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Bradley T. Conner, Ph.D.

KEYNOTE ADDRESS

How Cannabis Research and Cannabis Policy Can Inform Each Other

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Cannabis policies in the United States (and globally) are changing rapidly, far outpacing the knowledge needed to determine and minimize the public health impacts of these changes. Cannabis is already the most commonly used federally illicit substance; and use has been increasing in young and older adult populations for the last 10 years; with at least 4 million individuals in the U.S. meeting diagnostic criteria for cannabis use disorder each year. Cannabis now refers to a diversity of products, with varying potencies (i.e., tetrahydrocannabinol (THC) concentrations), including some with little or no THC and in turn, minimal abuse liability (e.g., cannabidiol or CBD products). Federal and State laws don't align, which creates multiple obstacles for researchers, patients, public health officials, and even those in the cannabis industry—who may be forced into unwieldy (e.g., cash only) business practices.

This presentation highlights what we know and what we need to know about the adverse and potential therapeutic effects of cannabis, with the goal of identifying research needs and opportunities. While more evidence is needed on the long-term impact of cannabis, particularly in relation to causality and permanence, populations such as adolescents, pregnant women (and their offspring), and individuals with mental illness are likely to be the most at risk for adverse outcomes. The potential therapeutic uses of cannabis and its constituent cannabinoids are vastly understudied, despite their widespread use. There are many reasons for this, including long-standing barriers to research, some of which are starting to be addressed. As the evidence is being generated, it is crucial that we remain unbiased in our assessment of it, and forthright in our dissemination of information. Only then can we advance the science and better inform policy and public health.

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The Complex, Bi-Directional & Nuanced Associations between Cannabis and Posttraumatic Stress Disorder

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POSTER PRESENTATIONS

All poster presentations and symposia were peer-reviewed by the 2018 Conference Program Committee of the Research Society on Marijuana (RSMj) (Chair: Bradley T. Conner, Colorado State University). All abstracts below were approved and voluntarily submitted for publication in Cannabis by the presenting or contact author.

Association between Coping Strategies and Marijuana Use among Pre-Clinical Trauma-Exposed Students

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Background: Marijuana is the most commonly used illicit substance in the United States (NIDA, 2014) and has been linked to both short-term and long-term negative developmental, physical, and physiological outcomes (e.g., altered brain development, diminished life satisfaction; Volkow et al., 2014). Although epidemiological work has primarily emphasized sociodemographic characteristics (e.g., sex) associated with marijuana use (Pacek et al., 2015), a burgeoning literature also has focused on the impact of trauma exposure and posttraumatic stress. Indeed, extant work indicates that individuals exposed to trauma and/or that are evidencing posttraumatic stress disorder (PTSD) symptomatology are at increased risk for marijuana use and related problems (Boden et al., 2013; Cougle et al., 2011). Expanding on this literature, recent work has focused on underlying mechanisms that may influence associations between trauma exposure and marijuana use, including specific coping motives and strategies that individuals use to manage posttraumatic stress (e.g., avoiding coping; Bonn-Miller et al., 2007). However, much of this work has been conducted in clinical populations with PTSD and/or cannabis use disorder, providing little insight or guidance for prevention efforts in pre-clinical populations following trauma. The current study begins to address this gap in the literature by evaluating 14 adaptive and maladaptive coping strategies that may be associated with increased or decreased likelihood of marijuana use in a heterogeneous sample of pre-clinical trauma survivors. Methods: The sample included 1,152 participants (M = 20.72, SD = 3.26; 73.7% female) drawn from a large university in a Southwestern state where marijuana use is not legal for medical or recreational purposes – that met the following eligibility criteria: (1) exposure to at least one DSM-5 Criteria A traumatic event (APA, 2013) according to the List of Events Checklist for DSM-5 (LEC-5; Weather et al., 2013) and (2) their indexed trauma occurred more than 30 days prior to assessment. Participants completed the Brief COPE (Carver, 1997) to assess 14 coping strategies related to dealing with stress and a single-item, face-valid question to assess past-month marijuana use. Responses were dichotomized to 0 ("No") or 1 ("Yes") based on any endorsement of past-month marijuana use. Forward stepwise binary logistic regression (Wald statistics) was conducted to isolate which coping strategies (or collection of variables) were most strongly associated with increased odds of marijuana use in the past-month. Results. Overall, five iterative steps identified the final model, which accounted for approximately 15% of the variance in past-month marijuana use. Expectedly, substance use coping has identified as the coping strategy most strongly associated with past-month marijuana use (OR = 1.65). Further, increased frequency of self-distraction (OR = 0.92), denial (OR = 0.87), and religion (OR = 0.89) coping strategies were associated with decreased likelihood of using marijuana; conversely, frequency of active coping was positively associated with increased likelihood of using marijuana (OR = 1.13). Conclusion: The results of this study indicate that certain coping strategies are more strongly associated with marijuana use after trauma exposure, and may inform future prevention-oriented work. Coping strategy-specific implications, study limitations, and future research will be discussed.

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Supplemental Materials Here

Does the Form of Marijuana Use Impact the Relation between Marijuana Use Motives and Daily Frequency?

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Background: Past research has illustrated a relationship between a range of marijuana use motives (e.g., coping, social) and marijuana use frequency. With a growing market of new marijuana forms (e.g., concentrates, edibles), strains (hybrid, indica, sativa), and methods of ingestion (e.g., vaping, dabbing), it is important to gain a better understanding of how variations in marijuana might influence these established associations. Therefore, the goal of the current study is to examine whether marijuana form (flower vs. concentrates) moderates the relation between marijuana use motives and marijuana use frequency. Methods: Active college-student marijuana users (n = 79) were recruited and completed a baseline assessment that lasted approximately 90 minutes. Participants were trained on a signal-contingent ecological momentary assessment (EMA) protocol and responded to three random prompts each day for two weeks through a smartphone app. A baseline question examined the primary form of marijuana used (e.g., flower, concentrate, edibles). Five subscales from the Marijuana Motives Measure were used to assess specific reasons for using marijuana, including Coping, Social Anxiety, Enjoyment, Boredom, and Altered Perceptions. Marijuana use frequency was assessed using an EMA question assessing the average number of times marijuana was used each day over the two-week period. Results: Participants were 60% female, 61% Caucasian, and averaged 20.35 (SD = 3.65) years of age. At baseline, participants reported an average of 22.77 (SD = 7.3; 4 - 30) days of marijuana use in the last month and an average of 5.23 (SD = 1.81) days of use per week. EMA data showed that participants used, on average, once per day (M = 1.17; SD = .59). Over the two-week EMA period, participants reported using a mean of 16.32 (SD = 8.29) times over the two-week period. Most participants were using flower (n = 60) or concentrates (n = 15) as their primary form of marijuana. Four participants reported primarily using edibles or other forms; these participants were excluded from further analyses. We found that form of marijuana was related to the EMA daily average of marijuana use. When examining the interactions between form and motives in five separate models, we found a moderated effect of form on daily EMA average only for enjoyment motives (p = .04). More specifically, as enjoyment motives increased, concentrate users reported greater marijuana use daily instances via EMA. In the relationship between altered perceptions and marijuana use frequency, marijuana form approached significance as a moderator (p = .08). Conclusions: Our findings suggest that the relationship between enjoyment motives and marijuana use frequency was particularly relevant for marijuana concentrate users. As more forms of marijuana become available, a more nuanced approach to understanding the relation between motives and frequency is needed.

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Cannabis and Schizotypy: Revisiting an Old Problem

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The link between cannabis and schizotypy (i.e., patterns of behavior which typify a genetic predisposition schizophrenia-spectrum pathology) is well documented, with some research indicating individuals with schizotypy are two-to-four more likely to report cannabis use (e.g., Cohen et al., 2010). However, as previous work has indicated (e.g., Earleywine, 2006), several markers of schizotypy assessed on self-report measures (e.g., speech-related problems, such as forgetting what one is saying) may also represent common effects of cannabis use (e.g., working memory deficits). Given this, it is imperative to determine whether these items intended to assess schizotypal personality traits function the same across users and nonusers of cannabis. If these items exhibit differential item functioning, cannabis users may be erroneously classified as exhibiting schizotypy,

which can yield deleterious consequences in clinical work and impede research progress. The current study aimed to determine whether speech-related items on the Schizotypy Personality Questionnaire-Brief Revised (SPQ-BR) exhibit measurement invariance as a function of cannabis use status.

Participants consisted of college students from a southwestern university (N = 602, 63% female, 66% White, 27% LatinX) who completed a battery of self-report measures, including the SPQ-BR and a modified Daily Drinking Questionnaire to assess cannabis use. To ensure adequate power, lifetime use (n = 353) versus non-use (n = 249) was used for the current analyses. To assess differential item functioning, measurement invariance was tested using structural equation models in Mplus version 7.4 with SPQ-BR items modeled as ordinal indicators using a WLSMV estimator. The DIFFTEST was used to assess statistically significant changes in model fit.

Preliminary results indicated the four-item Odd Speech subscale was not invariant across cannabis use status when comparing the configural (i.e., freely estimated) to scalar model (i.e., factor loadings and thresholds constrained across groups; DIFFTEST $\chi(15) = 36.96$, $p = .001$). Next, partial scalar invariance was tested by freeing one item at a time. Partial measurement invariance could not be achieved when freeing any one item, suggesting all four items of the Odd Speech subscale of the SPQ-BR function differently across cannabis users versus nonusers (DIFFTEST $\chi(14) = 25.61$- 44.48, $p < .05$). Although it is difficult to interpret differential item functioning, speculatively, it may be that cannabis users are reporting on cannabis-induced outcomes on items of the Odd Speech subscale (e.g., "I sometimes forget what I am trying to say"; "Do you tend to wander off the topic when having a conversation?"), rather than endorsing indications of schizotypy. Although directions on the SPQ-BR specifically ask individuals not to consider substance-induced experiences when answering, this may not be sufficient. Cognitive interviewing with cannabis users while taking the SPQ-BR may be beneficial in understanding why these items function differently across users and nonusers. Given these preliminary findings, establishing measurement invariance across cannabis use status for measures assessing schizotypy and similar constructs will be necessary going forward before any relation, causal or correlational, between cannabis use and schizophrenia-spectrum pathology can be elucidated.

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The Intersectionality of Race, Biological Sex, and Past 30-Day Marijuana Use among Trauma Exposed Emerging Adults

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Background: Marijuana is the most widely used illicit drug in the United States (SAMHSA, 2013), and is linked to various health, emotional, social, and legal consequences (Degenhardt & Hall, 2006). An extensive literature has consistently identified trauma exposure as a risk factor for problematic marijuana use (Vlahov et al.,2002; Kilpatrick et al., 2000; Bremner et al., 1996). In an attempt to better understand substance use after trauma exposure, related research (e.g., alcohol) has identified both biological sex and race/ethnicity as risk markers (Danielson et al., 2009). However, limited work has focused on these factors in relation to marijuana use in trauma-exposed populations, and no work has evaluated the intersection of these sociodemographic markers (e.g., black males, white females). The current project begins to address this gap by assessing marijuana use frequency and the intersectionality of race/ethnicity and biological sex among trauma-exposed college students. Method: A sample of 805 trauma-exposed undergraduates (M_{age}= 20.68; 70.7% female) were recruited through an online participant pool. Participants were included in the study if they reported (a) a Diagnostic and Statistical Manual for Mental Disorders–Fifth Edition (DSM-5) Criteria A traumatic event (APA 2013), and (b) some level of PTSD symptom severity in the past 30 days (i.e., not asymptomatic). Due to limited sample sizes in other reported racial/ethnic categories (e.g., Asian, Pacific Islander), only those primarily identifying as Black/African American, White/Caucasian, or Hispanic/Latinx were examined in the current analyses. A single-

item, face-valid question was used to assess past 30-day marijuana use, with response options ranging from 1 (no use) to 7 (20 or more times). A 3 X 2 factorial ANOVA was conducted to examine the differences in marijuana use frequency between groups based on race/ethnicity and biological sex (i.e., male and female). Results: Results indicated no main effect for race/ethnicity [$F(2, 799) = 0.59$, $p = .592$, $\eta^2 = .00$], but a significant main effect was found for biological sex [$F(1, 799) = 11.46$, $p < .001$, $\eta^2 = .01$], indicating that individuals identifying as biologically male endorsed greater past 30-day marijuana use frequency ($M = 2.03$, $SD = 2.58$) than female peers ($M = 1.52$, $SD = 2.18$). Further, the interaction was significant [$F(2, 799) = 3.05$, $p = .048$, $\eta_p^2 = .01$]. Specifically, men who identified as Black/African American endorsed the most frequent marijuana use ($M = 2.63$, $SD = 3.03$), and females who identified as Black/African American endorsed the least frequent marijuana use ($M = 1.09$, $SD = 1.85$). Discussion: These results indicate that, across all race/ethnicity groups, trauma-exposed males endorsed greater frequency of past-month marijuana use than females. However, for individuals who identified as Black/African American, that disparity appears to be more extreme, with Black/African American males endorsing the highest frequency of marijuana use and Black/African American females endorsing the lowest frequency of marijuana use. This finding highlights the importance of evaluating and meaningfully addressing the intersectionality of sociodemographic variables. Further, these findings emphasize the need for prevention intervention methods that are tailored towards identifying the at-risk intersecting identities of minority groups.

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A Meta-Analytic Investigation of the Associations between Cannabis Use and Negative Consequences

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In the current climate on policy change regarding cannabis (i.e., decriminalization, medicalization, and legalization), various stakeholders have strong interest in determining the associations between cannabis use and important outcomes, ranging from positive outcomes (e.g., medicinal benefits like decreased pain) to negative outcomes (e.g., psychosis). The present study sought to quantify the association between indicators of cannabis use and the experience of negative cannabis-related consequences. We are conducting an exhaustive search of the cannabis literature to identify studies that examine the use-consequence association, and are using meta-analytic methods to quantify this association and examine possible moderators of this association (e.g., percentage of females, measure of consequences, indicator of cannabis use, population). To date, we have coded 19 articles and present these findings here. Given our expectation that we would find significant heterogeneity in effect sizes across studies, we conducted a random-effects meta-analysis. We found that cannabis use had a medium-sized effect on consequences, $r_w = .293$, indicating that about 8.6% of the variance in consequences was attributed to the frequency or amount of cannabis use. In addition, we found significant heterogeneity of this effect, $Q = 217.832$, $p < .001$, $I^2 = 93.114$. In fact, over 90% of various across studies was due to true heterogeneity rather than chance/sampling error. When we have coded all articles, we will examine moderators of this association to further probe this heterogeneity. This study is important in that it describes the average effect size of cannabis use on a broad measure of negative consequences. Given that 91.4% of the variance in negative cannabis-related consequences was not explained by any single indicator of cannabis use, pointing to the fact that additional factors need to be examined to explain the experience of negative consequences

from cannabis use and that additional indicators of cannabis use may be needed.

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Prevalence Rates of Marijuana, Alcohol, and Simultaneous Use and Associations with Alcohol-Related Consequences in At-Risk Youth

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Objective: Studies suggest that concurrent and simultaneous use of alcohol and marijuana (CAM and SAM, respectively) are associated with experiencing more alcohol-related consequences and higher rates of binge drinking, than alcohol use alone. However, rates of CAM and SAM, and possible associations with alcohol-related consequences have been little studied in samples of youth (e.g., ages 9-18) and at-risk samples. This study aimed to assess prevalence rates of marijuana and alcohol use (including CAM and SAM use) and associations with alcohol-related consequences in a sample of at-risk youth. Methods: Youth ages 9-18 (N=505, M=14.36, SD=2.57) were recruited from community mental health agencies and a juvenile correctional facility in the Northeast United States (53% male; 25% Hispanic; 67% White, 18% Black, 6% American Indian/Alaskan Native; 4.7% Pacific Islander; 2.2% Asian). Past 30-day prevalence rates of alcohol and marijuana use were measured using Timeline Follow-Back (TLFB). Five distinct use groups were identified: Youth with (1) no substance use, (2) alcohol use only, (3) marijuana use only, (4) simultaneous use (operationalized as reporting same day use of alcohol and marijuana), and (5) concurrent use (reported using both substances but not same-day use). Number of binge drinking occasions as defined by NIAAA for youth was also measured using TLFB. Alcohol-related consequences were measured by the Risks and Consequences Questionnaire. Negative binomial regression and zero-inflated negative binomial regression (ZINB) analyses were conducted to compare alcohol-only versus SAM users on rates of binge drinking and alcohol-related consequences. Results: Overall, 64% of youth reported no substance use in the past 30 days, 12.5% reported marijuana use only, 5.5% reported alcohol use only, 15% reported SAM, and 3% reported CAM. Past 30-day prevalence across age was also calculated, and all youth ages 9-11 reported no substance use. As expected, prevalence of substance use increased from ages 12-18 (e.g., 0% of 12 year olds versus 51% of 18 year olds reported SAM use). An equal proportion of males and females reported no substance use (50% vs. 50%), but a larger percentage of males as compared to females endorsed SAM use (22% vs. 8%). Negative binomial regression and ZINB analyses indicated that youth reporting SAM use had significantly higher rates of binge drinking compared to those who endorsed alcohol use only (IRR = 2.74, $p < .001$), and significantly higher rates of drinking and driving (IRR = 10.94, $p < .001$). No other consequences (e.g., alcohol related injuries, unprotected sex) were found to be significant. Conclusions: Among the substance using youth, SAM and marijuana use only were most prevalent, especially among the older youth. These findings are alarming given the strong associations found with SAM use and drinking and driving and higher rates of binge drinking. More research is needed to determine causal relationships between SAM use and harmful drinking consequences.

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Impulsivity-like Traits, Use of Protective Behavioral Strategies, and Marijuana-Related Outcomes

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The UPPS-P model of impulsivity (Cyders et al., 2007) posits that there are five unique impulsivity-like traits that result in impulsive behaviors: Negative Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency. Similar to findings in the alcohol field (Coskunpinar et al., 2013), negative urgency has been found to be robustly associated with marijuana-related consequences (Bravo et al., 2017). Although a 5-factor model of impulsivity-like traits has much empirical

support, alternative factor structures have been examined, including a 3-factor model with positive and negative urgency loading onto a higher-order Urgency factor, and perseverance and premeditation loading onto a higher-order Deliberation factor. The present study examined whether use of marijuana protective behavioral strategies (PBS) mediates the effects of impulsivity on marijuana-related outcomes. Further, we examine whether the mediating role of PBS use is best understood in the context of 1-, 3-, and 5-factor models of impulsivity-like traits. Using a sample of 6,584 students recruited from one of eight universities across the U.S., we compared a 5-factor, a higher-order 3-factor model, and a 1-factor model. The 5-factor structure of impulsivity-like traits fit best and unique effects support examining these facets independently in the prediction of marijuana-related outcomes. Consistent with previous research with alcohol (Coskunpinar et al., 2013) and marijuana (Bravo et al., 2017), negative urgency was directly related to negative marijuana-related consequences. However, the effect of negative urgency on both typical marijuana quantity and negative marijuana consequences was partially accounted for by lower use of marijuana PBS. Personality-targeted interventions have demonstrated promise among adolescents in particular (Conrod, 2016), but perhaps PBS use could be one promising intervention target for these interventions individuals with elevated levels of negative urgency and/or sensation seeking. The fact that negative urgency demonstrated a direct effect even after controlling for PBS use suggests that additional factors need to be examined to explain why individuals with higher negative urgency experience more harms from their marijuana use.

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Individual Difference Factors Influencing Cannabis Non-Use Motives

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Introduction: Research on cannabis use motives is well established. However, there is limited research exploring cannabis non-use motives (i.e., motivations to not use cannabis). Previous research on non-drinking motives shows evidence that greater non-use motives predict lower lifetime rates of alcohol use. Additionally, research on American Indian (AI) populations specifically shows factors such as ethnic identity can protect against substance use. AI populations have a higher prevalence of substance use compared to non-AI populations. These studies suggest that exploring non-use motives in relation to cannabis can assist in understanding cannabis use decisions. Methods: This study investigates cannabis non-use motives in a national sample of individuals that report no lifetime cannabis use and live on or near reservations in the United States (N = 1867). Approximately 22% of the present sample identified as White and 73% identified as AI. Additionally, the relation between non-use motives and ethnic identity, ethnic pride, perceived discrimination due to ethnicity, parental awareness, and parental care/concern was explored. Twelve non-use motives were included in the analysis. All analyses were conducted in MPlus version 8 and were specified as complex to account for clustering by school. First, an exploratory factor analysis (EFA) was run to assess the factor structure of the non-use motives scale. Second, structural equation modeling (SEM) was used to assess the relation between cannabis non-use motives and several demographic and other factors. Results: Results of the EFA indicated that a one-factor solution best fit the data, with all goodness-of-fit indices falling within acceptable ranges. Structural equation modeling results showed AI ethnic identity, ethnic pride, parental awareness, and parental care/concern were positively related to non-use motives. In contrast, perceived discrimination and White ethnic identity were not related to non-use motives. Conclusion: AI ethnic identity was positively associated with non-use motives, but White ethnic identity had no

association with non-use motives. AI populations have previously been regarded to be particularly at-risk for substance use and misuse. The positive relation between AI ethnic identity and non-use motives suggests that AI cultural identity may be protective against marijuana use. Parental care, awareness of cannabis use, and concern about cannabis use were also associated with a greater number of reported non-use motives. These findings indicate potential protective factors that all contribute to an individual's choice to ultimately not engage in cannabis use. Furthermore, these analyses suggest non-use motives are strongly related to protective factors in predicting use patterns. Incorporation of non-use motives has the potential to direct future prevention strategies, primarily for at-risk and underrepresented populations.

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The Influence of Mentor Relationship Quality on Marijuana Use during the Campus Connections Mentoring Program

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Background: Adolescent substance abuse is a serious public health concern. Adolescents who abuse substances, particularly those who begin during early adolescence, are more likely to engage in risky sexual behavior, commit crimes, drop out of school, and develop a substance use disorder. Additionally, adolescent marijuana use is associated with adverse consequences in later adulthood, including short-term memory impairments, altered brain development, and addiction. Identification of programs, practices, and policies that have the capacity to prevent adolescent substance abuse are needed. Mentoring has been recommended as one such initiative; however, not all mentoring programs are successful. Nearly 50% of all mentoring relationships end prematurely and many do not produce improvements in the adolescent's developmental trajectory. We propose that positive outcomes of mentoring will be heightened when the adolescent and mentor develop a high-quality relationship. Methods: The data for this study comes from a mentoring program called Campus Connections (CC). We hypothesized that adolescents who develop a high-quality relationship with their mentor during the CC program will be less likely to engage in marijuana use compared to youth who develop a low-quality relationship with their mentor. Mentees self-reported their perception of the Mentor Relationship Quality (MRQ) using the Cavell et al. (2009) Mentor Alliance Scale ($\alpha = 0.86$) at the end of the mentoring program. Mentees also self-reported marijuana use at baseline and at the end of the program. Marijuana use appeared to be over-dispersed and was specified as a count variable. A negative binomial regression model was used to estimate the association between MRQ and marijuana use at the end of the CC program, controlling for baseline use and a set of confounders (gender, age, ethnicity, socioeconomic status, and baseline marijuana use prior to CC program start). Results: A negative binomial regression model was used to calculate the results. Adjusting for baseline marijuana use and relevant confounders, the expected days of marijuana use is 67% lower for each one unit increase in MRQ. Conclusions: Consistent with prior research, we find that mentoring relationship quality is associated with better outcomes for adolescents. Although having a mentor may be beneficial, having a strong alliance and relationship quality with a mentor appears to be more favorable. Methods to enhance relationship quality are needed, and effective strategies may substantially enhance the effectiveness of mentoring interventions, including reductions in substance use for participating adolescents.

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Meaning in Life and Sensation Seeking on Marijuana Use

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Presence of meaning in life has been identified as a protective factor decreasing the likelihood of marijuana use. Meaning in life is defined as the sense and significance regarding the nature of

one's being and existence. Meaning in life is composed of two constructs, search for meaning and presence of meaning in life. Sensation seeking is defined as the desire for novel experiences and the willingness to take risks for these experiences. Past studies identify experience seeking as a predictor of initial drug use, but not of drug maintenance. However, risk seeking has been shown to predict drug maintenance and not initiation. Previous research on meaning in life, sensation seeking, and substance use have demonstrated that religious meaning in life is a protective factor for marijuana use regardless of an individual's level of risk seeking. The relations among existential (meaning in life not associated with religion) and personality factors (sensation seeking) and marijuana use has not yet been explored. The current study examined the relation among meaning in life, sensation seeking, marijuana use, using the Meaning of Life, Sensation Seeking Personality Type, and Risky Behavior Inventory scales. We hypothesized meaning of life would moderate the relation between sensation seeking and past 30-day marijuana use. Further, we hypothesized that individuals who had low search for meaning in life and high experience seeking, would use marijuana more frequently than individuals with high search for meaning in life and low experience seeking. The current study is a secondary data analysis of data that was collected in fall 2016 as a part of a larger study on health risk behaviors. Study hypotheses were tested using negative binomial regression due to past 30-day use being a highly skewed count variable. Marijuana use was determined by an individual's reported frequency of use over the previous 30 days. We found a significant interaction between search for meaning in life and experience seeking on past 30-day marijuana use. At low levels of the moderator, experience seeking negatively predicted past 30-day marijuana use, whereas high levels of the moderator were associated with experience seeking predicting increased use. These results suggest that search for meaning in life moderates the relation between experience seeking and marijuana use. Contrary to previous studies, which have identified experience seeking being a protective factor against drug use, the present study implicates it as a risk factor when moderated by search for meaning in life. Thus, if a client present high in experience seeking and is searching for meaning in life, then he or she may be at risk for marijuana use.

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Repetitive Transcranial Magnetic Stimulation of the Medial Prefrontal Cortex for Reduction of Polysubstance Use Craving: A Pilot Study

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Polysubstance use has been associated with myriad deleterious consequences in college students including increased risk for substance use disorders, poor academic performance, and risky sex behaviors. Recent studies among college students suggest that over 50% of past-month substance users have engaged in use of two or more of the following substance: alcohol, tobacco, and cannabis (ATC). Repetitive transcranial magnetic stimulation (rTMS) has been implemented as an alternative treatment to psychotherapy and has shown promise as a brief, noninvasive intervention for substance craving. The medial prefrontal cortex (mPFC) has been implicated in cognitive processes such as impulsivity and drug related cue responses making the mPFC a brain region of interest for the application of rTMS. Thus, the aim of the current study was to determine whether rTMS on the mPFC could be utilized to reduce polysubstance craving over a brief four day intervention. Participants (N = 14, 5 females, M_{age} = 21.5, 50% white) completed demographics, the Penn Alcohol Craving Scale (PACS), the PACS adjusted for cannabis, and the PACS adjusted for tobacco. Participants completed TMS stimulation sessions of either two or three cycles on four consecutive days. In following with previous literature, rTMS was set to 50Hz with 1800 pulses per cycle at 110% of the individual's resting motor threshold. Dependent means t-tests were conducted to assess for decreases in ATC craving from pre- to post-rTMS sessions. Results indicate a significant decrease in cannabis craving ($p < .01$) amongst cannabis users (N = 12). Decreases in alcohol craving amongst users (N = 12) approached significance ($p < .10$). Removal of an

outlier resulted in nominally significant decreases in alcohol craving (p = .01). Results did not indicate significant decreases in tobacco craving (p = .43) amongst tobacco users (N = 8). Although replication is necessary, these results show promise in using rTMS as a means of reducing alcohol and cannabis craving. Lack of significant decreases in tobacco craving may suggest that tobacco craving evidences differential patterns of cognitive control and impulsivity as compared to alcohol or cannabis. Future studies should compare findings to a control group of ATC users. Additionally, comparison of decreases in ATC craving between those receiving active rTMS and those in a sham rTMS condition would assist in dismantling if it is rTMS or other factors (e.g. expectancy effects) driving the decreases in craving. Future studies would also benefit from assessing how long decreases in craving are maintained and how decreases in craving relate to decrease in ATC use.

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Problems Associated with Adolescents' and Young Adults' Marijuana and Alcohol Co-Use

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Although the adverse effects of marijuana use are debated, its use during adolescence and young adulthood has been associated with a variety of negative consequences, including increased risk of accidental injury, fatal motor vehicle crashes, respiratory illness, psychotic disorders, impairment of cognitive functioning and brain development, low educational attainment, drug dependence, and involvement in crime. These adverse outcomes may be exacerbated by the co-use or simultaneous use of marijuana and other substances, including alcohol. We investigated the associations of co-use of marijuana and alcohol with experiences of negative outcomes using survey data obtained from 706 adolescents and young adults aged 16-21 years (mean age 18.3 years; 49% female) who lived in 24 midsized California cities. Based on past year self-reported alcohol and marijuana use, we identified three groups: (a) non-users, (b) alcohol only users, and (c) co-users of alcohol and marijuana. Interestingly, there were few marijuana only users in the sample (3%). Marijuana only users were thus excluded from the analyses. Of the study sample, 30% reported alcohol use only and 40% reported past year marijuana and alcohol co-use. Multi-level mixed effects logistic regression analyses were used to predict whether participants who reported alcohol only use or co-use of alcohol and marijuana had experienced each of eight problems in the past year (got into argument/fight; got hurt/injured; had unprotected sex, had sex with a stranger; had an unwanted sexual experience, rode with an intoxicated driver, and drove while intoxicated). We controlled for individual-level demographics (age, sex, race/ethnicity) and city-level variables (% minors, % White, % Hispanic, median household income). Compared with non-users, young people who used alcohol only were significantly more likely to report unprotected sex (*OR* = 1.85; 95% CI = 1.14, 3.02). They did not differ significantly from non-users in the likelihood of reporting any of the other problems. In contrast, those who reported alcohol and marijuana co-use were more likely than non-users to report getting into a fight (*OR* = 1.53; 95% CI = 1.04, 2.26), unprotected sex (*OR* = 4.98; 95% CI = 3.16, 7.85), sex with a stranger (OR = 8.25; 95% CI = 3.83, 17.73), unwanted sex (*OR* = 3.05; 95% CI =1.23, 7.52), riding with a drinking driver (*OR* = 3.57; 95% CI = 2.04, 6.28), and driving after drinking (*OR* = 10.44; 95% CI = 3.68, 29.62). Overall, the findings suggest that young people who use both alcohol and marijuana are at greater risk for problem outcomes than are those who use alcohol only. It is unclear whether the associations are causal (i.e., co-use leads to greater problems) or the result of other common factors (i.e., impulsivity) that predispose young people to engage in risky behaviors more generally. Nonetheless, prevention efforts should target the co-use of marijuana and alcohol.

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Are We Asking the Right Questions: Results of a Pilot Study on Marijuana Use Patterns and Terminology?

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With the quickly changing landscape of marijuana products, it is difficult to accurately capture marijuana use. Frequency can be relatively easily ascertained, but quantity is much more challenging; a standard in the field is yet to be widely accepted. Without a common terminology and standard of measurement between user and researcher, either scant data is collected or tremendous detail is gathered that is difficult to distill into usable measures. In an effort to balance participant burden and reporting accuracy, it is important to better understand common terminology and patterns of use. An online screening survey was sent to a nationwide Qualtrics panel. Inclusion criteria for the full survey were age 18-24, weekly alcohol and marijuana use in the past-month. 811 individuals completed the screening survey, 207 met inclusion criteria with an average age of 21.9 years. 123 completed an anonymous online survey. The sample used marijuana an average of 20 days of the last 30 (range 2-30). To understand if patterns of marijuana use exist "When you use marijuana… how often would you say that your use follows a pattern or routine" was asked; 97.6% reported that their use at least sometimes follows a pattern; 30.1% reported their use was always patterned. Participants were queried on several factors that contribute to patterns of use; they reported always using with the same people (39%), using the same mode of delivery (35.8%), in the same place (33.3%) and the same time of day (25.2%). Participants also described their pattern in their own words. A content analysis of responses revealed mention of the following factors in descending order of prevalence: time of day, method, who with, quantity, associated activities, and motivations. Participants were also asked to report in detail on their use in three different formats: hourly, block of day (day/evening/night), and with an open-ended item. In terms of reported quantity here (measured in grams), the hourly report generated the highest daily quantity with an average of 3.2 grams (range 0.1g-32g). The block format produced a daily average of 2.0g (range 0.1-12). When comparing the daily report to the block report 24.3% reported an equal quantity (defined by less than 0.1g disparity) with the 2 methods, while 45.5% reported greater quantity with the hourly, and 30.0% reported greater quantity with the block. Those that had an equal report across the two methods reported using lower quantities (range 0.1-4, mean=0.9g) compared to those that had disparities between methods (mean range 1.6-5.4). The open-ended responses were examined for content–terms bowls and joints were most frequently used, followed by grams, hits and blunts. Findings indicated that the terminology used around an important factor of use such as quantity needs to be thoroughly considered. Additionally, the measurement terminology researchers utilize may not be how users conceive of their use, and different timeframes appear to elicit different responses, especially for heavier users. In this frequently-using sample, patterned use is common. With this in mind, future research may be able to reduce participant burden by continuing to understand these nuances.

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Development of an mHealth Diary that Examines the Effects of Cannabis Use on Chronic Neuropathic Pain in Individuals Living with HIV

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Background: HIV sensory neuropathy (HIV-SN), typically characterized by sensory deficits and pain in the feet or hands, affects more than 50% of people living with HIV (PLWH). HIV-related neuropathic pain (NP) is often described as a chronic "stabbing", "burning" or "aching" sensation that is a frequent source of disability in this population. Traditional analgesic treatments are ineffective for many PLWH with NP, but recent data indicate that administration of smoked or vaporized cannabis can provide pain relief. However, previous clinical trials are limited by several factors, including short duration (typically 1-2 weeks), a focus on low doses of delta-

9-tetrahydrocannabinol (THC), but not cannabidiol (CBD), and a lack of data about various methods of cannabis administration, such as edible products or dabbing. There is thus a significant need to close the gap between existing clinical data and assessing the effects of "real-life" cannabis use on NP. This abstract describes qualitative data from focus groups designed to obtain feedback about the effects of self-administered cannabis on pain and the utility of mHealth methods (collection of health data via cell phones or other mobile devices) to track this information for subsequent intervention studies. Methods: We recruited outpatients (n = 20) experiencing chronic pain (neuropathy, arthritis, or back pain) and self-reported cannabis use during the prior three months, including both PLWH and HIV-uninfected participants, to obtain diverse feedback about cannabis use in the context of chronic pain. Two focus groups, with 8 and 12 individuals, respectively, were conducted at the HIV Neurobehavioral Research Program in San Diego to discuss how to report the effects of cannabis exposure on daily pain using a mobile interface on their phones. Results: Two investigators independently coded focus group transcripts using the MAXQDA software. The kappa value for interrater reliability was 0.85, indicating a high degree of rater agreement. Data analysis revealed three primary themes: 1) effective methods for reporting pain; 2) effective methods for reporting cannabis use; 3) the impact of cannabis on pain. Participants expressed preferences for both qualitative (impact on everyday functioning) and quantitative (0-10 pain scale with anchors at 0 and 5) measures of pain, endorsed the feasibility of reporting cannabis content (THC and CBD), dose, and route of administration via a once-a-day text-message link to an online survey, reported that cannabis use allowed them to reduce their exposure to narcotic analgesics (opioids), and indicated that cannabis-reduced pain was associated with improvement in affect and everyday function. Conclusions: Focus group feedback enabled the development of a mobile smartphone platform designed to record daily pain and cannabis effects on pain, including technical design (text links to survey), pain question content (inclusive of affect/everyday functioning), and a detailed assessment of cannabis use. These data were used to support an ongoing study that evaluates the consequences of THC and CBD on HIV-related NP, including a 6-month observational electronic diary (Individual Monitoring of Pain and Cannabis Taken or IMPACT).

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Marijuana Policy Research Tool

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The purpose of the poster is to spread the word about a research tool that can be used to study the effects of marijuana legalization policy. NIAAA's Alcohol Policy Information System (APIS) now contains an authoritative and systematic coding of policies to legalize the recreational use of cannabis. The original APIS coverage is being expanded to cover about double the number of policy features covered by its earlier coverage. Members of the Research Society on Marijuana are positioned to take the lead in studying the effects of legalized cannabis, and hence need to know about the availability of this tool. Also depicted in the poster is an example of the fact that policy has been changing quite rapidly in the recreational cannabis field compared to policies affecting alcohol use. Finally, calls for grant applications are highlighted. These NIH Funding Opportunity Announcements are sponsored by both NIAAA and NIDA.

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Incidental Effects of Naltrexone Maintenance on Cannabis Use in the COMBINE Study

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Reciprocal functional interactions between the endogenous cannabinoid and opioid systems are well known. THC can reduce pain perception (Vivian et al., 1998), and rhesus monkeys administered THC reduced their self-administration of heroin (Li et al., 2015). Consistent with this, recent work in humans found that joint administration of cannabis and

low doses of oxycodone produce analgesia similar to that of larger doses of oxycodone alone (Cooper et al., 2018). Naltrexone is an opioid antagonist that also acts on cannabinoid receptors. In nonhuman primates, acute naltrexone reduces THC self-administration (Justinova et al., 2004). In humans, the effects of naltrexone on cannabis use appear to vary with the experience of the individual. In non-cannabis-smokers, acute naltrexone potentiates the effects of low cannabis doses (Haney, 2007), while in daily cannabis smokers, maintenance doses of naltrexone are associated with decreased cannabis self-administration (Haney et al., 2015). The COMBINE Study was a large multi-site medication (naltrexone, acamprosate) clinical trial for alcohol use disorder that did not exclude participants on the basis of cannabis dependence (Anton et al., 2006). COMBINE participants who used cannabis generally had higher alcohol use at the end of treatment did than those who did not use cannabis (Subbaraman et al., 2016). However, cannabis users randomized to receive naltrexone and the Combined Behavioral Intervention (CBI) reported end-of-treatment drinking equivalent to those randomized to receive naltrexone who did not use cannabis. The goal of the present study was to text the incidental effects of naltrexone maintenance for alcohol use disorder on self-reported cannabis use in the COMBINE Study. Data on cannabis use days were obtained from the Structured Clinical Interview for DSM-IV (SCID-I). Naltrexone dose estimates in COMBINE were generated by inspection of used blister packs. 206 participants (19.9% female) reported cannabis use during the 16-week treatment period. Cannabis use was significantly lower in the naltrexone-taking groups than in other groups ($X^2(1)=3.865$, p=.049). In a follow-up analysis comparing 85 participants assigned to receive either naltrexone or placebo, negative binomial regression controlling for baseline use indicated that participants randomized to receive naltrexone had significantly fewer cannabis use days during treatment than did those assigned to receive placebo (b=-1.969, p=.043). There was not a significant effect of CBI (b=-.563, p=.078). At the 12-month follow-up, there were no significant effects on cannabis use days. Results of the present analysis suggest that in the COMBINE study, naltrexone had incidental effects on participant cannabis use. That is, although COMBINE was not designed to influence cannabis use, participants who used cannabis and took naltrexone had fewer cannabis use days during the treatment period than did those who did not take naltrexone, and participants who took the prescribed dose of naltrexone had fewer cannabis use days than those who did not. After participants stopped taking naltrexone, cannabis use did not differ between groups. Although limited data on cannabis use reduce confidence in the study findings, these results suggest that naltrexone should be examined further as a treatment for cannabis use disorder, particularly in populations that also use alcohol.

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Greater Past Month and Lifetime Marijuana Use Are Associated with Poorer Cognitive Flexibility in Young Adult College Students

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Objective: Marijuana (MJ) is the most commonly used illicit substance in the United States. The use of MJ is particularly common among college and university students with 4.9% of them reporting daily or near-daily MJ use. Substantial evidence suggests frequent MJ users exhibit deficits in memory and attention, beyond the acutely intoxicated state. However, less is known about how recent and lifetime MJ use affect components of executive functioning, such as cognitive flexibility, which is critical to set-shifting and overcoming habitual actions. Due to the continued maturation of the prefrontal cortex during young adulthood, and the importance of this region for executive functioning, it is necessary to examine frequent MJ users in this age range for aberrations in cognitive flexibility related to MJ use. This is particularly important to investigate in young adult college students, as MJ use has been associated with adverse academic outcomes. The current study examined the association between quantity of MJ use and cognitive flexibility in frequent MJ users, ages 18-22, who were recruited as part of a larger study on MJ use and executive functioning. Method: Seventeen heavy MJ users (mean age: 20.12 ± .27; 9 male, 8 female) reporting 5 or more episodes of

MJ use per week over the past year were included in the current study. Participants were instructed to remain abstinent from MJ use for 12 hours prior to their study visit to insure they were not acutely intoxicated during testing. The 30-day Timeline Followback (TLFB) was used to assess recent MJ use and participants were asked to estimate lifetime MJ use occasions. Participants completed the Modified Wisconsin Card Sorting Test (M-WCST), a measure of cognitive flexibility. Results: Greater past 30-day MJ use was associated with poorer performance on the M-WCST. Past 30-day use was negatively correlated with T-scores for the following variables: categories correct ($r = -.59$, $p = .01$), perseverative errors ($r = -.67$, $p = .003$), percent perseverative errors ($r = -.62$, $p = .008$), and executive function composite ($r = -.67$, $p = .003$). Greater lifetime use was negatively correlated with perseverative errors ($r = -.59$, $p = .01$), percent perseverative errors ($r = -.65$, $p = .005$), and executive function composite ($r = -.49$, $p = 0.046$) T-scores. When controlling for recent use, lifetime use significantly predicted percent perseverative errors ($F(2,14) = 8.60$, $p = .004$, $\Delta R^2 = .17$, $\beta = -.46$, $t = -2.31$, $p = .04$), above and beyond recent use. Conclusion: These findings suggest a dose-dependent relationship between MJ use and cognitive flexibility in young adult college students who are frequent users of MJ. Cognitive inflexibility may result in the maintenance of craving and preoccupation with MJ use due to an impaired ability to consider alternatives to and consequences of MJ use. Further research is needed to understand whether these deficits are the result of neurotoxic effects of MJ or pre-existing impairments in cognitive flexibility prior to initiation of use, and whether these deficits persist after longer periods of abstinence.

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Mental Health Symptoms and Marijuana Consequences: Protective Behavioral Strategies as a Mediator

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Individuals that have elevated mental health symptoms are more likely to suffer from consequences of marijuana use than individuals without such mental health symptoms. Several mechanisms could be responsible for this relationship, including the individuals' motives for use, their expectancies, or their use of protective behavioral strategies (PBS). PBS are behavioral strategies that can be used to reduce the negative consequences from substance abuse, such as only using during a certain time or limiting the amount used. PBS use was examined as a possible mediator for the effect of mental health symptoms on marijuana consequences. From a larger sample of 6,584 college students recruited from 8 universities in the U.S., we examined a subsample of marijuana users who completed the DSM-5 Level 1 Cross-Cutting Symptom Measure (*n*s range from 909 – 922 across models), which assesses 13 psychiatric domains. In separate models (i.e., each mental health symptom), PBS use significantly mediated the association between each mental health domain and marijuana consequences (14.29% - 43.90% of the total effect) except for anger. In a combined model with all 13 mental health symptoms, there were significant indirect effects through PBS use for memory, dissociation, and anger, though the effect through anger was opposite of its total effect. Lastly, we found PBS use partially mediated the effect of a latent factor of all 13 mental health symptoms on marijuana consequences. PBS use was found to be a partial mediator for the amount of marijuana consequences experienced by individuals that have elevated mental health symptoms, suggesting that PBS use may be a promising intervention target for these individuals. Research is needed to determine why these individuals use fewer PBS (e.g., lower perceived harm of marijuana use, lower capability of planning their use, etc.) in order to determine optimal intervention strategies. Importantly, PBS use only accounted for some of the effects of

mental health symptoms on consequences, indicating that other possible mediators should be examined

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Trauma Cues Elicit Greater Conditioned Craving Responses than Do Cannabis Cues in Cannabis Users with Trauma Histories

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Conditioned craving is said to develop in drug users in response to drug cue exposure. Through repeated pairing of drug cues with desired outcomes of drug use, strong associations are formed in memory, such that presentation of the drug cue alone is sufficient to elicit a conditioned craving response. Through a similar learning process, exposure to trauma cues is theorized to elicit conditioned drug craving in individuals with trauma histories, following the repeated use of the drug for the relief of trauma-related symptoms. Little is known regarding whether this type of trauma cue-induced conditioned craving occurs in traumatized cannabis users. We examined the link between trauma cue exposure and cannabis cravings using a cue-reactivity paradigm in cannabis users with trauma histories. Participants are exposed to three types of personalized audio and visual scripts (trauma, cannabis, neutral) in random order. Following exposure to each cue, participants rate their cannabis cravings (Marijuana Craving Questionnaire – Short Form (MCQ-SF); Heishman et al., 2009) and mood (Positive and Negative Affect Schedule (PANAS); Watson, Clark, & Tellegen, 1988; Mood-VAS scale; Lundahl & Greenwald, 2016). Although data collection is ongoing, we present preliminary results on our first eight participants (mean age = 42.63, 87.5% male, 50% military, 37.5% met criteria for PTSD). We conducted one-way (cue type) repeated measures ANOVAs (with Greenhouse-Geisser adjustment) separately for each mood and cannabis craving scale, followed by LSD post-hoc tests. On the PANAS, the trauma cue induced significantly more negative mood than both cannabis and neutral cues, $F(1.684, 11.787) = 7.963$, $p = .008$, although there was no difference between cue types for positive mood, $F(1.106, 7.744) = .457$, $p = .538$. Participants also reported feeling significantly more "anxious" ($F(1.382, 9.674) = 11.580$, $p = .005$) and "down" ($F(1.905, 13.334) = 10.848$, $p = .002$) on the Mood-VAS scale after trauma vs. both cannabis and neutral cue exposure, supporting the validity of the trauma cue exposure in inducing negative mood. On the MCQ-SF subscales, trauma cues were significantly more likely to elicit cannabis cravings for relief (i.e. "emotionality"; $F(1.878, 13.145) = 6.522$, $p = .012$), induce an inability to control cannabis use (i.e. "compulsivity"; $F(1.538, 10.768) = 7.808$, $p = .011$), create an anticipation of positive outcomes from using cannabis (i.e. "expectancy"; $F(1.448, 10.135) = 6.752$, $p = .019$), and induce cravings reflecting an intention and planning of using cannabis (i.e. "purposefulness"; $F(1.431, 10.017) = 17.516$, $p = .001$), when compared to both cannabis and neutral cues. Cannabis cues in turn elicited more craving in the purposefulness domain than neutral cues. Overall, these preliminary results indicate that trauma cues elicit more craving, as well as more negative affect (anxiety, sadness), than both cannabis and neutral cues in this cannabis-using population with significant trauma histories. This suggests that exposure to trauma cues (i.e., external trauma reminders and/or internal trauma memories) may be a strong predictor and motivator for cannabis use in this population. Thus, exposure to trauma cues may promote cannabis use for regulating negative affect via conditioned craving processes.

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Campus Climate Matters: The Impact of Racial Microaggressions on Marijuana Use among Undergraduate Students of Color

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Background: Microaggressions are verbal, behavioral, or environmental indignities,

intentional or not, that communicate hostile, derogatory, or other negative racial assertions to people of color. Recent research focused on racial microaggressions indicates that experiencing them is associated with a higher risk for stress, low self-esteem, and anxiety among college students of color. Also, students of color who perceive an unwelcoming campus climate can experience academic difficulties and increased risky substance use. At the same time, marijuana use by all college students has seen a steady increase over the last decade. In 2016, more than 20% reported use in the past 30 days, up 5% from 2006. Many students use marijuana to cope with stress and social anxiety, with related negative health and academic outcomes. We sought to identify associations between perceived microaggressions, marijuana use, and motivations for use among undergraduate students of color, hypothesizing that the more a student experienced racial microaggressions, the more likelihood of marijuana use. Methods: A sample of 251 undergraduate students of color from a medium-size university in the northeastern US responded to a racial microaggressions and substance use survey. Original data were collected using the Racial Microaggressions Scale (RMAS), which is factored into six subscales: invisibility, criminality, low-achieving/undesirable culture, sexualization, foreigner/not belonging, and environmental. We explored relationships among racial microaggressions, motives for marijuana use, and marijuana use, conducting a path analysis to test the significance of hypothesized connections between variables. Results: The majority of students were aged 18-20 (62.5%) and female (69.9%). Approximately 42% of the sample reported using marijuana during the past 30 days, 22% reported use 1-3 times per month, and 17% multiple times per week. Path analysis indicated that motives for marijuana use mediated the relationship between racial microaggressions and actual marijuana use. Discussion: and Implications. Although our analyses showed no direct relationship between perception of racial microaggressions and marijuana use, taking into account motives for use revealed that racial microaggressions do indirectly influence marijuana use. Specifically, our study suggests that when undergraduates of color perceive negative characteristics of their environment related to race (e.g., absence of people from one's racial background in school or being in contexts where an individual is the "only person of color"), their motives to use marijuana, especially those involving social reasons (e.g., to fit in with peers), increase the likelihood of their using marijuana. Our study demonstrates that students of color may have unique reasons for marijuana use and reinforces the importance of college administrators' efforts to make the campus climate more inclusive and welcoming for all students. Implications for practitioners include tailoring substance use prevention programs and counseling services to better address the health and well-being of students of color.

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Who Volunteers for Cannabis Research? Examining Potential Participation in Cannabis Research among Emerging Adults

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While many contemporary empirical studies draw inferences from the undergraduate student population, little is known about the patterns of research participation in this group. The sensitive nature of substance use may play an influential role in studies investigating illicit use, particularly in the emerging adult population. The present study examined cannabis use and willingness to participate in cannabis-related research in emerging adults. Undergraduate students enrolled in a psychology course (n=262) reported frequency of cannabis use and if they would be willing to participate in hypothetical research studies on cannabis, varying in study type and compensation. Chi-square tests for independence revealed significant relations between gender and cannabis use per week, as well as use per year and lifetime use. Notable significant associations also appeared between willingness to ingest marijuana for pay and lifetime use (Cramer's V=.433, p<.0001), as well as willingness to ingest marijuana for scientific contribution with both yearly and lifetime use (Cramer's V=.434, p<.001; Cramer's V=.580, p<.001). Additionally, significant relations with

gender suggested that males were less willing to complete a survey for a prize, but more willing to come to a lab study for scientific contribution, and to ingest cannabis for scientific contribution; odds ratios (respectively) were, OR=.372 [95% CI, .171-.811], OR=2.336 [95% CI, 1.318-4.138] and OR=2.182 [95% CI, 1.154-4.123]. These results demonstrate important trends exist in potential participation for cannabis-related research in the emerging adult population, specifically around gender, and suggest cautious interpretation for the generalizability of studies on cannabis in undergraduate students.

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Marijuana Expectancies as a Predictor of Substance Use Initiation among High School Students

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Adolescence is a high-risk period for substance use onset. Expectancies have been identified as proximal predictors of adolescent onset of substance use. However, little is known about whether change in marijuana expectancies is a risk factor for marijuana use onset. The present study was conducted to examine trajectories of marijuana expectancies and to investigate whether change in marijuana expectancies was predictive of marijuana use onset. Data from 3,396 ethnically diverse high school students were collected across eight waves of assessment (follow-up assessments were 6-months apart with baseline assessment commencing when participants were in 9th grade and concluding when participants were in 12th grade) and analyzed within a latent growth modeling framework. Parallel process latent growth models with robust weighted least squares estimation were conducted to derive the slopes and intercepts from the first four waves of positive and negative marijuana expectancy data to examine whether these parameters were predictive of marijuana use onset that occurred during the last four waves of assessment. The results from the study indicate that the slopes of positive marijuana use expectancies were prospectively predictive of marijuana use onset. Specifically, the slope of positive marijuana expectancies was positively associated with the likelihood of initiating marijuana use for the first time after controlling for gender, age, and baseline level of positive marijuana expectancies (B=1.26, p<.001; β=.32). Moreover, the slope of positive marijuana expectancies accounted for unique variance that was not accounted for by baseline levels of positive marijuana expectancies. That is, regardless of the level of positive marijuana expectancies endorsed by participants at baseline, change in positive marijuana expectancies was still predictive of marijuana use onset. Baseline level of positive (B=.63, p<.001; β=.54) and negative (B=-.19, p=.03, β=-.15) marijuana expectancies were also found to be prospective predictors of marijuana use onset. Results from the present study indicate that change in marijuana expectancies – as well as level of positive and negative marijuana expectancy endorsement at 9th grade – may be markers of risk propensity for prospective marijuana use onset that occurs in high school.

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Retail Availability of Cannabis in Oregon Counties, Perceived Availability, and Cannabis Use among Adolescents

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Research on local cannabis policies, retail cannabis availability and cannabis use among adolescents is limited. This study examines relationships between cannabis sales policy in Oregon counties, retail availability of cannabis, perceived availability of cannabis, normative beliefs, and cannabis use among adolescents. We hypothesized that a higher density of cannabis retail outlets would be present in counties that allowed cannabis sales for medical or recreational use, and that greater retail availability would be positively associated with perceived cannabis availability, normative beliefs favorable to cannabis use, and cannabis use among adolescents. We also hypothesized that perceived

availability of cannabis and normative beliefs more favorable to cannabis use would act as mediators of the association between retail cannabis availability and cannabis use among youth. Data on Oregon county cannabis sales policy and licensed retail outlets were obtained from the Oregon Liquor Control Commission, indicating which cities and counties prohibited sales of cannabis for medical and recreational use, and the locations of licensed retail outlets, respectively. We computed licensed retail outlet density per 10,000 county population. We obtained county-level prevalence rates for past-30-day cannabis use among 11th graders from the 2015-16 Student Wellness Survey (N=57,742) conducted by the Oregon Health Authority. The SWS also included questions about perceived availability of cannabis and perceived disapproval of cannabis use by parents and friends. Bivariate correlations for 32 Oregon counties indicated significant positive associations between the prevalence of past-30-day cannabis use among 11th graders and counties allowing sales of cannabis for medical or recreational use ($r = .58$, $p<.01$), density of licensed outlets ($r = .48$, $p<.01$), and the perception that cannabis would be very easy to get ($r = .70$, $p<.01$). Parents' disapproval of cannabis use was inversely related to the prevalence of past-30-day cannabis use among 11th graders ($r = -.51$, $p<.01$), as was friends' disapproval ($r = -.48$, $p<.01$). Perceived availability of cannabis was positively associated with counties allowing cannabis sales ($r = .55$, $p<.01$) and a higher density of licensed cannabis outlets ($r = .40$, $p<.05$). Parents' and friends' disapproval of cannabis use were inversely related to counties allowing cannabis sales and density of licensed cannabis outlets. Linear regression analyses indicated possible indirect effects of county cannabis sales policies and cannabis outlet density on past-30-day cannabis use among 11th graders, as the beta coefficients for these predictors were no longer significant in models with perceived cannabis availability. However, the normative beliefs variables did not appear to act as mediators. These results suggest that legalization of cannabis for medical and recreational use is associated with greater retail availability of cannabis and greater perceived availability of cannabis among adolescents, which may increase their risk for cannabis use. Further research is needed to better understand effects of local cannabis policies and availability on cannabis use and related problems among youth.

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PTSD Symptom Severity and Cannabis Use: The Moderating Role of Race/Ethnicity

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Elevated posttraumatic stress disorder (PTSD) symptoms appears to be a significant risk marker for problematic cannabis use. However, unlike the PTSD-alcohol literature, few studies have evaluated sociodemographic characteristics that may moderate the association between PTSD and cannabis use. Epidemiological work has identified differences in cannabis use patterns as a function of race/ethnicity, but the nature of the relation differs when trauma history and psychological characteristics (e.g., diagnostic status) are also considered. For example, in the recent National Surveys on Drug Use and Health, individuals identifying as Black or Native American reported the highest rates of cannabis use and related problems; however, in a large sample of trauma-exposed individuals, Kevorkian and colleagues (2015) found the highest rates among those identifying as White. To date, no work has addressed race/ethnicity as a potential moderator of the association between PTSD and cannabis among those exposed to trauma expressing clinical and preclinical symptoms. The present study tested whether race/ethnicity moderated the association between PTSD symptom severity (PTSDSS) and past-year cannabis use. Based on prior studies, we hypothesized that Whites and Hispanics who present PTSS would have higher rates of cannabis use, followed by African Americans and Asians who would report the lowest rates. The final sample consists of 1,067 college participants (M = 20. 71 years; 72.9% female) who completed a demographics questionnaire which assessed the participants' race/ethnicity; a single, face valid question measured past-year cannabis use; and the PTSD Checklist which measured PTSDSS. First, ANOVA and multiple regression analyses were

conducted to preliminarily examine the influence of racial/ethnic identity on past-year cannabis use. For primary analyses, separate moderation analyses were conducted using PROCESS in SPSS to examine specific race/ethnicity identification groups as moderators in the relationship between PTSDSS and cannabis use. Consistent with past literature, results of the ANOVA found that individuals identifying as White (M = 4.20) and African American (M = 4.25) used significantly more frequently than those identifying as Asian (M = 3.30) or Hispanic/Latino (M = 3.59); further, results of the regression analyses indicated that identification as Asian (ß = -.01; p = .021) or Hispanic/Latino (ß = -.12; p = .007) was significantly associated with less past-year cannabis use. However, results of the primary analyses indicated that race/ethnic identity was not a significant moderator in the association between PTSDSS and cannabis use. Results indicated that race/ethnicity did not play an important role in the association between PTSS and cannabis use among trauma-exposed college students. Future research addressing race/ethnicity, as a function of diagnostic status (e.g., with or without PTSD, cannabis use disorder), and across other contextually- and developmentally-distinct periods, is needed. For example, work-addressing periods characterized by relevant vulnerability (e.g., puberty) could be a key to understanding the nature and boundaries of these relations.

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Does Marijuana Use Impact Academic Performance in the College Setting?

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Background: Past research has examined the impact of marijuana use on college student academic performance. Marijuana use has been associated with GPA and failure to obtain a university degree. A recent longitudinal study found that as marijuana use escalated, college students were more likely to skip classes and performed more poorly academically, as measured by GPA. Few studies have assessed other academic components that might influence completion of one's college degree among marijuana users, such as academic motivation and self-efficacy. The goal of the current study was to assess whether frequency of marijuana use, problem use, academic motivation, academic self-efficacy, and academic self-regulation impact university retention and performance. Methods: Active college-student marijuana users (n = 52) were recruited and completed a baseline assessment. Although all participants completed two-week ecological momentary assessment, the current presentation focuses on baseline data. Marijuana use frequency was assessed through days of marijuana use over the last month. Problem marijuana use was assessed through the Rutgers Marijuana Problem Index (RMPI). Academic self-efficacy and self-regulation were assessed using subscales of the Motivated Strategies for Learning Questionnaire (MSLQ). Academic motivation was assessed using a subscale from the Learning and Study Strategies Inventory (LASSI). Results: The sample was 57.7% female, 59.6% Caucasian, and averaged 20.04 (SD = 1.49) years of age. Mean cumulative GPA was 2.80 (SD = 0.65; range from 1.07-3.93). Participants were heavy marijuana users, reporting near daily use across the past 30 days (M = 23.56, SD = 6.85). We examined whether academic variables and marijuana use/problem use predicted current GPA via multiple regression. The overall model accounted for 32.9% of the variance. Self-efficacy (b = .05, SE= .02, p =.006) and academic motivation (b = .07, SE = .03, p = .017) contributed to current GPA. After controlling for academic variables, neither the frequency of marijuana use, nor problem use, were associated with current GPA. Logistic regression was used to assess whether academic variables and marijuana use/problem use contribute to student retention. In the current sample, 86.5% (N = 45) of participants remained at the university one semester after their baseline appointment. Due to the large number of retained students, there were no significant predictors of academic retention. Conclusions: Frequency of marijuana use over the last 30 days did not contribute to GPA when controlling for academic factors (academic self-efficacy and motivation).

There were no significant predictors for retention, although this was due to a lack of power to detect differences. Future studies with more participants should continue to evaluate the potential impact of marijuana use on college student success. Research reported in this abstract was supported by NIDA of the National Institutes of Health under award number R15DA041656 (PIs: K. Phillips, M. Phillips).

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Reduction of Benzodiazepine Use in Patients Prescribed Medical Cannabis

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Background: Benzodiazepines are a class of medication with sedative properties, commonly used for anxiety and other neurological conditions. These medications are associated with several well-known adverse effects. This observational study aims to investigate the reduction of benzodiazepine use in patients using prescribed medical cannabis. Methods: A retrospective analysis was performed on a cohort of 146 medical cannabis patients (average age 47 years, 61% female, 54% reporting prior use of cannabis) who reported benzodiazepine use at initiation of cannabis therapy. These data are a part of a database gathered by a medical cannabis clinic (Canabo Medical). Descriptive statistics were used to quantify associations between the proportion of benzodiazepine use with time on medical cannabis therapy. Results: After completing an average two-month prescription course of medical cannabis, 30.1% of patients had discontinued benzodiazepines. At a follow-up after two prescriptions, 65 total patients (44.5%) had discontinued benzodiazepines. At the final follow-up period after three medical cannabis prescription courses, 66 total patients (45.2%) had discontinued benzodiazepine use, showing a stable cessation rate over a six-month period. Conclusion: Within a cohort of 146 patients initiated on medical cannabis therapy, 45.2% patients successfully discontinued their pre-existing benzodiazepine therapy. This observation merits further investigation into the risks and benefits of the therapeutic use of medical cannabis and its role relating to benzodiazepine use.

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Examining Protective Behavioral Strategies as a Mediator in the Relationship between Social Anxiety and Cannabis-Related Consequences

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Individuals high in social anxiety have been shown to experience a greater number of alcohol- and cannabis-related consequences relative to those lower in social anxiety, despite insignificant differences in levels of substance use. Therefore, an important goal for researchers in this field is to determine what factors may reduce the risk of experiencing both alcohol- and cannabis-related consequences. Protective behavioral strategies are strategies an individual can utilize when using both alcohol and cannabis to reduce the number of negative consequences experienced as result of use. Previous research has shown that both alcohol and cannabis protective behavioral strategies are robustly negatively associated with use frequency and consequences for both substances. Recent work in the study of social anxiety and alcohol protective behavioral strategies has found that serious harm reduction strategies mediates the relationship between social anxiety and alcohol-related consequences. Given similarities in the social anxiety literature in regards to alcohol- and cannabis-related consequences, the purpose of the current research was to examine if cannabis protective behavioral strategies similarly mediates the relationship between social anxiety and cannabis-related consequences. Participants were 1022 students from multiple universities who completed measures assessing social anxiety, cannabis protective behavioral strategies, and cannabis-related outcomes. Cannabis protective behavioral strategies were found to mediate the relationship between social anxiety and cannabis-related consequences such that those higher in social anxiety used fewer protective behavioral

strategies, and in turn experienced more cannabis-related consequences when controlling for quantity and frequency of use. These results indicate that those with social anxiety who also use cannabis may benefit from interventions designed to increase the use of cannabis protective behavioral strategies.

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Differences between College Student Medical and Recreational Cannabis Users: More Similarities or More Differences?

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Currently, thirty states and the District of Columbia have legalized medical use of cannabis, with several other states allowing the use of some constituent of cannabis for medical purposes (i.e., cannabidiol). Common reasons for medical use include posttraumatic stress symptoms, anxiety, chronic pain, stress, insomnia and depression (Bonn-Miller et al., 2014). Few studies explicitly examine differences between medical and recreational users of cannabis (Lin et al., 2016), especially in the college student population. In some ways, one may expect some difficulties with separating medical from non-medical use. For example, many "recreational" users report using marijuana to cope (e.g., with negative affect), thus the degree to which a distinction between medical and non-medical use can be made is unclear. Using two large college student samples, the purpose of this study was to determine the extent to which college student medical users (i.e., individuals reporting having a medical card) differ systematically from recreational users. Using two large samples of college students (Study 1: 7307 college students, 4081 lifetime users, 2226 past month marijuana users, 46 medical users; Study 2: 6584 college students, 3744 lifetime users, 1969 past month marijuana users, 70 medical users). Although we found reliable differences between medical and recreational users in use patterns, cannabis use disorder symptoms, and use of protective behavioral strategies, we failed to find reliable differences on negative consequences, mental health symptoms, and most marijuana use motives. Although one may expect medical users to report higher coping motives or expect coping motives to be their strongest motive for use, they actually reported higher use of expansion motives and (like recreational users) reported enhancement motives as their strongest motive for use. Although not replicated due to not being assessed in both studies, the largest differences found were medical users reporting higher craving, higher marijuana identity, and lower perceived negative consequences of marijuana use Taken together, we found some striking similarities as well as some reliable differences between college student medical and recreational users. Future research should examine the extent to which these risk/protective factors operate similarly across medical vs. recreational users.

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A Person-Centered Approach to Investigate Relations among Substance User Profiles and Impulsivity

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Alcohol use and other substance use remain highly prevalent for college students in the United States. The extant literature has supported the notion that impulsivity-like facets are significant correlates and predictors of consumption and problematic usage of alcohol and other substances. However, there is a scarcity in the literature on how polysubstance use relates to these facets. Further, most studies in the literature have focused on variable-centered approaches to examine these relations. Although person-centered approaches like Latent Class Analysis (LCA) have been utilized to profile drinking patterns, and more recently, subgroups of marijuana users, more work is needed to explore the relations between profiles, impulsivity facets, and alcohol use outcomes. Provided these gaps in the literature, the present study aimed to use a person-centered approach to examine whether empirically-identified latent substance

use profiles relate to impulsivity-like facets (i.e., positive urgency, negative urgency, lack of perseverance, lack of planning, and sensation seeking) and problem drinking differently among college students. A sample of 702 students from a large, southwestern university was used (*M*age = 19.30, *SD* = 1.74; 71.79% female). A latent class analysis of various past-month indices of alcohol and other substance use (e.g., marijuana use, binge drinking, E-cigarette use) was conducted in Mplus. After examining the AIC, BIC, adjusted BIC, Vuong-Lo-Mendell-Rubin likelihood ratio, and entropy model-fit statistics from one- to seven-class solutions, a three-class solution was identified as the most parsimonious and best-fitting solution. The classes consisted of (1) a predominantly drinking class (n = 288), (2) a non-users class (n = 209), and (3) a poly-substance users class (n = 205). A chi-square test of independence revealed that substance use profiles differed significantly on problem drinking as measured by AUDIT χ^2 (4, N = 700) = 360.26, p < .001. Pairwise comparisons indicated that the poly-substance users reported the highest levels of severe and moderate problematic drinking, followed by predominantly drinkers, then non-users. Conversely, poly-substance users reported the lowest level of minimal problematic drinking, followed by non-users and predominantly drinkers. Additionally, analysis of variance tests revealed significant effect of substance use profiles on each of the impulsivity-like facet as measured by the Short UPPS-P, with varied pairwise differences between substance use profiles. For example, poly-substance users reported greater positive urgency than either predominantly drinkers (p < .001) and non-users (p < .001). In contrast, both poly-substance users and predominantly drinkers endorsed higher sensation seeking levels than non-users (p < .001, p = .003, respectively), but did not significantly differ between one another. These findings indicate that different groups of substance users exhibit varied levels of impulsivity-like facets and severity of problem drinking. Future work could further delineate and explain differences in profiles, as distinct profiles could be targets of intervention to prevent or intervene on problem drinking.

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Antecedents, Contexts, and Consequences of Marijuana Use: A Comprehensive Review of Microlongitudinal Studies

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Due to a lower level of research interest on marijuana over the past few decades relative to other drugs, there are substantial knowledge gaps regarding the antecedents, contexts, and sequelae of marijuana use. Importantly, all study designs are not equal with regards to closing these knowledge gaps. When considering cost and feasibility, we argue that the microlongitudinal design can most rapidly close these knowledge gaps. The microlongitudinal design includes repeated measurement in relatively close proximity to one another and is facilitated by the use of ecological momentary assessment (EMA; Shiffman, 2009) methods, also known as experience sampling and ambulatory assessment, among other things. The simplest EMA design is the daily diary design in which individuals complete a single assessment per day, but EMA studies can include several assessments per day or even continuous assessment (e.g., transdermal alcohol monitoring, Alessi, Barnett, & Petry, 2017; heart rate monitoring, Wilhelm, Pfaltz, & Grossman, 2005). EMA studies are able to examine the associations among variables at both the between-subject and within-subject levels. Importantly, when examining the associations between a putative antecedent and outcome at the within-subject level, each individual is essentially serving as their own control. The present comprehensive review examines all EMA studies that had been published on marijuana use (or related outcomes) at the time of the writing of this review. To date, we have 47 articles published through April 2016, but will be presenting all articles published up until June 2018. The purpose of this review is threefold: 1) summarize EMA studies to better characterize the

antecedents, contexts, and consequences of marijuana use, 2) identify methodological limitations of these studies that can be overcome in future research, and 3) identify areas of research that have not yet taken advantage of EMA methods that would help to close important knowledge gaps in the marijuana field. The most common form of EMA collection was the use of a PDA which emitted random signals throughout the day which participants would answer pre-programmed assessments. The assessments most commonly measured the frequency of marijuana use since previous signal as well as subjective effects (i.e., anxiety and depression levels), environment, and social situation the participant was in. The range of signals emitted per day was as little as one-time (daily diaries) to as much as twelve times. The range of the duration of EMA data collection was as few as six days to as much as thirty days. One clear limitation across studies is that quantity of marijuana use is still not often measured in EMA studies, diminishing our ability to detect dose-response associations.

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Marijuana Use Patterns Among College Students: Promise of Probing User Heterogeneity

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The majority of marijuana research to date has been a comparison of marijuana users versus non-users, assuming that the marijuana user population is a homogenous group. Using Latent Profile Analysis (LPA), previous studies have shown that marijuana users are a heterogeneous group, exhibiting several subpopulations as opposed to a single use pattern. Pearson et. al. (2017) have found four classes of college student marijuana users, with the largest group being low-quantity, infrequent users who reported the least number of consequences. The current study sought to distinguish subpopulations within college student marijuana users, measuring the quantity (in grams) of marijuana used, number of consequences reported, frequency of use within the past 30 days, and "typical frequency" of use during a "typical week". A weekly grid was used to divide each day of the week into six 4-hour time blocks where the participant was asked to record the amount of marijuana in grams they used during a time block. A brief form of the Marijuana Consequences Questionnaire (Simons, Dvorak, Merrill, & Read, 2012) was used to measure marijuana consequences. Using LPA, we identified four classes of marijuana users. Class 1 was low-quantity, infrequent users which contained 71.29% of users; class 2 was low-quantity, moderate users containing 17.16% of users; class 3 was moderate-quantity, frequent users containing 9.97% of users; and class 4 was frequent, high quantity users containing 1.59% of users. Between classes, there were substantial differences in quantities, with class 1 reporting on average 2.352 grams on average per typical week, and class 4 reporting approximately 80 grams per typical week. These classes also differed on the reported number of consequences, with class 1 reporting the least, and class 4 reporting the most consequences. Class 4 also reported the highest likelihood for cannabis use disorder symptoms, used less protective behavioral strategies, and identified the most strongly as a marijuana user. For future research, there needs to be a more immediate and accurate way of reporting use and quantity in order to corroborate results.

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Endorsing Beliefs for Using Cannabis Around Exercise: An Exploratory Study

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There is limited knowledge concerning the relationship between cannabis use and exercise. As accessibility to cannabis increases, there is growing need to study how cannabis influences health and daily activities. Cannabis decreases motivation to exercise and can negatively affect motor control, while cannabis can also decrease inflammation and physical discomfort brought on by exercise (Gillman et al., 2015). Using a cross-sectional survey, a community sample of at least

twice weekly cannabis users (N = 88) indicated if they ever use cannabis one hour before engaging in exercise and/or within four hours after exercising. Participants then rated their beliefs about the positive influence of cannabis on exercise (e.g., cannabis enhances performance, cannabis makes it easier to recover) from 1 (Strongly Disagree) to 7 (Strongly Agree). Participants also indicated the concentration of tetrahydrocannabinol (THC) and cannabidiol (CBD) in the cannabis they use most often. This was multiplied by average quantity (in grams) of use to create a dose score. Participants reported an average THC dose of 0.06 g (SD = 0.10) and average CBD dose of 0.02 g (SD = .03) per use episode. The majority of individuals (87.5%) used cannabis one hour before and/or four hours after exercise. Overall, participants who used cannabis around exercise reported higher agreement (M = 4.89, SD = 1.21) with the positive beliefs compared to participants who did not report using cannabis around exercise (M = 3.62, SD = 1.12), $t(81) = -3.07$, $p < .01$. Similar results were observed for each of the five beliefs individually. Regarding the specific beliefs, people were most likely to support the belief that cannabis makes it easier for them to recover from exercise (M = 5.44, SD = 1.64). This belief was also the only one significantly associated with THC dose ($r = 0.27$, $p < .05$) and demonstrated a trend with CBD dose ($r = 0.20$, $p < .1$). These results suggest that cannabis users who use cannabis around times of exercise may do so because of their positive beliefs about exercise-related benefits of cannabis. Alternatively, the act of using cannabis around exercise may serve to enhance the positive beliefs cannabis users hold around exercise-related benefits of cannabis. Negative exercise-related beliefs of cannabis were not assessed in the current study, which also may be a contributing factor to the strength of the cannabis-exercise relationship. Further research on cannabis beliefs around exercise performance and recovery and THC and/or CBD consumption, together with biological mechanisms, could inform efforts to understand the risks and benefits of cannabis on physical activity.

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Cognitive and Behavioral Risk Correlates of Marijuana Use by Older Adults

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Marijuana use by older adults is on the rise. Published data from the National Survey of Drug Use and Health (NSDUH) suggested that rates of self-reported marijuana use increased significantly among adults aged 50 to 64 and substantially among adults aged 65 or older (seniors). Notably, however, of 447,196 individuals in the combined 2006-2013 NSDUH dataset, seniors represented only 4.0% of the sample (n=17,837), and only 154 seniors (0.8%) reported marijuana use in the past year. Little is known about older marijuana users; most research has been conducted with young adults, in whom marijuana use is associated with cognitive impairment and risk-taking behavior. Using data from the Behavioral Risk Factor Surveillance System (BFRSS), we examined whether similar associations were evident in an older adult population. In 2016, 13 states (4 with legal non-medical use, 3 with legal medical use, 4 with legal CBD use, and 2 with no legal use) optionally queried marijuana use in the prior 30 days as part of the BRFSS. Of 129,782 individuals in the 13-state dataset, seniors comprised 36.5% of the sample (n=47,422) and 892 seniors (1.9%) reported marijuana use in the past 30 days. Percentages of persons aged 45-64 who self-reported marijuana use ranged from 2.1% to 12.8%, varying by state. Percentages of seniors who did so ranged from 0.3% to 6.7%. Any marijuana use in the prior 30 days was negatively correlated with healthy days/health-related quality of life in both age groups and positively correlated with having fallen in the last 12 months; ongoing difficulty concentrating, remembering, or making decisions; and cognitive decline over the last 12 months, particularly in the 45-64 age group. In the small subset of senior marijuana users who reported cognitive decline and completed optional follow-up questions administered by 3 states (n=50), there was a strong association between level of marijuana use and the extent to which cognitive decline had led respondents to give up household activities or chores (r=.425) or interfered with work or social activities (r=.420). Any marijuana use in the prior

30 days was positively associated with likelihood of alcohol use, binge or heavy drinking, driving under the influence of alcohol, and HIV risk-taking in both age groups. Among marijuana users, level of marijuana use was negatively associated with likelihood of drinking alcohol and HIV risk-taking. Findings suggest that older adults who use alcohol and take other risks are more likely to use marijuana than those who do not, which may reflect non-medical use, and those who use marijuana tend to be in poorer health than those who do not, which may reflect medical use. However, because the data are purely correlational and cannot demonstrate causality, the nature of these relationships is unclear. The effect of marijuana on cognition is concerning as older adults are vulnerable to harm from cognitive errors, such as errors in medication self-administration. Cognitive and behavioral effects of marijuana in older adults require further examination with controlled studies.

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The Role of Risk Seeking, Negative Urgency, and Perseverance in Marijuana Use Frequency and Marijuana Related Consequences

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The acceptance of marijuana as a medicine and a recreational drug has been increasing in the U.S. The number of marijuana users in the U.S. is increasing. The need for research that helps us understand variables that influence marijuana use, and the strategies that help people abstain from misuse/abuse and evade marijuana related consequences (MRC) is also increasing. Sensation seeking has been shown to predict substance use. Researchers have also found that impulsivity and emotion dysregulation have a close link to drug use and abuse. Research concerning the influence of personality traits on MRC is becoming more abundant. Research has supported the fact that impulsivity predicts MRC in frequent users. Research also supports the notion that emotion dysregulation is a predictor of increased frequency of use. One group of researchers examined the influence of emotion dysregulation, impulsivity, and sensation seeking on marijuana use frequency, and MRC. Negative binomial regressions indicated that negative urgency, a facet of impulsivity, and risk seeking a facet of sensation seeking, significantly predicted the experiencing of MRC. Risk seeking was also found to predict past 30-day intoxication frequency and typical week marijuana use. Perseverance, a facet of impulsivity, showed to be a protective factor that decreases MRC, past 30-day intoxication frequency, and typical week marijuana use frequency. Further research concerning variables that either cause or interfere with these relations will help us understand how to predict marijuana outcomes. Past research has supported the notion that protective behavioral strategies (PBS) mediates the relation between sensation seeking and MRC. Therefore, PBS may also mediate the relation between other personality traits and MRC. Since PBS serve to reduce MRC, continued research on this factor is warranted. In this study, we will test if there are significant effects of risk seeking, perseverance, and negative urgency on three marijuana outcomes; MRC, past 30-day intoxication frequency, and typical week marijuana use frequency. We will also test to see if the use of PBS mediates those interactions. Based on previous literature, we hypothesize that the use of PBS will mediate the effect risk seeking has on MRC, past 30-day intoxication frequency, and typical week marijuana use frequency. Further, we hypothesize that PBS use will mediate the interaction between perseverance and all three outcomes being analyzed. Lastly, we hypothesize that PBS use will mediate the interaction between negative urgency and MRC. We expect results to uphold our hypothesis. The data that shows the relations between these traits and outcomes will increase our ability to predict marijuana outcomes. If the mediation of PBS is shown to be significant in these relations, useful clinical implications could be made. This study could support an emphasis on PBS in clinical and counseling settings.

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Examining Predictors of Initial Marijuana Engagement Using Recursive Partitioning

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While several constructs have been associated with initiating marijuana use, most studies have examined only a few risk factors at a time, often due to statistical constraints of a priori analyses. Exploratory analyses that use machine learning allow for the joint analysis of hundreds of predictor variables without concern for statistical power. Thus, exploratory analyses may identify risk factors for marijuana use that have not been examined in previous literature. We used recursive partitioning to identify sets of variables that are associated with lifetime presence of marijuana use. Data are repeated cross-sectional survey responses to the American College Health Association's National College Health Assessment (ACHA NCHA) from 2011, 2013, and 2015. Participants were students at a Colorado university (N = 4052, 77% White, 61% female, mean age = 22.77). The ACHA NCHA measures a wide range health-related constructs, including alcohol and substance use behaviors and norms, sexual behaviors, physical and mental health, negative and positive affect, academic difficulties, and stressful and/or traumatic experiences. Thus, the ACHA NCHA provides an opportunity for a broad assessment of factors that may be associated with marijuana use. Given multicollinearity between marijuana and other substance use variables, non-alcohol substance use measures were not included in these analyses. We tested two recursive partitioning models to examine correlates of ever having used marijuana. Our first model evaluated all constructs within the ACHA NCHA dataset that had an endorsement frequency of ≥ 50 (193 variables). Alcohol consumption amount and frequency were the strongest correlates, and this first tree explained 39% of the variability in user status (relative error = 0.61, cross-validation error = 0.62, SE = 0.02). In our second model, we removed alcohol variables to identify constructs that were most correlated to user status in the absence of substance and alcohol measures (160 variables). In this second tree, sexual behavior variables were the strongest correlates, and this model accounted for 25% of the variability in this sample (relative error = 0.75, cross-validation error = 0.75, SE = 0.02). Both recursive partitioning models produced parsimonious decision trees that accounted for a substantial amount of variance in the lifetime presence of marijuana use. Among a wide-ranging set of predictor variables, higher engagement in alcohol use and sexual behaviors seem to be the most salient correlates of ever having used marijuana. These exploratory analyses corroborate previous literature suggesting that individuals who engage in multiple types of health-risk behavior are more likely to initiate marijuana use.

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Perceived Risk, Perceived Addictive Potential, and Protective Behavioral Strategies' Impact on Marijuana Outcomes

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Perceptions about the risk associated with marijuana use behaviors have been changing over time. A recent study examining the perception of how risky marijuana use behaviors are found that the perceived risk of marijuana use behaviors (e.g. regularly using marijuana) has changed between 1991 and 2016 while a protective effect remained stable among most populations of US 12th grade students (Terry-McElrath et al., 2017). Large national samples, like the National Survey of Drug Use and Health, typically use these questions to assess the perceived risk of marijuana use. Another protective factor for marijuana outcomes are protective behavioral strategies (PBS), which are cognitive behavioral strategies used proximal to substance use, which limit consumption or mitigate negative consequences (Pedersen et al., 2016). In the present study we sought to 1) examine Perceived risk an alternative measure of perceived risk among college students and 2) assess the relationship between marijuana protective behavioral strategies and perceptions of risk with marijuana-related outcomes. We used the data from the Marijuana Outcomes Study Team, which is a large multisite study examining a myriad of

marijuana related topics at 8 US universities in 8 states. We found that a traditional measure of perceived risk and perceptions of addictive potential were constitutionally different factors and interacted with PBS to influence marijuana outcomes.

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Sleep Difficulties, Marijuana Use and Suicidal Behaviors in Adolescents

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This study examined the relationship among sleep difficulties, marijuana use and suicidal behaviors (ideation and attempts) in adolescents. Additionally, we also tested whether marijuana use mediated the relationship between sleep difficulties and suicidal behaviors. Previous research reported that sleep difficulties and substance use predicted suicidal thoughts and attempts (Roane & Taylor, 2008; Wong & Brower, 2012). Here we extended the literature by specifically testing whether marijuana use had any relationship with suicidal behavior, after controlling for other prominent risk factors of suicide such as depressive symptoms and alcohol related problems. Study participants were 6504 adolescents from the National Longitudinal Study of Adolescent Health (ADD HEALTH) (Harris et al., 2009). Data were collected from interviews and questionnaires. The current study analyzed data from both Times 1 and 2 (T1 and T2), which were one year apart. Sleep difficulties were measured by the question, "Please tell me how often you have had each of the following conditions in the past 12 months - Trouble falling asleep or staying asleep?" (0=never, 1=a few times, 2=once a week, 3=almost every day, 4=every day). Lifetime marijuana use was examined by the question, "During your life, how many times have you used marijuana?" Suicidal thoughts were measured by the question, "During the past 12 months, did you ever seriously think about committing suicide?" Suicidal attempts were measured by one question, "During the past 12 months, how many times did you actually attempt suicide?" Marijuana use and suicide variables were recoded as dichotomous variables (0=no; 1=yes). Data were analyzed by logistic regression. All analyses controlled for demographic variables that are associated with suicidal behaviors (i.e., sex, age, school grade, poverty, and chronic health problems) as well as depressive symptoms and alcohol-related problems (e.g., driving under the influence of alcohol, getting into a fight with family due to drinking). In T1, controlling for demographic variables, depressive symptoms and alcohol-related problems, both sleep difficulties (OR = 1.26, p<.001) and marijuana use (OR = 2.45, p<.001) were associated with suicide ideation. Controlling for T1 suicide ideation and all other covariates, both sleep difficulties (OR = 1.13, p<.05) and marijuana use (OR = 1.33, p<.05) were significant predictors of T2 suicide ideation. Marijuana use at T1 significantly mediated the relationship between T1 sleep difficulties and T2 suicide ideation (95% asymmetric confidence interval = .004 to .08, p<.05). Both sleep difficulties (OR = 1.35, p<.001) and marijuana use (OR = 3.05, p<.001) were associated with suicide attempts at T1. Controlling for T1 suicide attempt and all other covariates, sleep difficulties were not a significant predictor (OR = 1.14, p=.09) while T1 marijuana use was a significant predictor (OR = 1.81, p<.01) of T2 suicide attempt. Both sleep difficulties and marijuana use were concurrently and longitudinally associated with suicide ideation. Suicide prevention programs for adolescents could include information on management of insomnia symptoms, as well as the health effects of both acute and chronic marijuana use.

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Insomnia Symptoms, Protective Behavioral Strategies for Marijuana and Hazardous Marijuana Use among College Students

Maria M. Wong, Bianca Montoya, Elizabeth Craun, & Protective Strategies Study Team
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Previous research has reported that sleep problems longitudinally predicted both onset of substance use and substance-related problems (Wong, Brower, & Zucker, 2009; Wong, Robertson,

& Dyson, 2015). However, the mediators of this relationship remain unclear. The main goals of this study were to examine (i) the relationship between insomnia symptoms and cannabis use problems and (ii) whether protective behavioral strategies for marijuana mediated this relationship. Study participants were 984 college students from ten different universities in the U.S. These students participated in an anonymous survey on substance use and related risk and protective factors. Insomnia symptoms refer to problems falling asleep, problems staying asleep, and early morning awakening. These symptoms were measured by the Insomnia Severity Index (ISI) (Morin, Belleville, Bélanger, & Ivers, 2011). Protective behavioral strategies for marijuana were measured by the Protective Behavioral Strategies for Marijuana Scale (PBSM) (Pedersen, Huang, Dvorak, Prince, & Hummer, 2017). Cannabis use problems were measured by the Cannabis Use Disorders Identification Test Revised (CUDIT-R) (Adamson et al., 2010). Cut-off scores of 8 and 12 were used to indicate hazardous cannabis use and possible cannabis use disorder respectively. All analyses controlled for three demographic variables that have been shown to associate with substance use, i.e., gender, age and race. Insomnia symptoms were associated with an increase in the odds of hazardous cannabis use (*OR*=1.02, $p<.05$) and cannabis use disorder (*OR*=1.04, $p<.01$). Insomnia symptoms also had a significant relationship with PBSM (b=-.02(.01), □=-.08, t=-2.51, p=.01). Severity of insomnia symptoms negatively predicted the use of protective behavioral strategies for marijuana. Controlling for insomnia symptoms and demographics variables, PBSM significantly predicted lower odds of hazardous cannabis use (*OR*=.50, $p<.001$) and cannabis use disorder (*OR*=.49, $p<.001$). PBSM significantly mediated the relationship between insomnia symptoms and hazardous cannabis use (95% ACI=.002 to .018, $p<.05$), as well as the relationship between insomnia symptoms and possible cannabis use disorder (95% ACI=.002 to .020, $p<.05$). We discussed the implications of these findings on the prevention of cannabis use problems among college students in the U.S. Past research showed that insomnia symptoms were associated with alcohol and drug-related problems. However, in those studies, the use of cannabis was not examined separately from other drugs. This study extended past research by showing that insomnia symptoms were associated with both hazardous cannabis use and possible cannabis use disorder. Additionally, protective behavior strategies significantly mediated the relationship between insomnia symptoms and cannabis use. Higher insomnia symptoms were associated with lower scores of protective strategies, which in turn was associated with higher cannabis consumption. The use of protective strategies (e.g., limit use to weekends, avoid using marijuana to cope with emotions such as sadness or depression) requires planning and thinking in advance before marijuana use. Problems falling or staying asleep may make it difficult for individuals to have the mental energy and self-control to engage in these strategies. Prevention and intervention programs of marijuana use could consider the potential impact of insomnia symptoms on protective behavioral strategies.

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SYMPOSIA

Symposium: Co-Use of Marijuana with Alcohol and Tobacco among Young Adults: Current Research and Future Directions

Chair: Adrian J. Bravo
University of New Mexico

Concurrent polysubstance use can be defined as the use of two or more substances within a given time period (e.g., over the past month or year) and can lead to dramatic health consequences due to the additive or interactive effects of combining substances. Within the present symposium, we feature five researchers who have examined diverse research questions on the concurrent use of marijuana with either alcohol or tobacco among young adults. First, Dr. Pedersen will present on findings examining the effects of differing co-use patterns (e.g., simultaneous use vs using both, but on separate occasions) of marijuana and tobacco and their effects on negative consequences. Second, Dr. Prince will present on findings exploring the relations among a variety of alcohol and cannabis co-use patterns (i.e., use of alcohol and cannabis on the same day; alcohol first; cannabis first; alcohol last; cannabis last; simultaneous use) and alcohol and cannabis related consequences (both separately and combined). Third, Dr. Jackson will present on the predictive utility of simultaneous alcohol/marijuana (SAM) motives as compared to motives for drinking and marijuana use on substance use. Fourth, Dr. Villarosa-Hurlocker will present on findings testing motivational models of alcohol and marijuana use problems among college students who endorsed both past-month marijuana and alcohol use, and endorsed varying levels of social anxiety. Fifth, Dr. Bravo will present on findings comparing etiological models of protective behavioral strategies for both alcohol and marijuana among college student co-users. Finally, Dr. White will discuss the clinical and research implications from these studies.

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Co-Use of Marijuana with Tobacco and Nicotine Products among Young Adults

Eric R. Pedersen, Joan S. Tucker, Rachana Seelam, & Elizabeth J. D'Amico
RAND Corporation

As an increasing number of states within the United States legalize marijuana for recreational sale and possession, it is important to understand if certain methods of use are associated with increased risk for heavy use and consequences among young adults. One manner by which marijuana is used is through co-use with tobacco and/or nicotine products (e.g., using marijuana and combustible cigarettes right after one another, vaping marijuana together with nicotine-containing e-liquid in electronic cigarettes). There is a significant public health concern that changes in recreational marijuana policy may have the unintended consequence of increasing use of tobacco/nicotine products and impeding smoking cessation efforts among young people who are co-using the products. However, to date, there is little information on methods of tobacco/nicotine and marijuana co-use, as well as how co-use may associate with negative outcomes among the young adult population. Existing research on the correlates and consequences of tobacco and marijuana co-use has been limited in that most studies in this area (1) were conducted at a time when these substances were almost exclusively smoked and do not reflect the recent proliferation in product types (e.g., electronic cigarettes, marijuana edibles) and methods of use (e.g., ingesting, vaporizing, dabbing) and (2) did not have the ability to differentiate between tobacco and marijuana concurrent use, simultaneous use, and co-administration. In this study, we examined the marijuana and tobacco/nicotine co-use behavior of a sample of over 1,200 young adult (mean age of 21 years old) marijuana users living in California. Participants completed an online survey about their use of marijuana and tobacco/nicotine products in the past year. The most prevalent co-use behaviors were using an e-cigarette to vape marijuana, smoking a cigarette and then smoking a joint on the same occasion, and smoking a joint that contained both tobacco and marijuana. We compared marijuana users who reported no co-use of tobacco/nicotine products to marijuana users who reported co-use

of marijuana and tobacco/nicotine as (a) concurrent use (i.e., using both, but on separate occasions), (b) simultaneous use (i.e., using one right after the other, such as smoking a marijuana joint and then smoking a combustible cigarette), and (c) co-administration use (i.e., using both through the same delivery system, such as smoking tobacco and marijuana together in a blunt). Compared to marijuana users who reported no co-use, marijuana users who reported concurrent use, simultaneous use, or co-administration use reported more frequent marijuana use, had higher rates of screening for cannabis use disorder, and reported greater frequency of marijuana consequences. Co-administration use emerged as the riskiest of the three co-use behaviors. Those who reported engaging in all three types of co-use were the most at-risk for frequent use and consequences. However, those who reported marijuana use without any co-use reported a higher quantity of marijuana use than those in the co-use groups. These findings help to illuminate both the prevalence and risks associated with co-use of marijuana and tobacco/nicotine products and can be used to inform policies for states considering regulation of marijuana and tobacco/nicotine products.

Alcohol and Cannabis Co-Use and Consequences: The Role of Timing

Mark A. Prince, Kristina T. Phillips, Michael M. Phillips, & Trent L. Lalonde
Colorado State University & University of Norther Colorado

Approximately one-fourth of U.S. college students report use of cannabis in the last month, one-third report heavy drinking, and up to 90% report co-use of both substances. Recent data shows that cannabis use among college students in U.S. states with legal recreational use is higher than in states without legal use. College students are an important sub-group to assess, as cannabis and alcohol use peak in young adulthood and can still have an impact on the developing brain. Both substances are associated with lower academic achievement, cognitive impairment, addiction, driving impairment and injury, and mental health effects. Past research has shown that simultaneous or concurrent use of cannabis and alcohol can lead to more negative consequences than use of either substance alone. Method: The present study examined college students (N = 632) who reported both alcohol and cannabis co-use across 2-semesters of cross-sectional data collection. We explored the relations among a variety of alcohol and cannabis co-use patterns (i.e., use of alcohol and cannabis on the same day; alcohol first; cannabis first; alcohol last; cannabis last; simultaneous use), and alcohol and cannabis related consequences both separately and combined (i.e., a sum of the two scales) using Path Analysis. Results: Alcohol and cannabis consequences were negative binomial distributed when examined separately, and the combined consequences outcome was Poisson distributed. Patterns of significance and the direction of the effects were the same when alcohol and cannabis consequences were modeled separately or together (both using a composite score or separate variables in the same model). Using cannabis last was a robust positive predictor of alcohol, cannabis, and combined consequences. Using alcohol and cannabis on the same day, but not necessarily simultaneously, was a significant and negative predictor of alcohol, cannabis, and combined consequences. Surprisingly, simultaneous use was not associated with any of the three consequences outcomes. Using cannabis first negatively predicted alcohol consequences and was not associated with either cannabis or combined consequences. Similarly, using alcohol first was negatively associated with cannabis consequences but not associated with either alcohol or combined consequences. Finally, using alcohol last had a trend towards a positive effect on alcohol consequences and was not related to either cannabis or combined consequences. Discussion: The most salient clinical implication of the current study is that using cannabis after alcohol portends risk for both alcohol and cannabis related problems. While it is possible that there may be a manner of using both alcohol and cannabis on the same day that results in fewer consequences, future studies using person-centered and episode-level approaches are needed to identify risky and safer patterns of co-use. Understanding how the timing of alcohol and cannabis co-use relates to alcohol and cannabis consequences provides insights that can be used in prevention and intervention efforts aimed at college students.

Using Marijuana and Alcohol Together: Specificity in Substance Use Motives among College Students

Kristina M. Jackson, Alexander W. Sokolovsky, Kerri L. Hayes, & Helene R. White
Brown University & Rutgers University

The majority of college students who use both alcohol and marijuana have used them simultaneously on at least one occasion, but the motivations underlying simultaneous alcohol-marijuana (SAM) use have been understudied. Although SAM motives may overlap conceptually with alcohol and marijuana motives, the degree to which simultaneous use is uniquely driven by SAM motives is unclear. The purpose of this study is to examine the predictive utility of SAM motives as compared to motives for drinking and marijuana use. Additionally, we explore the moderating role of negative affect and peer descriptive norms on the relationships between SAM use and conceptually related coping motives and social motives, respectively. Past-year alcohol and marijuana users age 18-24 (N=1,390; 62% female; 69% White; 12% Hispanic) recruited from three college campuses in the U.S. completed a 30-45-minute web survey assessing alcohol and marijuana use, motivations for use, affect, and peer descriptive norms at two time points separated by three months. Past 30-day alcohol use was reported by 93% of the sample and 75% reported past 30-day marijuana use, with at least one occasion of SAM use in the past 30 days reported by 71% of users of both alcohol and marijuana. The most frequently endorsed SAM motives were coping motives, social motives, desire to attain greater positive effects with combined use, and boredom. In a series of regression models we predicted past 30-day use of each type of substance from coping and social motives pertaining to each substance or SAM. Coping and social motives were significant predictors of use with strongest associations observed in models where there was correspondence between type of motive and type of substance use behavior. Further, accounting for SAM-specific coping motives, using marijuana to cope was still predictive of SAM, but using alcohol to cope was not; alcohol and marijuana social motives were not significant predictors of SAM when SAM-specific social motive were included the model. Finally, in a set of models testing interactions with affect and norms, the interaction between coping motives and negative affect was significant for alcohol, marijuana, and SAM use. Somewhat unexpectedly, coping motives were greater for those low on negative affect. There was also a significant interaction between social motives and friend norms such that the effect for social motives was most pronounced for those who reported SAM-using friends; the same effect (although less pronounced) was observed for marijuana use but was not significant for alcohol use. For the most part, use of alcohol and marijuana together appears to be driven by motives specific to simultaneous use. Additionally, the strength of these motivational influences depends on salient individual and contextual characteristics. Future work should examine the extent to which motives may indicate particular vulnerability for some young adults to established contextual antecedents of substance use.

The Relationship between Social Anxiety and Alcohol and Marijuana Use Outcomes: A Motivational Model of Substance Use

Margo Villarosa-Hurlocker, Adrian J. Bravo, Matthew R. Pearson, & Protective Strategies Study Team
University of New Mexico

Background: College students with social anxiety are particularly vulnerable to problematic alcohol and marijuana use given their susceptibility for elevated anxiety symptoms in social settings combined with the normative nature of substance use. Existing research has supported coping-motivated substance use for these students when examining alcohol and marijuana use problems separately. The next step is to determine whether students with social anxiety who use both substances, do so for similar or different reasons. Objectives: The current study tested motivational models of alcohol and marijuana use in a sample of college students from 10 universities across the U.S. who endorsed both past-month alcohol and marijuana use. Method: Among college student dual alcohol/marijuana users (n = 2,034), the majority of participants identified as being either White, non-Hispanic (67.95%) or of Hispanic/Latino ethnicity (15.88%), female

(69.08%), and reported a mean age of 20.24 (SD = 3.16) years. Results: Path analyses revealed that negatively reinforcing drinking motives (coping with anxiety and conformity) significantly mediated the positive relationship between social anxiety symptoms and alcohol-related problems. Further, coping and expansion marijuana use motives significantly mediated the positive association between social anxiety and marijuana-related problems. Conclusions: Taken together, students with social anxiety who are focused on anxiety management may use either alcohol or marijuana; however, these students may be more inclined to drink to fit in with peers and use marijuana to expand their perceptual experiences.

The Relationship between Distal Antecedents and Alcohol and Marijuana Use Outcomes among Dual Users: A Comprehensive Examination of Protective Behavioral Strategies

Adrian J. Bravo, Andrew Weinstein, Matthew R. Pearson, & Protective Strategies Study Team
University of New Mexico

Background: Protective behavioral strategies (PBS) are behaviors that are used immediately prior to (e.g., setting a limit on consumption), during (e.g., using only in a safe context), and/or after substance use (e.g., using a designated driver) that reduce consumption, intoxication, and/or substance-related harm. Among college samples, increasing evidence suggests that both alcohol and marijuana PBS use are robust protective factors and have been shown to mediate the effects of known risk factors (i.e., gender, age of drinking onset, college substance use beliefs, drinking motives, and impulsivity-like traits) on alcohol (Bravo et al., 2015, 2016, 2017a) and marijuana outcomes (Bravo et al., 2017b). However, it is unknown whether PBS use would operate similarly for both substances among dual users. Objectives: In an extension of previous research, the present study examined which distal antecedents uniquely (i.e., controlling for other factors) relate to alcohol/marijuana outcomes via alcohol/marijuana PBS use and among a large group of college students who use both alcohol and marijuana. Method: Participants were college students that consumed both alcohol and marijuana at least one day in the previous month (n=2,034, 69.09% female). Across two models (one for each substance), proposed distal antecedents (i.e., gender, age of first use, college substance use beliefs, impulsivity-like traits, and motives) were modeled as predictors of negative consequences via PBS use and substance use consumption. Results: Across both models and controlling for the effects of all other predictors, PBS use was significantly negatively associated with all substance use outcomes. Across both substances, PBS use significantly mediated the associations between gender (women reported higher PBS use), age of first use (having an older age of first use was associated with more PBS use), and college substance use beliefs (higher beliefs was associated with lower PBS use) on all substance use outcomes. In the alcohol model only, alcohol PBS use significantly mediated the associations of both negative urgency and enhancement motives (both associated with lower PBS use) on each alcohol outcome. Within the marijuana model only, marijuana PBS use significantly mediated the associations between coping (associated with lower PBS use) and conformity motives (associated with more PBS use) on all marijuana outcomes including the double-mediated paths. Discussion: Our results suggest that PBS use is a good candidate to be considered as a mechanism by which dual alcohol/marijuana users moderate their substance use and attenuate their risk of experiencing related consequences. Based on the current sample, we can identify certain characteristics that might be particularly good targets for PBS based intervention efforts. For example, our results indicate that male college students and those with higher college substance use beliefs may benefit from increasing their PBS use for both substances. Moreover, several differences were found across substances and targeting specific characteristics for a particular substance may improve the efficacy of PBS interventions.

Discussant: Helene R. White
Rutgers University

Symposium: Dealing with the Frequently Comorbid Condition of Depression and Cannabis Use Disorder in Adolescents

Chair: Albert J. Arias
Yale University

This symposium will deal with the frequently comorbid conditions of depression and cannabis use disorder (CUD). Dr. Chris Hammond will present on the literature linking depression and CUD, including epidemiology, and including the possible pathophysiological basis for comorbidity. CUD in adolescents is associated with clinically significant depression. Reliable data estimating the prevalence of significant depressive symptoms and major depressive disorder (MDD) in this population are scarce, although one estimate based on literature review is about 20 to 30% of adolescents with CUD are depressed. Depression and co-occurring drug use disorder in adolescents are associated with higher rates of alcohol use and alcohol use disorders, as well as greater risk of suicidal behavior. Multiple pathways to developing depression and CUD are possible, and there is data suggesting that some adolescents develop CUD after becoming depressed, and some develop depression after CUD. Another important clinical question is whether or not having depressive symptoms foils the treatment of substance use disorder. The second talk by Dr. Albert Arias will review a secondary analysis of the Cannabis Youth Treatment study of N=600 adolescents in treatment for CUD which asks that question and examines the relationship between depression and cannabis use over time in that sample. Lastly, Dr. Yifrah Kaminer will discuss research on treatment of CUD in adolescents, and will discuss how to deal with depression in this population, and with commentary on directions for further research.

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The Link between Affective Disorders and Cannabis Use in Adolescents

Christopher J. Hammond
Johns Hopkins University

This talk will review the scientific evidence linking cannabis use and mood disorders in adolescents. The talk will include epidemiology, as well as a review of longitudinal studies examining the risk of developing mood disorders with cannabis use. Pathways to developing dual diagnosis will be discussed. A clinical case presentation will be included.

The Impact of Depressive Symptoms on Cannabis Use Treatment Outcomes in Adolescents

Albert J. Arias
Yale University

Objectives: Depressive symptoms are common in adolescents with cannabis use disorder (CUD), and can complicate assessment and treatment. A question remains about whether depressive symptoms interfere with cannabis use treatment. This is a report of a retrospective analysis of a data set where we examine the response of depressive symptoms to treatment of only the CUD. Method: N= 600 adolescents (age 12-18) with CUD received three months of active treatment for substance use with one of five types of psychotherapeutic psychosocial treatment. None of these treatments was aimed specifically at treating depressive symptoms. Self-reported number of days having used cannabis in the past 90, as well as self-reported level of depression was assessed at Baseline (BL) and again at 3-, 6-, 9-, and 12-months. A dual change Latent Change Score (LCS) model was used to examine the trajectory of frequency of cannabis use and depressive symptoms. Results: Rates of major depressive disorder (MDD) and any depressive symptoms at BL were 18% and 70.2% respectively. Depressive symptoms improved over the course of treatment, as did cannabis use (reduction). Greater baseline depression was a significant associated with attenuated improvement in subsequent cannabis use (less improvement for those with greater depressive

symptoms). Change in cannabis was not associated with subsequent change in depression, suggesting that the improvement in depressive symptoms was not specifically due to the improvement in cannabis use. Conclusion: In this cohort of adolescents with CUD, depressive symptom severity improved over time, however there was a measurable impact of depression on the treatment effect for cannabis use.

Research on the Treatment of Youth with Cannabis Use Disorder and Comorbid Conditions

Yifrah Kaminer
University of Connecticut Healthcare Center

Dr. Kaminer will describe his work in developing treatments for adolescents with CUD, as well as its common dual diagnoses of depression and anxiety disorders. Also reviewed will be the common strategies for clinical treatment in this population. Additionally, directions for future research will be reviewed.

Discussant: Yifrah Kaminer
University of Connecticut Healthcare Center

Symposium: Rehashing Approaches to Marijuana-Related Consequences: A Budding Area of Research

Chair: Jamie E. Parnes
Colorado State University

Understanding physical and mental health risks of marijuana use is critical to harm reduction interventions. As such, research has extensively focused on understanding factors associated with negative consequences of use. While many antecedents of harm have been identified, there remain unexamined factors that may account for significant variance in negative consequences. Moreover, most literature to-date has measured consequences as a count of the number of negative consequences experienced. However, other consequence-related factors, such as the severity of reported consequences, or positive consequences, have yet to be examined. Other unexamined influences on negative consequences, such as price of marijuana, may help inform interventions. Four symposium talks will address unexamined factors and alternative ways of examining consequences of marijuana use. The first talk will focus on incorporating the marijuana purchasing task into understanding the relation between marijuana use motives (MUMs) and number of negative marijuana-related consequences experienced. This study examined the influence of marijuana price breakpoint (i.e., price at which one no longer purchases marijuana) as a potential mediating variable. The second talk examined how use relates to negative consequence count, consequence severity, and individual differences. The third talk examined if classes based on MUMs were associated with marijuana-related negative consequences and severity. The final talk will discuss the relation between MUMs and positive consequences of use. The four talks will provide greater understanding of marijuana consequences from various perspectives. Results may inform harm reduction interventions seeking to reduce negative consequence number and severity, as well as increase positive outcomes.

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A Behavioral Economic Approach to Analyzing the Relations between Marijuana Use Motives and Marijuana Related Consequences in Young Adults

Kirstyn N. Smith-LeCavalier, Samuel R. Davis, & Mark A. Prince
Colorado State University

As the landscape of marijuana changes with greater social acceptance, prevalence of use, and more permissive legislation, the demand for a deeper understanding of the factors that relate to marijuana misuse and related negative consequences is increasing. Previous studies have described the direct positive association between marijuana use motives (MUMs) (i.e., social, coping, enhancement, conformity, expansion), marijuana use, and marijuana-related consequences (MRC). Moreover, MUMs account for unique variance in marijuana related consequences that is not fully explained by marijuana use alone. Recently, purchase tasks have been used to establish economic demand for marijuana use. The marijuana purchase task (MPT) assesses estimated consumption of

marijuana at specific prices per "hit" of marijuana. From a behavioral economics view, MPT has been used to demonstrate a negative association between demand for marijuana and price. Additionally, greater demand for marijuana and lower sensitivity to price fluctuations have been observed in persons who display marijuana dependence symptoms. However, little research has examined the MPT in relation to psychological constructs such as motives and negative consequences. This study focused on whether breakpoint (i.e., cost where individuals are no longer willing to purchase marijuana) mediated the relation between MUMs and MRCs. The present study is a secondary data analysis of the initial Marijuana Outcome Study Team (MOST) data collection. The analytic sample consisted of the young adults who reported using marijuana in the past 30 days (n = 2044). All study hypotheses were tested using path analysis. Number of consequences was specified as a negative binomially distributed count variable. Monte Carlo Confidence Intervals will be used to assess the significance of the indirect effects in each model. Results indicated that when controlling for other motives, enhancement, coping, and expansion motives positively predicted MPT breakpoint. Furthermore, controlling for MUMs and breakpoint, all MUMs were associated with MRC. With regard to the direct effects of the individual models, social motives are negatively related to MRC. In addition, coping, enhancement, conformity, and expansion motives are positively associated with experiencing negative consequences. Findings for the indirect effects suggest that breakpoint may partially mediate the relation between social, enhancement, expansion, and coping motives. Results from the current study can contribute to the understanding of factors that are associated with marijuana demand characteristics and purchasing behaviors among college student marijuana users.

Negative Consequence Severity: What's the Worst That Can Happen?

Theodore J. Fetterling, Jamie E. Parnes, Samuel R. Davis, Mark A. Prince, & Bradley T. Conner
Colorado State University

Marijuana use rates are highest among college-aged individuals for both annual (41%) and past 30-day (25%) use compared to all other age groups. Additionally, marijuana use has been linked to a variety of negative consequences (e.g., feeling sluggish, dependence). While the prevalence of negative consequences related to marijuana use has been widely studied, research has yet to examine the perceived severity of marijuana-related consequences. Although heavier users report experiencing significantly more marijuana-related consequences, they are not more likely to anticipate future consequences than individuals with low use. Thus, consideration of consequence severity is warranted. Studies have shown perceived consequence severity can decrease likelihood of engagement in various health risk behaviors. Further, sex differences have been noted for engagement in risky activities. The present study has two aims. The first is to test the relations between recent marijuana use, endorsement of negative consequences, and reported negative consequence severity. The second aim is to explore potential descriptive differences (e.g., sex, age) on consequence severity ratings. We hypothesized that past 30-day marijuana use would predict greater average consequence severity and highest severity consequence, and that number of consequences endorsed would mediate this relation. We also explored descriptive differences among severity ratings of consequences. College student marijuana users (n = 695) completed a survey containing items from the Marijuana Consequences Questionnaire (MACQ) with an associated 5-point Likert scale to rate consequence severity ("minimally negative" to "extremely negative"). Hypotheses were tested using path analysis. Number of consequences endorsed was a negative binomially distributed count variable and Monte Carlo Confidence Intervals were used to test the indirect effects. Findings indicated that the direct effect of past 30-day marijuana use significantly predicted increased average and highest consequence

severity ratings. When including number of endorsed consequences as a mediator, significant indirect effects were detected for both average, and highest consequence severity. Exploratory analyses were used to test for differences in perceived consequence severity among descriptive variables. Results suggest the effects of past 30-day marijuana use on perceived consequence severity are transmitted through number of endorsed consequences. We expected the consequences rated as more negative to vary by sex as well as other demographic variables. The current study provides preliminary evidence that marijuana users who endorse greater negative consequences are likely to experience higher severity of negative consequences. The combined findings may inform interventions aimed at reducing specific marijuana-related consequences, informed by demographic differences, to attenuate the frequency and severity of experienced consequences.

Marijuana Use Motives Relation to Frequency and Severity of Negative Consequences

Samuel R. Davis, Mark A. Prince, & Bradley T. Conner
Colorado State University

Marijuana use motives (MUMs) are positively associated with marijuana use and marijuana-related negative consequences. In particular, motives to enhance positive affect are associated with greater use and fewer consequences, while motives to cope are associated with greater frequency of negative consequences. However, no research has examined the relation between MUMs and severity of these negative consequences. This study examines MUMs and their relation to frequency and severity of marijuana-related negative consequences. This study is a secondary data analysis of college-aged marijuana users at a large public University (N = 668, Mage = 20.40). A series of Latent Class analyses (LCAs) were conducted to discern latent classes of MUMs. Once latent classes were identified, differences among latent classes of frequency of negative consequences experienced in the last 30 days, frequency of consequences in a typical week of use, frequency of consequences in a heavy week of use, and severity of negative consequences experienced in the last 30 days were tested using the BCH method in MPlus version 8. A four-class solution provided the best overall model fit to the data. Class 1, labeled as the enhancement class (ENH), was characterized by higher enhancement motives and low conformity, coping, social, and expansion motives. Class 2 was characterized by low MUMs and was labeled the low motives class (LM). Class 3, labeled as the low conformity class (LCON), was characterized by high enhancement, coping, social, and expansion motives and low conformity motives. Class 4 was characterized by moderate marijuana use motives and was labeled the moderate motives class (MM). The BCH test was significant for past 30-day consequences, typical week consequences, heavy week consequences, and severity of consequences. Comparisons revealed that the LCON and MM classes reported greater severity of negative consequences, and greater frequency of negative consequences compared to the ENH and LM classes. The ENH class reported significantly lower severity of negative consequences than the LM, LCON, and MM classes. Results suggest that among college marijuana users, profiles for moderate-to-strong overall motivation to use marijuana are associated with greater negative consequences and severity of those consequences compared to low overall motive users. However, a profile of just high enhancement users is associated with less severity of the negative consequences compared to low, moderate, and high overall motive users. Future interventions should target persons with greater coping, social, and expansion motives compared to persons with greater enhancement motives when working to attenuate severity and frequency of marijuana-related negative consequences.

Motivated to Feel Good: Marijuana Motives Predict Positive Consequences of Use

Jamie E. Parnes
Colorado State University

Past research has extensively examined negative consequences of marijuana use. However, despite experiencing negative consequences, many individuals continue using. Therefore, it is important to understand the factors that maintain use. One of these factors is positive consequences of use, such as activity enhancement, euphoria, and stress reduction.

Another influencing factor is marijuana use motives. Motives for use, including social, coping, enhancement, conformity, and expansion motives, all uniquely relate to negative consequences of use. However, it is not known how these motives relate to positive consequences. Each motive may uniquely relate to positive outcomes. Motives associated with greater positive outcomes likely become more reinforced over time than other motives. The present study seeks to examine how motives predict positive consequences of marijuana use. Given the lack of previous research, exploratory analysis was conducted to examine these relations. Undergraduate marijuana-using students (N = 676) completed a survey measuring past 30-day marijuana use, marijuana use motives, and positive consequences of use. Multiple linear regression was conducted with all five marijuana use motives predicting positive outcomes of use, controlling for past 30-day use. Given the multiple comparisons made in this study, alpha was set to .01 to reduce likelihood of type 1 errors. Results indicate that coping motives, enhancement motives, expansion motives, and past-30 day use positively predict positive consequences of use. Additionally, conformity motives negatively predict positive consequences. Social motives were unrelated to positive consequences. Overall, results support that positive outcomes experienced by users vary by use motive. Those using to conform with peers experience fewer positive consequences, possibly as these users may feel extrinsic pressure to use rather than an intrinsic desire. Alternatively, those using for their own desires, such as coping, enhancement, or expansion, experience greater positive outcomes as they may be using for internally motived reasons. Moreover, positive experiences related to specific motives may reinforce continued use for certain motives rather than others. For example, positive consequences from use to cope with negative affect may reinforce using to cope. However, using to cope also predicts greater negative consequences of use that pose various health risks. Harm reduction interventions seeking to maximize the benefits of use may target marijuana use motives. Intervening on those using for conformity motives may help reduce use when it is likely to lead to fewer positive consequences. Future research should continue to examine positive consequences as both an outcome and predictor of continued use. Doing so may help increase understanding of how to help users maximize the benefits of use and reduce occasions associated with fewer positive consequences.

Discussant: Jamie E. Parnes
Colorado State University

Symposium: Brain Imaging in Relation to both Acute and Chronic Cannabis Use

Chair: Godfrey Pearlson
Yale University

Consequent on widespread medical marijuana legalization and recreational marijuana decriminalization/legalization, there is a growing need to understand cannabis' acute and longer-term effects on brain function and behavior, many facets of which are under-documented. This symposium will examine brain and behavioral consequences of acute cannabis use relevant to a variety of different contexts by describing emerging findings from our studies that employ task-based fMRI, resting state fMRI, and proton spectroscopy. To examine cognitive and brain consequences following acute use, we were interested in how single doses of vaporized cannabis impact behavioral performance on time-estimation and three separate measures of simulated driving behavior that represented different crucial aspects of motor vehicle operation. In particular, we wanted to document the time courses of these behavioral and brain changes, their relationship to administered dose and blood levels of THC and its metabolites and any differences attributable to baseline marijuana use frequency. Because of concerns about the drug's effect in younger individuals, particularly on memory function, we were especially interested in measuring brain metabolic effects using proton spectroscopy in relationship to robust functional MRI assessment of memory encoding. Overall, this symposium will attempt to showcase novel uses of MRI-based neuroimaging in the context of human marijuana neuroscience.

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Alterations in Resting State Functional MRI Connectivity Following Acute Doses of Cannabis

Shashwath Meda
Olin Research Center, Institute of Living

Resting state functional MRI (rs-fMRI) examines how activation in numerous distal brain regions engage in synchrony over time in the absence of formal experimentally-driven performance demands. As such, rs-fMRI characterizes frequently engaged-neural systems and can quantify many different types of network connectivity abnormalities in those circuits. rs-fMRI have not only been used to characterize physiological perturbations such as drowsiness and a large number of different neuropsychiatric illnesses such as schizophrenia and Alzheimer's disease, but fs-fMRI has demonstrated its sensitivity to acute intoxication with a variety of medications. Numerous studies suggest the sensitivity to THC, but the evidence comes indirectly from studies that examine samples with different types of regular THC use, dependence, or abstinence. There is an absence of cannabis challenge studies that directly characterize the acute effects of THC intoxication or its persistence over time. As part of a NIDA-funded study, we examined the differences in rs-fMRI between placebo marijuana (MJ) and two doses of active drug (0.5 G of ~6% and ~13% THC -containing floral MJ) administered using a Volcano vaporizer in N = 14 subjects. Data were acquired from 6m 43s of resting fMRI signal acquired on a 3-T MRI scanner. Data were preprocessed using the minimal preprocessing guidelines prescribed by the Human Connectome Project (HCP) that include distortion correction, surface generation, cross-modal registration and spatial alignment. Low frequency drift was then removed from the preprocessed data and analyzed using the Group ICA toolbox to derive temporally coherent intrinsic resting networks. Within-network spatial differences in resting connectivity across different doses and over time within sessions were assessed using a repeated measure ANCOVA design (adjusted for age, sex and motion) implemented in the PALM package. We will present preliminary results from analyses that quantify functional connectivity within the nodes of brain systems that are highly reproducible across people and different task contexts (e.g., the frontoparietal executive network, cingulo-opercular salience network, etc.), as well as ICA-identified neural systems that integrate those brain regions that have a high density of CB receptors (e.g., striatal, cerebellum). Results are pending and will be discussed at the time of the symposium.

Effects of Chronic Cannabis Use on Brain Proton Spectroscopy Measures, and Working Memory fMRI

Alecia Dager
Yale University

Emerging adults show the highest rates of heavy marijuana use. Marijuana use is associated with memory impairments and altered functional magnetic resonance imaging (fMRI) response, but the neurochemical underpinnings remain unclear. To better understand the relationship between marijuana use and memory dysfunction, we collected information on hippocampal and frontal lobe neurochemistry, brain activation levels during an active memory encoding and recognition fMRI task, and performance on neurocognitive measures of verbal list learning in current heavy marijuana users and controls, ages 18-22. The California Verbal Learning Task (CVLT) assessed verbal learning. During fMRI, participants performed an object-pair encoding and recognition task (Ragland et al., 2012). Magnetic resonance spectroscopy yielded N-acetylaspartate (scaled to total creatine, NAA/tCr), a marker of neuronal integrity, in left hippocampus and left prefrontal cortex. Marijuana users performed worse than controls during CVLT immediate recall ($t=2.28$, $p=0.049$), and trended toward poorer CVLT delayed recall ($p=0.051$). Groups did not differ on frontal or hippocampal fMRI response during encoding or recognition. However, left hippocampal response during encoding correlated with better CVLT delayed recall (rho=0.991, $p=0.001$). Although there were no group differences in NAA/tCr, groups differed in their relationship between NAA/Cr and fMRI response in hippocampus ($t=2.5$, $p=.042$). Here, controls demonstrated a trend for a positive relationship ($t=2.5$, $p=.069$), whereas marijuana users demonstrated no relationship. This within-subject comparison of

fMRI and magnetic resonance spectroscopy provides preliminary evidence of altered relationships between hippocampal neurochemistry, memory-related fMRI response, and verbal learning. Ongoing data collection will further characterize these relationships, providing critical insight into the neural impact of marijuana use in this vulnerable population. This work has important implications as marijuana use increases with legalization and medicalization.

Acute Cannabis Exposure Alters Behavior and Brain Activation on an fMRI Time Estimation Task

Michael Stevens
Olin Research Center, Institute of Living

Time estimation is impaired by acute cannabis use. As part of an ongoing NIDA-funded study (R01DA038807), fMRI data were collected from n=10 regular MJ users. On three separate days, participants used a vaporizer and paced inhalation method to smoke marijuana, randomly receiving 0.5gm of either NIDA herbal 13.4% THC, 5.9% THC, or placebo cannabis. On each visit, participants were administered drug using paced inhalation by 9:00 a.m., then underwent fMRI 3 separate times post-dose (1½ h, 3½ h and 5½ h), in a randomized, double-blind, counter-balanced design across visits. After dosing, participants underwent fMRI while performing a rapid, event-related time estimation task, where they were presented with a sequence of boxes and were instructed to decide which box was on the screen longest. The task presented short (500-900 msec) or long (1500-1900 msec) stimuli durations within either of these ranges to assess drug impact on both neural systems. Both Short and Long intervals for all 9 fMRI runs for each participant were included in analyses to determine the extent of regional activation regions during the task. As expected from prior studies, time estimation task performance engaged bilateral cerebellum and putamen, plus an extended set of bilateral cortical regions comprising anterior insula, inferior frontal gyri, middle frontal gyri (BA 9/46), and dorsal anterior cingulate and medial frontal gyrus. Short interval time estimation elicited greater cerebellum activity, whereas lateral and medial prefrontal regions were more engaged during Long interval estimation. An analysis of reaction time (RT) and accuracy found significant changes over time since THC use only for Short interval RT for the moderate MJ dose condition. Here, RT decreased with continued recovery from drug use (T1 vs. T3 $p = .029$). As behavioral effects were greater for Short interval trials, we focused fMRI analyses on this condition. The predominant effect of recent THC use was to reduce brain activation. Common to both drug doses, less activity was elicited in basal ganglia and frontoparietal network regions. Cerebellum was relatively unaffected in by moderate, but was hypo-functional following low dose. There were different dose effects in SII somatosensory processing regions. A large effect size change was observed in dorsal anterior cingulate (dACC), where over time the amount of activation decreased for low dose days (xyz = 0, 32, 30, Cohen's $d = 1.57$). In addition, throughout low dose days, more BOLD signal change was noted in left putamen and left amygdala. By 5½ h post-drug, right putamen activation had not yet returned to normal in either the low or moderate dose conditions. Interestingly, after 5 ½ h post-MJ use, activation in frontoparietal regions consistent with the dorsal attention network showed greater activation relative to the comparable placebo fMRI for both drug doses. Overall, MJ use resulted in relative hypoactivation compared to placebo for striatal brain regions known to play an important role in mental timekeeping cognitive processes, as well as for several distributed neural systems engaged for higher-order cognition.

Disruption of Brain Circuits Involved in a Simulated Driving fMRI Task Following Acute Cannabis Exposure

Godfrey Pearlson
Yale University

Although numerous studies provide evidence that recent marijuana use can impair performance on tests of cognitive abilities thought to be important for optimal motor vehicle operation, there is little understanding of exactly how the drug affects the brain to cause such impairments. fMRI data were collected from n=12 regular marijuana users. On three separate days in a randomized, double-blind, counter-balanced design across visits,

participants used a vaporizer and paced inhalation method to smoke marijuana, randomly receiving 0.5gm of either NIDA herbal 13.4% THC, 5.9% THC, or placebo cannabis. Although the overall protocol collected fMRI data 3 separate times following marijuana use at 9:00 a.m., here we focused on fMRI data collected 1½ hours post-dose to observe dose effects related to virtual driving performance not only after peak THC intoxication. Using Real Time, Inc. realistic virtual driving simulation software, multiple instances of different driving demands were naturalistically embedded into three ~10-minute fMRI driving tasks administered during each in-scanner drive. Event onsets were extracted, then modeled to create activation maps for each condition. We contrasted study doses in repeated-measures statistical comparisons to identify which brain regions had greater or lesser BOLD signal response for the events in that task relative to the implicit baseline formed by the remainder of the timeseries for each paradigm: Gap Acceptance is a strategic planning task where participants decide when to accelerate from a stop to overtake a parked car by merging into a lane of oncoming traffic. The task engaged diverse prefrontal cortex regions within both frontoparietal executive and ventral attention networks, disengaged motor planning regions, lateral orbitofrontal cortex, and regions within dorsal attention and default mode networks. Car-Following measures tactical decisions when participants respond to the acceleration/deceleration of a lead car that pseudo-randomly alters speed. The task elicited greater activation in motor planning/execution brain regions, motor anterior cingulate, posterior dorsal attention network and right putamen. The caudate disengaged to these events, as did bilateral SII somatosensory cortex. Lane Keeping assesses operational vehicle control where participants maintain car position despite unpredictable wind gusts that elicit Vehicle correction. The task elicited greater left hemisphere lateral prefrontal cortex activation in superior frontal sulcus, mid-dlPFC, anterior vlPFC and bilateral cerebellum and relative decreases in activity in right caudate, dorsal cingulate and bilateral precentral gyri. Marijuana use altered brain function in every driving context. Across all driving tasks, bilateral putamen was less engaged by active study drug. All other effects were diverse and differed by THC dose. During Gap Acceptance, both doses showed extensive right hemisphere frontoparietal deficits and lower anterior cingulate cortex activation. For Lane Keeping, supplemental motor area and secondary visual cortex activity were reduced after both low and moderate MJ doses, as were greater right dorsolateral, ventrolateral, and ventromedial prefrontal cortex activity. For Car Following, putamen deficits were dose specific, with higher doses linked to lower activation. Other dose-specific effects included bilateral precentral gyri and left frontoparietal cortex deficits. After both doses, there was greater activity in visual association, motor, premotor, and supplementary motor cortices.

Discussant: Godfrey Pearlson
Yale University

Symposium: Measuring Marijuana: Assessment Challenges and Our Partial Solutions

Chair: Matthew R. Pearson
University of New Mexico

Every known drug of abuse has dose-dependent effects. In the context of increased medicalization and legalization of marijuana (or cannabis) in the United States and throughout the world, there is a rising pressure to quantify the risks and benefits of marijuana use. However, the crude assessment of marijuana use is at best obscuring and at worst preventing our ability to detect the associations between marijuana use and important outcomes. A review of the marijuana literature reveals that there are two primary ways that marijuana (or cannabis) use is assessed: 1) user status (a comparison of marijuana users and non-users with various time windows: past month, past year, lifetime, etc.) and 2) marijuana use frequency (i.e., number of days used in the past 30 days). Unfortunately, marijuana use quantity is not typically measured and there is no clear gold standard for assessing marijuana use quantity. The lack of a gold standard measure of marijuana is not befuddling. There are several challenges with assessing marijuana use. Marijuana is available in many different preparations including flower, concentrate, and edible preparations. These products can have different routes of administration (e.g., smoking, vaping,

eating) and there is not a standard apparatus for most of these (e.g., bowl/bong sizes vary). Even within each preparation, potency of marijuana varies significantly. In the present symposium, each presentation will measure marijuana use in a unique way to overcome some of the limitations mentioned above, and we will discuss how the field can improve upon the measurement of marijuana use.

Contact: Matthew R. Pearson
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Marijuana Use Grid: A Brief, Comprehensive Measure of Marijuana Use

Matthew R. Pearson
University of New Mexico

The present study introduces a brief, yet comprehensive retrospective self-report measure of frequency and quantity of marijuana use: the Marijuana Use Grid (MUG). A large sample of college student marijuana users were recruited from 8 universities throughout the United States (total sample n = 6,584, past month marijuana users n = 1,969), including states that reflect each of the categories of legal marijuana: 1) no legal marijuana, 2) legal medical marijuana, and 3) legal medical and recreational marijuana. Using a weekly grid, the MUG asks participants to report the amount of marijuana that they use (in grams) during each of 6 4-hours blocks of time each day (12a-4a, 4a-8a, 8a-12p, 12p-4p, 4p-8p, 8p-12a) during a typical week of marijuana use (Monday – Sunday). From this measure, we can calculate a large number of variables including frequency (i.e., counting all non-zero values) and quantity (i.e., summing number of grams) of marijuana use for each day of the week, for each time of day, and for the entire week. We used Spearman rank correlations to examine the associations between these marijuana use measures and marijuana consequences and symptoms of cannabis use disorder (CUD). We found moderate associations between overall marijuana frequency and consequences/CUD symptoms (strongest r = .546 for CUDIT-R, weakest r = .326 for CAST). We also found moderate associations between overall marijuana quantity and consequences/CUD symptoms (strongest r = .466 for CUDIT-R, weakest r = .274 for CAST). To explore whether frequency and/or quantity of use on particular days or during particular time periods were most predictive of consequences, we conducted four stepwise regressions: 1) day of week frequency, 2) time of day frequency, 3) day of week quantity, and 4) time of day quantity. Week-end use (i.e., Friday/Saturday) tended to be most predictive of consequences, but time of day analyses were inconsistent across frequency and quantity estimates. Lastly, to test for incremental validity, we examined with MUG frequency or quantity measures predicted consequences above and beyond the effect of a simple past month frequency measure. Although marijuana use frequency assessed by the MUG predicted consequences above and beyond the effect of a simple past month frequency measure, marijuana use quantity did not. This finding suggests either that quantity is less important than frequency in the determination of marijuana consequences, or that significant error in the assessment of quantity diminishes our ability to detect such relationships. Although improvements on marijuana use measures need to continue, 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.

Quantifying Cannabis: A Field Study of Marijuana Quantity Estimation

Mark A. Prince, Bradley T. Conner,
& Matthew R. Pearson
Colorado State University & University of New Mexico

The assessment of marijuana use quantity poses unique challenges. These challenges have limited research efforts on quantity assessments. The goal of the present study was to examine regular and heavy marijuana users' ability to estimate quantity (e.g., weight in grams) of both flower and concentrated marijuana to narrow the gap between tightly controlled lab studies and survey-based observational studies. This study had four primary aims: 1) determine the typical dose (i.e., grams used) for two common types of marijuana products (i.e., flower and concentrates), 2) determine the relative accuracy of marijuana users' estimations of quantities of marijuana, 3) identify salient predictors of quantity of

marijuana prepared for a single dose, and 4) identify salient predictors of estimation (in)accuracy. We recruited a sample of 128 regular-to-heavy marijuana users (48% female) for a field study wherein they prepared and estimated quantities of marijuana flower in a joint or a bowl as well as marijuana concentrate using a dab tool. For Aim 1, we found that participants typically packed .25 grams of marijuana into a bowl, rolled about .58 grams into a joint, and loaded about .08 grams of concentrate using a dab tool. For Aim 2, we found that the vast majority of participants overestimated the quantity of marijuana that they used in their preparations (71% - 81% across preparations). Effect sizes indicate these overestimations were medium-to-large in size (.557 < ds <. 823). In terms of proportional difference, the estimates of concentrated marijuana were the most inaccurate (estimated quantity was 113.2% higher than actual quantity) followed by flower in bowls (estimated quantity was 68.3% higher than actual quantity) and flower in joints (estimated quantity was 37.2% higher than actual quantity). For Aim 3, we used Spearman's rank correlations and found that males used significantly more marijuana flower in their preparations than females (ρ= .259), an effect driven by their tendency to prepare larger joints (ρ = .463). Individuals who reported being a recreational user only (compared to individuals who endorsed being a medical user, both a recreational and marijuana user, or a CBD only user) used significantly more marijuana flower generally, significantly more flower in a joint, marginally more flower in a bowl, and significantly more concentrate (.348 < ρs < .587). Compared to individuals not employed in the cannabis industry, individuals employed in the cannabis industry also used significantly more flower in a joint, in a bowl, and more concentrate (.267 < ρs < .412). For Aim 4, we used Spearman's rank correlations and failed to find robust predictors of estimation accuracy. Self-reported quantity estimates are inaccurate, which has implications for studying the link between quantity and marijuana use outcomes.

Introducing the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU)

Carrie Cuttler, Alexander Spradlin, & Protective Strategies Study Team
Washington State University

We created the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU) because the current lack of psychometrically sound inventories for measuring these dimensions of cannabis use has impeded research on the effects of cannabis in humans. In Study 1, we recruited a sample of 2,062 cannabis users to assess the DFAQ-CU's factor structure and reliability. To assess validity, a subsample of 645 participants completed additional measures of cannabis dependence and problems. A six-factor structure was revealed, with factors measuring: daily sessions, frequency, age of onset, marijuana quantity, cannabis concentrate quantity, and edibles quantity. The factors were reliable, with Cronbach's alpha coefficients ranging from .69 (daily sessions) to .95 (frequency). Results further provided evidence for the factors' convergent (MSHQ, TLFB), predictive (CAST, CUDIT-R, CUPIT), and discriminant validity (AUDIT). In Study 2, we recruited 1,976 cannabis users, of which 1,285 completed the DFAQ-CU. To assess validity, we included other measures of marijuana use (Marijuana Use Grid [MUG]), cannabis-related problems, symptoms of cannabis use disorder, marijuana use motives, marijuana refusal self-efficacy, and marijuana protective behavioral strategies. Supporting its convergent validity, DFAQ-CU's frequency measure was strongly correlated with MUG frequency (r = .74) and past month frequency (r = .86); DFAQ-CU's age of onset measure was strongly correlated with an alternative measure of age of first use (r = .82); DFAQ-CU's marijuana quantity measure was most strongly associated with MUG quantity (r = .47). Among the facets of the DFAQ-CU, its frequency measure was most strongly positively associated with cannabis-related problems, symptoms of cannabis use disorder, and marijuana use motives, and most strongly negatively associated with refusal self-efficacy and use of protective behavioral strategies. Supporting its discriminant validity, none of the DFAQ-CU subscales were significantly correlated

with eating disorder behaviors. Overall, the DFAQ-CU is a psychometrically sound inventory that measures frequency, age of onset, and quantity of cannabis use. It contains pictures of marijuana to facilitate the measurement of quantity of marijuana used, as well as questions to assess the use of different forms of cannabis (e.g., concentrates, edibles), methods of administering cannabis (e.g., joints, hand pipes, vaporizers), and typical THC levels. As such, the DFAQ-CU should help facilitate research on frequency, quantity, and age of onset of cannabis use.

Supplemental Materials Here

Examining the Role of Potency on Marijuana Use and Problems Utilizing Retrospective Self-Report and Ecological Momentary Assessment

Benjamin O. Ladd & Renee E. Magnan
Washington State University, Vancouver

Tetrahydrocannabinol (THC) potency has increased by as much as tenfold in the past 40 years and with the greater availability of concentrated marijuana products this trend is likely to continue. One perspective is that with increased potency, users may titrate their consumption; on the other hand, increased potency may lead to greater adverse consequences. Due to a variety of ethical, legal, and practical reasons, assessment of marijuana use has largely overlooked variability in marijuana potency. The purpose of the current study was to examine relationships among self-reported marijuana use and preferred cannabinoid potency at the aggregate and event levels. Recreational marijuana users (N = 94) aged 21 and older were recruited from the community in two bordering states with legal recreational markets. At baseline, participants completed a past-month quantity-frequency measure that included items on typical THC and cannabidiol (CBD) potency. Participants then completed a 14-day ecological momentary assessment (EMA) protocol using their personal smartphone, during which they self-initiated a brief survey after each use episode. Results from the baseline assessment suggest that higher THC was associated with greater frequency, $r = .32$, $p < .01$, but not quantity of use. CBD levels were not associated with either frequency or quantity. Additionally, THC and CBD levels were not significantly correlated. A similar pattern was observed in the EMA data. Participants reported similar THC levels across the baseline and EMA assessments, $t(91) = -1.35$, $p = .18$, $M = 21.3\%$, $SD = 5.1\%$ and $M = 20.6\%$, $SD = 5.2\%$, respectively. Significantly higher baseline CBD levels were reported compared to EMA reports, $t(91) = -4.41$, $p < .001$, $M = 9.1\%$, $SD = 6.5\%$ and $M = 6.4\%$, $SD = 3.7\%$, respectively. Baseline THC was not associated with marijuana problem severity. Baseline CBD was negatively associated with problem severity, $B = -7.57$, $SE = 3.77$, $p < .05$, however this effect became a trend ($p = .06$) when quantity and frequency of use were also entered into the regression model. When considering the EMA data, an opposite effect emerged such that THC was positively predictive of problem severity, $B = 9.42$, $SE = 4.36$, $p < .05$, while CBD was not a significant predictor. However, again the effect of THC was reduced ($p = .07$) when quantity and frequency were included. Results suggest that contrary to the titration hypothesis, users selecting higher THC marijuana also report more frequent use. Additionally, relationships among consumption variables and marijuana problem severity differed based on the measurement modality. These findings further support the need for greater consideration and refinement of marijuana use measurement. As with other substances, researchers should carefully consider the goals and demands of a given research project when selecting a measurement approach.

Discussant: Matthew R. Pearson
University of New Mexico

Symposium: Examining Both Sides of the Coin: Cannabis as Treatment Target and Potential Therapeutic Agent

Chair: Eric R. Pedersen
RAND Corporation

Cannabis occupies a peculiar space among drugs. By some metrics, it has a lower addictive potential/abuse liability than most other drugs of abuse; however, given higher prevalence rates, cannabis use disorder is more prevalent than any of other illicit drug use disorder. In the United States, use/sale/possession of cannabis is federally

illegal and it is listed as a Schedule I drug, which indicates that it is without medical value; however, 30 of 50 states permit the use of cannabis for medical purposes. In this symposium, researchers explore the different sides of cannabis in the context of treatment. Dr. Ozechowski reports the effects of enhanced supervision of Functioning Family Therapy, an evidence-based family-centered intervention, on marijuana-related outcomes among adolescents. In a sample of adolescents with alcohol use disorder (and majority with a cannabis use disorder), Dr. Kaminer examines how commitment to a harm reduction vs. abstinence goal affects cannabis outcomes. Dr. Houck observes incidental effects of treatment for alcohol use disorder on cannabis outcomes in patients from Project MATCH and COMBINE. Dr. Sisley reviews the barriers and discusses the implications of such barriers to conducting research examining the therapeutic potential of cannabis.

Preventing Adolescent Marijuana Use with a Family-Centered Behavioral Health Intervention: A 12-month Follow-up Study

Holly B. Waldron, Michael S. Robbins, Timothy Ozechowski, Hyman Hops, Charles W. Turner, & Janet Brody
Oregon Research Institute

Background: With an increasing number of US states legalizing adult recreational and/or medical marijuana use, with a concomitant increase in teen use, the need for effective prevention efforts is clear and imperative. Most efforts to date have been school-based with mixed results. Another potential avenue for marijuana use prevention is via community-based treatment for adolescent mental health problems. The primary aim of the current study was to examine implementation processes associated with Functional Family Therapy (FFT), an evidence-based family-centered intervention for youth disruptive behavior, and widely disseminated in community practice settings. A critical feature of efficacious interventions as shown in a number of studies is maintaining fidelity to the program. In research based interventions, fidelity is maintained via observation-based methods, whereas in most community based interventions, supervision is based on the therapists' self-report, the latter a much less expensive approach. Yet, evidence for the clear superiority of the different methods has not been established. We compared observation-based supervision (BOOST Building Outcomes with Observation-Based Supervision: An FFT Effectiveness Trial) using session audio recordings uploaded to the supervisor, with the FFT dissemination program's supervision as usual (SAU; using self-reports) for youth referred for behavioral health treatment in community practice settings. None of the adolescents was referred specifically for drug-related problems, thus, the rates of drug use were relatively low with a number of non-users (approximately 65%). However, supervisors were knowledgeable in techniques specific to drug treatment. Hence, in the context of this study, we examined the extent to which FFT, implemented using BOOST versus SAU, would have preventive effects on adolescent substance use over a 1-year period. Sample: BOOST (26 therapists, 105 families) and SAU (21 therapists, 59 families) supervision was implemented in eight community mental health settings with FFT experienced therapists (77% female). Method: Participating youth (41% female) had been referred for treatment for diverse problem behaviors (e.g., delinquent and/or disruptive behaviors, depression, noncompliance). Families included those with Hispanic (62%), African American (19%), Non-Hispanic White (12%) or other (7%) ethnic/racial origins. Therapy sessions were audio-recorded. Clinical process variables included treatment fidelity, engagement, and retention. Clinical outcomes, including adolescent behavior, family functioning, and substance use, were measured at baseline, 5 months, and 12 months after treatment initiation. Results: The BOOST therapists did not differ significantly from SAU therapists in engagement, retention rates, or rated adherence. However, BOOST adolescents with a prior history of use had significantly lower rates of marijuana use at the 5th and 12th month assessment. Moreover, the rates for adolescents in the SAU condition continued to increase through the 12-month assessment. In contrast, teens in the BOOST condition decreased from baseline to the 5-month assessment and maintained these levels through to 12 months. Conclusion: The results suggest that enhanced and more expensive therapy supervision of family-based therapy can prevent

the normal escalation of marijuana use in high-risk adolescents. Moreover, the results also suggest that family-based therapy needs to focus on drug-specific components in order to achieve success.

Adolescents in Treatment for Cannabis Use: Goal Commitment Predicts Outcome

Yifrah Kaminer, Christine M. Ohannessian, & Rebecca H. Burke
University of Connecticut School of Medicine

Objective: Commitment to change is an innovative potential mediator and mechanism of behavior change (MOBC) that has not been examined in adolescents with cannabis use disorders (CUD). The Adolescent Substance Abuse Goal Commitment (ASAGC) questionnaire is a reliable and valid 2-scale measure developed to assess the adolescent's commitment to either abstinence (i.e., recovery model) or harm reduction (HR) model, that in addition to decrease in negative consequences, includes consumption reduction as a stated treatment goal. The objective of this paper is to examine the ASAGC's ability to predict treatment outcome of youth with CUD. Method: During sessions three and nine of a 10-week treatment program, therapists completed the ASAGC for 170 adolescents 13-18 years of age with alcohol use disorder (AUD), the majority of whom (82%) were diagnosed with co-occurring CUD. Cannabis use during treatment and aftercare was confirmed by drug urinalysis and self-reports until 12-month from study onset. Results: Results from logistic regression analyses assessing goal commitment at Session 3 indicated that both HR and recovery predicted marijuana use at Session 3. However, only recovery assessed predicted later marijuana use (assessed at Session 9 and during aftercare). When goal commitment at Session 9 was examined, only recovery predicted marijuana use, concurrently and longitudinally. These results indicated that adolescents who had higher scores for recovery were less likely to be positive for marijuana use. HR was not a significant predictor for outcome. Conclusions: Study findings demonstrate that goal commitment consistently predicts CUD treatment outcome. HR may not be an attainable goal for youth due to delayed neurodevelopmental processes of inhibitive behaviors. Commitment to recovery specifically is a salient predictor for concurrent and future marijuana use.

Incidental Effects of Treatment for Alcohol Use Disorder on Cannabis Use: Results from Project MATCH and the COMBINE Study

Jon M. Houck
University of New Mexico

Reciprocal functional interactions between the endogenous cannabinoid and opioid systems are well known. THC can reduce pain perception (Vivian et al., 1998), and rhesus monkeys administered THC reduced their self-administration of heroin (Li et al., 2015). Consistent with this, recent work in humans found that joint administration of cannabis and low doses of oxycodone produce analgesia similar to that of larger doses of oxycodone alone (Cooper et al., 2018). Naltrexone is an opioid antagonist that also acts on cannabinoid receptors. In nonhuman primates, acute naltrexone reduces THC self-administration (Justinova et al., 2004). In humans, the effects of naltrexone on cannabis use appear to vary with the experience of the individual. In non-cannabis-smokers, acute naltrexone potentiates the effects of low cannabis doses (Haney, 2007), while in daily cannabis smokers, maintenance doses of naltrexone are associated with decreased cannabis self-administration (Haney et al., 2015). The COMBINE Study was a large multi-site medication (naltrexone, acamprosate) clinical trial for alcohol use disorder that did not exclude participants on the basis of cannabis dependence (Anton et al., 2006). COMBINE participants who used cannabis generally had higher alcohol use at the end of treatment did than those who did not use cannabis (Subbaraman et al., 2016). However, cannabis users randomized to receive naltrexone and the Combined Behavioral Intervention (CBI) reported end-of-treatment drinking equivalent to those randomized to receive naltrexone who did not use cannabis. The goal of the present study was to text the incidental effects of naltrexone maintenance for alcohol use disorder on self-reported cannabis use in the COMBINE Study. Data on cannabis use days were obtained from the Structured Clinical Interview for DSM-IV (SCID-I). Naltrexone dose estimates in COMBINE were generated by inspection of used blister packs. 206

participants (19.9% female) reported cannabis use during the 16-week treatment period. Cannabis use was significantly lower in the naltrexone-taking groups than in other groups ($X^2(1)=3.865$, p=.049). In a follow-up analysis comparing 85 participants assigned to receive either naltrexone or placebo, negative binomial regression controlling for baseline use indicated that participants randomized to receive naltrexone had significantly fewer cannabis use days during treatment than did those assigned to receive placebo (b=-1.969, p=.043). There was not a significant effect of CBI (b=-.563, p=.078). At the 12-month follow-up, there were no significant effects on cannabis use days. Results of the present analysis suggest that in the COMBINE study, naltrexone had incidental effects on participant cannabis use. That is, although COMBINE was not designed to influence cannabis use, participants who used cannabis and took naltrexone had fewer cannabis use days during the treatment period than did those who did not take naltrexone, and participants who took the prescribed dose of naltrexone had fewer cannabis use days than those who did not. After participants stopped taking naltrexone, cannabis use did not differ between groups. Although limited data on cannabis use reduce confidence in the study findings, these results suggest that naltrexone should be examined further as a treatment for cannabis use disorder, particularly in populations that also use alcohol.

Slaying Dragons for Science--Navigating the Inexplicable Barriers to US Marijuana Efficacy Research

Suzanne Sisley
Scottsdale Research Institute

This lecture, led by Sue Sisley, MD, will discuss the barriers to Cannabis efficacy research and myriad ways US government has systematically impeded this work. We will use our recent battle to implement the veterans research as prime example of this research blockade trying to use medical marijuana to treat patients with treatment-resistant Post-Traumatic Stress Disorder (PTSD).