

Abstracts from the 2020 Virtual Scientific Meeting of the Research Society on Marijuana July 24th, 2020

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Special Section Editor
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KEYNOTE ADDRESS

"Stoned Driving: What We Know and What We Don't Know"

Godfrey Pearlson
Yale University School of Medicine

"Stoned driving" is a topic with important public health implications, given the increasing legalization/decriminalization of recreational marijuana and legalization of medical marijuana in the US, that has led to more drivers being exposed to increasing potencies of THC. The talk covers a series of questions regarding marijuana-impaired driving. Does marijuana impair driving behaviors? If so, which ones, to what extent and for how long, after an acute marijuana dose? Does this driving impairment profile resemble that of alcohol? Is cannabis' impairment of driving related temporarily to dose, or to blood levels of THC or its metabolites? What impairment results when alcohol and cannabis are used in combination? What are the barriers to reliable detection of stoned drivers at the roadside?

POSTER PRESENTATIONS

All poster presentations and symposia were peer-reviewed by the 2020 Conference Program Committee of the Research Society on Marijuana (RSMj) (Bradley T. Conner, Colorado State University, Benjamin O. Ladd, Washington State University Vancouver, Kristina T. Phillips, University of Northern Colorado, Verlin Joseph, University of Florida). All abstracts below were approved and voluntarily submitted for publication in Cannabis by the presenting or contact author.

Marijuana Use among Young Adults: Findings from the 2015-2018 National Survey on Drug Use and Health

Andrew Yockey, Shanna Stryker
(University of Cincinnati)

Marijuana is the most commonly used drug for young adults. A greater understanding of risk factors associated with recent use can inform health prevention messaging. Pooled data from the 2015-2018 National Survey on Drug Use and Health were utilized among 89,446 individuals ages 18-34. Weighted logistic regression analyses, controlling for covariates, were utilized to determine conditional associations to past-30-day use. A sizeable percentage (18.5%) of individuals reported smoking marijuana in the past 30 days. Individuals who identify as African American or Multi-Racial, Gay/Lesbian, Bisexual, reported their health as poor, not covered by health insurance, reported prior drug use, or who had reported any thoughts/plans of suicide were at risk for use. Of concern, high rates of alcohol (14.7%) and cocaine (1.50%) were found among users. We believe our findings can inform harm reduction efforts and policy creation.

Risk and Protective Factors Associated with Cannabis Use in Massachusetts Youth

Julie K. Johnson, Samantha M. Doonan
(Commonwealth of Massachusetts, Cannabis Control Commission)

Cannabis policies are continuously evolving, over half of U.S. youth now live in a state with a form of legalized cannabis. Monitoring risk and protective factors is critical to ensure evidence-based youth prevention in this post cannabis-prohibition era. Massachusetts has enacted and implemented three forms of legalization: (1) Decriminalization (2008), (2) medical cannabis (2012), and (3) adult-use cannabis (2016). This study used state Youth Risk Behavior Survey (YRBS) data of participants in grades 9-12 from 2007-2017 (N=17,691). Logistical regression models were run to assess effects of varying cannabis policy and risk or protective behaviors on cannabis use outcomes: (1) Lifetime use; (2) Past 30-day; and (3) Past 30-day heavy use. The enactment of cannabis policies was not associated with greater odds of youth reporting Lifetime and Past 30-day cannabis use behaviors. Any adult-support [heavy use OR=0.43 (95% CI=0.37,0.50), $p < .001$], better grades [heavy use OR=0.25 (95% CI=0.21,0.29), $p < .001$], and being heterosexual [heavy use OR=0.42 (95% CI=0.34,0.51), $p < .001$] were associated with lower odds of all cannabis use outcomes. Multiple risk factors broadly categorized under: risky sexual behaviors, non-heterosexual orientation, weapon carrying/exposure, hopelessness and suicidality behaviors, driving behaviors, and disability were associated with greater odds of cannabis use. Sensitivity analyses showed only one risk behavior was moderate by cannabis policy enactment. Results suggest that cannabis prevention efforts should not occur in a silo, rather evidence-based models for reducing risky behaviors generally may have the largest impact. Building and supporting relationships with trusted adults for youth at higher risk should be emphasized.

Participation in the Massachusetts Adult-Use Cannabis Industry by Race/Ethnicity and Gender Across Job Titles

Samantha M. Doonan, Julie K. Johnson

(Commonwealth of Massachusetts, Cannabis Control Commission)

States across the U.S. are increasingly legalizing cannabis for recreational purposes (“adult-use”) through licensure of privately-run cannabis establishments. Legalization efforts have partially emerged in response to unequal prohibition enforcement which disproportionately affects Black and Hispanic/Latino communities. However, the extent to which people from communities most affected by prohibition are included in the legal industry is unknown. This study is a preliminary analysis of participation by race/ethnicity and gender across job titles in the Massachusetts adult-use cannabis industry from its inception through April 2020 (18-month time span). Data were extracted from cannabis establishments (i.e., licensed adult-use cannabis businesses that collectively form the cannabis industry in Massachusetts). Agent registration forms are required for board members, directors, executives, managers, employees, and volunteers across all license types (e.g. retail, cultivation, product manufacturing). As of April 2020, there were 4,907 unique agents (volunteers excluded) across 205 cannabis establishment licenses. Among agents, 77% were White, 9% were Hispanic/Latino, and 6% were Black/African American, <3% identified other racial and ethnic groups, and data were missing for approximately 6% of the sample (exceeds 100%, as persons can be included in more than one race/ethnicity). Excluding agents with missing race/ethnicity or gender (n=347) and grouping persons at two-levels: (1) white or not-white identifying, and (2) male or female, we found 53% of agents were white and male, 29% were white and female, 12% were an ethnicity and/or race(s) that did not include white (“non-white”) and male, and 5% were non-white and female. Approximately 8% of agents held senior-level positions (i.e., board members, directors, executives) versus less senior positions (i.e., employees, managers). However, white males held 72% of senior positions, white females held 17%, non-white males held 9%, and non-white females held 1%. This study is subject to limitations, including that persons who identified as white and another race(s) (n=103) are included in white-identifying categories; future work will address this limitation. Further, all data is typically reported by supervisors rather

than self-reported, therefore race/ethnicity and gender are subject to misidentification. Nonetheless, findings suggest that at approximately one and a half years after retail stores opened, participation in the Massachusetts adult-use cannabis industry skews white and male, and this trend is pronounced in senior-level positions.

Average Intoxication as a Proxy for Cannabis Use

Brianna R. Altman, Maha N. Mian, Luna F. Ueno, Mitch Earlywine
(University at Albany, State University of New York)

Assessing cannabis use is challenging due to the lack of standardized doses, differing potencies among products, and the potential for sharing with others. Although legalization of cannabis might give users a better sense of the quantity purchased and THC/CBD composition of products, issues in assessment and measurement can still preclude researchers from understanding use patterns. Given these challenges, the present work examines whether an individual's average level of intoxication after cannabis consumption might serve as a better proxy for cannabis use than quantity of use. Data was aggregated from several studies related to cannabis use and health behaviors and collapsed across common variables ($N = 2,659$, Mean age = 34.08, 61.9% Male, 84.8% Caucasian). Our sample reported using cannabis either six or seven days per week, consuming approximately 1.12 ounces of cannabis per month ($SD = .35$ ounces), attaining an average intoxication of 3.49 on a scale from 0 ("Not at all") to 6 ("Extremely high;" $SD = 1.21$), and experiencing a mild amount of cannabis-induced impairment as measured by the Cannabis-Associated Problems Questionnaire (CAPQ; $M = 8.21$, $SD = 9.08$). In this sample of frequent users, average intoxication levels were significantly related to cannabis problems ($r = .153$, $p < .001$) while quantity per month appeared to be unrelated ($r = .005$, $p = .798$). Using Meng's (1992) procedure for comparing correlated correlation coefficients, these relations were found to significantly differ from each other ($Z = -5.53$, $p < .001$). Our results provide preliminary evidence supporting cannabis-induced intoxication as a better proxy for cannabis use than quantity

consumed. Individuals might more accurately remember their experiences of being high as opposed to recalling how much they consumed over a month's span. Future work should continue to examine relations between intoxication and other indices of cannabis use to confirm and extend our findings.

Cannabis's Link to Schizotypy: Phenomenon, Measurement Bias, or Delusion?

Brianna R. Altman, Maha N. Mian, Luna F. Ueno, Mitch Earlywine
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Links between cannabis use and psychosis continue to generate research and media attention. Cannabis users have outscored non-users on the Schizotypal Personality Questionnaire-Brief (SPQ-B) by a small amount in multiple studies, but previous work on biased items suggests that the groups do not differ if these items are removed. The present study examined links between schizotypal personality, as measured by the SPQ-B, and cannabis use in a large sample recruited from Amazon's MTurk platform. Over 500 participants (72.5%) reported lifetime cannabis exposure, 259 participants (36.7%) reported current cannabis use, and on average, used 3.5 days per week. Users and non-users failed to differ significantly on total SPQ-B scores or any of the three established subscales, with effect sizes all lower than $d = .20$. The null results inspired a re-examination of the SPQ-B's factor structure, which identified a novel 3-factor solution (difficulty opening up to others, hyperawareness, and odd or unusual behavior). Only the "odd or unusual behavior" factor showed cannabis-related differences ($g = .234$), but a differential item functioning test revealed that one item on that subscale showed potential bias against users. Removing this item dropped the group differences to a non-significant $g = 0.149$. These results suggest that links between schizotypy and cannabis require cautious interpretation with careful attention to potential measurement bias. In addition, the Schizotypal Personality Questionnaire-Brief might have an alternative factor structure that could help answer important questions in psychopathology.

Effects of Age and Sex on Primary Method and Form of Cannabis Use

Marika Huffer, Anita Cservenka
(Oregon State University)

While cannabis is the most commonly used illicit substance, few studies have focused on the relationship between sociodemographic factors and primary method or form of cannabis use. The primary aims of this study were to understand the effects of age and sex on primary form (marijuana, concentrates, edibles) and method (joints, blunts, hand pipe, bong, hookah, vaporizer, edibles) of cannabis use. Participants ($n=852$; $n=536$ male) completed an online survey that included the 'Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory' used to collect information on the primary method and form of cannabis use in male and female participants divided into young adults ages 18 to 25 (Y) and adults 26 and older (O). Chi square analysis showed a significant effect of sex for primary method ($\chi^2(1)=122.4$, $p<.001$) and primary form ($\chi^2(1)=24.6$, $p<.001$) of cannabis use. Post hoc comparisons using Bonferroni corrections (adjusted $p=0.002$) showed that males were significantly more likely to report blunts ($M=35\%$; $F=10\%$), while females were significantly more likely to report joints ($F=16\%$; $M=8\%$) and edibles ($F=15\%$; $M=4\%$) as their primary method of cannabis use. Males were also significantly more likely to report marijuana ($M=66\%$; $F=55\%$), while females were significantly more likely to endorse edibles ($F=17\%$; $M=10\%$) as their primary form of cannabis use. Chi square analysis showed a significant effect of age for primary method ($\chi^2(1)=139.9$, $p<.001$) of cannabis use. Young adults were significantly more likely to report using bongs ($Y=19\%$; $O=11\%$), vaporizers ($Y=26\%$; $O=9\%$), and edibles ($Y=12\%$; $O=5\%$), while participants 26 or older were significantly more likely to report using blunts ($O=39\%$; $Y=10\%$) as their primary method of cannabis use. There were no significant differences between age groups for the primary form of cannabis use. Findings from this study suggest there are significant effects of age and sex on primary method and form of cannabis use. Future studies should examine how other sociodemographic factors may affect cannabis use and how method and form of cannabis use affect long-term health outcomes.

The Cannabis Retail Environment for Young Adults in Los Angeles: Which Metrics Matter

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Background: Currently, there is no consensus on how to measure cannabis retailer density. Researchers and policy makers need clear measures to support policies that mitigate unintended harms of legalization. To address this gap, our unique study leverages cannabis retailer location data in Los Angeles County (LA), California, and home addresses from an LA-based cohort of young adults (21-25 years) to develop a series of cannabis retailer density metrics and assess their relationship with cannabis use.

Methods: Drawing from GIS-based measures of alcohol outlet density, we developed a series of cannabis retailer density metrics: proximity, counts within 5- 10- 15-, and 30-minute driving distances, and considered retail licensure. Retailer addresses were compiled by webscraping cannabis registries (e.g. Weedmaps) and conducting field visits (March 2019). Home addresses were geocoded for participants who completed a 2019 survey ($n=1097$). A series of retailer metrics was created for each person. We fit a series of multi-level logistic regression models with a random intercept by census tract (CT) (models adjusted for age, gender, race/ethnicity, college student, and CT median household income) to assess which retailer metrics were associated with any past month cannabis use.

Results: Thirty percent of participants used cannabis in the past month, and 430 retailers were operating in LA in 2019. Thirty-nine percent of participants had a retailer within a mile from home and an average of 14 retailers within a 10-minute drive. Licensed retailers were less prevalent; the nearest licensed retailer was on average 2.4 miles from home. The odds of past month cannabis use significantly increased by 3% ($OR:1.03$, 95% $CI:1.00-1.07$) for every additional licensed retailer within a 10-minute drive in adjusted model; use was also significantly associated with licensed retailers within a 30-

minute drive (OR:1.01, 95% CI:1.00–1.01). Proximity metrics were not significantly associated with past month cannabis use.

Emotion Dysregulation Moderates the Association Between Stress and Problematic Marijuana Use

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Objective. Marijuana is the most widely used illicit substance in the United States and in 2018 alone, an estimated 40.3 million adults reported using marijuana in the past year. This is concerning since growing research suggests that marijuana use is associated with adverse health and life outcomes, such as mental health issues, and cognitive impairment. Thus, determining factors that influence marijuana use-related problems is critical for understanding how to effectively implement prevention, intervention, and treatment efforts. Because research has proposed that emotion dysregulation is a transdiagnostic risk factor for substance use and addiction, the investigation of emotion regulation capabilities in marijuana users is warranted. Furthermore, since prior studies suggest that stress may lead to greater marijuana use-related problems, additional research into how emotion dysregulation may affect these relationships is needed. Thus, the current study examines how emotion dysregulation moderates the association between stress and problematic marijuana use in adults through an online survey.

Methods. 852 adults reporting any lifetime marijuana use completed an online survey through Qualtrics. Participants completed a brief demographic questionnaire and were asked to report their past 30-day use of marijuana, alcohol, nicotine, and illicit substances. To assess past month problematic marijuana use, participants completed the Marijuana Problem Scale (MPS). To assess emotion dysregulation, participants completed the Difficulties in Emotion Regulation Scale (DERS). Participants completed the Perceived Stress Scale (PSS) and the Holmes-Rahe Life Stress Inventory (H-RLSI) to assess past month perceived stress and past year stressful life events, respectively. We investigated the association between scores on the DERS, PSS, and H-RLSI with scores on the MPS. Additionally, we conducted hierarchical multiple linear

regression models to test whether emotion dysregulation, stress, and their interaction predicted problematic marijuana use.

Results. Scores on the DERS ($r = .53, p < .001$), PSS ($r = .13, p < .001$), and H-RLSI ($r = .32, p < .001$) were significantly correlated with scores on the MPS. Additionally, emotion dysregulation ($B = .32, p < .001$), stressful life events ($B = .21, p < .001$), and their interaction ($B = .07, p = .003$) were significant predictors of problematic marijuana use. Finally, emotion dysregulation ($B = .44, p < .001$), perceived stress ($B = -.18, p < .001$), and their interaction ($B = -.06, p = .04$) were significant predictors of problematic marijuana use.

Conclusion. These findings indicate that when examined separately, greater emotion dysregulation, experiencing more stressful life events in the past year, and experiencing more perceived stress in the past month were associated with greater problematic marijuana use in the past month. However, when examining the moderating role of emotion dysregulation, more stressful life events and less perceived stress predicted greater problematic marijuana use, and these associations were stronger at higher levels of emotion dysregulation. Overall, these results suggest that emotion dysregulation and greater stress may be risk factors for developing problematic marijuana use, and could be possible targets for prevention, intervention, and treatment efforts.

What's Pain Got To Do With It?: Young Adults With and Without Chronic Pain Perceive Minimal Risks and Moderate Benefits from Cannabis Use

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Many young adults experience chronic pain and given its wide availability and potential pain reducing properties, young adults may use cannabis to self-medicate for pain. However, little is known about young adult users' perceptions of potential health risks and benefits of cannabis, and whether these perceptions differ by chronic pain status. As a part of a larger study, young adult recreational cannabis users ($N=176$, ages 18-29) who reported using at least once a week completed assessments of use frequency and perceived cannabis-related risks and benefits. The

sample had a high proportion of participants who met criteria for chronic pain (51.1%). The majority of the sample reported using daily or multiple times daily (80.7%) with an average of 2.68 (SD=1.42) sessions per day across administration modes (e.g. smoking, edibles, tinctures). Participants answered questions about their lifetime chances of experiencing five cannabis-related risks (personal harm, negative health outcome, negative mental health outcome, harming someone else, increased pain) and benefits (personal benefit, positive health outcome, positive mental health outcome, benefitting someone else, decreased pain; 1=Very low to 7=Very high). Overall, young adult users perceived their risk to be very low (M=1.62, SD=.73) and 40.3% of the sample had an average risk score (combined across the five risk items) of 1.00, while only one participant reported an average risk above 4.00. In particular, participants reported a low lifetime chance of experiencing personal harm (M=1.51, SD=.90), harming someone else (M=1.20, SD=.58), or experiencing increased pain (M=1.24, SD=.74) due to their cannabis use. In contrast, young adult users perceived somewhat high chances of experiencing benefits related to their cannabis use (M=4.78, SD=1.46). In particular, participants perceived a high chance of experiencing reduced pain (M=5.88, SD=1.55), personal benefit (M=4.84, SD=1.86), and positive mental health outcomes (M=4.82, SD=1.77). There was no difference based on pain status on frequency of use, average daily sessions, or perceived risks, and only one difference in perceived benefits. Participants without chronic pain anticipated more personal benefit from cannabis use (M=5.15, SD=1.74) than those with chronic pain (M=4.53, SD=1.94, $t(171)=2.21$, $p=.03$). Overall, results suggest young adult recreational users perceive very low risks of their cannabis consumption and moderately high benefits, regardless of pain status. Looking at individual areas of potential risk and benefits may yield targets for future health education campaigns. For example, perceptions of low risk/high benefits regarding mental health outcomes may not be accurate for this heavy using sample.

Co-use of Tobacco/Nicotine and Cannabis Among Veterans: A Preliminary Investigation of

Prevalence and Associations with Mental Health Outcomes

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While tobacco and cannabis use rates remain high in the general U.S. population, veterans from the conflicts in Iraq and Afghanistan (i.e., OEF/OIF veterans) are at particularly high risk of high rates of cannabis and tobacco use. Co-use of tobacco/nicotine and cannabis (i.e., using both substances within a specified period of time or combining the drugs within the same device for use) is of growing prevalence in the United States. Tobacco/nicotine and cannabis use is often associated with poor mental health outcomes such as stress, anxiety, and depression. However, little is understood about the prevalence rates of tobacco/nicotine and cannabis co-use among U.S. veterans as well as associations with mental health symptomology. The current study aimed to investigate types of tobacco/nicotine and cannabis co-use among veterans, as well as associations between co-use and mental health outcomes of stress, depression, anxiety, and posttraumatic stress disorder. Participants (N= 1,548) were recruited through social media websites and completed an online survey as part of a larger study. The majority (80%) endorsed tobacco/nicotine and/or cannabis use in the past 30 days. Descriptive analyses were run to assess prevalence of use within the sample. Mean comparisons were conducted to assess differences in past 30-day frequency of use and for mental health outcomes between co-users and single users of either substance. Among the larger sample, 90% endorsed lifetime use of tobacco/nicotine, 23% endorsed lifetime use of cannabis, and 21% endorsed any lifetime co-use of both substances. These participants also endorsed past 30 day use of tobacco/nicotine (77%), cannabis (10%), and co-use (7%). Among the past 30-day cannabis users, 66% reported also using tobacco/nicotine, while 9% of past 30-day tobacco/nicotine users also reported cannabis use. When comparing cannabis-only users to co-users of cannabis and tobacco/nicotine, anxiety symptoms were reported as significantly higher among co-users. Tobacco/nicotine-only users endorsed higher past 30-day frequency of cigarettes and e-cigarettes compared to co-users;

however, co-users endorsed significantly higher levels of stress and symptoms of PTSD, depression, and anxiety compared to tobacco/nicotine-only users. Results suggest that the addition of cannabis use in conjunction with tobacco/nicotine use may be associated with greater mental health symptoms among veterans. Findings have implications for future veteran mental health care and substance use treatment among tobacco/nicotine and cannabis co-users.

**Impulsivity and Childhood Physical Abuse
Predict Past 30-day Cannabis Use Among
Bisexual Women**

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Previous research suggests that bisexual women's rate of cannabis use is 2 to 7 times higher than their heterosexual peers; however, factors contributing to this are unclear. Trait impulsivity (i.e., tendency to act without forethought) and history of childhood physical abuse (CPA) are two risk factors that may be relevant for bisexual women's cannabis use. Specifically, bisexual women indicate high levels of risk-taking and commonly report histories of CPA. While both impulsivity and CPA have been identified as predictors of cannabis use in heterosexual women, research has yet to explore these factors as predictors of cannabis use among bisexual women. Consequently, the present study examined CPA and trait impulsivity as predictors of cannabis use in a sample of bisexual women. It was hypothesized that both trait impulsivity and exposure to CPA would predict greater frequency of cannabis use. Participants were 225 bisexual women aged 22.77 years ($SD = 3.45$) recruited from a southeastern university and community area. Participants completed an online survey including questions about their past 30-day frequency of cannabis use (5-point scale ranging from 0 = never to 4 = daily), CPA using the Child Maltreatment Scale-physical abuse subscale, and impulsivity using the Barratt Impulsiveness Scale-version 11. A majority of the sample reported cannabis use in the past 30 days (60.3%), with 23.2% using once or twice, 12.9% using weekly, 11.2% using almost daily, and 12.9%

using daily. To account for the large number of zero values on the cannabis use score, we tested a Poisson hurdle model to evaluate the effects of CPA and impulsivity on cannabis use. Frequency of cannabis use was modeled first as a binary logistic model (0 versus any use) and then as a truncated regression model for non-zero responses. Results indicated that across all participants, greater impulsivity predicted any cannabis use in the past 30 days ($p = .003$), but CPA did not ($p = .942$). Among participants who reported past 30-day cannabis use only, CPA was associated with increased frequency of cannabis use ($p = .003$), and impulsivity did not predict frequency of cannabis use ($p = .683$). Overall, results indicated that greater trait impulsivity was associated with past 30-day cannabis use, but not frequency of cannabis use. Conversely, greater CPA exposure was not associated with whether one used cannabis in the past 30 days but instead was related to increased frequency of past 30-day cannabis use. Thus, although trait impulsivity may identify cannabis users, CPA may identify sexual minority women who are at risk for increased frequency of cannabis use. Given the potential long-term harms associated with increased cannabis use (e.g., changes in brain morphology, cognitive impairment, and respiratory issues), prevention efforts targeting bisexual women may want to consider impulsivity and CPA.

**Cannabis Use and Sleep: a look at the
Expectations, Outcomes, and the Role of Age.**
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Objectives: Estimate the associations between cannabis use with expectations of cannabis being a sleep aid, subjective sleep outcomes, and the influence of age on these relationships.
Methods: In 152 moderate cannabis users (67% female, mean age = 31.45, $SD = 12.96$, age range = 21-70) we assessed the influence of cannabis use history and behaviors on expectations of cannabis being a sleep aid and subjective sleep outcomes via the Pittsburgh Sleep Quality Index (PSQI). We used moderation analysis to examine the role of age in the relationship between cannabis use and subjective sleep outcomes.

Results: Cannabis use along with more frequent cannabis use were associated with increased expectations that cannabis use improves sleep (all $\beta > 0.03$, $p < 0.04$). Frequency of recent cannabis use and reported average THC or CBD concentration were largely not associated with subjective sleep outcomes. However, endorsing current cannabis use was associated with worse subjective sleep quality ($\beta = 1.34$, $p = 0.02$) and increased frequency of consuming edibles was associated with worse subjective sleep efficiency ($\beta = 0.03$, $p = 0.04$), lower sleep duration ($\beta = 0.03$, $p = 0.01$), and higher global PSQI scores (worse overall sleep) ($\beta = 0.10$, $p = 0.01$). Furthermore, age was determined to have a moderating influence on the relationship between increased concentration of CBD and both better sleep duration and sleep quality (both $p < 0.03$).

Conclusion: Cannabis users have higher expectations of cannabis being a sleep aid, but few associations existed between cannabis use and subjective sleep outcomes with the exceptions of endorsing any cannabis use and frequency of edible use. Additionally, age may be an important moderator of the potential positive influence CBD concentration can have on sleep.

An Examination of Relationships Between Mental Health Symptoms, Marijuana Use Motives, and Marijuana Use Outcomes Among Late Adolescents in Washington State

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Adolescence is a critical period of development which can be affected by the initiation and escalation of marijuana use. Examining risk factors of marijuana misuse among adolescents is a public health priority. Previous research examining depression and anxiety as risk factors for marijuana use among young adults is mixed. Some studies found a positive relationship between mental health symptoms and marijuana use, while other studies have found gender-specific relationships or no relationship at all. Despite this research, little is known regarding mental health symptoms and marijuana use among adolescents. The aims of current analysis were to 1) examine associations between mental health symptoms and marijuana use behavior among adolescents, and 2) examine coping motives as a moderator of the relationship

between mental health symptoms and marijuana outcomes. The current study included 170 late adolescents (15-18 years old, Mage = 16.86, SDage = 0.94, 50% female) recruited from Washington State. The sample was stratified by gender and marijuana use such that participants ranged from never using marijuana to reporting heavy, regular marijuana use. Participants were asked to complete three online assessments over the course of six months. Data described here come from the first online assessment. This included a 4-item measure of mental health symptoms (depression and anxiety) in the past 2 weeks, in addition to measures of marijuana use, marijuana-related consequences, and marijuana use motives. A series of initial linear regression models that controlled for age and sex found that mental health symptoms were not significantly associated with typical marijuana use ($p > .05$) but were significantly positively associated with marijuana-related consequences ($\beta = 0.33$, $p < .001$). Additional models that also included coping motives found that stronger endorsement of using marijuana to cope with negative affect was associated with more hours high in a typical week ($\beta = 0.25$, $p < .05$) and more marijuana-related consequences ($\beta = 0.24$, $p < .05$). There were no significant interactions between coping motives and mental health symptoms in predicting either marijuana use or consequences ($ps > .05$). The findings suggest that adolescents who report more mental health symptoms do not necessarily use more marijuana than those who report fewer symptoms, but may be at greater risk for experiencing negative consequences as a result of their usage. Additionally, the results suggest a stronger endorsement of using marijuana to cope with negative affect is related to greater marijuana use and risk for experiencing negative consequences. No evidence of moderation was found suggesting the relationships between mental health symptoms and marijuana use outcomes do not vary as a function of coping motives. Screening during adolescence for early signs of mental health symptoms to predict risk may be beneficial towards preventing negative outcomes and providing early interventions for marijuana misuse.

Marijuana Use Grid: A Brief, Comprehensive Measure of Marijuana Use

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 Marijuana Outcomes Study Team
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The present study introduces a brief, yet comprehensive retrospective self-report measure of frequency and quantity of marijuana use: the Marijuana Use Grid (MUG). Using two large samples of college student marijuana users recruited from several universities throughout the United States, we characterized how various indicators of marijuana use frequency and quantity relate to consequences and symptoms of cannabis use disorder (CUD), and whether marijuana use frequency and quantity as assessed by the MUG predict outcomes above and beyond the effect(s) of a simple measure of marijuana use frequency. Typical frequency and quantity estimates from the MUG interacted to predict marijuana-related outcomes. The MUG has shown utility in its association with important outcomes and given its brief nature, the MUG can easily be integrated in future marijuana studies. Additional work is needed to examine the predictive utility of the MUG in the context of other marijuana-related assessments.

**Cannabis Protective Behavioral Strategies:
 Moderating the Effects of Antecedents on
 Consequences?**

Alexander J. Win, Dylan K. Richards, Matthew R. Pearson
 (University of New Mexico)
 Protective Strategies Study Team

The purpose of the present study was to replicate and extend tests of interaction effects between cannabis protective behavioral strategies use and a wide range of risk/protective factors for cannabis-related consequences. We recruited 2,226 college students (Mage = 20.28, SD = 3.37; 68.8% female; 75.4% white) from 10 universities throughout the U.S. who reported using cannabis in the past month to complete an online survey. Measures included in the survey assessed cannabis use, cannabis-related consequences, cannabis protective behavioral strategies use, and 35 risk/protective factors (including socio-demographic characteristics [e.g., biological sex]). Cannabis protective behavioral strategies use was negatively correlated with cannabis-related consequences while controlling for the

risk/protective factors. Most importantly, 33% and 54% of the interaction effects tested were statistically significant, depending on the covariates entered into the model. The interaction effects had a consistent pattern such that the positive association between greater risk and cannabis-related consequences was weaker as cannabis protective behavioral strategies use increased. These findings suggest that none of these interaction effects are particularly specific for any given risk/protective factor. We draw parallels to research on alcohol protective behavioral strategies and offer suggestions for moving the cannabis protective behavioral strategies field forward.

**Self-Reported Symptoms of Cannabis Use
 Disorder (SRSCUD): Psychometric Testing and
 Validation**

Melissa Sotelo, Dylan K. Richards, Matthew R. Pearson
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Findings from national surveys demonstrate that cannabis use peaks in young adulthood and that the annual prevalence of marijuana use among young adults (34.0%) is the highest it has been in decades (Johnston et al., 2016). We developed a 13 item measure designed to characterize the 11 symptoms of CUD as described in the DSM 5 (APA, 2013). To evaluate the performance of this Self Reported Symptoms of Cannabis Use Disorder (SRSCUD) measure, we examined its associations with other measures of CUD symptoms, negative cannabis related consequences, and other known risk factors for CUD (i.e., coping motives). Colleges students (n = 7000) recruited from 9 universities in 9 states throughout the U.S. Our analyses focus on past month cannabis users (n = 2077). We split our sample in half to conduct exploratory factor analysis (EFA, n = 1011) and confirmatory factor analysis (CFA, n = 1012). All items loaded saliently on a single factor of CUD symptoms in both EFA (.553 = λ = 805) and CFA models (.524 = λ = 830) (see Table 1). In our final model, we allowed correlated errors between the two indicators of tolerance (items 10 and 11) and the two indicators of withdrawal (items 12 and 13), and obtained acceptable model fit across most indices: CFI = .941, TLI = .927, RMSEA = .059,

SRMR = .042. As shown in Table 2, the total score of the SRSCUD was strongly correlated with other CUD symptoms measures (.617 < r s < .697), demonstrating convergent validity. SRSCUD was moderately positively correlated with a well known risk factor for CUD (coping motives) and moderately negative correlated with a well known protective (cannabis protective behavioral strategies). We conducted receiver operator characteristic (ROC) curve analyses to identify well how our continuous measure of CUD symptoms could identify individuals who exceed the cutoffs for probable CUD on these other symptom measures. For the most well validated measure (CUDIT R), we had excellent sensitivity/specificity (mean score of 1.5 on SRSCUD) for predicting probable CUD. Although more research evaluating performance of the SRSCUD compared to a clinical diagnosis is needed, we have preliminary evidence for construct validity of this measure.

Changes in Late Adolescent Marijuana Use During the COVID-19 Outbreak Vary as a Function of Typical Use

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Adolescent marijuana use is a significant public health concern given that many individuals first begin using during this developmental period and an earlier age of onset is prospectively associated with numerous marijuana misuse outcomes. The outbreak of COVID-19 has resulted in stay-at-home orders and social distancing guidelines across the United States. For many adolescents, these orders resulted in a number of changes that could alter one's marijuana use including changes to marijuana availability, parental supervision, amount of free time, and stress levels. Despite these possible changes, the impacts of the COVID-19 outbreak on adolescent marijuana use are unknown. The aims of this analysis were to 1) assess changes to marijuana use among late adolescents related to the COVID-19 outbreak, and 2) examine whether these changes vary as a function of one's pre-COVID-19 levels of use. Data described here come from a screening survey for a larger study which was completed by 156 adolescents (ages 14-18, 78% male) after the stay-at-home order was put in place in Washington state on March 23rd, 2020. All participants

completed a self-report questionnaire that included demographic information, marijuana use, and changes to marijuana use following the state's stay-at-home order. In the sample, 55 participants described themselves as never having tried marijuana, and none of these participants reported having used during the COVID-19 outbreak. Of the 101 participants who reported any prior marijuana use, 44 reported stopping or decreasing their use as a result of COVID-19, 30 reported using similar amounts as before, and 27 reported increased marijuana use as a result of COVID-19. A chi-square test of independence revealed that changes in use significantly varied as a function of pre-COVID-19 levels of use, $\chi^2(2, N = 98) = 29.79, p < .001$. The odds of irregular and light marijuana users decreasing their use was 13.73 times higher than moderate and heavy users. Moderate and heavy users had higher odds of maintaining their current use (5.04 times higher) and increasing their use (3.07 times higher) compared to irregular and light users during the COVID-19 outbreak. Primary reasons given for decreasing use included decreased availability and less socialization. Primary reasons for increasing use included more free time, fewer responsibilities, and coping with stress and anxiety. The findings suggest that although marijuana use may appear to decrease on average across a range of late adolescents that vary according to their regular use, these decreases are not likely among moderate and heavy users who may actually be at increased risk of marijuana misuse during the COVID-19 outbreak.

COVID-19's impact on cannabis use: Can we trust retrospective cross-sectional data?

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Background: Emergent research suggests there has been an increase in cannabis use levels during the COVID-19 pandemic; however, several gaps remain. It is unclear what impact the pandemic has had on the frequency vs. quantity of cannabis use. Additionally, research has not focused on emerging adults, a population often more likely to use cannabis. Moreover, as existing studies are cross-sectional and retrospective, it is not clear whether participant reports of increasing

cannabis use during COVID-19 are accurate. We sought to fill these gaps to provide further information about the impact of COVID-19 on cannabis use and the accuracy of related retrospective self-reports. **Design and Methods:** Seventy emerging adults in an ongoing longitudinal study on alcohol and cannabis users completed surveys on COVID-19 and substance use between March 23rd-June 5th. Their substance use four months earlier was extracted from the existing dataset. **Results:** 54% of participants reported an increase in cannabis use frequency during the pandemic, while 39% reported an increase in cannabis quantity. An examination of objective change scores indicated 50% of participants actually increased their cannabis use frequency during the pandemic, while 32% actually increased their cannabis quantity. A comparison of retrospective subjective change with longitudinal objective change scores indicated participants were relatively accurate in their retrospective reports of change in cannabis use frequency but were relatively inaccurate in their retrospective reports of change in cannabis use quantity. **Discussion:** The COVID-19 pandemic appears to increase cannabis use frequency in the slight majority of cannabis using emerging adults. Our results suggest that retrospective cross-sectional reports may be a reasonable proxy for COVID-19 related cannabis use change in the case of cannabis use frequency. But our results question their use for determining how the pandemic is impacting cannabis use quantity. Importantly, our results suggest the COVID-19 pandemic poses health threats that extend beyond the virus itself. It is essential that public health efforts address the increasing frequency of cannabis use in emerging adult users.

The Role of Motives in Understanding the Link Between Personality and Cannabis Misuse

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Background and aim: A robust association exists between substance use and personality, with personality risk factors representing phenotypes

of vulnerability to substance misuse. As such, personality risk factors may be valuable constructs for understanding specific motivations for substance misuse. Given the loosening of restrictions on cannabis worldwide, research focusing on understanding cannabis use in young adults, a particularly at-risk population, remains a vital area of research. The existing data provides extensive support for the mediating role of coping motives on personality risk factors and problematic cannabis use; however, the role of other types of motives has remained largely unexplored. Our study examined the mediating role of cannabis use motives between personality and cannabis misuse among university students. We also explored the predictive value of personality phenotypes for cannabis use problems.

Research question and hypothesis: Do motivations for cannabis use mediate or explain the relationship between personality type and cannabis use problem severity? **Hypothesis 1:** sensation-seeking (SS) and impulsivity (IMP), but not anxiety sensitivity and hopelessness, will be associated with greater cannabis use problem severity. **Hypothesis 2:** motives for use (i.e., coping, conformity, social, enhancement, expansion) will mediate the association between personality risk and cannabis use problem severity.

Method: A survey was administered to 1073 undergraduate students. We examined whether motivations for use (mediator variable) explained the relationship between personality (predictor variable) and cannabis use disorder severity (outcome variable) using an ordinary least-squares (OLS) based mediation analysis.

Results: As hypothesized, SS and IMP predicted greater cannabis use problems. A noteworthy finding was that conformity motives were a significant mediator between SS and IMP and cannabis use, whereby higher levels of SS/IMP led to greater endorsement of conformity motives, which in turn led to lower cannabis misuse. Enhancement motives were also a significant mediator between IMP and cannabis use. Expansion motives were a significant mediator between SS and cannabis use.

Conclusion: Understanding reasons for use (i.e., motives) allows us to identify those at greatest risk for cannabis misuse. Findings from this study may help explain the underlying mechanisms by

which personality risk factors lead to cannabis use disorder in young adults. A greater understanding of these personality phenotypes may have implications for the development of personality-specific interventions for cannabis use.

Poison Center Reports of Cannabis Exposures among Children in Washington State, 2016

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Washington State began legal cannabis retail sales in 2014. Legalization of adult use cannabis and retail sales may result in more cannabis products in homes and opportunities for accidental exposures among young children. Consumption of cannabis by young children can result in significant adverse health effects.

This study examined details of cannabis exposure events involving children under age 12 that were reported to the Washington State Poison Center (WAPC) during January – December 2016. Redacted charts were obtained from the WAPC “Toxicall” database. 50 eligible events were identified. Structured data were used to describe child age and gender and to obtain information about the involved products, route of administration, exposure setting, and clinical effects. Additional information about the exposure event was available in case notes; qualitative methods were used to develop themes and categorize the cases.

Most exposure events (62%) were for children ages 0-2, and 26% were for ages 3-5. None of the exposures were reported as intentional. Of those where the source of the product could be determined (N=29) either a parent (n=20, 69%) or grandparent (n=6, 21%) was the most common source. Nearly all (94%) exposures occurred at the patient’s home and involved a single substance (90%). Of those that noted the type (N=13), 85% indicated that the cannabis was obtained for medical purposes. Most exposures were by ingestion (86%), and edibles were the most often reported form (52% of 41 cases with product specified). Nearly all edibles were brownies, cookies, and candies (96%). Baked goods were reported to be both homemade and purchased. Three cases were exposures to cannabidiol (CBD) among children being treated for seizures by their parents: one was the result of a therapeutic error, one an adverse reaction, and one an unintentional

exposure. A single child was reported as exposed through breastmilk. Of those with known medical outcomes (N=33), nearly all caused no or minor clinical effects (78%), and nearly all had symptoms for less than 24 hours, most commonly lethargy and drowsiness (50%), but five children were hospitalized for non-critical care and one child with a history of seizures, who was given CBD oil containing THC, required intensive care and intubation.

Risk for accidental exposures to cannabis among young children may be increasing as legal cannabis markets become more common. Although most exposures do not cause long-lasting harms, some children can experience significant harm requiring medical intervention. Caregivers of young children are advised to safely store cannabis products in the home so that they are out of reach of children, and to use caution and consult with a healthcare provider about use of cannabis products for medical treatment of a child or adult use while breastfeeding. Clinicians may play a role by screening for household cannabis use among parents and other caregivers, and advising about safe home practices. Continued regulatory approaches to limit exposure, such as limits on THC potency and single-serving packaging designs, may also be useful.

Longitudinal Effects of Acute Cannabis Exposure on Automobile Driving Behavior in a Naturalistic Simulated Environment

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Background: Driving is a complex day-to-day activity that employs a variety of cognitive and psychomotor functions in harmony, many of which are known to be affected acutely by CNB intoxication which could in turn pose a significant

public health risk. The recent legalization of both recreational and/or medicinal marijuana in several states has thus created an urgent need to better understand the effects of CNB on such functions in the context of driving. The present study employs a longitudinal, double-blind, placebo- 2 active dose study to investigate the effects of CNB on a variety of driving-related behaviors in a controlled, naturalistic simulated environment.

Methods: The current study employed N=37 subjects (N=25 male, frequent cannabis users, mean age 24.25+7.01), each exposed to a placebo, low and high dose of CNB on three separate days. On each day, following a single acute inhaled 0.5 g dose of either 0%, 3% or 5-7% of THC via a desktop vaporizer, subjects drove a virtual driving simulator (RTI SimVehicle platform) three times inside an MRI scanner and once out of scanner, randomized, and dispersed throughout an eight hour daily period. During each driving session three distinct real time behavioral tasks corresponding to lane-keeping following simulated wind gusts (operational), lead car following (tactical) and safe overtaking (strategic) were assessed and corresponding behavioral data were computed using custom Matlab scripts. Data were analyzed using a mixed model framework in SPSS v24 which included dose, session, instrument (desktop v MRI), dose*session, dose*instrument and session*instrument as primary factors, covarying for age and sex.

Results: Intoxicated subjects made significantly fewer gas pedal corrections ($p<0.02$) during the car following task and similarly fewer corrections to the steering reversal rate ($p<0.02$) during the lane weaving task, suggesting reduced awareness under the influence of cannabis. In addition we found that several variables showed significant differences in terms of estimates captured throughout the day suggesting that overall risk taking lessened as the day progressed and CNB effects wore off. Also, data trends suggested that under the high dose subjects took longer to return to baseline from their 'impaired' driving patterns. Key metrics that showed such significant daily effects included mean headway ($p<0.001$) and time to collision ($p=0.02$) from the car following task, deviation of lane position ($p=0.03$) from the lane weaving task, median gap ($p=0.02$) and overtaking speed ($p=0.02$) from the overtaking task. Although many driving measurements

differed depending on whether driving was done in MRI or at a desktop setting, these differences had no relationship to different drug dose levels. **Conclusion:** In summary, key driving functions affected under higher doses of CNB largely agreed current cross sectional literature. Generally, largest impairments in driving behavior seemed to occur within 1-4 hours after drug exposure, which might have important implications for real life driving situations. Our preliminary analyses yield numerous metrics that changed throughout the day, suggesting broad-based impairment on many metrics commonly used to quantify driving performance and risk.

Information Sources and Training Needs on Medical Marijuana- Preliminary Results from a State-wide Provider Survey

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Medical marijuana (MMJ) is legal in the state of Florida for the treatment of specific qualifying medical conditions.^{1,2} As of July 2020, over 2,450 physicians are authorized to order MMJ, and 360,000 patients are registered in Florida's MMJ program.³ With this rapid uptake come concerns regarding physicians' knowledge about MMJ,⁴⁻⁷ and the lack of preparing physicians-in-training to manage MMJ.^{4,7,8}

We conducted a state-wide survey of certified MMJ providers in Florida. The survey was developed by the Consortium for Medical Marijuana Clinical Outcomes research team. The aim of the survey was to inform physicians of the mission of the consortium, which is to support and disseminate research. The survey items were developed accordingly, and the survey was pilot tested with a small group of physicians. We identified all physicians licensed to certify patients for MMJ who care currently practicing in the State of Florida ($n=1609$), to investigate their information sources and training needs regarding MMJ. The survey was disseminated via mail and email, including a \$40 incentive for survey completion. Preliminary responses from 51 (5%) providers (mean age 56, 74% male) are

summarized here. The sample included providers from 22 Florida counties and represented a broad range of medical specialties. The majority (92%) practiced in both medical marijuana and traditional medical practice.

To learn about MMJ, 98% used research articles, 90% used online sources, 86% learned from dispensary staff, 84% learned from discussions with other providers, 72% used books, 65% used conferences, 61% used magazines, and 35% had a personal experience with marijuana. The sources most cited as “very useful” were conferences (51%), research articles (50%), discussions with other providers (47%), and online sources (47%).

Topics rated as a high priority for training included drug-MMJ interactions (80%), strategies to help patients reduce their use of opioids or other drugs (80%), information about the selection of doses and CBD: THC ratios (80%), evidence for managing specific medical conditions or symptoms (78%), information about the effect of different phytocannabinoids and terpenes (75%), advantages and disadvantages of specific modes of delivery (71%), general updates on research findings (71%), educational information about the endocannabinoid system (67%), the safety of medical marijuana use (55%), identification and management of cannabis use disorder (51%), and comparison of products available in different dispensaries (49%). The majority of providers either strongly agreed or agreed (77%) that they could provide better care if they knew which products their patients receive at dispensaries.

Physicians use a blend of primary research, online sources, and exchanges with colleagues to learn about MMJ. Perceived needs for more pharmacological information and indication-specific detail for treatment regimen were high. Most physicians believe that details on dispensed MMJ would improve patient care.

Contexts of Marijuana Use: A Latent Class Analysis among Argentinean College Students

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Background: Substance use and the association between substance-related variables and outcomes seem to be context dependent. We employed Latent Class Analysis (LCA), a person-centered approach, to identify distinct subpopulations based on contexts of marijuana use. We also examined whether the resulting classes differ in a set of marijuana-related variables that hold promise as potential targets of interventions. Method: A sample of 1083 Argentinean college students (64% women; M age = 19.73±3.95) completed an online survey that assessed substance use and related variables (motives for substance use, protective behavioral strategies [PBS] and internalization of the college marijuana use culture). For the present study, only data from students that reported last month (i.e., past 30-day) marijuana use (n = 158) were included in the analysis. Participants reported whether or not they used marijuana in different places (i.e., own house, party at home, friends' house, parties at friends' house, university party, non-university party, bar, dance-club, outside [street, park], or pregaming) or social contexts (i.e., alone, with family members, strangers, boyfriend/girlfriend, close friend, small group of same-sex friends, ≥10 same-sex friends, small co-ed group of friends, ≥10 co-ed friends). Results: LCA identified a 2-classes model for marijuana use context. Class 1 comprised 40% of last-month marijuana users. Students within this class endorsed a high probability of consuming marijuana across different places (e.g., at home, at parties, outdoors) and social contexts (e.g., close friend and in small same sex and coed groups). Participants in Class 2 exhibited a low endorsement of marijuana use across contexts, yet they reported a moderate to high probability of using marijuana with a small group of same-sex friends or with the close friend, at a friend's home. The two classes significantly differed, as shown by Student's t, on all marijuana outcomes (i.e., use and negative consequences) and marijuana-related variables (motives, PBS and internalization of the college marijuana use culture). Students in class 2 exhibited significantly less marijuana use, both in terms of frequency and quantity, and less marijuana-related negative consequences than those in class 1. The latter class exhibited more normative perceptions about marijuana use in college, more marijuana use motives particularly social, coping

and expansion motives- and less use of PBS than students in class 2 did. Conclusions: Our findings revealed subpopulations of college students that are heterogeneous regarding contexts of marijuana use, patterns of use and in a number of relevant variables. These distinctive subpopulations require different targeted interventions.

Validation of the Spanish Version of the Marijuana Consequences Questionnaire (S-MACQ)

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Background: The Marijuana Consequences Questionnaire [MACQ] assesses marijuana-related problems. This 8-factor (50-items) measure covers a broad array of multiple dimensions encompassing 50 negative consequences of gradient severity that are particularly relevant in the context of college. The present study aimed to validate the Spanish version of the 50-item Marijuana Consequences Questionnaire (S-MACQ) by analyzing the psychometric properties of internal, convergent, and concurrent validity and estimating internal consistency. We also examined the correlation between the brief (SB-MACQ) and the full S-MACQ and whether they similarly correlate with marijuana outcomes and marijuana-related variables. **Method:** College students from the two largest public universities of Cordoba city (Argentina) completed an online survey as part of a broader study focused on marijuana use and risky sexual behaviors. Only data from students that reported last-year marijuana use (n=470; 70.6% women; Mean age 22.67±3.52 years; 45.7% enrolled in psychology) were included in the study. We conducted independent samples t-tests to evaluate differences in the number of negative consequences (for the total scale and for each S-MACQ dimension) as a function of biological sex or frequency of use. Confirmatory factor analyses (CFA) was conducted to examine the factor structure of the S-MACQ. We conducted Pearson correlation analyses to examine the association

between the number of marijuana-related consequences as measured by the S-MACQ and scores (a) in the CUDIT, a standardized measure of marijuana-related problems (i.e., convergent validity), (b) frequency and quantity of marijuana use (i.e., concurrent validity), (c) motives for marijuana use (i.e., concurrent validity). We examined the Pearson correlation between the SB-MACQ and the S-MACQ and then we estimated the difference between the Pearson correlation of the SB-MACQ and the S-MACQ with all the marijuana outcomes and marijuana-related variables. **Results:** Results from the CFA supported an 8-factor structure. The scores of the S-MACQ showed appropriate internal, concurrent and convergent validity, alongside with adequate internal consistency. The S-MACQ was largely correlated with the SB-MACQ and the correlations between these two versions and marijuana outcomes/marijuana-related variables did not significantly differ. **Discussion:** Findings supported the S-MACQ as a valid measure to assess marijuana-related problems in Spanish-speaking students. The instrument can be used to identify a broad diversity of marijuana problems in this population.

A Mapping Literature Review of Medical Cannabis Clinical Outcomes and Quality of Evidence in Approved Conditions in the United States, from 2016 to 2019

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Background: Medical cannabis is available to patients by physician order in two-thirds of the United States (U.S.) as of 2020, but remains classified as an illicit substance by federal law. States that permit medical cannabis ordered by a physician typically require a diagnosed medical condition that is considered qualifying by respective state law.

Objectives: To identify and map the most recently (2016-2019) published clinical and scientific literature across approved conditions for medical cannabis, and to evaluate the quality of identified recent systematic reviews.

Methods: Literature search was conducted from five databases (PubMed, Embase, Web of Science, Cochrane, and ClinicalTrials.gov), with expansion and update from the National Academies of Sciences, Engineering, and Medicine's (NASEM) comprehensive evidence review through 2016 of the health effects of cannabis on several conditions. Following consultation with experts and stakeholders, 11 conditions were identified for evidence evaluation: amyotrophic lateral sclerosis (ALS), autism, cancer, chronic pain, Crohn's disease, epilepsy, glaucoma, HIV/AIDS, multiple sclerosis (MS), Parkinson's disease, and posttraumatic stress disorder (PTSD). The following exclusion criteria were imposed: preclinical focus, non-English language, abstracts only, editorials/commentary, case studies/series, and non-U.S. study setting. Data extracted from studies included: study design type, outcome, intervention, sample size, study setting, and reported effect size. Studies classified as systematic reviews with or without meta-analysis were graded using the AMSTAR-2 tool by two raters to evaluate the quality of evidence, with additional raters to resolve cases of evidence grade disagreement.

Results: A total of 438 studies were included after screening. Five completed randomized controlled trials (RCTs) were identified, and an additional 11 trials were ongoing, and 1 terminated. Cancer, chronic pain, and epilepsy were the most researched topic areas, representing more than two-thirds of all reviewed studies. The quality of evidence assessment for each condition suggests that few high-quality systematic reviews are available for most conditions, with the exceptions of MS, epilepsy, and chronic pain. In those areas, findings on chronic pain are mostly in alignment with the previous literature, suggesting that cannabis or cannabinoids are potentially beneficial in treating chronic neuropathic pain. In epilepsy, findings suggest that cannabidiol is potentially effective in reducing seizures in pediatric patients with drug-resistant Dravet and Lennox-Gastaut syndromes. In MS, recent high-quality systematic reviews did not include new RCTs, and are therefore not substantially expanding the evidence base. In sum, the most recent clinical evidence suggests that for most of the conditions assessed, we identified few studies of substantial rigor and quality to contribute to the evidence base. However, there are some

conditions for which significant evidence suggests that select dosage forms and routes of administration likely have favorable risk-benefit ratios (i.e., epilepsy and chronic pain), with the higher quality of evidence for epilepsy driven by FDA-approved formulations for cannabis-based seizure treatments.

Conclusion: The body of evidence for medical cannabis requires more rigorous evaluation before consideration as a treatment option for many conditions and evidence necessary to inform policy and treatment guidelines is currently insufficient for many conditions.

A Comparison of Engagement in Cannabis-related Protective Behavioral Strategies across Sex and Cultures

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Cannabis-related protective behavioral strategies (PBS) are behaviors used before, during, and/or after using cannabis to reduce its associated harms. Despite the effectiveness of PBS in reducing both cannabis use and negative cannabis-related consequences, few studies have examined whether there are sex and cultural differences in PBS use. In the present study, we compare PBS use across males and females and across five countries. We also examine whether the associations of PBS use with cannabis-related outcomes differ by sex and country. We recruited 1,175 college students (63.3% female; Mage = 20.96, SD = 3.95; 45.1% Freshman, 20.2% Sophomore, 16.6% Junior, 9.7% Senior, 8.4% other) who reported past-month cannabis use from eight universities in five countries (U.S., Spain, Argentina, Uruguay, and the Netherlands) to complete an online survey. The online survey included the Marijuana Use Grid (MUG; Pearson & Marijuana Outcomes Study Team, 2020), Protective Behavioral Strategies for Marijuana scale (PBSM; Pedersen et al., 2016; revised by Pedersen et al., 2017), and Brief-Marijuana Consequences Questionnaire (B-MACQ; Simons et al., 2012). Results of a series of ANOVAs suggested differences across countries on the

PBSM total score, $F(4, 1,126) = 20.93, p < .001$, such that participants in the U.S. ($M = 4.53, SD = 1.11$) and Spain ($M = 4.48, SD = 0.95$) endorsed the most frequent PBS use and participants in the Netherlands ($M = 3.46, SD = 1.49$) endorsed the least frequent PBS use. There were many item-level differences in PBS use across countries with a pattern similar to that for the PBSM total score. Results of a series of independent sample t-tests suggested that females ($M = 4.51, SD = 1.11$) scored higher than males ($M = 4.17, SD = 1.09$) on the PBSM total score, $t(1,123) = -4.88, p < .001$, as well as nearly every item. The correlations between PBSM total score and cannabis-related outcomes across gender and countries were mostly in the expected direction: more frequent PBS use was associated with less cannabis use and fewer cannabis-related consequences. These correlations were largest for the U.S. sample. Interestingly, however, the correlation between the PBSM total score and B-MACQ was positive for the Argentina sample and every correlation between the PBSM total score and cannabis-related outcome was positive for the Netherlands sample. The results of the present study suggest there are several gender and cultural differences in the use of cannabis-related PBS. However, future studies are needed to replicate these findings, especially given the relatively small samples for some of the countries in the present study (our smallest sample size was for Uruguay [$n = 46$]). Gender and cultural differences in PBS use should be considered in developing and tailoring PBS interventions, especially because the PBSM was validated with a U.S. sample and most existing interventions were developed for use with U.S. participants.

Do Cannabis Use Motives Mediate the Relationship between PTSD Symptoms and Cannabis Craving to Trauma Cues?

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Cannabis use is common in individuals with posttraumatic stress disorder (PTSD). The PTSD-cannabis relationship is important as cannabis use can worsen PTSD outcomes. Cannabis use motives are a useful construct for understanding the PTSD-cannabis relationship. Frequent

pairing of a trauma cue with substance use to cope can lead to conditioned substance craving. The extant research has not yet examined potential mechanisms to explain this effect. We recruited 51 cannabis users with a trauma history for a cannabis cue-reactivity study to examine coping motives as a potential mediator of the hypothesized relationship between PTSD symptoms and cannabis craving to trauma cues. Participants first completed a validated cannabis use motives measure. They were then exposed to a personalized audio and visual cue based on their trauma experience and reported on their cannabis craving immediately following using a standardized measure. Coping motives were contrasted with enhancement motives as the mediator. Results supported our first hypothesis: PTSD symptoms were associated with increased cannabis craving following personal trauma cue exposure. However, our second hypothesis of an indirect effect through coping motives was not supported. We did find an independent main effect of coping motives on cannabis craving triggered by trauma cue exposure. The lack of an interaction between PTSD symptoms and coping motives on trauma-cue induced craving is potentially due to other factors we did not examine that help strengthen the relationship (e.g., sleep). These findings have important clinical implications for targeting both PTSD symptoms and coping motives to prevent the development of conditioned cannabis craving to trauma reminders.

Gender and Age Differences in Comorbid Cannabis Use Disorders and Suicidality in a National Sample

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Approximately 40 million adults use marijuana annually, making marijuana one of the most commonly used substances in the United States (SAMHSA, 2019). Men and emerging adults (ages 18-25) report higher prevalence of cannabis use disorders (CUDs) relative to women and older

adults (CBHSQ, 2015; Khan et al., 2013). More frequent marijuana use is associated with greater likelihood of suicidal ideation (Ilgen et al., 2009), and past year use in emerging adults is associated with future suicide attempts (Pedersen, 2008). Similar to correlates of marijuana use, emerging adults and men have higher rates of suicidality (SAMHSA, 2019; Krug et al., 2002). Limited research has tested gender and age differences in comorbid CUDs and suicidality. The current study evaluated gender and age differences in CUDs only, suicidality only, or comorbid CUDs and suicidality in a national sample of adults. We hypothesized that men and emerging adults would be over-represented in comorbid CUDs and suicidality and CUDs only groups.

Data were from four consecutive years (2015-2018) of the National Survey of Drug Use and Health. Multinomial logistic regressions tested gender and age differences in adults with DSM-IV cannabis abuse or dependence (CUDs) only, suicidality only, and comorbid CUDs and suicidality, all compared to adults with neither CUDs or suicidality. Four separate regressions were conducted for passive suicidal ideation, active suicidal ideation, suicide planning, and suicide attempts. Gender was coded as male or female. Age groups were 18–25, 26–34, 35–49, and 50 years or older. Analyses controlled for survey year, race/ethnicity, sexual orientation, education, household income, past year major depressive episode, past year DSM-IV alcohol abuse or dependence, and past year illicit drug abuse or dependence other than CUDs.

Men disproportionately reported CUDs only (ORs=1.73-2.19, p 's<.001) and comorbid CUDs and passive suicidal ideation, active suicidal ideation, and suicide planning (ORs=1.72-2.12, p 's<.01), but not attempts (OR=1.16, p =.45) relative to women. Men reported 22% higher odds of active suicidal ideation than women. Women reported 15% higher odds of suicide attempts than men. Gender differences in passive suicidal ideation and planning were not statistically significant. Compared to older age groups, emerging adults were significantly more likely to report CUDs only (ORs=1.74-10.49, p 's<.01) and showed 2.36 to 14.24 times greater odds of comorbid CUDs and all four forms of suicidality (p 's<.001). Emerging adults were at 18% to 66% higher odds of either passive or active suicidal

ideation alone compared to all older age groups (p 's<.001).

This study investigated the relations between CUDs, suicidality, gender, and age in a nationally representative sample of adults. Results indicated that men and emerging adults consistently reported the highest likelihood of negative outcomes. Next steps include determining the direction of the relationship between CUDs and increasing severity of suicidality. Further, development and investment in programs for emerging adults with CUDs and suicidality are vitally important given the striking risk profile compared to other age groups. Future research should include program development and evaluation as well as gathering more information on risk and protective factors for these populations.

Evaluating expectancies: Do community-recruited adults believe that cannabis is an effective stress reliever?

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There is growing interest in using cannabis or specific cannabinoids (e.g., THC, CBD) as therapeutic agents for various stress-related psychiatric disorders (e.g., PTSD, anxiety). While beliefs about a drug, such as expecting to feel a certain way, have strong influences over the actual effects experienced by individuals, they are rarely evaluated in clinical research. In the present exploratory report, we sought to (1) evaluate the extent to which individuals believe that cannabis relieves stress, and (2) examine whether individual characteristics (i.e., age, sex, psychiatric illness, cannabis use frequency) are related to these beliefs. A sample of 234 adults (54.7% female; Mean age=31.37, SD=11.03, 19-69 years old) from the Halifax Regional Municipality community took part in a brief telephone screening interview to assess their eligibility for a larger study (in progress). Information was gathered about the frequency of current (i.e., past month) cannabis use (days per week), the presence of current psychiatric disorder(s) ("yes"/"no"), and the extent to which they believed that cannabis was an effective stress reliever (rating scale from 1 ("not at all") to 10 ("extremely")). Subjects reported a mean belief rating of 6.39 (SD=2.26). A multiple regression

analysis was run to evaluate whether the belief that cannabis relieves stress was related to age, sex, psychiatric illness, and frequency of current cannabis use. Overall, the model significantly predicted cannabis belief ratings ($p < .001$, adjusted $R^2 = .17$). Among all variables, only frequency of cannabis use contributed significantly to this prediction ($B = .544$, 95% CI: [.387, .701], $p < .001$). In general, the present sample of community-recruited adults believed that cannabis was somewhat effective at relieving stress. Additionally, cannabis use frequency was the only variable that predicted the strength of this belief, such that more frequent use was associated with higher belief ratings. This is consistent with prior research indicating that heavier cannabis use is linked to positive cannabis expectancies. Given that stimulus expectancies influence substance-related responses, such findings would further the case for evaluating and controlling for these expectancies in clinical work with cannabis for stress-related conditions. Indeed, clinical cannabis research evaluating samples of heavy or frequent cannabis users may be subject to bias due to higher positive expectancies.

Cannabis Use Among Women: Does Daily Assessment Reactivity Affect Usage Patterns?

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BACKGROUND: Daily diary measurements are a common way to assess substance use behaviours, however researchers and clinicians are often cognizant of assessment reactivity (or “reactivity”) in daily substance use measurement. Reactivity involves changes to behaviours that result simply from self-monitoring those behaviours. When reactivity to substance use measurement has been found to exist, it has been identified both as a possible confound in daily diary research and a potential intervention tool in clinical practice. Reactivity to daily self-monitoring of alcohol and tobacco use has been investigated in prior research, however this research has been inconsistent. Reactivity to daily self-monitoring of cannabis use quantity has yet to be documented at all. **METHOD:** The current study involved secondary analyses of data from $N = 88$ women who self-monitored their cannabis use for 32

consecutive days (Joyce et al., under review). We examined objective reactivity of cannabis use to daily self-monitoring both for the probability of use each day as well as the quantity of cannabis used on each cannabis-using day. At study completion, participants were asked the degree to which they felt self-monitoring impacted their cannabis use (i.e., subjective reactivity). We explored the reported degree of subjective reactivity, and we examined correspondence between objective and subjective reactivity. **RESULTS:** Hurdle models were the best fit for the data. Participants’ probability of daily cannabis use and the quantity of cannabis use did not change significantly over the study period. For subjective reactivity, many respondents (45%) reported no subjective reactivity, though a majority (55%) reported some degree of subjective reactivity with 24% reporting moderate or more reactivity. A three-step hierarchical linear model was used to investigate the relationship between objective and subjective reactivity. Time was the only predictor in the first step, subjective reactivity was added as a predictor in the second step, and the time \times subjective reactivity interaction was explored in the final step. Subjective reactivity was not found to moderate the relationship between time and cannabis use, although there was a significant relationship between self-reported subjective reactivity and variability of cannabis use across the data collection period. **CONCLUSIONS:** This study determined that participants who report greater subjective reactivity to cannabis measurement are more likely to demonstrate variability in their cannabis usage. While this study did not find a significant change in cannabis scores over time because of reactivity, the non-significant results are valuable from both a research and a clinical standpoint. For research, the lack of change is an indicator that reactivity is likely not a confounding factor in studies involving cannabis daily diary research. From a clinical perspective, the non-significant change indicates that simply self-monitoring cannabis is unlikely to provide standalone benefits when daily self-monitoring is used in clinical practice. It is relevant to note that our study involved a non-help-seeking sample, and future research could benefit from determining whether cannabis reactivity may be moderated by help-seeking behaviours or motivations to change.

Mobile Phone Sensor-Based Detection of Subjective Cannabis “High” in Young Adults: A Feasibility Study in Real-World Settings

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"Aim: Acute cannabis intoxication can impair motor skills and cognitive functions. Given possible impairment related to acute cannabis intoxication, we explored whether mobile phone-based sensors (e.g., GPS, text/phone logs) can detect episodes of acute cannabis intoxication (subjective “high” state) as self-reported in natural environments by young adults.

Methods: Young adults (ages 18-25), who reported cannabis use at least twice per week, were recruited by research registry and Craigslist to participate in a mobile phone data collection study (up to 30 days) in Pittsburgh, PA (2017-2019). Participants responded to fixed time phone surveys (3 times/day) and self-initiated reports of cannabis use (start/stop time, rating of subjective high: 0-10, 10=very high). Our mobile AWARE app continuously collected phone sensor data, which was segmented into 5-minute windows for analysis. We built and tested multiple machine learning classifiers (e.g., Support Vector Machine, Light Gradient Boosting Machine (LGBM)) on training (60%), validation (20%), and test (20%) datasets to determine which classifier performed best in distinguishing subjective cannabis “high” (rating=1-10) vs “not high” (rating=0). To minimize the influence of imbalanced data on model performance in the training dataset, we used both over-sampling with Synthetic Minority Over-sampling Technique (SMOTE) and random under-sampling of the majority class, so that both

classes (“high”, “not-high”) had the same number of training samples. We also tested the importance of time features (i.e., day of week, time of day: morning, afternoon, evening) relative to smartphone sensor data only on model performance, since time features alone might predict “routines” in cannabis use.

Results: Young adults (N=57; 58% female; mean age=19.82 [SD=1.76]; 71.92% White, 15.78% Black, 12.28% Asian and other ethnicity) reported 451 episodes of cannabis use, mean subjective high rating=3.77 (SD=2.64). The sensor dataset included 1,648 datapoints representing reports of subjective “high” and 60,580 data points representing “not high” reports. For the two time-based features only model, the LGBM classifier had 91% accuracy in detecting subjective cannabis intoxication (vs “not-high”) in the test dataset (Area Under the Curve [AUC]=0.75). Combining smartphone sensor data with the two time-based features (day of week, time of day) improved model performance, with 95% accuracy (AUC=0.93), indicating that smartphone features contribute unique information, and that time features further improve model performance in detecting rating of subjective cannabis “high”. Among the 102 phone sensor features entered into the analyses (smartphone sensors + time model), some of the most important features (the top 2 were the time features) included travel (GPS: smaller travel radius within a day when feeling “high”), movement (e.g., smaller number of activity changes when feeling “high”), and communication/sociability (e.g., increased phone usage interactions, greater voice and noise level around individuals).

Conclusion: Results from this proof-of-concept study indicate the feasibility of using phone sensors to detect effects of cannabis intoxication in the natural environment in a population-based model among young adults. Mobile phone sensors show promise for automated and continuous detection of cannabis use in daily life in a sample of young adults, with potential implications for triggering the delivery of just-in-time interventions to minimize marijuana-related harm.

Effort Expenditure and Cannabis Use: Testing the Amotivational Hypothesis

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Cannabis is the most commonly used illicit drug in the US and appears to have an indirect effect on dopamine (DA) output in the mesolimbic projection, a circuit implicated in reward processing and effort expenditure. Thus, some have suggested that cannabis use might be associated with aberrant effort-based decision making. The most popular theory positing changes in motivation due to cannabis use is the amotivation syndrome hypothesis, which suggests that chronic cannabis use results in impaired executive functioning, arousal, and affective reactivity leading to reduced capacity for goal-directed behavior other than drug seeking. However, only one study has examined this among cannabis users, and the results suggested no difference between cannabis and non-cannabis users. Further, other studies suggest greater effort expenditure among the substance using groups compared to controls. The current study extends these findings by examining the relation between cannabis use and effort-related decision making in a sample of college students. Cannabis using ($n = 25$) and non-cannabis using ($n = 22$) students completed the Effort Expenditure for Rewards Task (EEfRT), in which participants choose between a 'hard' task that requires pressing a button 100 times with the nondominant little finger for a large sum of money (high effort/high reward) or an 'easy' task that requires pressing a button 30 times with the dominant index finger for a smaller sum of money (low effort/low reward). Results were then compared between the cannabis and non-cannabis using groups. On average, participants selected the hard trials 46% of the time ($SD = 19\%$). Participants successfully completed the hard trials 74% of the time ($SD 29\%$), while they completed the easy trials 97% of the time ($SD = 6\%$). No participant selected only hard or easy trials during the duration of the task. Cannabis users ($M=41.40$, $SD=3.55$) completed significantly fewer trials compared to nonusers ($M=43.64$, $SD=3.74$). Further, Nonusers ($M=26.82$, $SD=10.01$) selected easy trials significantly more often compared to cannabis users ($M=21.40$,

$SD=8.34$), and nonusers ($M=99\%$, $SD=2\%$) also successfully completed easy trials more often compared to cannabis users ($M=95\%$, $SD=7\%$). However, cannabis users and nonusers did not differ in the number of hard trials selected (Cannabis users $M=16.82$, $SD=5.67$; Nonusers $M=16.82$, $SD=7.68$) or the percentage of successfully completed hard trials out of the total number of hard trials (Cannabis users $M=72\%$, $SD=27\%$; Nonusers $M=76\%$, $SD =32\%$). Both the reward magnitude and probability of reward receipt predicted greater likelihood of selecting a hard trial. In generalized estimating equation models, past month cannabis days and cannabis use disorder symptoms predicted the likelihood of selecting a hard trial, such that greater levels of both cannabis use days and symptoms were associated with an increased likelihood after controlling for reward value, probability, and expected value. The results suggest that college students who use cannabis are more likely to expend effort, even after controlling for the magnitude of the reward and the probability of reward receipt, suggesting the possibility for aberrant reward processing, albeit in the opposite direction of the amotivational syndrome hypothesis.

A Perfect Storm: Unintended Effects of Homeschooling on Parents' Mental Health and Cannabis Use Behaviors During the Pandemic

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The COVID-19 pandemic resulted in families self-isolating under incredible stress. Viral containment strategies included school closures with parents left to homeschool their children with few supports from the educational system. Recent data show that those with children at home were more likely to drink heavily during the pandemic (Rodriguez et al., in press). Gaps remain, however, in understanding whether these effects are due to the stresses of homeschooling

and whether they extend to cannabis use. Seven-hundred-and-sixty Canadian romantic couples (total N=1520 participants; mean age = 57 years; 50% women) who were self-isolating together during the month of April 2020 were recruited through Qualtrics Panel Surveys. Measures were completed retrospectively in early July 2020; participants were asked to report on their feelings and behavior in April 2020 during lockdown. They completed the GAD-7 (Spitzer et al., 2006) and the PHQ-9 (Kronke et al., 2001) to assess anxiety and depression, brief versions of four subscales of the COVID-19 Stress Scales (Taylor et al., 2020) to assess stress around the pandemic, and the Life Orientation Test – Revised (Chiesi et al., 2013) to assess optimism. They completed a measure of role strain (Statistics Canada, 2015) and a measure of conflict with their partner (Murray et al., 2003). They also completed a validated measure of cannabis use frequency and quantity (Cuttler et al., 2017), as well as two validated items from the Brief Cannabis Motives Measures (Bartel et al., 2020) to assess cannabis use to cope with depression and anxiety, respectively. All measures were completed for a 30-day timeframe during the month of April. Participants also reported on whether they were homeschooling one or more children in Grade 1-12 during the month of April. Data was analyzed with a one-way (homeschooling group) Analysis of Covariance (ANCOVA) controlling for group differences in age; a Bonferroni-correction was applied to account for multiple tests. Compared to those who did not homeschool (n=1116), those who did homeschool (n=404) experienced significantly more depression ($p=.001$), more COVID-19-related stress around socioeconomic consequences ($p<.001$) and traumatic stress ($p<.001$), and less optimism ($p=.002$). And those who homeschooled experienced more role strain between their home and work responsibilities ($p<.001$) and more conflict both toward and from their partner ($p's<.001$) than those who did not homeschool. Those who homeschooled also used cannabis significantly more frequently in the month of April than those who did not homeschool ($p=.003$). Compared to cannabis users who did not homeschool (n=122), cannabis users who did homeschool (n=61) reported more frequent cannabis use to cope with both depression and anxiety ($p's = .003$). These findings suggest that unintended consequences of our societal viral

containment strategies include more depression, pessimism, role strain, inter-parental conflict, and certain COVID-related stresses, and extend to more frequent cannabis use to cope with negative affect, among parents required to homeschool during the pandemic. These unintended mental health and substance misuse consequences for parents need to be considered when planning for an educational strategy in the fall and for any future waves of the pandemic.

PMS Affective Symptoms Indirectly Linked to Cannabis Use Frequency and Problems via Cannabis Coping Motives

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Background: Women with PMS have higher rates of substance use disorders but underlying mechanisms remain poorly understood. Research on the links of PMS to problematic substance use has largely omitted consideration of cannabis use. Design/Method: To fill these gaps, 87 cannabis using women (mean age = 28.9 years) completed a cross-sectional survey involving self-reports on their PMS symptoms on the Pre-Menstrual Scale – Short Form (PMS-SF), their usual motives for cannabis use on the Marijuana Motives Measure (MMM), their frequency of cannabis use in the last 30 days on the Cannabis Timeline Followback (C-TLFB), and their level of cannabis use problems on the Cannabis Use Disorder Identification Test (CUDIT). Analyses/Results: A series of multiple regressions were performed, along with Sobel tests of indirect effects, to examine the potential mediational role of cannabis motives in explaining the expected links of PMS symptoms with cannabis use frequency and problems. Separate models were run with cannabis use frequency and problems as outcomes, and with PMS affective and physiological symptoms as predictors. In each case, both coping motives and social motives (as a control to determine specificity) were tested as simultaneous mediators. PMS Affective (but not Physiological) symptoms were indirectly

positively related to both cannabis use frequency and problems through Coping (but not Social) motives for use (Sobel tests = 2.01 and 2.26, respectively, p 's < .05). Discussion: Findings suggest that it is the affective symptoms of PMS (e.g., depressed mood), rather than the physiological symptoms (e.g., bloating, pain), that drive more frequent and problematic cannabis use in women. Moreover, the mechanism to explain this link appears to be coping (but not social) motives for cannabis use. Thus, those women with greater levels of PMS affective symptoms appear to use cannabis more frequently and problematically than other women by way of their greater use of cannabis to cope with negative mood.

Why Young Adults Obtain a Medical Marijuana Card: Associations with Health Symptoms, Risk, and Heaviness of Use

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Objective. Prior studies documenting more frequent and problematic use among young adults who have acquired medical marijuana (MM) cards have broadly compared those who use medically to those who use recreationally. Gaining a better picture of how health symptoms and problematic use vary both within those who have a MM card for specific condition domains and between those who do not have a MM card, can provide key information for medical practitioners and states interested in adopting or updating MM policies. **Method.** The current study categorizes young adults authorized to use MM into four mutually exclusive groups based on endorsements of qualifying conditions: (1) Physical Health only; (2) Mental Health only; (3) Sleep only; and (4) Multiple Conditions. Analysis of covariance examined differences across marijuana use, problems, mental and physical health, and sleep for MM condition categories, and for those that only use marijuana recreationally. **Results.** MM card holders, particularly those with physical health or multiple health conditions, reported heavier, more frequent, and more problematic and

risky marijuana use compared to those using recreationally. Despite this pattern, those in different MM condition categories were generally not found to be more symptomatic in domains of functioning relevant to their respective conditions, compared to different category groups or to those using recreationally. **Conclusions.** Findings emphasize the importance of providers conducting a careful assessment of reasons for needing a card, along with use, to reduce potential harms while adding credibility to a medical movement with genuine promise of relief for many medical conditions.

Anxiety, Expectancies for Cannabis-Induced Anxiolytic Effects, and Frequency of Cannabis Consumption

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This study explored relations among anxiety, expectancies for cannabis's anxiolytic effects, and frequency of use. Undergraduate users ($N=242$, Mage = 19.1, 64.5% male, 46.6% White, 18.6% African American, 13% Hispanic/Latino, 12.7% Asian, 9.1% Mixed) rated their anxiety on the TSC-40. They reported expectancies for cannabis's anxiolytic effects using the same TSC items with a rating from -2 (making the symptom worse) to +2 (making the symptom better). Average expectancies were 2.41, suggesting that users expected some impact of cannabis on anxiety symptoms. These expectancies showed a dramatic skew that required transformation. We regressed anxiety and expectancies and their centered interaction term on days of use per month. Expectancies ($B=.917$) served as a significant predictor, however anxiety did not ($B=.215$). The interaction term was not significant, ($B=.155$). These results suggest that users choose the number of days they use based on their expectations of cannabis-induced improvement of anxiety, not on their level of anxiety. The interaction was not an important contributor. These results suggest that alternative approaches for handling anxiety might decrease the frequency of cannabis consumption. In addition, challenging cannabis expectancies about anxiety could also decrease frequency of consumption.

Associations between Cannabis Use Characteristics, Impulsivity, and Mindfulness

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Impulsivity has been implicated as a factor in cannabis use and cannabis-related problems. However, impulsivity is a multi-faceted construct. Recent work in substance use has used the UPPS-P Impulsive Behavior Questionnaire (UPPS-P), which is designed to assess five facets of impulsivity. Research examining these facets of impulsivity and cannabis use characteristics is somewhat inconsistent, but generally has suggested that Sensation Seeking and Lack of Premeditation may be related to cannabis use and Negative Urgency may be associated with cannabis-related problems. In addition, a substantial literature exists suggesting that mindfulness, the ability to focus one's attention on the present moment in a non-judgmental, non-reactive, and tolerant manner, is decreased in substance users. However, the literature specific to mindfulness and cannabis use characteristics is relatively inconsistent. Thus, the aim of the current study was to replicate and extend prior research on the associations between impulsivity, mindfulness, and cannabis use. A community sample of adults (N = 289, 137 female) completed an online survey that included the Short UPPS-P (SUPPS-P) impulsiveness questionnaire, Mindfulness Attention Awareness Scale (MAAS), and questions about cannabis use and cannabis-related problems. A logistic regression in the full sample revealed that SUPPS-P Lack of Premeditation and MAAS total scores, as well as alcohol consumption, were significant positive predictors of cannabis user status (i.e., use in the past 30 days). The Lack of Premeditation finding is consistent with prior studies, but the association between increased mindfulness and cannabis user status was unexpected. It's possible that the mind set and physical setting in which cannabis is used has influence on the subjective experience, and thus, users may be seeking effects relevant for an overall sense of well-being similar to that seen in research on psychedelic drug use. In the subsample of cannabis users that reported use in the past 30 days (n = 87), no significant associations were revealed between impulsivity facets or mindfulness and cannabis use frequency. No impulsivity or mindfulness variables emerged

as significant predictors of cannabis-related problems in users; although, consistent with prior studies, the association with SUPPS-P Negative Urgency approached significance. Alcohol-related problems were associated with cannabis-related problems as well. These findings extend the previous literature and have implications in identifying risk for problematic/disordered use as well as improving upon interventions and treatment approaches for problematic cannabis use.

An Interactive Personalized Feedback and Text-Messaging Intervention is Associated with Reductions in Substance-Impaired Driving

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Background: Substance-impaired driving continues to be a national public health concern and data suggests that up to one-third of college students report driving after drinking and/or cannabis use in the past year. To date, little research has investigated whether brief, technology-based interventions can be used to reduce substance-impaired driving among young adults. Recent research indicates that interventions that incorporate personal contact lead to larger effect sizes than fully automated interventions. The present study compared an interactive text-messaging intervention to an automated text-messaging intervention in the context of a brief, mobile-phone based substance-impaired driving intervention.

Method: Participants were recruited through the university's subject pool (n = 46) and completed measures that assessed impaired driving at baseline and three-month follow-up. In order to be eligible, students had to be at least 18 years or older, have access to a motor vehicle, and report driving after drinking two or more drinks and/or driving after cannabis use at least three times in the past three months. Participants were randomly assigned into four conditions: personalized feedback plus text-messaging (n = 12), personalized feedback plus automated text messaging (n = 11), an active control condition (substance use information, n = 12), and an assessment only control condition (n = 11).

Results: Repeated measures ANOVAs were run to compare the number of times driving while

impaired over time across conditions. Analyses revealed the personalized feedback plus text-messaging led to significantly greater reductions over time in the number of times driving while impaired compared to participants in the assessment-only condition ($p = .022$). Additionally, participants in the personalized feedback plus text-messaging condition reported a greater reduction over time in the number of times driving while impaired than those in the personalized feedback plus automated text messaging condition, though this difference was not significantly significant ($p = .066$). Surprisingly, the text-messaging conditions did not result in significantly greater reductions in substance-impaired driving compared to the active control condition ($p = .227$).

Discussion: Overall, these findings provide preliminary support for the short-term efficacy of a mobile-delivered personalized feedback intervention with interactive text-messaging in reducing substance-impaired driving among young adults. Due to Covid-19, three-month follow-up data could not be collected from half of the originally enrolled sample, resulting in underpowered analyses. Additional data will be collected as part of this pilot trial in the coming year.

Examining Associations Between Trauma Exposure and Cannabis Use Frequency, Quantity, Duration, and Age of Onset

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Prior research has identified an association between trauma exposure and cannabis use, such that a history of trauma exposure is associated with greater likelihood of lifetime cannabis use. However, little research has expanded upon this association, making it unclear whether trauma exposure is associated with cannabis use outcomes beyond lifetime history of use. Given that heavy cannabis use and trauma exposure are risk factors for a number of deleterious outcomes, it is important to further examine the influence of trauma exposure on cannabis use. The purpose of the current study was to further explore this relationship by examining associations between trauma exposure and various indices of cannabis use.

Participants included a sample of 722 female undergraduates at least 18 years or older ($M = 19.0$) who were recruited through a campus-wide online study pool. Participants completed measures on trauma exposure (calculated as number of traumas experienced), cannabis use (i.e., Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use [DFAQ-CU]; Cutler & Spradlin, 2017), and mental health symptoms. Specific indices of cannabis use were lifetime history of cannabis use, age of onset of cannabis use, current frequency of use, current quantity of use (in grams), and length of use. Logistic regression analyses and correlations were used to explore the associations between trauma and cannabis use variables. Subsequent analyses were conducted controlling for posttraumatic stress disorder (PTSD) symptoms to determine whether relationships between trauma exposure and cannabis use remained after accounting for PTSD symptoms.

Thirty-seven percent ($n = 266$) of the sample indicated a lifetime history of cannabis use. Similar to previous research, greater trauma exposure was significantly associated with a greater likelihood of a lifetime history of cannabis use ($OR = 1.14$, $p < .001$). Additionally, number of traumas experienced and age of onset of cannabis use were significantly negatively correlated, $r(262) = -.16$, $p < .01$, indicating that greater trauma exposure was associated with earlier onset of use. Number of traumas experienced was positively correlated with duration of cannabis use, $r(236) = .14$, $p = .03$, indicating greater trauma exposure was associated with greater duration of use. Number of traumas experienced was also positively correlated with quantity of cannabis use, $r(175) = .20$, $p < .01$, showing that greater trauma exposure was associated with higher amounts of cannabis used. These associations remained significant even after controlling for PTSD symptoms. Frequency of cannabis use was not significantly correlated with trauma exposure, $r(266) = -.01$, $p = .82$.

The results of the present study indicate that trauma exposure is associated with a range of indices of cannabis use beyond lifetime history of use, even after accounting for the influence of PTSD. These findings highlight the importance of extending examination of trauma and cannabis beyond frequency of use. Although trauma

exposure may serve as a risk factor for elevated cannabis use, it is also possible that cannabis use may increase the risk of trauma exposure. Future studies should explore these associations longitudinally as well as examine the mechanisms that link these outcomes together.

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