

**CANNABIS UNDER THE INFLUENCE OF YOGA: THE IMPACT OF MINDFUL
MOVEMENT ON WELL-BEING OUTCOMES AFTER CANNABIS USE**

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CANNABIS UNDER THE INFLUENCE OF YOGA: THE IMPACT OF MINDFUL MOVEMENT ON WELL-BEING OUTCOMES AFTER CANNABIS USE

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Abstract

The prevalence of cannabis use in Canada is high, and there is increasing discussion around the therapeutic use of cannabis to enhance well-being and address mental health concerns. Clinical research and anecdotal reports are equivocal and inconsistent, with both positive and negative impacts on mental health reported. In studies of other psychoactive drugs used therapeutically (i.e., psychedelics) there is considerable attendance to extra-pharmacological factors during the drug experience, as it is well-known that such contextual factors can significantly impact clinical outcomes. In this study, 47 participants self-administered cannabis via the Naturalistic Cannabis Administration Protocol (NCAP) under two conditions that took place one week apart. After consuming cannabis, participants completed a 45-minute yoga practice, and in the control condition participated in activities as usual for 45 minutes (e.g., what they would normally do when high). Within-subjects assessment of well-being outcomes indicated significant improvements in mysticality of experience ($F(1,46) = 19.82, p < .001, \eta_p = .30$) and state mindfulness ($F(1,46) = 34.08, p < .001, \eta_p = .43$) following the yoga condition, and no difference in state affect. Results demonstrated that contextual factors can impact well-being outcomes following cannabis administration. These findings suggest that paying attention to contextual factors and providing guidelines for therapeutic cannabis users may improve clinical outcomes when using cannabis to support mental health and well-being.

Lay Summary

Many people in Canada use cannabis to improve well-being and mental health. When using other psychoactive drugs to treat mental health conditions, researchers pay particular attention to contextual factors beyond the direct drug effects, such as the mindset, setting, and behaviour, as there is considerable evidence that these factors can significantly impact the therapeutic outcomes. These factors are rarely considered during therapeutic cannabis use. This study aimed to examine the impact of contextual factors during cannabis use on well-being outcomes. Participants consumed cannabis in their home twice about one week apart. In one condition, they practiced yoga, and in the other they regular activities. Predictors of well-being such as state mindfulness and mysticality of the drug experience were improved in the yoga condition, however there was no difference in mood state. Findings suggest that contextual factors may impact therapeutic outcomes, and support the development of contextual guidelines for users.

Preface

The present studies included in this dissertation consist of original and unpublished data. Sarah Daniels was responsible for the conceptualization and design of the studies, overseeing the collection of data, data analysis and synthesis of findings, and writing the final dissertation.

Ethics approval was granted by the University of British Columbia's Behavioural Research Ethics Board. Ethics approval was assigned certificate number H20-01443.

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Chapter 1 Introduction

Of the more than 50,000 species of plants with documented therapeutic properties, cannabis is one of the oldest recognized plant medicines (Rajasekharan & Wani, 2020). Ancient carvings and texts depict and describe the use of cannabis for medical, therapeutic and spiritual purposes in India beginning around 3000 years ago and subsequently spreading throughout the globe. Reasons for use are broad, however treating mental health conditions has been a consistent theme since the earliest times. As cannabis regains legal status for both medical and non-medical use there is a renewed interest in utilizing cannabis to manage mental health and enhance wellness. However, the research is equivocal and there is a dearth of knowledge on how to employ cannabis therapeutically to maximize benefits and minimize harms.

Extra-pharmacological factors (elements of mindset and environment) have long been recognized as critical components when employing psychoactive medicines. When applying psychedelic medicines in a clinical setting, there is a significant focus on preparing the individual's mindset beforehand through preparatory psychotherapy, and the environment is carefully cultivated and controlled to maximize therapeutic benefit. However, these considerations are largely absent from the application of therapeutic cannabis. Patients using cannabis therapeutically often struggle with a lack of information on what and how much to use, including what to do while they are using it. Given the importance of extra-pharmacological factors in predicting salubrious outcomes in other psychoactive medicines, paying due attention to these factors during cannabis use may enhance outcomes for clients seeking to improve their mental health.

One promising approach is to examine how we might better integrate the vast body of traditional knowledge with current therapeutic use. Historically, cannabis use was embedded

within ceremonial and spiritual practices such as meditation, chanting, prayer, and Yoga¹ (Aldrich, 1977; Ren et al., 2019). Practices from the tradition of Yoga, such as mindful movement practices, have proliferated from their roots in subcontinental Asia and gained substantial popularity in North America as a tool to enhance mental health and wellness. In particular, the trifecta of physical postures (*asana*), meditation (*dhyana*), and breathing practices (*pranayama*) has flourished, and this combination now typically defines the mind-body practice of yoga (Patwardhan, 2017). The spread of yoga practices may provide an opportunity to reconnect therapeutically oriented cannabis use with its traditional roots: coupling cannabis use with yoga may provide a set and setting conducive to maximizing the benefits of this plant medicine while mitigating potential harms. The present study is the first to empirically test the effect of adding mindful movement to cannabis.

Cannabis

Cannabis is a leafy green plant that has been consumed by humans for ritualistic and medicinal purposes for at least 3000 years (Ren et al., 2019). The plant contains hundreds of active ingredients in the form of phytocannabinoids and terpenoids which act and interact to produce a range of effects when ingested, primarily through action on the endocannabinoid system (Russo, 2011). The endocannabinoid system can utilize both endogenously produced cannabinoids as well as those found in plants such as cannabis, and plays a crucial role in maintaining homeostasis through the action of receptors in the central nervous system and the immune system (Sallasberry & Astern, 2018). The specific effects of cannabis consumption can be both physiological and psychoactive, and both are of interest for their potential to impact symptoms of mental health conditions.

¹ Capitalized to denote the greater philosophical tradition of Yoga.

The cannabinoids found in cannabis have demonstrated clear anxiolytic and antidepressant effects, and can supplement healthy functioning of the endocannabinoid system which is implicated in maintaining proper functioning across many systems, including the ability to regulate mood and manage stress (Roberts, 2020). In addition, the psychoactive effects impact perception, emotion, and cognition, producing an altered state of consciousness. The history of drug research over the last century has been impeded by a sociocultural attitude of temperance, in which altered consciousness has largely been unpalatable, and begrudgingly tolerated as a side effect of therapeutic drugs (Nusbaumer & Reiling, 2007). Indeed, there is continued interest in developing strains of cannabis that retain therapeutic effects while diminishing or removing the psychoactive effects (Halverson, 2012). However, the altered state itself is widely recognized by experts and end users as an important component in maximizing therapeutic effects.

Altered States of Consciousness

The positive relationship between alterations in consciousness and the degree of positive change experienced both short- and long-term is consistently observed in the literature (Yaden & Griffiths, 2021). A review of descriptions by individuals using ketamine to address persistent low mood exemplifies the close connection between core features of altered states and the therapeutic value of the drug: altered sense (i.e., feelings of lightness/floating) was associated with the antidepressant effects of ketamine (Stocker et al., 2019). Changes in conscious perception have long been recognized as inherently therapeutic by philosophers and healers over millennia; the ability of altered states to disrupt current patterns of thinking, perceiving, and behaving opens the door to the opportunity for new and adaptive actions and perspectives (Brace, 2020).

Mystical experiences are a form of an altered state of consciousness defined by a profound experience of unity or oneness, sacredness, indescribability/ineffability, noeticism, positive mood,

and transcendence (Stace, 1960). Mystical experiences draw clinical interest as they are associated with substantial and sustained positive changes in cognition and behaviour (Johnson et al., 2019). In studies of other psychoactive drugs such as classic hallucinogens, mysticity during the drug experience is directly correlated with retaining positive changes over time (Griffiths et al., 2018; Ko et al., 2022; MacLean et al., 2011). While mystical experiences can transpire naturally on occasion, the ability of psychoactive drugs to induce mystical experiences in a more reliable manner has piqued the interest in utilizing these substances for that purpose. Indeed, the therapeutic value of altered states of consciousness has garnered substantial interest in the treatment of mental health conditions, with psychedelics such as psilocybin (found in fungi colloquially known as “magic mushrooms”), 3,4-methylenedioxymethamphetamine (MDMA), lysergic acid (LSD), and ayahuasca at the forefront of scientific investigation.

While cannabis is not considered a traditional psychedelic, recent evidence indicates that it shares many commonalities with psychedelic-induced altered states. A recent study characterized the altered states induced by an oral administration of the principal cannabinoid tetrahydrocannabinol (THC). Subjective effects included those commonly observed with classical psychedelic use including alterations in sense of self, sense of time, visual perception, natural language processing, mindfulness, insightfulness, and mind-wandering (Murray & Srinivasa-Desikan, 2022). Cannabis users have self-reported a state of oceanic boundlessness, an aspect of mysticity of experience associated with the positive effects of classic psychedelics (Earleywine et al., 2021). Other observed properties shared with psychedelics include experiences of spirituality, and the opportunity to work through and overcome difficult experiences (Johnstad, 2020). Cannabis may also share a common mechanism of action with psychedelics, as fMRI

imaging of cannabis-induced altered states has identified enhanced between-network communication in the brain (Zaytseva et al., 2019).

Cannabis and Mental Health

Rates of cannabis use are higher among individuals in North America reporting a mental health condition (Rup et al., 2021). Increased rates of cannabis may precipitate the onset of mental health conditions, represent a shared vulnerability, or may represent therapeutic use (Ksir & Hart, 2016). Indeed, managing mental health and enhancing wellness is one of the most prominent motives for cannabis use. A recent systematic review and meta-analysis of self-reported reasons for medical cannabis use indicated that half of participants endorsed anxiety and over a third endorsed depression as a reason for use (Kosiba et al., 2019). In a recent survey of 6,413 cannabis users in Canada and the United States, over half endorsed using cannabis to manage symptoms of mental health, and over 90% of individuals with bipolar disorder or post-traumatic stress disorder (PTSD) in the study reported utilizing cannabis to address their symptoms (Rup et al., 2022). In a study of Canadian university students who reported medical cannabis use, approximately 8 in 10 students endorsed mental health symptoms; and anxiety, sleep difficulties, and depression were the top three most commonly endorsed (Smith et al., 2019). Cannabis users also perceive that cannabis is highly effective in managing mental health. In a study of medical users in Canada, over 90% of participants reported that cannabis was *often* or *always* helpful in addressing mental health symptoms (Walsh et al., 2013). Over half of cannabis users polled in the Canadian Cannabis Survey reported that cannabis use had a positive impact on their mental health and quality of life (Health Canada, 2019).

Despite the frequency of therapeutic use, formal evidence for the efficacy of cannabis to treat mental health symptoms is equivocal (Wadsworth et al., 2020; Walsh et al., 2013, 2017). A

guided systematic review of therapeutic cannabis use for mental health exemplified this clash by illustrating that cannabis is repeatedly associated with both positive and negative impacts on mental health across a myriad of conditions (Walsh et al., 2017). Studies included in this review found that that therapeutic cannabis use was typically associated with decreased anxiety, however, use with co-occurring social anxiety was associated with more cannabis-related problems. Cannabis use was associated with improved mood, but also with a higher risk of developing depression. Similarly, both improvements and deteriorations in symptoms of PTSD were reported. A recent study examining positive and adverse effects of cannabis use found that individuals with mental health conditions were more likely to report positive social, physical health, work, studies, family life, and quality of life benefits compared to those with no reported mental health condition. However, in terms of effects on mental health, those reporting mental health conditions were more likely to report both positive *and* negative effects of cannabis use on mental health symptoms compared to those with no reported condition. Those reporting mental health conditions were also more likely to report medical help-seeking for adverse effects of cannabis use (Rup et al., 2022).

The impact of the contradictory literature has palpable effects on physicians' ability to prescribe cannabis for mental health purposes. This mixed messaging has led to a stance of ambivalence on behalf of physicians due to a lack of knowledge on the effective application of cannabis, that is, how to use cannabis therapeutically in a way that will maximize benefits and minimize harms. A national needs assessment of physicians pertaining to therapeutic cannabis identified that the area of lowest average knowledge and the biggest gap between current and desired knowledge was creating effective cannabis treatment plans (Ziemianski et al., 2015). This sentiment was echoed by Canadian medical school students: 96% of students rated their knowledge of creating treatment plans as *poor/very poor* (St. Pierre et al., 2020). In sum, equivocal literature

and a lack of concrete guidance on best practices for use present substantial barriers to the most effective use of cannabis to reduce psychological distress and enhance mental wellbeing.

Extra-pharmacological Factors

One potential explanation underlying the contradictory literature may be the role of extra-pharmacological factors. The premise that psychoactive drugs have a consistent affect across different people in different situations was an assumption that fueled peremptory drug laws for decades, but is now being revisited as contextual factors are considered (Dalgarno & Shewan, 2005). Often termed *set and setting*, recent research aligns with traditional knowledge pertaining to how personal and environmental parameters can impact the drug effects. *Set* refers to internal factors such as an individual's mindset, personality, intention, and expectations. *Setting* refers to external factors such as the physical environment and social and cultural factors. The set and setting hypothesis proposes that these non-pharmacological factors are important determinants of the subjective effects of a psychoactive drug (Hartogsohn, 2017). While the term is relatively new, the importance of context when using psychoactive drugs has historically been revered and strictly upheld by Indigenous people since the earliest documentation of use (Carhart-Harris et al., 2018).

The role of extra-pharmacological factors has been given serious consideration in the field of psychedelic science. Much like studies of cannabis today, studies of psychedelics in the 1960's were producing wildly varying results. Researchers at the time began to explore and document the impact of set and setting on the subjective drug effects, and how outcomes could be influenced by extra-pharmacological factors became a crucial consideration in studies of the effects of psychedelics and psychedelic psychotherapy. Indeed, once set and setting was attended to, recorded psychedelic experiences shifted from overwhelmingly negative to overwhelmingly positive (Hartogsohn, 2017). When applying psychedelics for therapeutic purposes, great care was

taken to prepare both the physical setting (e.g., lighting, furniture arrangement, music) and the individual undergoing the treatment (e.g., meditation, introspection, bibliotherapy, psychotherapy). The design of psychedelic psychotherapy in its contemporary re-emergence has affirmed the importance of considering set and setting, and formal scientific examination of the specific effects of extra-pharmacological factors has begun (Strickland et al., 2020). Attempts to create a “neutral” setting in service of “objective” results served to demonstrate that it is impossible to isolate the drug experience from the internal and external environment in which it occurs, and even a “neutral” environment will be experienced positively or negatively by the individual (Hartogsohn, 2017).

Attention to extra-pharmacological factors is also germane beyond the world of scientific inquiry. Examples can be found in the peyote ceremonies of the Native American Church and the Santo Daime religion, a contemporary church wherein ayahuasca is ceremonially utilized in service of spiritual growth. A key characteristic of the Santo Daime rituals includes a scrupulously organized procedure of preparation and orientation, utmost attention to detail during the ceremony, and supported integration. These parameters were maintained even as the ritual migrated online to virtual ceremonies during the COVID-19 pandemic; members were carefully instructed on how to meticulously maintain the set and setting even when participating from home (Hartogsohn, 2022). Hartogsohn (2021) describes how every aspect of the ceremony is considered and carefully maintained, including visual elements (specific colours, shapes, room arrangement, displays), musical elements (specific music and hymns), olfactory elements (incense and fragrance), and kinetic elements (movement and dancing). Of particular interest is the focus on organized behaviour during the ritual. Like all other elements, the activities that the members partake in during acute intoxication are deliberate. Members participate in a program that may consist of

singing, dancing, or sitting in a particular posture. There is also a focus on developing a skillset of mental and physical qualities to best engage in and benefit from the rituals. In addition, the rituals take place within a broader social setting which provides support, acceptance, integration, and community. Indeed, the use of psychoactive drugs in such contexts is associated with fewer harms and fewer adverse experiences compared to recreational use (Ona, 2018). While psychedelics have been described as *non-specific amplifiers or reflectors* and are thought to be particularly sensitive to the impact of set and setting, extra-pharmacological factors have demonstrated effects across psychoactive drugs from heroin to cannabis (Hartogsohn, 2017). Beyond formal settings, recreational users of psychoactive drugs are also highly cognizant of the impact of extra-pharmacological factors, and often go to great lengths to attend to set and setting, both to enhance the drug experience and as a viable component of harm reduction (Dalgarno & Shewan, 2005; Hartogsohn, 2017).

Extrapharmacological Factors in Cannabis Use

Sociocultural Factors

Cannabis use in North America today broadly takes place in a set and setting where the practice is often highly stigmatized, if not illegal. In North America cannabis use has seen a degree of normalization in comparison to other illegalized drugs, however, there are still pervasive legal sanctions and stigmatization impacting cannabis users, even in countries such as Canada where there is a federal legal framework. Eighteen months after legalization, almost 20% of polled Canadians reported concern if they were seen purchasing cannabis from a legal government facility. Over a third of Canadians indicated that they would not want to work with someone who regularly uses cannabis, and over a quarter reported that they would not want their co-workers to know that they used cannabis (Charlebois et al., 2020). The perpetuation of this stigma is a cause

for concern as previous research has identified the stigma related to cannabis use as a primary cause of cannabis-related harms, rather than the cannabis use itself (Beckett & Herbert, 2010). In addition, the anticipation of stigmatization predicts to a degree the amount of psychological distress an individual experiences, as measured by depression and anxiety symptoms (Quinn et al., 2014; Newhart & Newhart, 2018). The traditional set and setting for cannabis use, embedded in supportive spiritual or ceremonial practices, is in stark contrast to cannabis use today which for many occurs in an unsupportive psychological and sociocultural environment.

Motives for Use

The role of set in relation to cannabis has also been explored in the literature examining motives for cannabis use as an element of mindset. Motives are typically assessed based on five theoretically derived motives for use: enhancement (increasing pleasant feelings), social (make gatherings more fun), coping (dealing with stress and problems), expansion (increased experiential awareness), and conformity (because others are doing it) (Simons et al., 1998). Recent research has identified a sixth motive: routine, described as a “monotonous state of habituality” characterized by use out of boredom and habit (Benschop et al., 2015).

Cannabis use motives have been identified as contributing to 35% of the variance in cannabis use outcomes, including the presence of cannabis-related life problems (Simons et al., 1998). Coping, conformity, and routine motives are most associated with problems and dependence (Benschop et al., 2015). For example, in socially anxious men, using cannabis for coping and conformity motives was associated with problematic cannabis use (Buckner et al., 2012). Coping motives have the strongest relationship with negative affect and moderate the relationship between stress and depression, as well as mediating the relationships between problematic cannabis use and stress, distress intolerance, social anxiety and obsessive-compulsive

disorder (Glodosky & Cuttler, 2020). Using cannabis to cope with stress can be associated with poorer outcomes particularly when it represents a lack of other resources and coping strategies. This may help explain the higher rates of mental health pathology in regular cannabis users who endorse coping motives for use, while other motives do not carry the same association with cannabis-related problems.

While coping with stress may seem imbricated with therapeutic use for mental health, the functional and philosophical approach may vary under the umbrella of therapeutic use. For example, some users may “cope” with stress and problems by using cannabis to mentally avoid and distract from problems. Other users may harness the psychoactive effects of cannabis to expand their point of view or mindfully enhance their present moment experience. As evidenced in the literature, expansion and enhancement motives in particular are associated with better outcomes (Bresin & Mekawi, 2019; Simons et al., 1998). Of interest, these two motives are related to identified qualities of entheogenic drugs – those that can induce a spiritual experience (Johnstad, 2020). Individuals who use cannabis for spiritual purposes also seem to differ significantly from those who do not endorse this motive. A recent survey of 1087 individuals found that two thirds of cannabis users reported spiritual benefit from cannabis. Compared to those who did not report spiritual benefit, those who did were significantly more likely to endorse expansion motives, spiritual identity and regular spiritual experiences, meditate more frequently, and scored higher on measures of flourishing and mindfulness (Heide et al., 2021). Another study of individuals who use cannabis found that a quarter of their sample regarded cannabis as an entheogen and endorsed spiritual motives for use, and this motivation significantly predicted positive experiences of insight, connectedness, joy, love, and connection with transcendent forces (Johnstad, 2020).

Recognition of the importance of mental context has also been identified in harm reduction approaches to treating problematic cannabis use. Past research has identified lower baseline trait mindfulness in individuals diagnosed with substance use disorders (Dakwar et al., 2011). Mindfulness-based interventions have garnered interest for their potential to decrease problems associated with cannabis use (De Dios et al., 2012; Gates et al., 2016; Reiman, 2019). While most research has focused on using mindfulness to decrease or cease substance use, savoring is a mindful intervention that can be applied to amplify benefits and decrease harms without the goal of changing the quantity of use. Savoring is an active cognitive approach to engaging in activities and is an aspect of mindfulness inherent in enhancement and expansion motives for using cannabis. Savoring involves focusing on the present moment awareness of positive aspects of an experience in order to increase the degree of pleasure obtained from positive events (Bryant & Veroff, 2007). Savoring interventions have been developed and implemented across a broad range of contexts in positive psychology as well as clinical and health contexts. Outcomes of these studies have broadly associated savoring with increased positive affect and positive behavioural changes (Bryant, 2021). Previous research examining savoring and substance use have found that savoring is associated with a reduction of harms and an increase in positive affect and present-moment awareness, and in cannabis specifically it has been associated with fewer cannabis-related problems and increases in happiness (Luba et al., 2020; Mian et al., 2021; Mian & Earleywine, 2022).

Set and Setting in Therapeutic Use

Tremendous care, consideration, and research has been expended to delineate the details of a set and setting most conducive to therapeutic benefit for psychedelics, from the items and décor to the music choice (Hartogsohn, 2016; Leary et al., 1963; Strickland et al., 2020). This is a

prudent choice, as the set and setting can directly impact predictors of long-term therapeutic benefit, such as occasioning mystical experiences (Gandy, 2022). In contrast, despite the uptake of therapeutic cannabis use, little to no consideration of extrapharmacological factors is given. Medical users are provided a prescription for cannabis and sent home to use it with no guidelines pertaining to the set and setting. Some regular cannabis users do report paying attention to set and setting, however this is mainly discovered by trial and error, and through connection to a community of other cannabis users who can support the process (Skliamis et al., 2021). At present, there are no formal guidelines provided for therapeutic users, and new users may be unaware of how best to use cannabis to maximize therapeutic potential and minimize harms. This is a departure from the historical setting in which cannabis, much like psychedelics today and in the past, was integrated into a structured contextual framework.

Yoga

The most prominent style of mindful movement practiced in North America today originated in what is now India and Southeast Asia several millennia ago as part of Yoga, one of the six systems of Hindu philosophy, where it developed a rich tradition of use for therapeutic and spiritual purposes before spreading around the globe. In particular, the trifecta of physical postures (*asana*), meditation (*dhyana*), and breathing practices (*pranayama*) has flourished, and this combination now typically defines the mind-body practice of yoga. Yoga reached the popular culture in North America in the early 20th century and has remained a staple in the wellness industry since that time. Despite the relatively recent appearance in North America, yoga has been practiced in Eastern cultures for millennia, with the first yogic texts emerging around 2000 BC. The purpose of the practice as denoted in these ancient texts was parsimoniously described as “*yogas cittis vritti nirodha*,” translating to “calming the fluctuations of the mind”, and they laid

out a series of mind and body exercises and philosophies to remedy what we now recognize as anxiety, depression, and other mental health conditions (Patañjali & Shearer, 2002). The practices found in the tradition of Yoga are notable in that they were developed as one of the first evidence-based practices, as the ancient Yogis adhered to the researcher-practitioner model and tested many hypotheses to distill the practice to the most effective components (Cope, 2006). The traditional eight-limbed path of yoga includes ethics and observances (*yamas* and *niyamas*), physical postures (*asana*), breathing practices (*pranayama*), sensing inward (*pratyahara*), and focused concentration (*dharana*). These first six limbs culminate in meditative absorption (*dhyana*) and the experience of *samahdi*, what we would consider to be a mystical or peak experience. While traditional practitioners certainly dedicate to the eight-limbed path in its entirety, the practice has largely been distilled to postures, breathwork, and meditation over the course of its colonial adaptation.

At its core, yoga is a mindfulness practice with an interoceptive focus. In light of the considerable overlap between mindfulness and yoga, mindfulness has been proposed to underlie many of the positive effects of yoga practice (Riley & Park, 2015). Indeed, mindfulness practices such as yoga have been linked with positive mental health outcomes including improved emotional regulation, attention, memory, and quality of life alongside decreases in rumination, anxiety, depression, and sensory pain (Jeter et al., 2015; Kiecolt-Glaser et al., 2010; Nagy & Baer, 2017; Riley & Park, 2015; Ross & Thomas, 2010). The mechanisms of yoga's positive impact on well-being include both psychological factors (improved affect, mindfulness, and self-compassion) and biological factors (decreased cortisol and pro-inflammatory hormones, increased anti-inflammatory hormones and thalamic GABA) (Kiecolt-Glaser et al., 2012; Riley & Park, 2015; Yadav et al., 2012). In addition, the aim of the traditional yoga practice is to experience *samahdi*, which is quintessentially a peak or mystical experience. Indeed, practitioners of yoga and

meditation do report complete peak/mystical experiences equivalent to those typically experienced through psychoactive drugs (Shaner et al., 2017; Wilson & Spencer, 1990). While complete mystical experiences are associated with significant benefits, it has also been proposed that these experiences may exist along a continuum of intensity, with states of mindfulness and awe imparting some degree of benefit on this spectrum (Yaden et al., 2017).

Cannabis and Yoga

While the practice of cannabis-enhanced yoga is a vogue topic in North America today, the practice of combining cannabis and yoga has a long history. Traditionally, cannabis use was used ceremonially, and intended to amplify the experiences occasioned by spiritual practices (i.e., prayer, yoga, ceremony). The earliest evidence for combining cannabis with religious ceremonies are found in Vedic traditions in India millennia ago before spreading through other regions in Asia and the Middle East, and to other traditions including Buddhism and Abrahamic religions (Arie et al., 2020; Ferrara, 2020; Ren et al., 2019). Historical records indicate that the deliberate combination of cannabis and yoga was popular in India since at least the 7th century (Aldrich, 1977). While not all sects of the Yogic tradition support the practice, the Sadhus (ascetics who are devoted to Lord Shiva, the god of yoga and cannabis) continue to regularly combine cannabis and yoga in a ritualistic manner (Godlaski, 2012). Physiologically, cannabis and yoga demonstrate a natural synergy as some of the lasting positive effects of yoga have been attributed to its effect on the endocannabinoid system (McPartland et al., 2014). The subjective similarity of a cannabis high and the lasting state of tranquility and pleasant feelings following yoga is exemplified by the adaptation of the term “yoga high” to describe the experience after practice. Although the use of cannabis has largely been secularized, movements that re-place cannabis in a spiritual context are emerging in North America. The relationship between cannabis and mindfulness has been

espoused in the alternative and complementary wellness community in North America as cannabis-enhanced meditation and yoga events proliferate (Dussault, 2017; Smith et al., 2015).

Combining mindfulness practices and psychoactive drugs is experiencing a renaissance, as evidenced by recent studies of meditation combined with psilocybin (Griffiths et al., 2018). While the practice of cannabis-enhanced yoga has yet to be formally studied in modern time, the combination of cannabis and physical activity has received recent attention due to growing reports of individuals combining cannabis with their exercise routine. Those experienced with the combination report increased pleasurable feelings, faster recovery, decreased anxiety, and notably increased focus, concentration, and mind-body awareness (Nguyen, 2019). This aligns with the generally accepted position that the positive impacts of cannabis on physical activity performance are largely due to decreased anxiety/increased relaxation, improved well-being, and analgesic effects, rather than direct performance enhancement (Gillman et al., 2015). Studies of direct effects on physical performance have generally found no significant effects in most areas related to performance, however physical work output was decreased in two studies (Charron et al., 2021; Kramer et al., 2020; Ware et al., 2018). While this may have a negative impact on elite athletic competitive performance, the majority of physical activity does not take place under these conditions. However, a competitive milieu is often sold to even the leisure or recreational athlete, in which common adages encourage participants to push their bodies to or past their limits (e.g., “*no pain, no gain*”, “*go hard or go home*”).

In a blatant departure from the mindful orientation of the tradition of Yoga, yoga classes in North America are one such example in which participants are often lauded for pushing their bodies to extremes, resulting in an increase in injuries (Fishman et al., 2009). For those who are engaging in physical activity for recreational or wellness motives, the decrease in work output

following cannabis consumption may not be a negative effect considering today's environment, and may instead reflect a protective effect and opportunity for enhanced mind-body connection. This shift in approach could help individuals to connect with their bodies rather than disconnecting with them during physical activity, and enhance proprioception with a host of not only physical but also mental and emotional benefits. Indeed, bodily awareness is an intrinsic and necessary component of emotional regulation, as it is necessary to identify and appraise the physical features of emotional states in the body (Füstös et al., 2013).

The effects of cannabis consumption on mind-body awareness and enhanced mindfulness have been widely observed by both historical and contemporary meditators, yoga practitioners, and spiritual traditions (Dussault, 2017a). As observed in an early contemporary account in Psychologist Charles Tart's *Altered States of Consciousness* (1972):

“Awareness of proprioceptive responses is enhanced. The person using marijuana may become aware of usually automatic, non-conscious, muscle tensions, small movements, feedback and control processes, and feelings of physical comfort and discomfort. These can be perceived with great clarity and distinctness. Such effects vary with the individual and the situation.”

To the degree that cannabis amplifies mindfulness and mind-body awareness, it stands to amplify the benefits of yoga as a mindful movement practice. Conversely, the meditative and body-focused orientation of yoga may provide a set and setting to maximize the therapeutic potential of cannabis. Furthermore, both cannabis and yoga can occasion mystical experiences separately, however, recent data illustrated that yogis who reported combining cannabis and yoga reported mystical experiences higher in intensity and frequency during their yoga practice than yogis who did not combine cannabis and yoga (Thomas et al., 2023). Given the therapeutic potential of mystical experiences, adding cannabis and yoga may potentiate the opportunity for

positive results. Elucidating the effects of combining cannabis with yoga may contribute to providing clinicians with a contextual framework to inform best practices when prescribing cannabis to alleviate mental health symptoms.

Current Study

Studying Cannabis Use

A laboratory environment has traditionally been employed to exercise a high degree of control in order to isolate drug effects. However, in human studies, this pursuit of control has been found to introduce additional confounds as a result of interactions between participants and their environment. For example, simply being in a medical or laboratory environment with healthcare practitioners can induce measurable changes in physiology (i.e., “white coat effects” Pickering et al., 1988). To compound this, using drugs associated with a particular stigma or compartment can activate those beliefs and behaviours in a process known as stereotype threat (Steele & Aronson, 1995). Finally, tolerance to drug effects is intricately tied to set and setting, and using the same amount and type of drug in a novel setting can result in an acute decrease in tolerance (Jones, Benowitz, and Herning, 1981).

Thus, when studying the subjective effects of a drug, utilizing a participant’s typical environment may be the best practice in order to produce ecologically valid results. This has been attended to in studies of psychedelics through creating a comfortable, homelike environment in which to experience the drug, and through the creation of imitation bars in which to study alcohol use (Marlatt & Rohsenow, 1981). When studying cannabis use, researchers have demonstrated creativity in their efforts to access an ecologically valid environment while navigating issues of policy and legality that stymie the clinical administration of cannabis. For example, Bidwell et al. (2018) developed a protocol in which participants consume their own cannabis inside their own

home and then present to a mobile lab in a converted van to undergo assessment. While this method allows for improved validity during consumption of cannabis, the aptly dubbed *Cannavan* still represents a confound when the goal is to examine behaviour while intoxicated. Another attempt to address this problem can be found with the naturalistic cannabis administration protocol (NCAP; St. Pierre et al., 2022). This protocol utilizes videoconferencing to enable researchers to connect to participants at home, allowing them to consume their own cannabis products in a familiar and typical environment. In addition, research assistants who have contact with the participants adopt a casual and comfortable language and appearance in order to decrease the introduction of white coat effects. The results of this proof-of-concept study of the NCAP protocol indicated that the procedure was feasible for researchers and acceptable for participants.

In addition to improving ecological validity, this type of research may also increase the generalizability of findings by broadening the participant pool. Many people who use drugs have typically been excluded from laboratory-based studies due to a lack of proximity, lack of transportation or access to and from the facility, or discomfort participating in a lab-based setting. Protocols such as the NCAP reduce barriers to participating in studies of substance use, allowing for a broader sampling of people who use drugs which may result in more generalizability of results within relevant populations.

Acceptability

Assessing the acceptability of an activity is an important component in developing interventions that optimize clinical outcomes. High acceptability increases participation and adherence, thus leading to increased opportunity to benefit from the activity. Acceptability of a health intervention typically includes behaviour (i.e., dropout rates), as well as cognitions, feelings, and attitudes towards the intervention (Sekhon et al., 2017).

Yoga interventions have traditionally demonstrated high feasibility and acceptability. They utilize minimal equipment, are highly adaptable/modifiable, and participants across diverse populations typically report high satisfaction and a positive attitude towards yoga (Agarwal et al., 2015; Ahmadi et al., 2022; Bakshi et al., 2021; Combs & Thorn, 2014; Sheffield & Woods-Giscombé, 2016). The virtual delivery of yoga has long co-existed alongside in-person classes, however its prevalence increased exponentially beginning in 2020 as the COVID-19 pandemic drove brick and mortar yoga studios to migrate their offerings online. A recent systematic review evaluated the feasibility and acceptability of online yoga. Across studies, participants reported satisfaction with the online delivery, and attendance and practice rates suggested adequate feasibility (Brosnan et al., 2021).

Summary and Aims

In sum, equivocal literature and a lack of concrete guidance on best practices for use present substantial barriers to the most effective use of cannabis to reduce psychological distress and enhance mental wellbeing. Traditional practices related to yoga and mindfulness are increasingly prominent in mental health treatment and share historical antecedents and potential mechanisms of actions with cannabinoid therapy (McPartland et al., 2014). However, despite popular uptake of practices combining cannabis and mindfulness, the extent to which mindfulness practices impact the acute consequences of cannabis ingestion remains unexamined.

The current study seeks to evaluate the extent to which mindful movement impacts the acute consequences of cannabis ingestion using the naturalistic cannabis administration protocol (NCAP). The NCAP allows for the ability to observe cannabis use in the familiar and typical setting of the participant's home via video conferencing software, rather than in a lab environment. Participants in the study complete two contexts in counter-balanced order. In the control condition,

participants consume cannabis and then participate in their usual activities for 45 minutes, that is, whatever they would normally do after consuming cannabis if they were not participating in a study. In the intervention condition, participants consume cannabis and then participate in a 45-minute pre-recorded Yoga asana practice. The primary aim is to compare the effects of cannabis use on positive mental health outcomes including state mindfulness, mood, and mysticality of experience as they differ with a change in set and setting (i.e., activities as usual vs. a mindful movement practice). The secondary aim will be to evaluate acceptability of the cannabis-enhanced yoga activity. The third and supplementary aim is to evaluate the impact of participant characteristics including trait mindfulness, experience with yoga, and baseline mental health.

Aims and Hypotheses

Aim 1: Differences Between Conditions.

Hypothesis 1. Participants will report more mystical features of their experience in the cannabis and yoga condition at 45 minutes post administration relative to control condition.

Hypothesis 2. Participants will report more positive affect at 45 minutes post administration in the cannabis and yoga condition relative to the control condition.

Hypothesis 3. Participants will report less negative affect at 45 minutes post administration in the cannabis and yoga condition relative to the control condition.

Hypothesis 4. Participants will exhibit higher state mindfulness at 45 minutes post administration in the cannabis and yoga condition relative to the control condition.

Aim 2: Acceptability of Intervention.

Acceptability of the cannabis and yoga practice will be queried. Participants will report if they enjoyed the yoga and cannabis condition, if they are willing to try the yoga and cannabis practice again, and if they are willing to recommend the yoga and cannabis practice to people they know.

Aim 3: Differences Between Participants.

Hypothesis 1. Lower participant baseline mental health will be less responsive to the yoga and cannabis condition.

Hypothesis 2. Participants higher in trait mindfulness will be more responsive to the yoga and cannabis condition.

Hypothesis 3. Participants with more yoga experience will be more responsive to the yoga and cannabis condition.

Chapter 2 Methods

2.1 Participant Sampling and Characteristics

A power analysis conducted using G*Power to identify the appropriate sample size for the present study. The analysis suggested that a sample size of 36 would be sufficient to detect within-subjects effects in the small to medium range. Participants were recruited through two avenues. The first recruitment stream was drawn by inviting via email a pool of cannabis users who were previous participants in cannabis-related studies and indicated that they wished to be contacted for future opportunities to participate in research. The second recruitment stream was drawn using a respondent-driven social media method. A study ad was posted on social media pages, and interested individuals were instructed to contact the research team via email if they were eligible and wished to participate. Individuals of any gender were eligible to participate if they met the following inclusion criteria:

1. Between the ages of 19 – 50.
2. Used cannabis regularly (three or more times per week on average).
3. Proficient at reading and speaking English.
4. Able to consume cannabis via inhalation for the study appointment.
5. Have a space with enough room to do a yoga practice.

The criteria for exclusion were:

1. Currently pregnant.
2. Receiving treatment for bipolar disorder or a psychotic spectrum disorder.
3. Daily use of nicotine use within the past three months.

Participants were compensated with \$40 CAD via e-transfer after the completion of the second and final appointment. The study was approved by the University of British Columbia Institutional Review Board (H20:01443).

2.2 Procedure

NCAP Protocol

This study utilized the naturalistic cannabis administration protocol (NCAP; St. Pierre et al., 2022). After indicating interest and confirming eligibility, participants schedule their first appointment and receive an email with instructions and a link to a Qualtrics survey containing the consent form and physical activity waiver, demographics, and the baseline measures of trait mindfulness and mental health. In order to avoid a loss of tolerance due to a washout period, appointments were scheduled as close as possible to the time of day that participants reported that they would typically first use cannabis. They were asked to abstain from cannabis use during the day prior to their appointment time. They were instructed to have their cannabis ready to consume and to be located in a private space with room to participate in a gentle yoga practice. After logging on to Zoom, participants met with the researcher and reviewed any questions they had about the study, and confirmed their second appointment which was scheduled for the same time of day approximately one week later. Participants were then instructed to turn off their camera and consume their cannabis in a way they are familiar with (e.g., if they usually smoke a joint, they smoke a joint, or if they usually have two pulls from a vape pen, they have two pulls from a vape pen). After 5 minutes the participants returned to Zoom and completed a brief measure indicating their subjective highness and the amount and type of cannabis consumed, if known. Participants then completed the respective condition for the session as described below. After completing the condition, participants completed the retrospective measures reporting on their experience.

Conditions

Participants completed two conditions approximately one week apart at the same time of day. Conditions were randomly assigned in counterbalanced order. Participants were asked to use the same space for both sessions to maintain consistency in their physical environment. Researchers were available by Zoom and/or email throughout the duration of the participant's individual activities in case of any questions or troubleshooting.

Condition 1: Cannabis and Yoga Condition. In the yoga session, participants consume their own cannabis as per the NCAP protocol and were then provided a link to a pre-recorded 45-minute Ganja Yoga style yoga class. After participating, they completed the retrospective measures reporting on their experience and emailed their research assistant to confirm they were done.

The yoga practice consisted of a 45-minute practice in the Ganja Yoga style as developed by Dee Dussault, a registered yoga instructor who has been teaching cannabis enhanced yoga since 2009. Dussault developed the Ganja Yoga style of practice and teacher training program, and the author completed the certification with Dussault in 2018. The sequence consists of slow, meditative movements designed to be physically and psychologically safe and accessible for all bodies, abilities, and backgrounds. The movements are low to the mat and the majority are done from a seated, supine, or prone position. See Appendix C for the full sequence. Dee Dussault's Ganja Yoga Teacher Training is the principal cannabis-enhanced yoga training in North America, and as such it exemplifies the typical formal cannabis-enhanced yoga class available in North America today. The class was pre-recorded for consistency between participants and sessions.

Condition 2: Cannabis and Activity Condition. In the control condition, participants consumed cannabis as per the NCAP protocol and were then instructed to engage in their usual activities, that is, whatever they normally would do after consuming cannabis, for 45 minutes. They were

instructed to choose activities that would be most typical for them, as close to how it would be if they were not participating in this study. They were instructed to set an alarm for 45 minutes, at which point they completed the retrospective measures reporting on their experience and emailed their research assistant to confirm they were done.

2.3 Measures

Descriptive Characteristics

A brief demographic questionnaire was administered querying age, gender, and ethnicity. Participants also reported the frequency of past-year yoga practice (*Monthly or less, 2-4 times per month, more than weekly, or daily or almost daily*) and how often they practice yoga in conjunction with cannabis use (*never, rarely, less than half of the time, more than half of the time, or always or almost always*), and how often they use cannabis (days cannabis was used per week on average in the past month). After consuming cannabis in both conditions, participants responded to five additional items. They reported their method of consumption (*smoke, vaporize, dab, other*), subjective highness (*higher than usual, about as high as usual, less high than usual*), how much cannabis they consumed, and the name of the strain if known.

Trait Mindfulness

Baseline trait mindfulness was measured using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006). The FFMQ was developed based on a factor analysis of five independently developed mindfulness questionnaires. The scale consists of 39 items pertaining to the five identified factors: observing (e.g. *when I'm walking, I deliberately notice the sensations of my body moving*), describing (e.g. *I'm good at finding words to describe my feelings*), acting with awareness (e.g. *when I do things, my mind wanders off and I'm easily distracted*, reverse-scored), non-judging of inner experience (e.g. *I criticize myself for having irrational or*

inappropriate emotions, reverse scored), and non-reactivity to inner experience (e.g. *I watch my feelings without getting lost in them*). Each item is scored on a scale from 1 (*never or very rarely true*) to 5 (*very often or always true*).

State Mindfulness

State mindfulness was measured using the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013). The SMS has demonstrated convergent and discriminant validity with other measures of state mindfulness, and has demonstrated sensitivity to time and context, indicating that it is measuring state mindfulness in the moment rather than the more stable counterpart of trait mindfulness. The scale consists of 21 items encompassing a combination of both traditional Buddhist and contemporary psychology models of mindfulness. Items include statements related to both mental events and bodily sensation, such as “*I noticed pleasant and unpleasant thoughts*” and “*I noticed physical sensations come and go*”. Participants respond to each item by rating how well each statement describes their recent experience on a scale from 1 (*not at all*) to 5 (*very well*). The measure produces a total score as well as scores for the two subscales of bodily sensations and mental events.

Mystical Experience

The revised Mystical Experiences Questionnaire (MEQ-30; Barrett et al., 2015) is a retrospective phenomenological report of the degree to which an individual experienced characteristics of a mystical or peak experience during a defined period of time. The scale consists of 30 items pertaining to four aspects of a mystical experience: mysticality (e.g., *feeling that you experienced eternity or infinity*), positive mood (e.g., *feelings of peace and tranquility*), transcendence of time and space (e.g., *loss of your usual sense of time*), and ineffability (e.g., *sense that the experience cannot be described adequately in words*). Each item is rated by the participant

according to their experience at the time of the session using a rating scale consisting of 0 (*none; not at all*), 1 (*so slight cannot decide*), 2 (*slight*), 3 (*moderate*), 4 (*strong; equivalent in degree to any other strong experience*) and 5 (*extreme; more than any other time in my life and greater than 4*). The scale produces both a total score and 4 factor scores. The MEQ-30 was developed for use with psychedelic drugs, and has demonstrated reliability as well as external, internal, and convergent validity in this context. A key feature of the MEQ-30 is that it controls for the intensity of drug effects, which is beneficial in the current study.

State Affect

The short form of the Positive and Negative Affect Schedule (PANAS-SF; Watson, Clark & Tellegen, 1988) was used to measure state mood. Participants were asked to rate 20 items on 5-point Likert scale indicating how much they feel those emotions in the present moment. The measure produces two scores: one each for positive and negative affect. The scale demonstrates good internal reliability (0.84 to 0.90), has been validated against other measures of mood and is sensitive to fluctuations in mood (PANAS-SF; Magyar-Moe, 2009).

Mental Health

The short form of the Depression, Anxiety and Stress Scales (DASS-21; Lovibond & Lovibond, 1995) was used to measure baseline mental health. The DASS-21 is a 21-item scale measuring the presence of symptoms of depression, anxiety, and tension-stress. The measure produces three respective subscale scores. The DASS-21 has been validated in both clinical and non-clinical samples and displays excellent reliability (Antony et al., 1998).

Acceptability

The acceptability of the yoga intervention was measured by asking participants to rate the following three statements on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree):

- *I enjoyed the yoga practice.*
- *I plan to practice yoga while using cannabis again in the future.*
- *I would recommend practicing yoga while using cannabis to a friend.*

Participants were also asked their reason for intending or not intending to practice cannabis again in an open-ended format.

2.4 Analytic Procedure

Assumptions were examined using Levene's Test for homogeneity of variance, Box's M test for a multivariate normal distribution, and Bartlett's Test of sphericity. To address the first aim of assessing differences between conditions (yoga or activities as usual), a series of repeated measures ANOVA were conducted to compare the outcome variables according to condition. The second aim of assessing acceptability of the intervention is primarily descriptive. Qualitative data was assessed using a data-driven, inductive approach to identify the semantic themes present. To assess differences between participants, a series of repeated measures ANOVA were conducted on the primary outcome measures with condition as the within-subjects variable and categorical participant characteristics entered as a between-subjects variable. For trait mindfulness (FFMQ), an additional procedure was run to analyze the variable as continuous data. A difference score was computed between conditions for each outcome variable. Next, a series of Pearson biserial correlations were conducted to examine the relationship between the difference scores and trait mindfulness.

Chapter 3 Results

3.1 Sample Characteristics

50 individuals were recruited to participate in the study. Three participants did not complete their second session; two due to poor internet connection, and one failed to present to the second appointment without explanation, resulting in an attrition rate of 6%. Thus, the final sample consisted of 47 individuals, 16 of whom responded from the research pool recruitment stream and 41 of whom were recruited through the respondent-driven social media stream. 57.5% (n = 27) identified as women, 34% (n=16) identified as men, and 8.5% (n = 4) identified as non-binary/not listed. The self-reported average number of days per week of cannabis use in the past 30 days was five, and 32% (n = 15) reported daily use. Age of first cannabis use ranged from 10 to 30 years of age, with a mode age of 16. Six participants reported that they had never practiced yoga before. Thirty participants indicated that they practiced yoga rarely or sometimes, and 11 reported that they practiced often or very often. Of those that reported yoga experience, 59% (n = 24) described themselves as a “beginner”, 37% (n = 15) as intermediate, and 4% (n = 2) as advanced. Demographic characteristics of the sample including age, education and ethnicity are displayed in Table 1.

Table 1*Demographic Characteristics of the Sample*

	N	%
Age		
20-24	16	34.0%
25-29	12	25.5%
30-34	14	29.8%
Over 35	4	8.5%
Did not disclose	1	2.1%
Education		
13-16 years	27	57.5%
17-20 years	16	34.0%
Greater than 20 years	2	4.3%
Did not disclose	2	4.3%
Ethnicity		
African-American/Black/African	2	4.3
Asian-American/Asian/Pacific Islander	6	12.8
Latino/Latina/Hispanic	1	2.1
Indigenous/Aboriginal/Métis	3	6.4
European Origin/White	36	76.6
Biracial/Multiracial	2	4.3
Jewish	1	2.1

3.2 Control Condition Activities

In the control condition participants engaged in activities as usual (i.e., what they would typically do while using cannabis). Participants reported engaging in one to six activities during the 45 minutes ($M = 2.4$, see Table 2). The most frequently reported activities were making and

consuming food, watching television or movies, doing housework, socializing, and participating in hobbies. Activities completed are displayed in Figure 1.

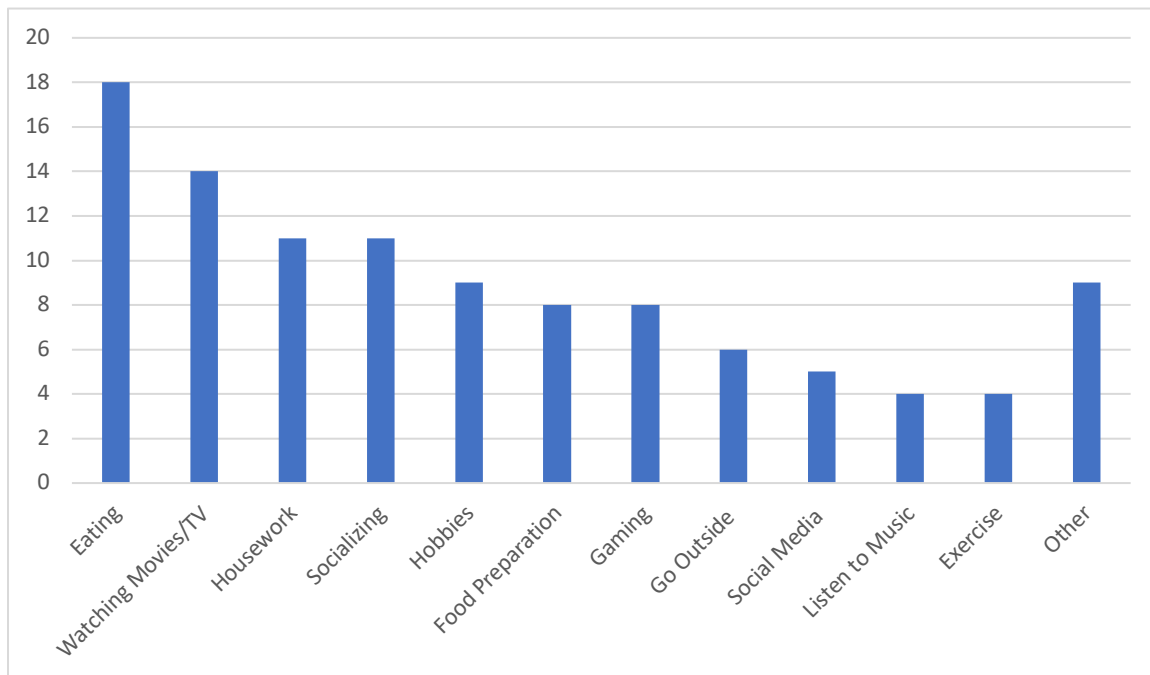
Table 2

Frequency of Number of Activities Engaged in During Activity Condition

Number of Activities	N	%
1	11	23.4%
2	18	38.3%
3	9	19.1%
4	7	14.9%
5	1	2.1%
6	1	2.1%

Figure 1

Incidences of Reported Activities During the Control Condition



3.3 Descriptive Statistics for Measures

Preliminary analyses were performed to characterize the study data and check the assumptions for the selected statistical procedures. None of the measures were normally distributed (Shapiro-Wilk's test $p < 0.05$ in all cases). However, because of the adequate sample size (greater than 40), the selected statistical procedures were considered to be robust against the non-normal distributions (Ghasemi & Zahediasl, 2012). Boxplots were produced for each dependent variable to inspect for the presence of outliers. There were nine outlying individual datapoints that fell greater than 1.5 box-lengths from the edge of the box. All were less than three box-lengths from the edge of the box and as such were not considered extreme outliers. The outliers were determined not to be due to data entry or measurement errors, and were in fact genuinely unusual values. The analyses were run both including and excluding the outlying data points, and findings remained consistent. As such, the outlying cases were included in the analyses.

The means and standard deviations of the primary outcome measures used in this study are displayed in Table 3. All primary outcome measure total scores were correlated with each other except for negative affect (PANAS negative). All other correlations ranged from small to large (minimum .02, maximum .55). The correlations are displayed in Table 4 for the activity condition and Table 5 for the yoga condition. The means and standard deviations of the baseline measures of mental health and trait mindfulness used in this study are displayed in Table 6. Correlations ranged from small to large (minimum .01, maximum .83), and are displayed in Table 7.

Table 3*Descriptive Characteristics of Primary Measures*

	Activity Condition	Yoga Condition
	<i>M (SD)</i>	
SMS Total	3.3 (0.9)	4.2 (0.6)
<i>Body</i>	3.2 (1.0)	4.3 (0.7)
<i>Mind</i>	3.3 (0.9)	4.1 (0.6)
PANAS Positive	27.8 (10.9)	30.1 (9.0)
PANAS Negative	14.7 (4.3)	13.5 (3.7)
MEQ30 Total	1.3 (1.0)	2.3 (1.2)
<i>Ineffability</i>	1.1 (1.2)	2.1 (1.4)
<i>Mysticality</i>	1.2 (1.1)	2.2 (1.3)
<i>Positive Mood</i>	2.0 (1.2)	2.8 (1.2)
<i>Transcendence</i>	1.3 (1.0)	2.3 (1.1)

Table 4*Pearson Correlational Analyses for State Measures of Mindfulness, Affect, and Mysticality of Experience in the Activity Condition*

	SMS Total	PANAS Positive	PANAS Negative	MEQ30 Total
PANAS Positive	.76**	–		
PANAS Negative	.12	.02	–	
MEQ30 Total	.66**	.75**	-.11	–

Note: ** $p < 0.01$.

Table 5

Pearson Correlational Analyses for State Measures of Mindfulness, Affect, and Mysticality of Experience in the Yoga Condition

	SMS Total	PANAS Positive	PANAS Negative	MEQ30 Total
PANAS Positive	.37*	–		
PANAS Negative	-.02	.15	–	
MEQ30 Total	.51**	.55**	.05	–

Note: * $p < 0.05$; ** $p < 0.01$.

Table 6

Descriptive Characteristics of Participant Baseline Mental Health and Trait Mindfulness

	<i>M (SD)</i>
DASS Total	36.4 (7.8)
<i>Depression</i>	11.4 (3.6)
<i>Anxiety</i>	10.6 (2.5)
<i>Stress</i>	14.4 (3.6)
FFMQ Total	128.0 (18.2)
<i>Observing</i>	28.6 (5.3)
<i>Describing</i>	29.0 (5.2)
<i>Acting with Awareness</i>	23.2 (4.8)
<i>Non-reactivity</i>	21.2 (5.1)
<i>Non-judgement</i>	26.1 (6.0)

Table 7*Pearson Correlational Analyses for Baseline Measures of Mental Health and Trait Mindfulness*

	DASS Total	Depression	Anxiety	Stress	FFMQ Total	Observing	Describing	Awareness	Non-reactivity
DASS Total	–								
Depression	.83**	–							
Anxiety	.74**	.45**	–						
Stress	.83**	.48**	.46**	–					
FFMQ Total	-.55**	-.49**	-.38**	-.44**	–				
Observing	-.24	-.23	-.22	-.15	.67**	–			
Describing	-.27	-.34*	-.22	-.10	.45**	.01	–		
Awareness	-.38*	-.39**	-.22	-.28	.77**	.49**	.22	–	
Non-reactivity	-.52**	-.37*	-.42**	-.48**	.77**	.48**	.20	.34*	–
Non-judgement	-.48**	-.37*	-.25	-.50**	.80**	.34*	.15	.63**	.61**

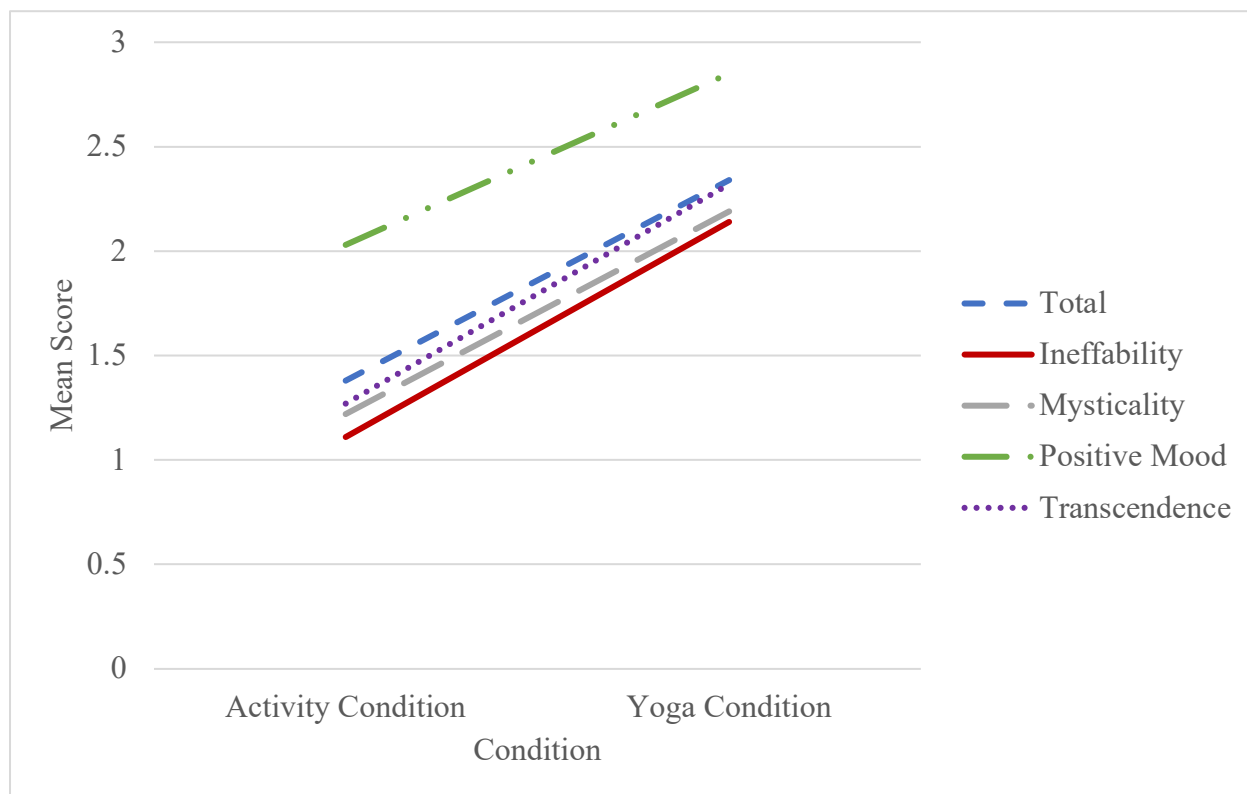
Note: * $p < 0.05$; ** $p < 0.01$.

3.4 Aim 1: Differences Between Conditions*Mysticality of Experience*

Repeated measures ANOVA were conducted to assess the difference in mysticality of experience with condition (activities as usual or yoga) as the within-subjects variable. Mysticality of experience as measured by MEQ-30 total score was significantly higher in the yoga condition ($F(1,46) = 19.82, p < .001, \eta_p = .30$). Scores were also significantly higher in the yoga condition for each of the four subscales of Ineffability ($F(1,46) = 17.17, p < .001, \eta_p = .27$), Mysticality ($F(1,46) = 16.64, p < .001, \eta_p = .27$), Positive Mood ($F(1,46) = 11.73, p = .001, \eta_p = .20$), and Transcendence ($F(1,46) = 21.90, p < .001, \eta_p = .32$). See Figure 2.

Figure 2.

Impact of Condition on Mysticality of Experience (MEQ30 Total Score and Subscales)

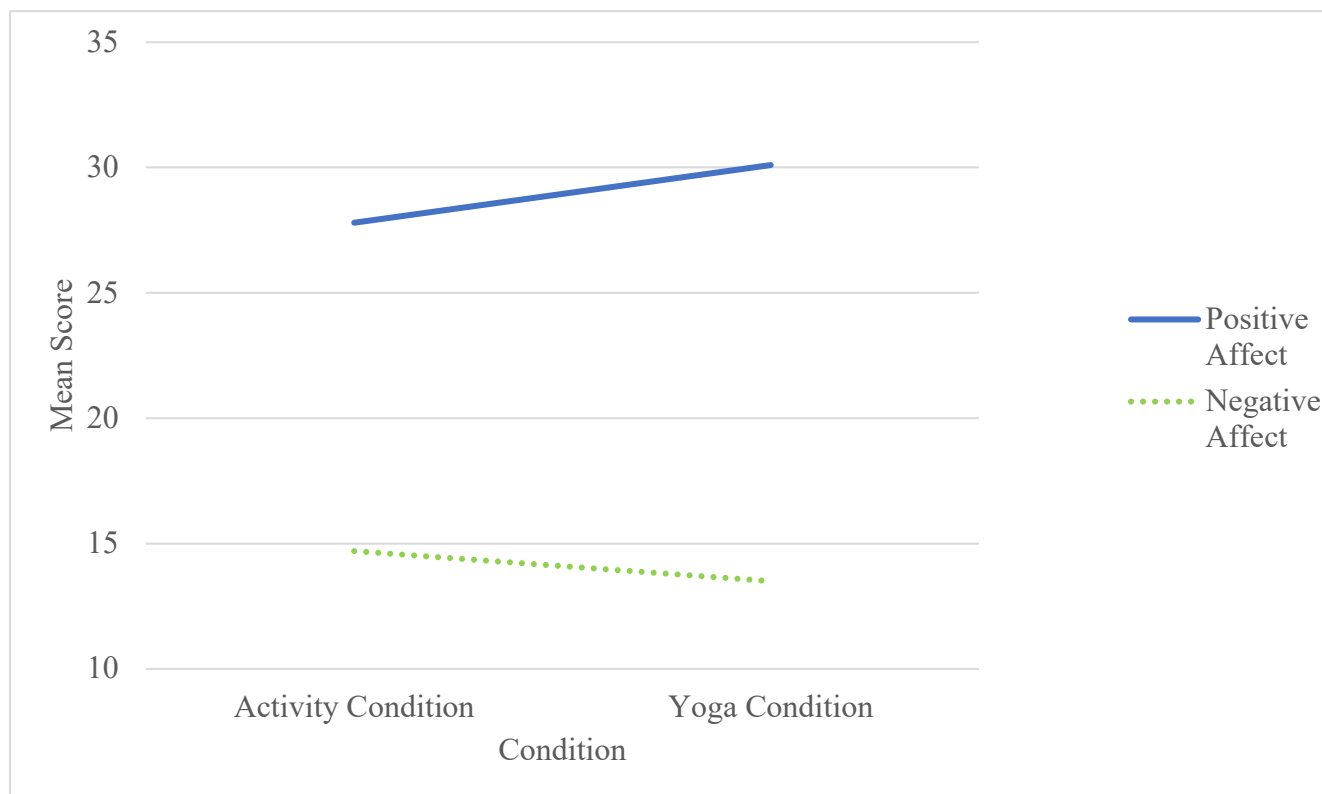


State Affect

Repeated measures ANOVA were conducted to assess the difference in state affect with condition (activities as usual or yoga) as the within-subjects variable. Positive affect as measured by PANAS positive affect total score was not significantly different per condition ($F(1,46) = 1.2$, $p = .28$, $\eta_p = .03$). Negative affect as measured by PANAS negative affect total score was also not significantly different per condition ($F(1,46) = 1.67$, $p = .20$, $\eta_p = .04$). See Figure 3.

Figure 3.

Impact of Condition on Affect (PANAS Positive and Negative Affect Scales)

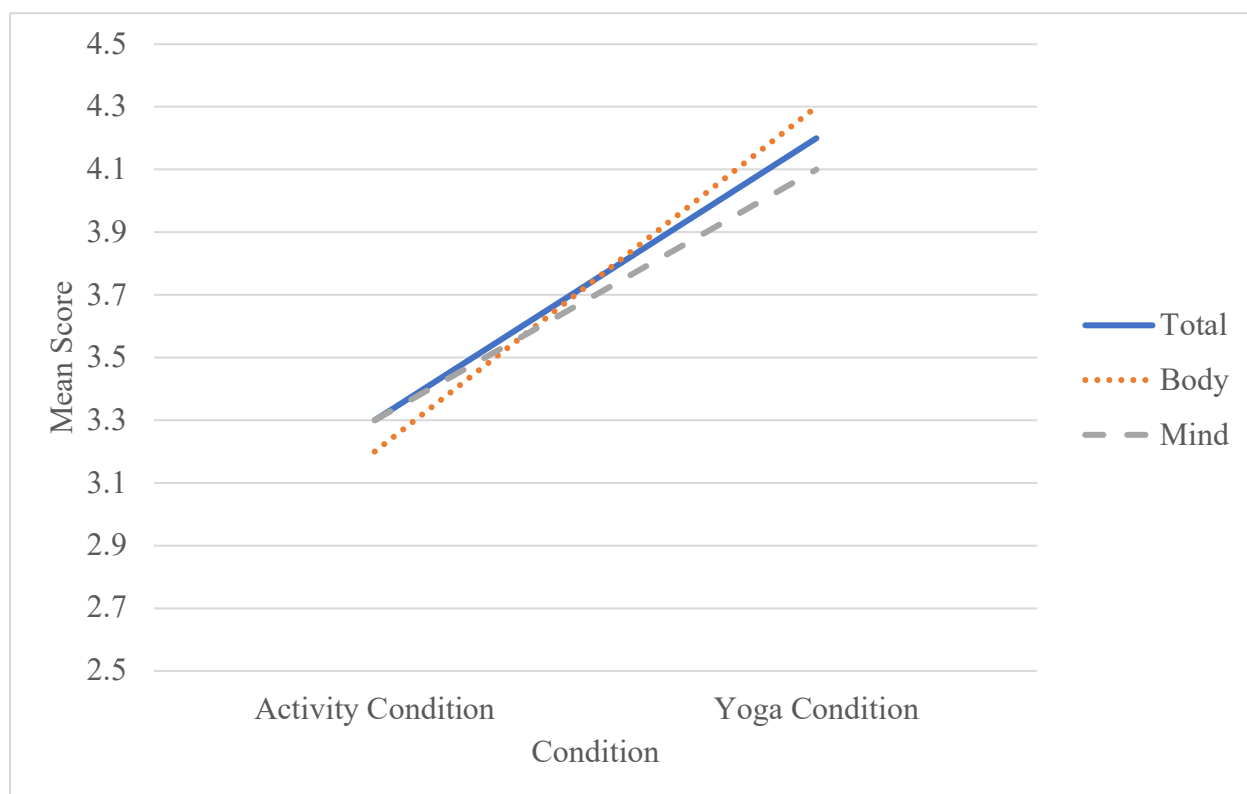


State Mindfulness

Repeated measures ANOVA were conducted to assess the difference in state mindfulness with condition (activities as usual or yoga) as the within-subjects variable. State Mindfulness as measured by the SMS Total Score was significantly higher in the yoga condition ($F(1,46) = 34.08$, $p < .001$, $\eta_p = .43$). Scores were also significantly higher for each of the two subscales of bodily awareness (SMS Body; $F(1,46) = 36.29$, $p < .001$, $\eta_p = .44$) and mental events (SMS Mind; $F(1,46) = 28.89$, $p < .001$, $\eta_p = .39$). See Figure 4.

Figure 4.

Impact of Condition on State Mindfulness (SMS Total Score and Subscales)



3.6 Aim 2: Acceptability of Intervention

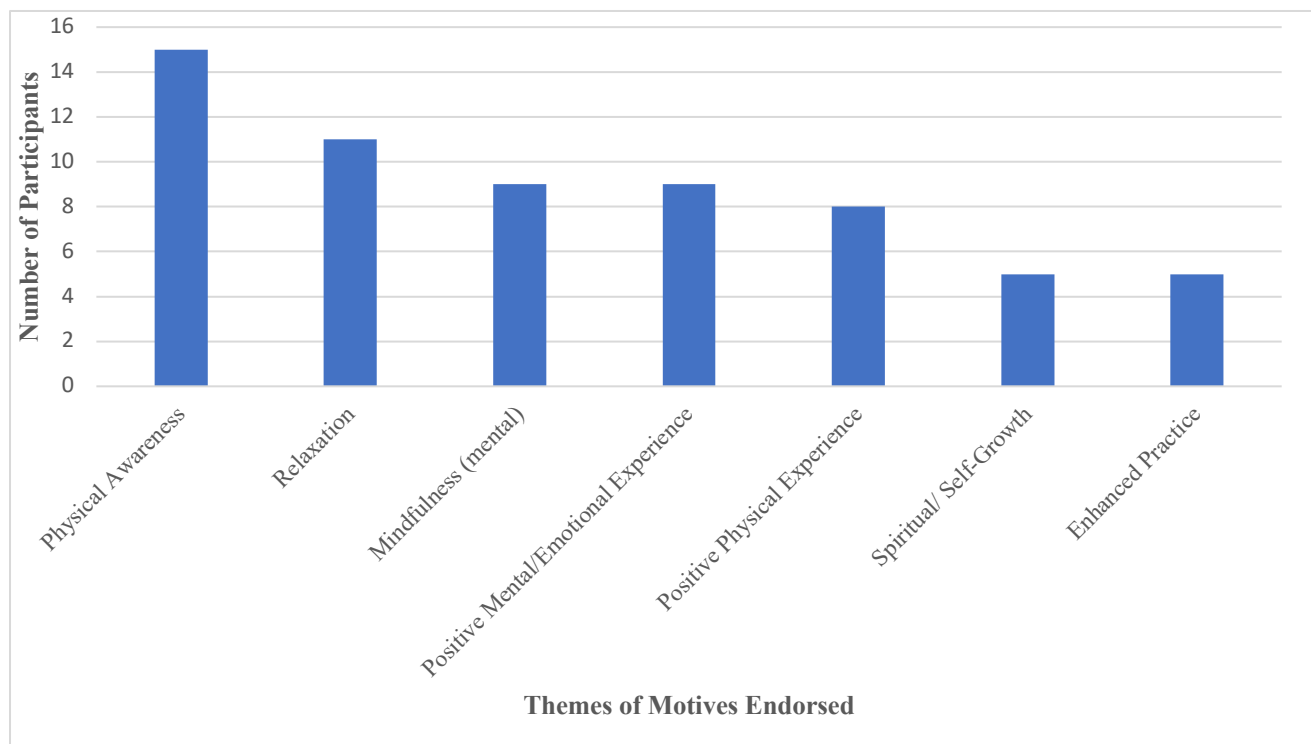
Participants were queried as to their enjoyment of the intervention, whether they intend to do the yoga practice while using cannabis again, and if they would recommend it to a friend. Seventy-two percent ($n = 34$) of participants indicated that they planned to practice yoga while using cannabis again in the future, while 15% ($n = 7$) indicated that they neither agreed nor disagreed with the statement, and 6% ($n = 3$) indicated that they did not plan to repeat the practice. The three participants who indicated that they did not plan to repeat the practice were asked an open-ended question querying, “*what are the reasons you do not plan to practice yoga while using cannabis again in the future?*”. The three responses provided were as follows:

- *It makes me feel sleepy, heavy and uncoordinated. Also makes it hard to focus on breathing or postures.*
- *I don't think yoga is for me, maybe I haven't found the right teacher.*
- *I felt more distracted. This could be due to the cannabis, or because I usually do yoga in a group setting and not in my home.*

The participants who reported that they planned to combine cannabis again were asked an open-ended question inquiring, “*what are the reasons why you plan to practice yoga while using cannabis again in the future?*” All thirty-four participants provided qualitative data in response to this question, and their responses are compiled in Appendix D. A thematic analysis was conducted on their responses. The analysis was conducted following guidelines for using thematic analysis in Psychology as outlined by Braun and Clarke (2006). An inductive approach was used to identify the semantic themes present. Themes were identified using a data-driven approach with the goal of producing a rich description of the data to capture all motives reported by participants. Most (62%, n = 21) participants reported more than one motive, resulting in a total of 67 reported motives. Following an iterative process, the following seven distinct themes were identified and converged upon by the author and a research assistant: *enhanced physical awareness, relaxation, mindfulness (mental), positive mental/emotional experience, positive physical experience, spiritual/self-growth, and enhanced practice*. Prevalence of reported motives can be found in Figure 5.

Figure 5.

Prevalence of Themes Identified as Motives for Combining Cannabis and Yoga Again in the Future.



The most frequently reported theme was *enhanced physical awareness* ($n = 15$), which captured an increased awareness of the body, movement, and physical sensory experiences. For example, participants reported they were more “in touch” or “in tune” with their body and their body’s needs, and felt their body, sensations, and sense of movement on a “deeper” level. They particularly emphasized that this was different from their usual (sober) experience of yoga, stretching, or physical activity, and that this experience represented a gain or a change from their experiences without cannabis. *Relaxation* was the second most prevalent theme identified ($n = 11$), and encompassed reports of increased calmness, tranquility, and peacefulness, along with “deeper” physical and mental relaxation.

Increased *mindfulness (mental)* was identified by nine participants, and this theme included reports of improved mental focus, clarity of mind, present moment awareness, greater awareness of thoughts, and cognitive skills contained within mindfulness such as decreased judgement and curiosity about the experience. A *positive mental/emotional experience* was a theme identified by nine participants. This theme encompassed motives related to the experience of positive mental and emotional states, and having a fun, enjoyable, pleasurable, and/or interesting experience. Beyond augmenting an already enjoyable experience, some participants indicated that combining cannabis with yoga changed the valence of the situation for them, that is, made what would usually be a neutral or negative experience into a positive one (e.g., “*made physical activity an enjoyable experience rather than being task-oriented*”). Eight participants reported motives encompassed by a theme of *positive physical experience*. Within this theme were reports of pleasurable physical sensation, feeling good in their physical body, and other improved body-related experience (e.g., greater sense of physical control, sense of strengthening the body). A theme of *spiritual/self-growth* motives emerged for seven participants. Included were reports of enjoying the ritualistic element of the practice, and senses of self-discovery, connection, and enlightenment. Five participants reported *enhanced practice* motivations, noting that they prefer or are more likely to practice yoga if combined with cannabis, and that it improved or deepened their experience of yoga.

The majority of participants (88.6%, n = 39) agreed that they enjoyed the mindful movement condition. Four participants indicated that they felt neutral about the experience, and one reported that they did not enjoy it. Most participants (77%, n = 34) reported that they planned to practice yoga while using cannabis again in the future. Most participants (86%, n=38) reported that they would recommend the practice to a friend.

3.6 Aim 3: Differences Between Participants

Baseline Mental Health

Repeated measures ANOVA were conducted on the primary outcome variables separately (MEQ30 Total Score, PANAS Positive Total Score, PANAS Negative Total Score, and SMS Total Score) with condition as the within-subjects variable and score on the DASS-21 Anxiety, Depression, and Stress subscales as the respective between-subjects factors.

Anxiety, Stress, and Depression subscale scores were divided into two groups, a low symptom group representing participants in the normal score range and a symptom group representing participants with at least mild symptoms according to the clinical cut-offs. Anxiety scores were divided into a low symptom group by a score of three or less ($N = 24, 53.3\%$) and a symptom group by a score of four or more ($N = 21, 46.7\%$). Stress scores were divided into a low symptom group by a score of seven or less ($N = 25, 55.6\%$) and a symptom group by a score of eight or more ($N = 20, 44.4\%$). Depression scores were divided into a low symptom group by a score of four or less ($N = 30, 63.8\%$) and a symptom group by a score of five or more ($N = 15, 36.2\%$).

There was no interaction between participant baseline mental health and mysticality of experience by condition (See Table 8). There was no interaction between participant baseline mental health and positive state affect or negative state affect by condition (See Table 9 and 10). There was no interaction between participant baseline depression or stress and state mindfulness by condition. There was a significant interaction between baseline anxiety and state mindfulness (See Table 11). A follow-up examination indicated that the low anxiety group reported higher state mindfulness ($M = 4.39, SD = 0.43$) in the yoga condition compared to the high anxiety group (M

= 3.87, $SD = 0.58$). The low symptom group also demonstrated a larger difference score ($M = 1.18$, $SD = 0.99$) compared to the high symptom group ($M = 0.49$, $SD = 0.96$).

Table 8

Effect of Participant Baseline Mental Health (DASS-21) on Mysticality of Experience (MEQ30 Total Score) by Condition.

	<i>df</i>	<i>F-test (1,45)</i>	<i>P (two-sided)</i>	η_p
DASS-21 Anxiety	1,43	.51	.48	.01
DASS-21 Depression	1,43	.17	.68	.00
DASS-21 Stress	1,43	.02	.88	.00

Table 9

Effect of Participant Baseline Mental Health (DASS-21) on Positive Affect (PANAS Positive Affect Total Score) by Condition

	<i>df</i>	<i>F-test (1,45)</i>	<i>P (one-sided)</i>	η_p
DASS-21 Anxiety	1,43	.49	.32	.02
DASS-21 Depression	1,43	.49	.49	.01
DASS-21 Stress	1,43	.62	.78	.00

Table 10

Effect of Participant Baseline Mental Health (DASS-21) on Negative Affect (PANAS Negative Affect Total Score) by Condition

	<i>df</i>	<i>F-test (1,45)</i>	<i>P (one-sided)</i>	η_p
DASS-21 Anxiety	1,43	.28	.60	.01
DASS-21 Depression	1,43	.02	.88	.00
DASS-21 Stress	1,43	.00	.97	.00

Table 11

Effect of Participant Baseline Mental Health (DASS-21) on State Mindfulness (SMS Total Score) by Condition

	<i>df</i>	<i>F-test (1,45)</i>	<i>P (two-sided)</i>	η_p
DASS-21 Anxiety	1,43	7.29	.01**	.15
DASS-21 Depression	1,43	.02	.88	.00
DASS-21 Stress	1,43	.12	.74	.00

*Note: ** $p < 0.01$.*

Yoga Experience and Practice Frequency

Repeated measures ANOVA were conducted on the primary outcome variables separately (MEQ30 Total Score, PANAS Positive Total Score, PANAS Negative Total Score, and SMS Total Score) with condition as the within-subjects variable and yoga experience and practice frequency as the respective between-subjects factors.

Participants reported frequency of practice categorically (*never, rarely, sometimes, often, and very often*). To increase power, the *never* and *rarely* groups were combined to create a *low frequency* group ($n = 21, 44.7\%$) and the *sometimes, often* and *very often* groups were combined to create a *high frequency* group ($n = 26, 55.3\%$). Participants self-reported yoga experience qualitatively (*no experience, beginner, intermediate, advanced*). To increase power, *no experience* and *beginner* groups were combined to create a *low experience* group and the *intermediate* and *advanced* groups were combined to create a *high experience* group.

There was no interaction between frequency of yoga practice or yoga experience and any of the primary outcome measures of mysticality of experience, state affect, or state mindfulness (See Table 12).

Table 12

Effect of Participant Yoga Frequency and Experience on Mysticality of Experience, Positive and Negative Affect, and State Mindfulness by Condition

	<i>df</i>	<i>F-test</i>	<i>P (two-sided)</i>	η_p
MEQ30 Total				
Yoga Frequency	1,45	1.03	.31	.02
Yoga Experience	1,45	1.88	.18	.04
PANAS Positive				
Yoga Frequency	1,45	.63	.43	.01
Yoga Experience	1,45	.29	.59	.01
PANAS Negative				
Yoga Frequency	1,45	.27	.61	.01
Yoga Experience	1,45	.84	.84	.00
SMS Total				
Yoga Frequency	1,45	.92	.34	.02
Yoga Experience	1,45	2.16	.15	.05

Trait Mindfulness

Repeated measures ANOVA were conducted on the primary outcome variables separately (MEQ30 Total Score, PANAS Positive Total Score, PANAS Negative Total Score, and State Mindfulness Total Score) with condition as the within-subjects variable and participant trait mindfulness (FFMQ total score) as the respective between-subjects factors. A median split was

conducted to divide participants into low and high trait mindfulness. A second analysis was conducted utilizing the FFMQ total score as continuous data. A Pearson bivariate correlation was conducted to examine the relationship between FFMQ total score and the individual participants' difference scores on the primary outcome measures between conditions.

There was no interaction between trait mindfulness and mysticality of experience by condition ($F(1,44) = .49, p = .49, \eta_p^2 = .01$). Trait mindfulness was not related to participant difference scores on mysticality of experience ($r(46) = .15, p = .16$).

There was no interaction between trait mindfulness and positive affect ($F(1,44) = .01, p = .93, \eta_p^2 = .00$) or negative affect ($F(1,44) = .64, p = .43, \eta_p^2 = .02$) by condition. Trait mindfulness was not related to participant difference scores on positive affect ($r(46) = -.05, p = .38$) or negative affect ($r(46) = -.20, p = .10$).

There was no interaction between trait mindfulness and state mindfulness by condition ($F(1,44) = .19, p = .66, \eta_p^2 = .00$). Trait mindfulness was not related to participant difference scores on state mindfulness ($r(46) = .10, p = .25$).

Chapter 4: Discussion

4.1 Discussion of Study Results

Well-Being Outcomes

The prevalence of cannabis use is high in North America, and there is increasing discussion around the therapeutic use of cannabis to enhance well-being and address mental health concerns. However, literature and anecdotal reports on the results of cannabis use in this context are equivocal, and both positive and negative mental health results are reported. This study aimed to contribute to the discussion by examining the impact of contextual factors, i.e., set and setting, on well-being outcomes following cannabis use.

The first well-being outcome examined was mysticity of experience. Mysticality of experience is associated with long-lasting positive impacts of psychoactive drug use. Mystical experiences are a common component of spiritual traditions, and previous research has demonstrated that the use of psychoactive drugs with entheogenic properties frequently produce mystical effects, the degree and presence of which are associated with persisting increases in well-being and life satisfaction (Griffiths et al 2006, 2008, 2011). The results of the current study indicated that participating in a mindful movement practice after consuming cannabis amplified all dimensions of mysticality of the experience with large effect sizes. This aligns with previous research indicating that in the use of psychedelics, set and setting has a significant impact on mysticality of experience (Gandy, 2022). Cannabis is not traditionally considered a classic psychedelic drug and exerts its effects through the endocannabinoid system rather than the serotonergic system. However, it is a psychoactive drug that shares common features of psychedelic drug experiences including mystical features. This finding highlights another similarity, in that mystical features display sensitivity to contextual factors including mindset and

activities, as induced by a yoga practice. As mysticality of experience is associated with enduring positive effects on their own and while using other psychoactive drugs (Ko et al., 2022), the increase in mysticality introduces the potential to increase the longevity of positive mental health and well-being outcomes. As such, engaging in mindful movement while experiencing cannabis effects may maximize the long-term therapeutic benefits of cannabis use.

The second well-being outcome examined was state mindfulness. The results of the current study indicated that participants experienced higher state mindfulness during the yoga condition compared to the control condition with large effect sizes. Yoga is considered a mindful movement practice, and there is a significant body of research indicating that practicing yoga acutely increases mindfulness (Cox et al., 2016; Riley & Park, 2015; Shelov et al., 2009). While many practitioners anecdotally indicate increased mindfulness as a motivation for consuming cannabis, others purport that cannabis interferes with the ability to be present and benefit from yoga (Thompson, 2018). This study is the first to demonstrate that the relationship between yoga and increased mindfulness remains while participants are under the influence of cannabis. This suggests that if cannabis users are using cannabis for the purpose of increasing mindfulness, greater results may be achieved by pairing cannabis with a mindful movement practice, rather than with typical activities of daily living. Insofar as increased mindfulness contributes to positive outcomes of cannabis use, the activities conducted while acutely under the influence of cannabis stand to impact the therapeutic outcome.

The second well-being outcome examined was state affect. State affect was not impacted by condition in this study. The PANAS was used to examine both positive and negative affect immediately following each condition. In both conditions, positive and negative affect appeared to be in a similar range from the mean of normative data for the PANAS (Crawford & Henry,

2004). This may be an artifact of the participants' broad choice of activities which included those that are typically considered both enjoyable (socializing, hobbies) and unenjoyable (cleaning, chores), obscuring a directional effect on state affect. While yoga on its own has demonstrated a positive impact on affect, this has previously been identified through comparing pre- and post-yoga scores, or looking at the long-term effects of regularly practicing yoga, rather than state affect during yoga (Shortway et al., 2018; Szabo et al., 2017). Participants in this study were asked to retrospectively report state affect over the past forty-five minutes, rather than taking a measure of affect following the yoga practice. Insofar as yoga's purpose is to "*calm the fluctuations of the mind*" and induce neither positive nor negative mental states during practice, it may be that any change in mental state is remote to the practice itself, and is better detected by measuring cumulative effects over time or measuring affect following the practice, rather than during.

Cannabis users report having their own guidelines such as "comfort rules" and "setting rules" to optimize enjoyment of the experience (Skliamis et al., 2021). Managing mood is a frequently reported motive for cannabis use, and it may be that as experienced cannabis users, participants were already purposefully pairing cannabis with activities in a way to manage their mental state in a way that did not significantly differ from the effects of combining cannabis and yoga. Indeed, many individuals already report using cannabis with the intent to make boring or unenjoyable tasks more pleasant and interesting (Benschop et al., 2015). This may reflect that the impact of cannabis on mood state is relatively more independent from activities, and may be more accounted for by direct drug effects and less sensitive to set and setting.

Participant Characteristics

This study did a preliminary exploration of participant characteristics including baseline mental health, trait mindfulness, and yoga experience to explore for whom a mindful yoga

intervention during cannabis use may be most effective. Baseline mental health did not have a statistically significant effect on outcomes. The sample was drawn from the general population and as such did not represent a clinical sample, however many participants reported at least mild symptoms of anxiety (46.7%), stress (44.4%) and depression (36.2%). The results of this study indicated that participants within the normal range benefitted similarly to those with at least mild symptoms of anxiety, depression, and stress. Most symptomatic individuals were in the mild range, so the results of this study are generalizable to individuals with mild mental health symptoms and differences may become evident if a clinical population was sampled.

While both low and high baseline anxiety participants demonstrated higher state mindfulness during the yoga intervention, those with lower baseline anxiety demonstrated greater state mindfulness in the yoga condition and a bigger difference in state mindfulness between conditions. This may reflect that individuals with higher anxiety might exercise more avoidance of internal bodily sensations and emotions, particularly if they tend to be more sensitive to such stimuli (Britton, 2019). Future studies drawing from a clinical sample and with a larger sample size may be better suited to elucidate the relationship between participant anxiety and well-being outcomes.

Yoga experience or practice frequency did not impact any outcomes. Previous research indicates that benefits from a meditation practice such as increased mindfulness is not associated with a history of practice but rather with continued practice in the present (Bergomi et al., 2015). The results of the current study may indicate that the same is true when combining cannabis with yoga, and individuals can benefit regardless of their history and experience with yoga. Trait mindfulness did not affect outcomes, suggesting that participants may benefit despite baseline levels of mindfulness in their daily life.

Acceptability of Intervention

The yoga practice was well-accepted by participants, as the majority stated that they enjoyed the practice, intend to do it again on their own, and would recommend it to a friend. This is congruent with the traditionally high degree of acceptance of yoga-based interventions in various populations (Ahmadi et al., 2022; Bakshi et al., 2021; Combs & Thorn, 2014; Sheffield & Woods-Giscombé, 2016). In addition, individuals in previous studies typically report high acceptability of savoring interventions for cannabis use (Mian & Earleywine, 2022). A Ganja Yoga practice (Dussault, 2017) contains elements of savoring, that is, mindfully focusing on positive aspects of the experience, which may contribute to the high acceptability of this activity.

Participants who reported that they planned to practice yoga while using cannabis again were asked to describe their motives for repeating the practice in the future. Increased physical and mental awareness, relaxation, positive mental/emotional/physical experience, spiritual or self-growth reasons, and enhancement of the yoga practice were reported as motives. The reported motives primarily relate to expansion and enhancement motives, both of which are associated with more positive outcomes (Bresin & Mekawi, 2019; Simons et al., 1998). Of note, all responses to the open-ended query consisted of approach motives rather than avoidance motives, which suggests the practice may align well with positive mental health strategies.

Most participants (88.6%) reported that they enjoyed the practice. While some mystical experiences induced by psychoactive drugs can result in challenging and unpleasant experiences, the combination of cannabis and yoga may provide access to mystical features of an experience with a decreased chance of experiencing the ego dissolution which is associated with the potential for “bad trips” with the use of psychedelics (Gashi et al., 2021). In the current study, participants were instructed to contact the research assistant who was on standby throughout the yoga practice

(or activity condition) should any adverse experiences occur. No participants contacted the research assistant to report an adverse experience during this study. While adverse experiences were not formally queried beyond this protocol, this suggests that the activity may be relatively more innocuous and manageable as a home practice compared to psychedelic experiences while still providing mystical benefits.

4.2 Limitations

The scope of this study explored outcomes in regular cannabis users, and as such the results may generalize to those who are already using cannabis regularly, rather than naïve users. Tolerance to some acute effects of cannabis, particularly cognitive effects, develops quite rapidly in regular users (Colizzi & Bhattacharyya, 2018; Ramaekers et al., 2020), and as such they may be in a better position to engage with and benefit from the yoga practice. Clinical measures of cannabis misuse were not included in this study, and the prevalence of cannabis use disorder in this sample is unknown. While yoga interventions have previously demonstrated positive effects on cannabis use disorder (Petker et al., 2021), this study is limited to the general population.

While the study demonstrated positive results and high acceptability of the intervention, invited participants self-selected into the study. It is possible that participants who would not enjoy or benefit from a yoga intervention chose not to participate after viewing the study ad. Much like studies of cannabis use, studies of yoga practice outcomes demonstrate mixed results. Yoga practices can benefit practitioners insofar as they are reversing deficiencies in bodily and emotional awareness and regulation, but can become iatrogenic when increasing these qualities to excess, resulting in anxiety, emotional blunting, and negative attention biases (Britton, 2019). However, similar to cannabis, individuals who do not tolerate yoga well tend to self-select out of the activity. The results of this study are generalizable to regular cannabis users who are interested in and opting

in to a yoga practice. However, it is noteworthy that most participants in the study did not have significant experience with yoga, as such individuals need not be experienced yogis to benefit from this practice. Acceptability was only measured retrospectively, as such the participants' willingness to select into the yoga activity if it were offered to them was not explored in this study.

Naturalistic Setting

Many cannabis use studies have taken place in an artificial lab environment. These environments have been shown to activate stereotype threats, increase the perception of stigma, and otherwise alter the effects of cannabis ingestion such that results of these studies may result in artefact. By utilizing the NCAP protocol so that participants are able to consume their own cannabis in a familiar environment, some of the negative effects of cannabis ingestion as observed in the lab are ameliorated (St. Pierre, 2022). Indeed, cannabis users typically report choosing to consume cannabis in private and safe environments (Skliamis et al., 2021), and as such the current study likely demonstrates ecological validity regarding when and where participants are typically consuming cannabis.

While the NCAP allows for excellent naturalistic validity, it introduces some limitations compared to a lab-based study. Research participants relied on self-report to verify the quantity of cannabis consumed and level of high, and selected their own cannabis strain which may have differed between appointments. However, cannabis users have demonstrated a strong ability to self-titrate to the desired level of impairment regardless of cannabis product (Marcotte et al., 2022). Given this approach, the results of this study are generalizable to individuals who are selecting their own strain and dose of cannabis, rather than consuming a dictated amount. In addition, self-report is necessary to measure subjective features of an individual's experience, as such this study shares the common limitations of other self-report based studies. Repeated measures studies are

sensitive to practice and familiarity effects, however in this study the appointment order was counterbalanced in order to mitigate these effects, and there was no evidence of an association between the order of conditions and any variables of interest.

4.3 Implications and Future Directions

Based on the outcomes of this study, further investigation to delineate the relationships between contextual factors surrounding cannabis use and well-being outcomes should be pursued. This study utilized a yoga practice as the activity. While acceptability of the intervention was high, the sample consisted of individuals who opted in to participate in the study knowing that it involved a yoga practice. While yoga-based interventions typically demonstrate high acceptability, there are likely many other activities that could potentially hold similar benefits. Future studies could explore alternate activities involving movement, mindfulness, or both for their potential therapeutic benefit, such as mindful walking outside, time in nature, exercise, or mindful creativity. Gathering data on other such activities can support cannabis users to make informed choices from a menu of options and find the set and setting that best fits their lifestyle, interests, and therapeutic intentions.

While one can practice mindfulness while doing any activity, yoga belongs to a group of practices often referred to as mindful movement, which intrinsically combine mindfulness and physical activity. Future research could also explore mindfulness and physical activity on their own, to delineate the unique contributions of each individual component to the overall effects observed in this study.

Healthcare practitioners including physicians, physicians-in-training, and nurse practitioners have identified a need for more education regarding therapeutic cannabis use for their patients to maximize benefits and minimize harms. Behavioural prescriptions are gaining

popularity with physicians, as an uptick in prescribing yoga or time spent in nature has been observed. Prescriptions for behavioural change, such as New Zealand's Green Prescription Program for prescribed physical activity, are typically well-received by both physicians and patients (Patel et al., 2011). When physicians are prescribing cannabis for therapeutic purposes, they may consider a behavioural prescription in conjunction with the pharmaceutical prescription. Future studies could explore whether information about providing a behavioural prescription alongside a prescription for cannabis would help to fill the identified gap in training. In addition, the interest and willingness of physicians to provide such a behavioural prescription should be assessed. This study examined retrospective acceptability of the activity by the end-user. To inform the utility of a behavioural prescription, future studies could also measure prospective acceptability to determine the interest and willingness of cannabis users to participate in the activity if it were suggested by a healthcare provider.

The current study compared regular cannabis users across two different behavioural conditions, yoga and non-yoga activities, while acutely using cannabis. The purpose of this study was to provide information for regular cannabis users about the effects of cannabis with and without yoga. This study was not designed to test the same outcomes following yoga with and without cannabis. This addresses a different but related question; if yoga practitioners can maximize the desired benefits of their practice by adding cannabis. Survey-based research has found that some yoga practitioners report adding cannabis to yoga to enhance connection to their body, enhance physical and mental relaxation, and to treat pain and physical and mental health conditions (Thomas et al., 2023). A design similar to the current study comparing yoga with and without cannabis could help identify if adding cannabis to yoga does further yogis in meeting these goals.

This exploratory study was limited to acute state outcome measures following a single practice. No impact on state affect during the conditions was found. Future studies should also measure any impact on affect following the practice, rather than solely retrospective state affect. Measuring affect later in the day after the practice may identify any impact on mood during the individual's daily activities following the practice, rather than during the practice. Next steps could also examine long-term results of a regular practice repeated over time. A longitudinal design evaluating the impact of a program of regular yoga practices over several weeks or months may be beneficial. Variation in program design could assess the frequency and quantity of cannabis-enhanced yoga practices which maximize long-term improvements in well-being. In addition, long-term follow-ups should be conducted to assess the longevity of effects following the cessation of the program.

4.4 Conclusion

The results of this study generally indicate that what you do while you experience cannabis effects matters. Specifically, engaging in a yoga practice while under the acute effects of cannabis may promote well-being outcomes, including outcomes that predict long-term positive change such as mysticality of experience and state mindfulness. These findings hold implications for how cannabis is used with therapeutic intent, a pertinent query given the high levels of use to address mental health symptoms. Many therapeutic cannabis users endorse using cannabis to treat mental health conditions, most often depression and anxiety, but the efficacy of cannabis to treat these conditions produces equivocal results. Mirroring psychedelics, this study supports the concept that set and setting during cannabis use may significantly impact the therapeutic benefit of the drug. For the end user, increased awareness of the impact of contextual factors related to cannabis use

may equip cannabis users to make informed decisions regarding behavioural elements of their cannabis use in order to maximize well-being and positive mental health outcomes.

Physicians have long described a knowledge gap pertaining to best practices when prescribing cannabis for therapeutic purposes. The results of this study may inform physician's best practices in terms of prescribing, by highlighting the potential benefit of a behavioural prescription adjunctive to the pharmaceutical prescription. Providing specific behavioural directions as well as psychoeducation on the role of set and setting may stand to maximize benefits and minimize harms of therapeutic cannabis use. Based on the high degree of acceptability of the yoga intervention, yoga or similar mindful movement may be a useful recommendation.

A typical trend in the pharmaceutical field when developing medications based off of traditional psychoactive plant medicines (i.e., cannabis, psychedelics) is to seek to remove the psychoactive effects. The focus is often on a biological mechanism while the "high" is seen as an undesired side effect (Hesselgrave et al., 2021). The results of the current study provide more evidence to support the intrinsic therapeutic value found in the altered states of consciousness occasioned by such psychoactive drugs. Indeed, enhancing the psychoactive effects through mindful movement may actually be a therapeutic goal, as alterations to awareness and the senses were identified as factors related to improved long-term well-being outcomes. The changes in cognition that accompany the cannabis high may play an important role in the benefits experienced by the user.

In summary, factors influencing the effects of cannabis use extend beyond the pharmacological features of the plant to the behaviours that an individual engages in while under the acute influence of cannabis. The importance of context cannot be ignored, and the addition of

mindful movement to cannabis use should continue to be examined for its potential clinical relevance in order to maximize the therapeutic effects of cannabis.

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Appendices

Appendix A

Naturalistic Cannabis Administration Protocol (NCAP)

Roles and Responsibilities

Study Coordinator

A study coordinator is recommended to facilitate appointment scheduling, coordinate and assign participants to research assistants, and facilitate recruitment, communication, and payment. The study coordinator may also act as a research assistant or maintain a separate role, depending on the scope of the study.

Research Assistants

Research assistants should be at the graduate student level or higher with clinical research experience and a strong ability to establish rapport. To reduce the white-coat effect and stigma activation, research assistants should be demographically similar to participants, i.e., in a study of undergraduate psychology students, research assistants were peer-appearing graduate students in Clinical Psychology. Further, the title Research Assistant is used in communication with participants rather than a more formal title. As session times correspond with the time of day when participants typically use cannabis, the research assistants will typically need to provide availability in the evenings. The number of research assistants required depends on the scope of the study and pace of data collection.

Study Sites

Participants and research assistants join the video conference from their home environment in a distraction-free (e.g., phone on silent) and private space (e.g., no one in the room, closed door).

Participants require a reliable, high-speed internet connection and a computer or other device with a large screen to connect via video conference. If research assistants need to join from a research lab, steps should be taken to de-medicalize the visible environment and create a homey atmosphere.

Recruitment

Participants are invited to participate via email. A study description along with the eligibility criteria and a copy of the consent form are included in the email. If participants express interest in participating, their first appointment is booked with a research assistant.

Retention

In the pilot study, the participants attended two appointments one month apart. To reduce attrition and absenteeism, email confirmation is sent at the time of booking and email reminders are sent the day before each session. In addition, the following options may increase participant retention when feasible:

- Collecting phone numbers for reminders and contacting absentees at scheduled appointment time
- Shorter intervals between appointments
- Paying participants at the end of the second appointment
- The session is scheduled during the time of day (i.e., morning, afternoon, evening) when the participant “usually consumes cannabis.”

The participant is emailed the day before their session and reminded to refrain from using cannabis during the day (i.e., from waking up) prior to their appointment time. They are provided the consent form prior to their appointment so that they can provide verbal consent during the video session.

Log-on information is provided in the email.

A step-by-step description of the session is also provided and included the following instructions:

- Prepare your cannabis (e.g., joint rolled, pipe packed) prior to the session.
- Join the call from your home environment in a distraction-free (e.g., phone on silent) and private space (e.g., no one in the room, closed door).
- The quantity of cannabis consumed during the study should be the same as a typical use session as defined by you, in other words “get as high as you would normally get.”

The study is described, and verbal consent is obtained prior to the consumption of cannabis.

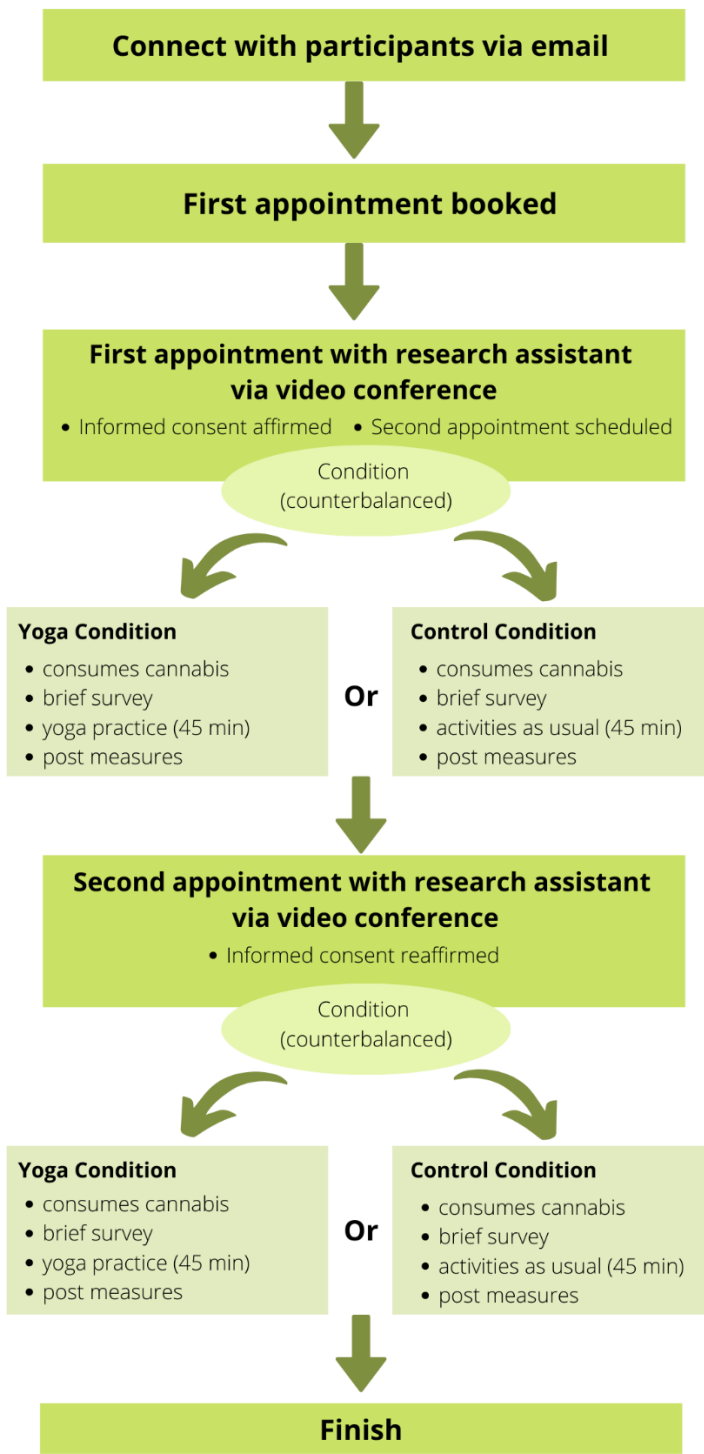
If it is the participant’s first session, their second appointment is scheduled prior to beginning the study to ensure they are able to return for a second time point. The web cameras are turned off during cannabis self-administration via inhalation and a 5-minute timer is shared onscreen.

Once the time has elapsed, web cameras are turned back on and a brief cannabis use interview is conducted. Participants are asked about their current subjective level of intoxication (i.e., “How high are you compared to when you usually get high?”). A brief survey is administered to record data on the quantity of cannabis consumed, inhalation method used (e.g., vaporizer, bong, joint), chemovar familiarity and access, and whether they know the common name of the chemovar (e.g., purple kush). The research assistant proceeds with the research condition (e.g., administers the test battery) approximately 5 minutes following cannabis use.

A within-subjects design is recommended to help control for individual differences. The appointments should be counterbalanced (cannabis use during first session vs. cannabis use during second session). If using cognitive tests, an alternative form should be utilized for the second time point as appropriate. Both appointments, should be scheduled for the same time of day to account for diurnal effects (i.e., morning, afternoon, or evening).

Appendix B

Current Study NCAP Study Flow



Appendix C

Cannabis-Enhanced Yoga Practice

Supplies

For this practice, participants were instructed to have on hand a folded blanket and something to use as a yoga strap (e.g., a necktie, belt, scarf, etc.). The use of a yoga mat was encouraged if they had one, however it was not necessary. The practice was pre-recorded and accessible on YouTube, so a device to watch the video on was necessary. Participants were instructed to have a quiet and private space with room to move around. The video was recorded with ambient music playing in the background.

Approach

Through the practice, verbal cues are utilized to highlight and encourage the following points:

1. While the sequence is designed to be accessible for most bodies and all abilities, participants should always listen to their own bodies and adapt the sequence as necessary to avoid pain. An attitude of exploration and nonjudgement is cultivated. Options and alternatives are provided throughout the practice to support participants in choosing the movement that best suits their own body in the moment.
2. Cues focus on encouraging mindful presence to the sensations, thoughts, and emotions throughout the practice.
3. Breathing deeply, slowly, and comfortably, and a connection to moving with the breath is encouraged throughout the practice.

Sequence

The following yoga asana sequence is instructed at a slow and comfortable pace, taking 45 minutes from start to finish. The timing on the sequence below adds up to 40 minutes, the remaining 5 minutes are comprised by the slow, mindful transitions between sections.

Section	Time
<p>Opening</p> <p><i>Arrival and Introduction</i></p> <p><i>Mindful Seated Deep Belly Breathing</i></p>	<p>Five Minutes</p>
<p>Seated Warm-Up</p> <p><i>Shoulder Rolls</i></p> <p><i>Deep Breathing with Overhead Arm Circles (Seated Sun Breaths)</i></p> <p><i>Side Bends with Arm Overhead</i></p> <p><i>Spinal Twists</i></p> <p><i>Forward Bend</i></p>	<p>Five Minutes</p>
<p>Supine Sequence</p> <p><i>Transition to supine position, laying on back with knees bent</i></p> <p><i>Knees to Chest (hold)</i></p> <p><i>Supine Knee Circles</i></p> <p><i>Supportive Core Activation: from knees to chest position tap toes to floor)</i></p> <p><i>Supine Arm Circles: slowly trace a circle on the floor with your fingertips utilizing your full range of motion (i.e., rolling to the side to extend the full circumference of the circle). Repeat on both sides</i></p>	<p>Fifteen Minutes</p>

<p><i>Supine Leg Circles: From a reclined position, grip the ends of a strap in one hand, loop the strap around one foot, and extend the heel towards the ceiling. Proceed through small and large circles with the leg. Repeat on both sides</i></p> <p><i>Rest and Reconnect: deep belly breathing in supine position with a mindful focus</i></p>	
<p>Tabletop Sequence</p> <p><i>Transition to a tabletop position with hands and knees planted on the ground</i></p> <p><i>Cat Cow (encourage other free movement throughout the spine)</i></p> <p><i>Supportive Core Engagement: tuck the toes, lift knees slightly from the ground and feel the full supportive core engaged</i></p> <p><i>Downward Dog</i></p> <p><i>Walk the Dog: bend through one knee at a time from downward dog position</i></p>	Five Minutes
<p>Prone Sequence</p> <p><i>Transition to lay on the belly, face down with the hands creating a pillow to rest the forehead on</i></p> <p><i>Dancing Cobra: walk the hands to the front two corners of the mat and tent the fingers. Inhale up into baby cobra, exhale to lower right shoulder and right cheek to the mat, keeping the elbows tented. Inhale back up through center, exhale to lower the left shoulder and left cheek to the mat, elbows tented. Inhale back up through center, and continue to alternate sides with the breath</i></p> <p><i>Half Frog: Remain in a prone position and extend the arms to the side. Rest the left cheek to the mat. Bend through the right knee, drawing it out to the side at a 90-degree angle. Hold for several breaths. Repeat on the other side</i></p> <p><i>Alligator Breathing: Lay in a prone position, resting the forehead on hands. Breathe deeply, feeling the belly press into the mat with each inhale and feeling an expansion through the lower back</i></p>	Five Minutes

<p>Closing</p> <p><i>Transition to a comfortable position laying on the back. Use blanket to support the posture (i.e., rolled up under the knees to release through the low back) and find comfort.</i></p> <p><i>Savasana with Guided Relaxation</i></p> <p><i>Close Practice: extend gratitude to self and others</i></p>	<p>Five Minutes</p>
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Appendix D

Participant Responses to “What are the reasons why you plan to practice yoga while using cannabis again in the future?”

1. It helps to bring an elevated sense of awareness to your movement
2. It was fun
3. Feels good to stretch when high
4. Both are relaxing - super relaxing when put together
5. I enjoy using cannabis before activities such as this, where I know I'll be busy doing something that doesn't require critical thinking or making decisions. I'd rather do yoga with cannabis than without.
6. It was very relaxing and enhanced my high in a calm way rather than a "party mood" way
7. I feel like it enhanced my experience, as well as helped relieve anxiety and cloudiness.
8. I think if I use it about 30 minutes beforehand I will be more relaxed. Also I'm very stiff and sore as I'm getting to have a yard sale in a couple of days. I think this will inspire me to get back into yoga.
9. Because it was an interesting way to spend your high
10. it made me focus more and was more in touch with my body than normal
11. I find the practice of mindfulness/meditation/yoga very calming and eye opening in general. However, with the added element of Cannabis, I feel more in-tune with my body and more present, which enhances the entire experience.
12. Maybe it's because I have not stretched in a while after I quit dance but feeling those familiar stretches felt amazing, felt very relaxed and enjoyed the 45 minutes I was convinced I was not going to enjoy. 10/10 experience would do it again

13. I feel like it helps me stay in the moment, I get really zoned into the movements and my breath, and then even when I notice my surroundings, I do get slightly distracted for a moment but it doesn't matter as much, I hear my breath the most
14. The sense of calmness and tranquility it helped me achieve
15. The body awareness you gain was shocking. Also, understanding where your areas of pain are, and sensing into those.
16. I plan to use this practice with cannabis in the future for aid in injury recovery. I am currently recovering from shoulder and hip overuse injuries from rock climbing and ski touring and the combination seems to be very beneficial; I also enjoy the heightened awareness and ritualistic element of it; It's has also been my norm to use while practicing yoga. I learned to appreciate yoga with cannabis around 5 years ago.
17. I find cannabis helps my mind relax and my body to flow through the postures
18. Higher body awareness, sensations of higher awareness when stretching, higher sense of mind awareness and awareness of thoughts
19. It promotes deeper relaxation for me and enhances my senses. I feel like I can listen to my body better.
20. For body release and to allow space for new thoughts
21. The feeling of inspiration, the feeling of strengthening mind and body makes me want to practice yoga under the influence of cannabis a few times a week
22. I regularly do stretch exercises as part of sport recovery and shorter mediation practice for sports performance but don't so much mix the two in yoga routines. Adding cannabis made it an enjoyable experience rather than being task oriented.
23. It felt good. Felt connected.

24. Deeper body sensations in the practice - more body awareness
25. Self discovery. Enhanced enlightenment, increase the depth of my practice.
26. I felt like my mind was able to quiet down quite a bit more during the yoga than usual activities, including using cannabis or yoga separately.
27. Made me be able to feel my body at a deeper level and really feel the stretch through some painful areas of my body.
28. Increased feelings of relaxation and enhanced the sensation of stretching the muscles in body
29. I felt much more embodied than normal, a great sense of experiencing all the minor sensations I might otherwise miss. I also felt I was able to have greater control over which muscles I was engaging. I felt as if I was noticing more sensations in the stretches and was curious about them.
30. At the beginning of the session, I felt a little distracted still-thinking about work/life etc., but I noticed a nice deep shift about 15 minutes in where I settled right into the practice, my breath changed, I became MUCH more focused on how things truly felt in my body with each movement. This is first time using cannabis with yoga, and I plan on making this a regular (daily???) ritual. I feel incredible-both physically and mentally/emotionally.
31. It allows me to fully feel the stretching of the muscles and listen to my body and what it needs.
32. I feel like I was able to better pay attention to bodily sensations, and experience peacefulness
33. It's just the bees knees! Cannabis is a remarkable plant ally to pair with yoga.
34. To heal