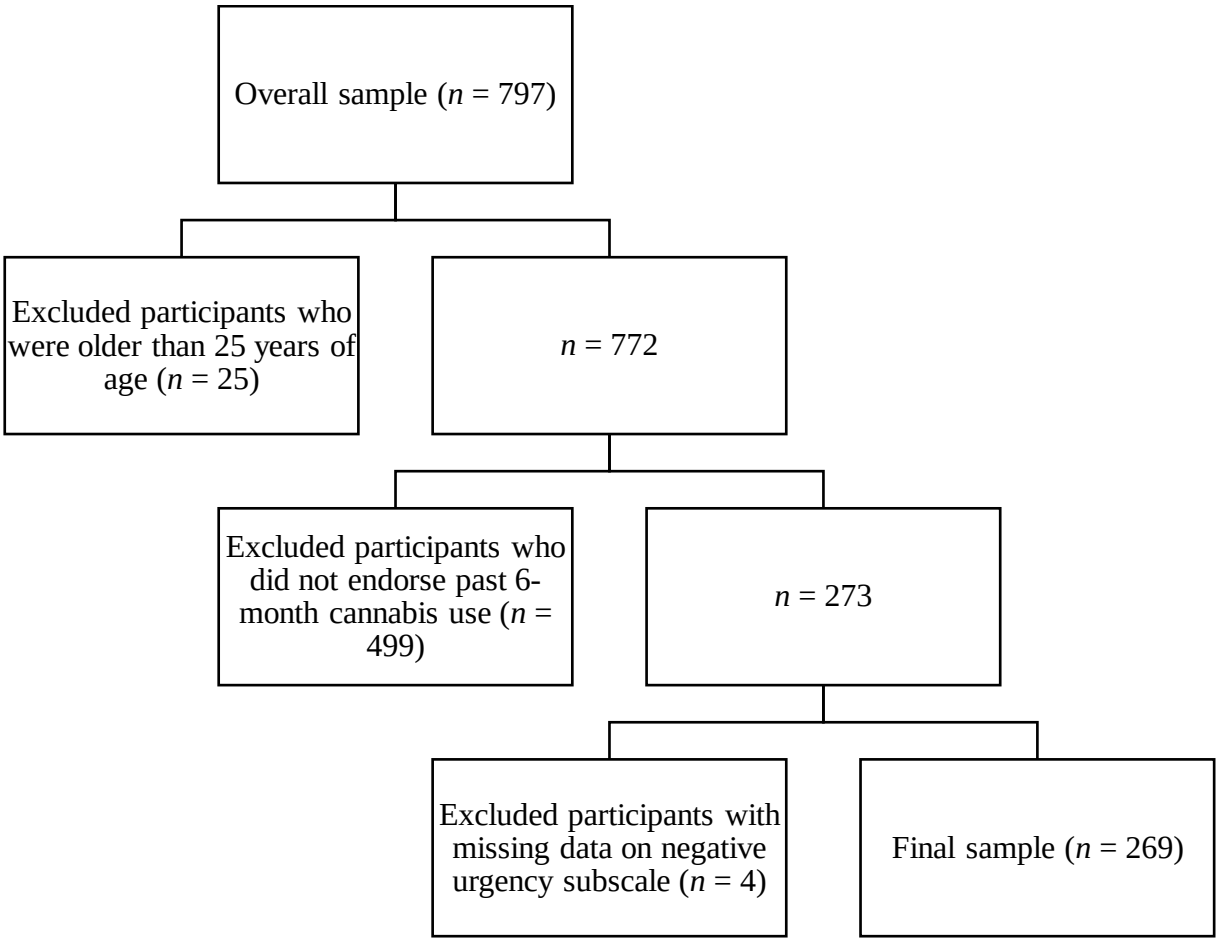
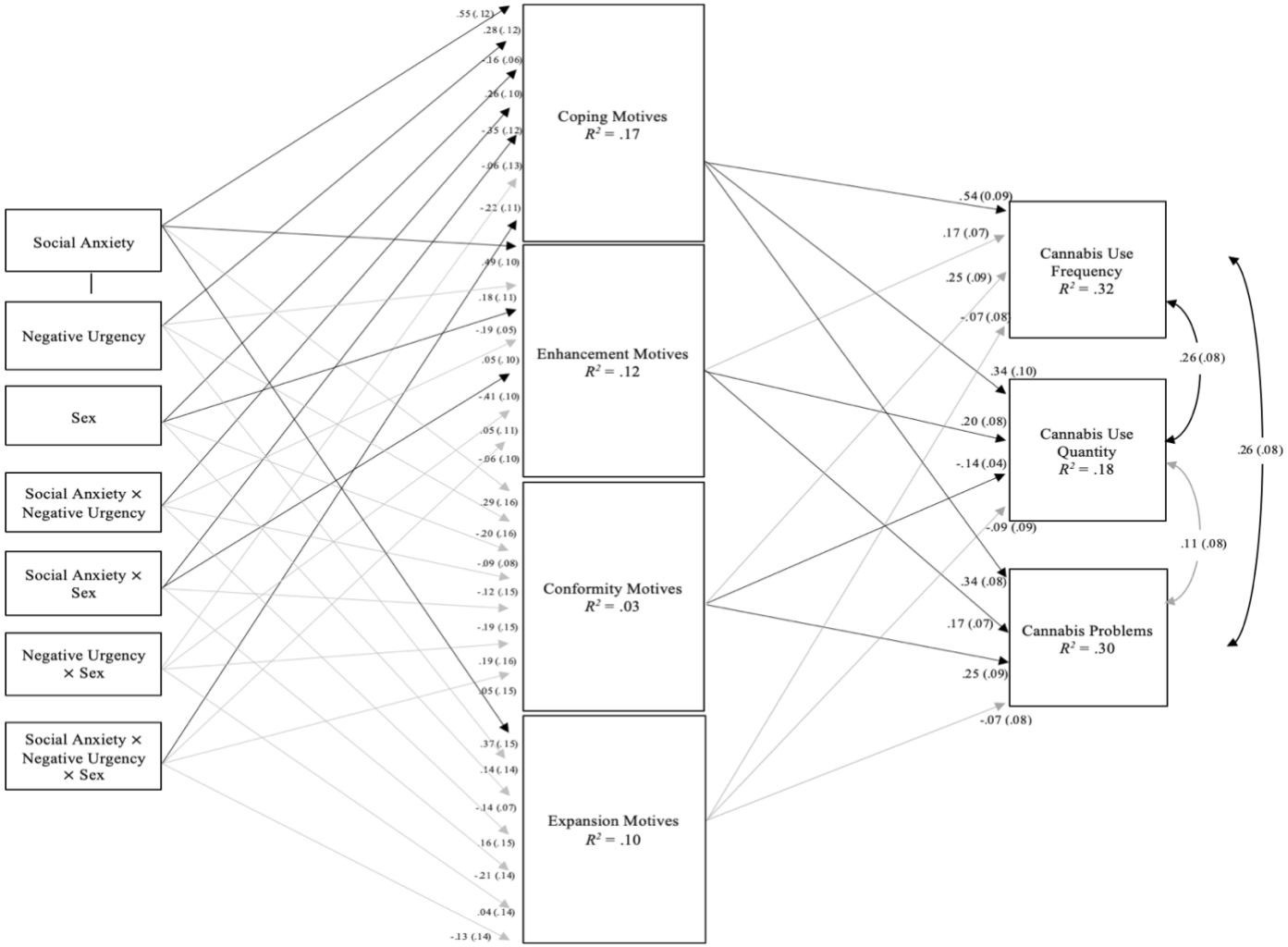


Figure 6.2

Mediated Moderation Path Model from Social Anxiety, Negative Urgency, and Sex to Cannabis Outcomes via Cannabis Use Motives



Note. Solid lines present statistically significant paths, gray lines are non-statistically significant. Standardized coefficients with standard errors (in parentheses) are presented.

Chapter 7: General Discussion

Summary of Research

The aim of the current dissertation was to clarify the association between social anxiety and cannabis outcomes during emerging adulthood. Persons who are socially anxious may be at increased risk of using cannabis to alleviate feelings of distress in social situations (Conger, 1956). Though a relatively newly studied area, it has been regarded that an association between cannabis use and social anxiety exists in adulthood (Agosti et al., 2002; Buckner, Heimberg, Schneier, et al., 2012; Cougle et al., 2015). However, research in emerging adulthood has shown inconsistent results in the relation between social anxiety and cannabis outcomes; namely problems (Buckner et al., 2007; Mueller et al., 2021) and cannabis use (Buckner et al., 2018; Ecker et al., 2014; Phillips et al., 2018; Villarosa-Hurlocker et al., 2019), suggesting that there may be other contributing factors that influence cannabis outcomes among individuals who are socially anxious. The current findings enrich our understanding of the association between social anxiety and cannabis outcomes in emerging adults.

The goal of Study 1 was to synthesize the current literature to quantify the associations between social anxiety and cannabis outcomes (i.e., problems, frequency of use) in emerging adulthood. Results of Study 1 found that social anxiety was significantly related, though with a small effect, to cannabis problems in cross-sectional studies with emerging adult samples. This small, direct effect broadly suggests that there are certain contributing factors that might moderate or mediate the association between social anxiety and cannabis problems. Social anxiety was not directly or significantly negatively related to cannabis use frequency. Additionally, Study 1 examined a number of informed moderators at the study level (i.e., sex, ethnicity, average age of the sample, percent of the sample that had clinical levels of social anxiety). Moderator analyses revealed that study samples with fewer individuals with clinically significant social anxiety produced larger effects in the relation between social anxiety and cannabis problems, and study samples with older average ages produced larger effects in the relation between social anxiety and cannabis use frequency.

The aim of Study 2 was to examine the prevalence of cannabis use and SAD in a nationally representative emerging adult sample, in addition to examining what risk correlates might be associated with co-occurring cannabis use and SAD in emerging adulthood. Study 2

found that the prevalence of co-occurring cannabis use and SAD was 1.10% in the sample. Additionally, results found that the sociodemographics of being White and being a part-time student or not a student were associated with increased risk of having co-occurring cannabis use and SAD relative to those with neither condition. Additionally, having another psychiatric disorder (i.e., MDD, bipolar I disorder, GAD, specific phobia, agoraphobia, and panic disorder) was associated with increased risk of having co-occurring cannabis use and SAD relative to those with neither condition, when adjusting for sociodemographics.

The goal of Study 3 was to explore additional moderators and mediators that might help to clarify the association between social anxiety and cannabis use in emerging adults. Study 3 found that higher social anxiety predicted cannabis outcomes (i.e., cannabis use frequency, cannabis use quantity, cannabis problems) through coping motives for use, but only for males who were higher in negative urgency. This work ultimately suggests that emerging adult males may have difficulty tolerating distress associated with social anxiety symptoms and therefore engage in cannabis use as a method to alleviate such distress. The results of Study 3 advanced our understanding of the complex association between social anxiety and cannabis outcomes, wherein negative urgency might be a factor that worsens cannabis outcomes in emerging adult males who are socially anxious.

Theoretical Contributions

The present dissertation provides numerous novel findings to the current literature on emerging adult cannabis outcomes and social anxiety. First, to the best of my knowledge, this work was the first to quantify the relation between social anxiety and cannabis use in emerging adults when the cross-sectional literature thus far had provided mixed findings. Previous work had sought to explore the cross-sectional associations between social anxiety and cannabis use and problems, mainly in emerging adult undergraduate samples (Buckner, Schmidt, et al., 2006; Buckner et al., 2011; Di Blasi et al., 2017; Rahm-Knigge et al., 2019; Villarosa-Hurlocker et al., 2019). The meta-analysis included in this dissertation provides an accurate estimate of the association between social anxiety and cannabis use frequency and problems in emerging adults by synthesizing the current literature to date, and in turn, setting the groundwork for further research. The results suggest that when measuring the associations between social anxiety and cannabis outcomes in emerging adulthood, cannabis outcomes are distinct, yet related components, and should be understood and investigated as such.

Second, this dissertation highlights the importance of evaluating and recognizing additional factors (e.g., sociodemographics, psychiatric disorders, individual differences) in the association between social anxiety and cannabis outcomes to better recognize what factors may place certain emerging adults at greater risk for the experience of social anxiety and cannabis problems. Previous work has examined a number of possible moderating and mediating factors in this relation, such as sex differences, cannabis use motives, post-event processing, and safety behaviours, among others (Buckner et al., 2007; Buckner et al., 2011; Ecker & Buckner, 2018b; Mueller et al., 2021), and some nationally representative studies have explored which sociodemographics are related to social anxiety and cannabis use, albeit in adult populations (Hasin et al., 2015; Odani et al., 2019; Stein et al., 2017; Turk et al., 1988). This dissertation furthered previous work by detailing the associations between social anxiety and cannabis outcomes in emerging adulthood and distinguishing how this relation is different compared to the trends observed in adulthood, which are accounted for by various moderating variables. As I have presented throughout this dissertation, emerging adulthood is a time of transition and new experiences (Arnett, 2000), which appears to cultivate an environment in which increased substance use, including cannabis, occurs (Arnett, 2005). Rooted in tension reduction theory (Conger, 1956), cannabis may be used to address underlying social anxiety symptoms in emerging adults, thereby leading to worsened cannabis outcomes. Collectively, the studies in this dissertation demonstrate that persons with social anxiety are at risk for experiencing cannabis-related problems, specifically with the goal of coping with unpleasant affect. Altogether, these findings appear to support tension reduction theory as a model in which cannabis is used to temporarily, but not permanently, alleviate social anxiousness in subsets of individuals in emerging adulthood (e.g., males with higher negative urgency, individuals with co-occurring conditions).

Clinical Implications

There are clinical implications that arise from this work. First, the results from the present dissertation have implications for clinicians and mental health service providers which may involve incorporating routine screening for detecting the co-occurrence of social anxiety and cannabis use amongst patients to enhance prevention and intervention efforts. This work, as a whole, has supported that an association between social anxiety and cannabis problems does exist during emerging adulthood. In general, emerging adults tend to experience mental illness

and subclinical psychopathology at higher rates compared to other developmental age groups (Kessler et al., 2005; Tanner, 2016) and there is a large overlap between mental health disorders and substance use disorders during this stage (Davis et al., 2012). The findings from the present dissertation highlight the necessity for assessing the presence of social anxiety if cannabis problems are experienced by an individual, or vice versa, to ensure that emerging adults who may be struggling with these conditions are identified to prevent worsening outcomes from occurring. Intervention efforts, then, could involve targeting some of the known malleable factors (such as negative urgency in male emerging adults) in treatment for co-occurring social anxiety and cannabis use for emerging adults with this personality profile.

Relatedly, proper psychoeducation about the experience of social anxiety and cannabis outcomes, and perhaps the experience of co-occurring conditions in general, is a worthwhile endeavor for clinicians and service providers. For instance, the results of this dissertation have outlined specific sociodemographics, psychiatric disorders, and individual differences which are associated with experiencing co-occurring social anxiety and cannabis use among emerging adults. It is well known that compared to the experience of singular psychiatric disorders, people with comorbid diagnoses experience greater functional impairment and greater symptom severity of impairment (Antai-Otong et al., 2016; Newman et al., 1996). One specific step may be to provide general information on the known association between social anxiety and cannabis use to emerging adults who are presenting to outpatient clinics. Of note, treatment rates for emerging adults are among the lowest across other developmental age groups for both mental health and substance use problems, with treatment-seeking rates of approximately 50% and 11%, respectively (Adams et al., 2014). Additionally, using cannabis to cope with social anxiety symptoms might emerge if emerging adults feel reluctant to disclose their social anxiety symptoms with a mental health professional, and therefore may be less likely to seek treatment (Olfson et al., 2000; Sareen & Stein, 2000). Indeed, research has found that treatment-seeking is low for individuals with SAD (Lecrubier, 1998), with approximately 21% of individuals with SAD seeking professional help (Ormel et al., 2008). Given these findings, efforts to convey information about the prevalence of and possible negative consequences that may arise from co-occurring social anxiety and cannabis use may be a crucial step in creating awareness among emerging adults who are at risk because of the aforementioned risk correlates and contributing factors.

Limitations and Future Directions

Limitations and possible future directions that stem from such limitations should be noted. First, across all studies in this dissertation, the research designs were cross-sectional in nature or analysed cross-sectional studies. Though cross-sectional research precludes an assessment of establishing temporal precedence between social anxiety and cannabis outcomes and subsequently from presenting a more detailed understanding of the association between social anxiety and cannabis outcomes, the presented studies are still among the first to quantify the literature in this research area and provide detailed information on specific risk factors for emerging adults with co-occurring social anxiety and cannabis use. A possible future direction that may result from this limitation could be to test some of the same research questions longitudinally, such as by examining the moderation of negative urgency in the association between social anxiety and cannabis outcomes across time (e.g., throughout emerging adulthood). Some research suggests that cannabis use can produce deficits in certain impulsivity responses (McDonald et al., 2003) whereas other work suggests that those who are higher in impulsivity tend to experience more cannabis-related problems (VanderVeen et al., 2016). Indeed, there exists an ongoing debate on the directionality of this correlation (for a review, see Rinehart & Spencer, 2021). Controlling for the temporal relations between cannabis outcomes and negative urgency could allow for establishing temporal precedence and help further clarify the role of negative urgency in the pathway between social anxiety and cannabis outcomes as emerging adults age through this developmental period.

A second limitation that arises from this work is that I was restricted in the breadth of theoretically-informed moderators or correlates that were included in analyses across the presented studies for numerous reasons (e.g., insufficient sample size, lack of consistency with reporting measures, etc.). Therefore, a second future direction could involve examining additional theoretically-informed moderators which may help increase our understanding of the complex relationship between social anxiety and cannabis outcomes. For example, investigating distress tolerance as a possible moderator might help to provide an extended explanation on the relation between social anxiety and cannabis use. Distress tolerance is defined as the ability to withstand uncomfortable internal states (Zvolensky et al., 2010) and is related to both social anxiety (Bacon & Ham, 2010) and cannabis problems (Bujarski et al., 2012; Farris et al., 2016). As this dissertation work uncovered that negative urgency, which involves more of a behavioural

response, is a factor that potentially worsens cannabis outcomes, it would be interesting to see if poorer distress tolerance, which involves more of a cognitive appraisal toward negative internal stimuli, holds true as well. Another possibility for further work could involve exploring the prevalence of co-occurring SAD and CUD (instead of lifetime cannabis use) in a nationally representative dataset, or whether the presence of an additional substance use disorder (e.g., alcohol use disorder) increases the odds of emerging adults having co-occurring cannabis use and SAD. Previous research has found that adults with SAD and CUD were more likely to have an additional substance use disorder compared to those with SAD alone (Tepe et al., 2012), though it is uncertain whether similar findings would emerge with emerging adult samples. Examining these correlates and factors, among others, could then increase our understanding on other possible contributing factors and in turn, other ways to identify and intervene so as to prevent harmful outcomes among emerging adult cannabis users who are socially anxious.

A third limitation is that the presented research in this dissertation assessed cannabis outcomes in an inconsistent manner across each study, that is, assessing cannabis problems, cannabis use frequency, cannabis use quantity, and/or past-year cannabis use. Although choosing to measure cannabis outcomes in this manner was done in accordance with previous literature, it should be noted that capturing an accurate estimate of cannabis consumption is difficult, particularly due to the multidimensional nature of cannabis use behaviour. As follows, a possible future direction may be to assess additional nuances in cannabis use, such as by exploring the composition of cannabis used to cope with social anxiety symptoms. Throughout this dissertation I have argued that cannabis and social anxiety are related through a symptom-driven pathway, that is, cannabis is used to cope with social anxiety symptoms, leading to greater problems from use at the expense of more adaptive coping strategies. However, this may depend on whether cannabis has higher THC or CBD content. As previously discussed, THC is a cannabinoid that produces intoxicating effects as it has psychoactive content whereas CBD is a cannabinoid primarily responsible for physiological effects and rarely produces intoxicating effects (Pertwee, 2005). Although many studies that examine cannabis use do not distinguish between these two cannabinoids, they do, in fact, produce differing pharmacological effects across a number of domains (e.g., cognition; Colizzi & Bhattacharyya, 2017). Cannabis with high CBD and low or no THC content might be a promising treatment option for individuals with social anxiety. Given that CBD is anxiolytic – that is, reduces anxiety – research supports CBD as a method for

improving social anxiety symptoms in both clinical and non-clinical populations (for a review, see Fliegel & Lichenstein, 2022). Work examining the different strains of cannabis used to cope with social anxiety is still nascent in the literature and is an important avenue of further research, though beyond the scope of this dissertation.

A fourth limitation pertains to practices in measuring and reporting gender and sex differences in psychological research. Though commonly conflated, sex and gender represent two different constructs. Sex refers to the physiological and anatomical traits of an individual whereas gender refers to the identity, expression, and expectations of oneself (Becker et al., 2022). Additionally, it is often (falsely) assumed that sex at birth defines gender—for example, if you were assigned male at birth then you would identify as a man. Further, the categories of sex and gender have historically been assessed dichotomously, though both sex and gender include more than two categories (e.g., man, woman, non-binary, transgender, etc.; Becker et al., 2022). Throughout this dissertation, information about sex and gender differences was reported as it was stated in published works. Still, there were within-article discrepancies where both gender and sex terminology were used interchangeably. It should be acknowledged that comparing the results from the current dissertation with results from other available data must be done cautiously because of the reporting limitations of previous research. These are limitations that likely exist outside the confines of the current dissertation and so careful attention should be paid to them—particularly within substance use research, where there can be an interaction between biological and socialized differences for sex and gender, respectively (Becker et al., 2017). Future research across all areas needs to make substantive efforts to be inclusive and sensitive when devising data collection plans, conducting data analyses, and interpreting results for issues pertaining to sex and gender differences.

Conclusion

The current dissertation adds noteworthy information to the literature on the association between social anxiety and cannabis outcomes in emerging adulthood. Using a variety of methodological approaches, findings from this dissertation demonstrated that there is a link between social anxiety and cannabis problems in emerging adulthood and highlighted some of the contributing factors to this association. Overall, the findings from this work contribute to our growing understanding of the association between social anxiety and cannabis outcomes, and outlines the importance of remaining cognizant of the prevalence of co-occurring social anxiety

and cannabis use, and in turn, negative outcomes that may be experienced by emerging adults who are socially anxious and use cannabis.

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*References marked with an asterisk indicate studies included in the meta-analysis.

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Appendix A

Coding Manual for Meta-Analysis on Cannabis Use and Social Anxiety in Young Adulthood

1. Study ID number: ____

2. Reference: _____
_____
_____

3. Publication Type
    a. Book chapter
    b. Journal article
    c. Conference paper
    d. Thesis or doctoral dissertation
    e. Technical report
    f. Other (specify): ____

4. Publication year: _____

5. Location
    a. United States
    b. Canada
    c. Europe
    d. Britain
    e. Australia
    f. South America
    g. Other (specify): _____

6. Design
    a. Cross-sectional
    b. Longitudinal
    c. Experimental
    d. Randomized Controlled Trial (RCT)
    e: Other (specify): _____

7. Recruitment/selection method (select all that apply)
    a. None
    b. High social anxiety
    c. Low social anxiety
    d. High cannabis use/problems
    e. Low cannabis use/problems
    f. High social anxiety, high cannabis use/problems
    g. High social anxiety, low cannabis use/problems
    h. Low social anxiety, high cannabis use/problems

i. Low social anxiety, low cannabis use/problems
j. Not reported
k. Other (specify): _____

8. Data collection method
a. In-person
b. Online
c. Not reported
d. Other (specify): _____

9. Sample size: ____

10. Age range: ____

11. Age mean (SD): _____

12. Predominant race/ethnicity (with %): _____

13. Predominant sex (with %): _____

14. Sample characteristics:
a. Student
b. Non-student
c. Both student and non-student
d. Other (specify): _____

15. % of sample meeting clinically significant levels of social anxiety: _____

16. Social anxiety measure (select all that apply)
a. Brief Fear of Negative Evaluation Scale (BFNE)
b. Fear of Negative Evaluation Scale (FNE)
c. Interaction Anxiousness Scale (IAS)
d. Liebowitz Social Anxiety Scale (LSAS)
e. Social Avoidance and Distress Scale (SAD)
f. Social Interaction Anxiety Scale (SIAS)
g. Social Phobia and Anxiety Inventory (SPAI)
h. Social Phobia Scale (SPS)
i. Structured Clinical Interview for DSM-IV-TR
j: Other (specify): _____

17. Cannabis use measure (select all that apply)
a. Marijuana Use Form (MUF)
b. Timeline Followback (TLFB)
c. Risky Behavior Inventory (RBI)
d: other (specify): _____
e. none

18. Cannabis use timeframe (in days; i.e., past month = 30 days): _____

19. Cannabis problems measure (select all that apply)
    a. Marijuana Problems Scale (MPS)
    b. Rutgers Marijuana Problem Index (RMPI)
    c. Brief Marijuana Consequences Questionnaire (B-MACQ)
    d. Other (specify): _____
    e. none

20. Social anxiety + cannabis use correlation: *r* = ____

21. Social anxiety + cannabis problems correlation: *r* = ____

Note: indicate "not reported" in Excel file if any of the above questions are not presented in the study.

Appendix B

Consent Form

Informed Consent

Research Project Title: Social Anxiety and Cannabis Use

Principal Investigator: Alanna Single, Doctoral Student, Department of Psychology
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Supervisors: Dr. Matthew Keough, Assistant Professor, Department of Psychology and Dr. Natalie Mota, Associate Professor, Department of Clinical Health Psychology

This consent form, a copy of which can be downloaded and/or printed for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The primary purpose of this study is to examine the association between social anxiety and cannabis use in young adults. This study is looking to recruit university students who are young adults between the ages of 18 and 25 to participate in this research. As a participant in this study, you will be asked to complete an online survey consisting of questions asking about demographic information, social anxiety, cannabis use. The study should take approximately 30-45 minutes and you will receive 2 credits for your participation.

While completing the survey, you may be answering questions of a sensitive nature pertaining to your substance use behaviour. If you experience significant distress during participation of after completing the survey, please seek help. Here are some potential resources:

Klinic Crisis Line – (204) 786-8686
Manitoba Addictions Helpline - 1-855-662-6605 (toll free)

There are also significant benefits of this research. You may enjoy learning about yourself through completing the survey measures. Also, you may use the experience to learn more about psychological research, specifically in the area of social anxiety and cannabis use. This research has the potential to improve our understanding of cannabis use among socially anxious young adults.

Your responses in this study will remain confidential at all times. Your answers to the consent form and survey are collected by Qualtrics™. Responses to all survey questions are completely confidential and recorded by an (arbitrary) participant number only and will not be linked to identifying information (i.e., name, student number, University of Manitoba email address). Once the study is complete, the data, which will be anonymized, will be stored confidentially on a University of Manitoba approved individual file storage software (i.e., OneDrive).

Participation in this study is voluntary and you may decline consent or withdraw at any time without reprisal by simply closing down your internet browser. You may also refuse to answer any questions that you do not wish to answer. If you decide to withdraw from participation in this research, the information in your research file will be destroyed. Should you choose to wish to opt out of the study after completing part or all of the survey, you may have the option to press the "next" button at the bottom of the webpage to submit your responses or have your responses deleted by contacting the principal investigator. The deadline for withdrawal will be in December 2021, after which it will be impossible to link your participant number to your survey responses (i.e., the data will be anonymized).

Results from the study will be disseminated through publication, research conferences, and in the form of a student thesis. The data presented will be in aggregate form, meaning individual responses will never be reported. Only the principal investigator and associated researchers will have access to the data. However, the completely anonymized data may also be made available upon request to authorized researchers outside the University of Manitoba. The final anonymized data set will be kept indefinitely.

By clicking "Agree" below you will indicate that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Psychology/Sociology Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at (204)-474-7122. A copy of this consent form has been given to you to keep for your records and reference.

__ Agree
__ Decline

Appendix C

List of Measures

Measure	Number of Items
***Marijuana Motives Measure** (Simons et al., 1998)	**25**
***Marijuana Problems Scale (MPS)** (Stephens et al., 2000)	**19**
***Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU Inventory)** (Cuttler & Spradlin, 2017)	**38 (Including branched items)**
***Cannabis Use Disorder Identification Test – Revised (CUDIT-R)** (Adamson et al., 2010)	**9 (Including branched items)**
NIAAA Recommended Alcohol Questions (NIAAA, 2021)	**4**
Alcohol and Cannabis Co-Use Item	**1**
Drinking Context	**16**
Smoking Context	**16**
Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001)	**9**
Executive Skills Questionnaire (Dawson & Guare, 2009)	**36**
The Buss-Perry Aggression Questionnaire (Buss & Perry, 1992)	**29**
Social Phobia Scale (SPS) (Mattick et al., 1998)	**20**
***Social Interaction Anxiety Scale (SIAS)** (Mattick & Clarke, 1998)	**20**

Liebowitz Social Anxiety Scale (LSAS) (Liebowitz, 1987)	**24**
***UPPS-P Impulsive Behaviour Scale** (Lynam et al., 2007)	**59**
Difficulties in Emotion Regulation Scale (DERS-18) (Victor & Klonsky, 2016)	**18**
Barratt Impulsiveness Scale (BIS) (Patton et al., 1995)	**30**

Note: These measures were included as part of a larger survey. Measures marked with an asterisk indicate measures included in Study 3.

Appendix D

Recruitment Materials

(description will be posted on the Department of Psychology Sign-Up System)

Abstract: We are conducting an online survey on social anxiety, cannabis use, and personality variables among young adults. It involves answering questions about demographics, social anxiety, cannabis use, and personality traits.

Description: As a participant in this study, you will be asked to complete an online survey consisting of questions regarding demographics, social anxiety, cannabis use, and personality traits. These measures will permit us to examine the primary goals of this study. The survey should take approximately 30-45 minutes and you will receive 2 credits for your participation. The credit will be provided no later than two weeks after your scheduled study session. At the end of the survey, you will be provided with additional feedback that more fully explains the study aims and procedures.

Eligibility: Participants must be university students between the ages of 18 and 25 years old.

Researcher Contact Information: If you have any questions about this study, you may contact the researcher, Alanna Single, at singlea@myumanitoba.ca

Appendix E

Feedback Form

Feedback Form

Thank you for participating in the current study. Your time and cooperation are much appreciated. For further questions, comments, or information about the study please contact the principal investigator.

Study Objective:

Goals: The primary goal of the project was to examine if there are different profiles of socially anxious young adults based on levels of impulsivity and aggression. The scientific literature tells us that people with social anxiety may not all be shy and withdrawn in their presentations, and some people may present with impulsive or aggressive traits. However, we do not know how these different social anxiety profiles might be related to cannabis use behaviours during young adulthood. We aimed to fill this gap in the literature with this study.

Design: We asked you to complete a web-based survey in order to achieve the aforementioned goal. We asked you to complete a battery of self-report questionnaires online, which assessed demographics, social anxiety, cannabis use, and personality traits. Ultimately, these measures will help us identify if there are different profiles of socially anxious individuals based on personality characteristics, and how they may differ on cannabis-related behaviours.

Implications: The findings of the study may lead to a better understanding of social anxiety, particularly during the young adulthood period.

If you're interested in receiving a summary of results for this study, please click the link below and enter your email address. This is optional. Remember that email addresses are collected as part of a separate survey so that they cannot be linked to your individual survey responses.

[LINK TO REQUESTED RESULTS EMAIL WILL BE INSERTED HERE]

Please contact the principal investigator, Alanna Single, at singlea@myumanitoba.ca if you have any additional questions or concerns about the research.

If participating in this research has made you feel like you are struggling with addiction or mental health symptoms, please seek help. Here are some resources:

Klinic Crisis Line – (204) 786-8686
Manitoba Addictions Helpline - 1-855-662-6605 (toll free)

Appendix F

Demographic Questionnaire

1. What is your age?
    a. 18
    b. 19
    c. 20
    d. 21
    e. 22
    f. 23
    g. 24
    h. 25
    j. 26 or older

2. Education (check highest achieved):
    a. Less than high school
    b. High school diploma
    c. One or two year post high school but not college
    d. One or two year diploma from a trade or professional school but not college
    e. Some college or university education
    f. College or university degree (Bachelors)
    g. Post graduate work
    h. Post graduate degree

3. Do you currently have a job?
    a. No
    b. No (enrolled as post-secondary student)
    c. Yes, part-time (on average 9 hours or less per week)
    d. Yes, part-time (on average 10-19 hours per week)
    e. Yes, part-time (on average 20 or more hours per week)
    f. Yes, full-time (on average 40 hours per week)

4. Are you currently in university studies?
    a. Yes, full-time
    b. Yes, part-time
    c. No

5. What is your biological sex?
    a. Male
    b. Female

6. What is your gender?
    a. Man
    b. Woman
    c. Transgender

d. Non-binary
e. Specify:_____

7. What is your ethnicity?
   a. East Asian, South-East Asian, Pacific Islander (e.g., Chinese, Japanese, Korean, Vietnamese, Thai)
   b. Middle Eastern, North African, Central Asian (e.g., Jordanian, Saudi, Egyptian, Moroccan, Iranian)
   c. Hispanic or Latino (e.g., Brazilian, Chilean, Mexican, Cuban)
   d. Caucasian or White (e.g., Russian, German, Latvian, French, Scottish, Italian)
   e. Black (e.g., African- American, Nigerian, Haitian, Jamaican, Somali)
   f. Aboriginal (e.g., First Nations, Inuit, Métis, Native American, Native Australian)
   g. South Asian (e.g., Indian, Pakistani, Sri Lankan, Nepalese)
   h. Other (please specify:_____)