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KEYNOTE ADDRESS

Health Effects of Cannabis: What We Know and What We Don't Know

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This keynote address consisted of an overview of current findings about the health effects of cannabis and cannabinoids. Currently, 44% of adults self-report lifetime use of cannabis (past month = 8%). Those between the ages of 18 and 25 years, report the highest prevalence (53% lifetime, 20% past month). The current patchwork of cannabis policies includes seven states (e.g., WA, CO) and DC that allow recreational use of cannabis and 44 states (e.g., FL, NY) and DC that allow some form of medical cannabis. Federal statutes state that the use and/or possession of cannabis are not legal. Cannabis is a complex plant that contains more than 500 phytochemicals, about 104 of which are cannabinoids. The most commonly studied cannabinoids are Δ9 tetrahydrocannabinol (THC, psychoactive) and cannabidiol (CBD). Information about the health effects of cannabis was taken from the 2017 report from the National Academies of Sciences, Engineering and Medicine, entitled The Health Effects of Cannabis and Cannabinoids: Current Evidence and Recommendations for Research. I served as a member of the multidisciplinary committee that compiled the report. Among its tasks, the committee rated the evidence for different cannabis-related health harms and benefits, based on recent systematic reviews and/or the primary literature. The research evidence was rated as either conclusive (i.e., supportive findings, no credible opposing findings); substantial (supportive findings, but credible opposing findings); moderate (supportive findings, but some limitations); limited (few supportive findings, studies are weak or biased). There was substantial evidence for health harms related to respiratory diseases (e.g., bronchitis), injury and death (e.g., motor vehicle crashes) and prenatal exposure leading to lower birth weight of babies. There was moderate evidence of cannabis being related to impairments in cognition, memory and attention. Regarding mental health, there was substantial evidence for cannabis being related to the development of schizophrenia and psychosis. There was moderate evidence for increased risk of other mental health conditions including bipolar disorder, depression, and social anxiety. The report concluded that smoking cannabis was the least effective ways of delivering health benefits because it also delivers other harmful byproducts. There are a range of natural cannabis products (e.g., oral capsules, oils) that are being evaluated. Synthetic cannabis/cannabinoid products have existed since 1985. There was substantial evidence for cannabis health benefits for addressing chronic pain, chemotherapy nausea, and spasticity. There was moderate evidence for improving sleep/sleep apnea, fibromyalgia, and multiple sclerosis. There was limited evidence that cannabis was effective for increasing appetite and decreasing weight loss related to HIV/AIDS and improving symptoms of PTSD. Cannabis does not seem to be effective for mental health conditions such as dementia or depression. The committee's recommendations for research prioritized; 1) clinical and observational studies (short- and long-term effects); 2) health policy and economics research; and 3) public health and public safety. Barriers to research include the designation of cannabis as a Schedule 1 drug for

which researchers require licenses from the DEA, FDA and NIDA. Rigorous research is needed to continue to build the evidence about cannabis-related harms, health benefits, prevention and treatment.

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POSTER PRESENTATIONS

All poster presentations and symposia were peer-reviewed by the 2017 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.

Perceived Norms Moderate the Effects of Individual Differences in Sensation-Seeking on Marijuana Use

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Sensation-seeking has been established as a consistent predictor of marijuana use among college students. Two distinct types of sensation-seeking include desires for novel, unique, or interesting experiences (experience-seeking) and desires to engage in risky or dangerous activities (risk-seeking). However, some facets of sensation-seeking may be more socially motivated or inclined than others and needs for stimulation among those higher in risk- and/or experience-seeking may only be expressed through marijuana use if students believe use is uncommon among their peers as higher perceived norms may reduce a given behavior's novelty and thus its appeal. Therefore, the current study aimed to examine perceived norms as moderators of the associations of specific sensation-seeking facets with marijuana use. Specifically, we expected that some facets of sensation-seeking would be less strongly associated with use among those who viewed marijuana use as more common. Students (n = 7,947) from 11 universities completed an online survey assessing marijuana use. The Sensation-Seeking Personality Type scale (SSPT),

Urgency, Perseverance, Premeditation, and Sensation-seeking (UPPS), and the Substance Use Risk Profile Scale (SURPS) captured sensation-seeking. Measures of perceived norms and marijuana use included the number of days marijuana was used during a typical week (i.e., frequency). The sample included a large proportion of abstainers; thus, analyses employed a negative binomial hurdle (NBH) model. Exploratory factor analysis using a bifactor modeling framework was used to examine factor structure. Confirmatory bifactor models were estimated. Norms moderated two of the sensation-seeking measures such that higher risk and experience-seekers were less likely to use if they thought use was more common. Results indicated that among users, norms and risk-seeking were both positively and uniquely associated with rates of use across outcomes. In addition, interactions with both measures of sensation-seeking suggested positive associations of experience-seeking and risk-seeking with rates of use were attenuated when accompanied by perceptions of use as common. Notably, interactions were indicated only for models of lifetime use and odds of 30 day use. Thus, lower norms may increase marijuana use initiation, but not increases in frequency of use. Overall, the pattern of results suggests that non-users perceive use as more common than users, perhaps due to having negative prototypes of users or false uniqueness (i.e., seeing themselves as superior to users). Among users, norms were positively associated with rates of use. Yet, sensation-seeking tended to be more weakly associated with use when use was perceived as common for specific facets. Higher perceived norms for a behavior may reduce its perceived novelty among experience-seekers and perceptions of potential danger among risk-seekers. Collectively, our findings suggest that 1) sensation-seeking is a multi-faceted construct, and 2) targeting those higher in sensation-seeking, globally, may be less fruitful than targeting the facets of sensation-seeking most strongly associated with use.

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Post-traumatic Stress and Marijuana Outcomes: The Mediating Role of Marijuana Protective Behavioral Strategies

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College student marijuana use is on the rise and is currently at an all-time high, with 38% of students reporting annual use and 20% reporting monthly use. This is particularly concerning because increased marijuana use is related to an increase in negative marijuana-related consequences and escalates the risk for developing a cannabis use disorder. According to the American College Health Association, over 50% of college students report experiencing more than average or tremendous stress. Specifically, Posttraumatic stress disorder (PTSD) is one mental health problem that exacerbate one's marijuana use. Additionally, there are positive associations between trauma exposure and marijuana use, as well as PTSD symptom severity and cannabis use disorder. Because of the harmful nature of these relationships, researchers have begun to examine other variables that may better explain the associations between PTSD and marijuana. Protective behavioral strategies (PBS) are behaviors individuals can engage in that reduce substance use and decrease substance use-related negative consequences. Recently, researchers found that increased use of marijuana PBS (PBSM) is negatively correlated with frequency of marijuana use and negative marijuana-related consequences. Yet this research is in its infancy and further exploration of PBSM and marijuana use is warranted, especially within the context of PTSD. The purpose of the current study was to examine the relationships between PTSD symptoms and marijuana use frequency, marijuana use quantity, marijuana dependence, and negative marijuana-related consequences, and to examine the mediating role of PBSM among college students. College student who consumed marijuana at least one day in the previous month, reported their gender, and completed the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5) participated in this study (n=296).

Participants completed the Protective Behavioral Strategies for Marijuana, a Modified Daily Drinking Questionnaire applied to marijuana use, Marijuana Consequences Questionnaire (MACQ), and the Cannabis Use Disorder Identification Test-Revised. Mediation analyses controlling for gender (conducted using the PROCESS macro for SPSS) revealed that PBSM use significantly mediated the associations between PTSD and all four marijuana outcomes, such that PTSD was associated with lower PBSM use ($\beta = -.14$), which, in turn, was associated with higher marijuana outcomes ($-.36 < \beta s > -.16$). These results suggest that students with PTSD symptoms are at greater risk for experiencing marijuana related outcomes when their PBSM use is lower.

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What's in a Word? How Do Emerging Adults Refer to Cannabis Intoxication

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Background: Although researchers have investigated what words are commonly used to describe intoxication for alcohol, as well as subjective intoxication levels associated with such words we are unaware of any studies that have done so for marijuana. This study investigates emerging adults' marijuana-related vocabulary by identifying the most current common terms for cannabis intoxication, perceptions of quantities of marijuana needed to reach such states, and whether individuals meeting diagnostic criteria substance use disorders (SUD) possess expanded marijuana-related vocabularies. Method: Participants (n=468) were recruited for an online survey from Amazon MTurk after being screened for eligibility (i.e., ages 18-29) using qualification test questions. We eliminated survey responses that were completed in short times and those that missed validity check questions. A majority of the sample was male (58.1%), Caucasian (72.7%), enrolled at a four-year college or university or not currently enrolled in any type of school (81.6%), and employed full time (54.1%). The average respondent was 25.4 years of age and earned just over $27,000 in the past year. Participants responded to questions regarding what words they may use to describe their feelings after using

marijuana (e.g., high, stoned, baked, blazed, wrecked, and blitzed). They likeliness of using each word for describing cannabis intoxication (0 = Completely Unlikely, 5 = Completely Likely). Similarly, participants rated each word for subjective level of intoxication (0 = Not Intoxicated, 5 = Extremely Intoxicated). Results: The most common words used to describe cannabis intoxication were high (M=4.61, SD=.75), stoned (M=4.09, SD=1.26), and baked (M=3.11, SD=1.67). Blazed (M=2.54, SD=1.76), wrecked (M=1.19, SD=1.49) and blitzed (M=1.03, SD=1.41) were the least common. Stoned (M=4.27, SD=.80), baked (M=4.21, SD=.99), and wrecked (M=4.18, SD=1.47) were associated with the highest levels of marijuana use, while blazed (M=4.00, SD=1.27), high (M=3.79, SD=.87), and blitzed (M=3.43, 1.78) were associated with lower levels of use. We found no significant differences between individuals with past year DSM 5 SUDs (n=105) and those with no diagnoses (n=353) for either likeliness or subjective intoxication ratings. However, subjective intoxication was negatively associated with number of past your DSM 5 symptoms endorsed (r = -.134, p<.01), perhaps indicating that individuals with higher tolerances/more symptoms provide lower ratings. Age related differences were found for likeliness ratings on two items (e.g. wrecked, blitzed), with older emerging adults more likely to use such descriptors of cannabis intoxication. Conclusions: Findings have practical value for designing intervention scripts for on-line marijuana treatment interventions as some words are were more likely to be used to describe the effects of smoking cannabis.

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Medical Cannabis: The Most Effective Treatment for a Range of Medical and Psychological Conditions?

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Background: Previous research has shown that medical cannabis (MC) is effective for treating the symptoms of a wide range of conditions including chronic pain, several psychological disorders, appetite/nausea conditions, and numerous neurological conditions (i.e., multiple sclerosis, epilepsy). The current study evaluated MC patients' lifetime use of eight different treatments that commonly are used to manage the symptoms of a variety of medical and psychological conditions (i.e., MC, prescription medications, therapy/counseling, yoga/meditation, acupuncture, physical therapy, exercise, and change in diet). In addition to assessing which treatments patients had ever tried, we evaluated which treatment each patient found to be the most effective at treating the symptoms of his or her primary condition (i.e., pain, mental health, neurological, appetite/nausea, or sleep disorder). Finally, we examined whether treatment preference differed based on primary condition. Method: The study sample comprised 373 MC patients (65.1% female, 82.3% White, mean age = 33.0 [10.4] years, duration of MC use = 3.0 [3.4] years) who completed an online survey about MC use. To be eligible for the study, participants had to reside in a state where MC is legal, report current cannabis use, and report having a valid MC "card" that they use to obtain MC. Participants reported on the primary condition for which they currently use MC. They subsequently reported whether they had ever tried any of the following eight treatments to manage the symptoms of their primary condition: MC, prescription medication, therapy/counseling, yoga/meditation, acupuncture, physical therapy, exercise, or a change in diet (participants could choose as many treatment options as were applicable). Finally, patients indicated which treatment they experienced as most effective at treating the symptoms of their primary condition. In addition to examining descriptive statistics, we ran a χ^2 analysis to determine if the treatments identified as most effective by MC patients varied by primary condition. Results: Patients reported

the following primary conditions: pain (53.4%), mental health (33.2%), neurological (3.8%), appetite/nausea (1.3%), and sleep problems (8.3%). On average, participants reported trying 4.43 (1.80) different treatments, and there was no difference in the total number of treatments tried based on primary condition. Overall, 80.7% of MC patients reported that MC was the most effective treatment for their primary condition. The χ^2 analysis indicated that MC was chosen as the most effective form of treatment irrespective of primary condition (pain: 81.4%; mental health: 78.2%; neurological: 71.4%; appetite: 100%; sleep: 87.1%). Conclusions: Over 80% of MC patients selected MC as the most effective treatment out of 8 common treatment options that included gold standards like prescription medication and therapy. Importantly, MC was chosen as the most effective treatment irrespective of patients' primary medical condition, indicating that patients find MC effective at treating a diverse range of symptoms.

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Associations between Cannabis Use and UPPS-P Impulsive Traits by Gender

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Substantial evidence suggests that impulsivity is associated with substance-related behaviors, including cannabis use. Although impulsivity is a contentiously-debated term in the literature, many researchers agree that impulsive dispositions encompass traits like urgency and lack of premeditation. In light of evidence that impulsivity is a heterogeneous construct comprised of distinct facets, the UPPS-P Impulsive Behavior scale is often used to gain a more nuanced understanding of relations between impulsive-like traits and psychopathology, including substance use behaviors. However, less work has focused exclusively on cannabis use among college students when examining traits assessed by the UPPS-P. Thus, the current work used hierarchical linear modeling to examine UPPS-P impulsivity profile differences between users and non-users of cannabis, and whether

these profiles differed across gender. Participants consisted of college students, ages 18-25, from a southwestern university (N = 718, 66% female, 69% White, 26% Hispanic). Past-month (endorsed by 29%) and past-year cannabis use (endorsed by 43%) were assessed using items from the American Drug and Alcohol Survey. Cannabis use was dichotomized for each analysis. Each UPPS-P facet score was standardized for ease of interpretation (i.e., M = 0, SD = 1). Significant main effects of cannabis use and gender emerged from both analyses, as did significant gender x impulsivity interactions. Although no gender x cannabis use or cannabis use x gender x impulsivity interactions were statistically significant, we planned several a priori contrasts to examine UPPS-P disposition differences between users and non-users of cannabis as a function of gender. Contrasts indicated that all five facets significantly distinguished between past-month female users and non-users of cannabis, such that users scored higher (ßs = .27 - .44, ps < .0001 - .05). Among males, positive urgency (ß = .30, p < .05), lack-of-planning (ß = .51, p < .001), and sensation seeking (ß = .37, p < .001) were higher among past-month cannabis users versus non-users. All facets of UPPS-P were significantly higher among male and female past-year cannabis users compared to non-users (ßs = .29 - .59, ps < .0001 - .01). Given that all five UPPS-P facets significantly distinguished between past-month and past-year female users and non-users of cannabis, the UPPS-P may have more utility in identifying college student females at risk for cannabis use. However, sensation seeking and lack-of-planning may be important predictors of cannabis use across gender, whereas urgency relations are stronger for negative urgency among females and positive urgency for males. Clinically, this suggests that different emotion-regulating motives may be associated with cannabis use as a function of gender.

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Medical Cannabis Patients' Preferences for Different Routes of Cannabis Administration

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Background: Medical cannabis (MC) effectively treats the symptoms of a wide range of medical and psychological conditions (chronic pain: Whiting et al., 2015; PTSD: Bonn-Miller et al., 2014). Currently, patients have many options for how they ingest MC, and recent research indicates that many non-combustible methods of administration (e.g., "edibles"; tinctures; vaping bud/concentrates) may be healthier alternatives to traditional, combustible methods of MC administration. Further, research indicates that specific routes/methods of administration may be experienced as more effective for managing the symptoms of certain conditions (e.g., oral cannabis to treat pain stemming from Multiple Sclerosis; Hill, 2015). However, few studies have examined patients' preferences for using different MC administration methods. Thus, we evaluated: 1) what administration methods MC users had ever tried (i.e., oral, tincture, smoked, vaporized concentrate, vaporized bud, raw/juiced cannabis, topical) and 2) what administration method patients experienced as most effective for managing the symptoms of their primary condition (i.e., pain, mental health, neurological, appetite/nausea, insomnia/sleep problems). Method: In total, 373 adult MC users who reported residing in a state in which MC is legal and possessing a valid MC "card" completed an online survey. Due to small cell sizes, individuals with primary neurological (n = 14) or appetite/nausea (n = 5) conditions were excluded from the analyses. In addition to descriptives, we ran a χ^2 analysis to explore whether patients with different primary conditions preferred different routes of MC administration. Finally, we assessed how often patients successfully obtained their preferred method of MC administration (5-point scale; never-always). Results: The analytic sample comprised 354 MC patients (64.1% female, 82.5% White, 33.02 [10.46] years, duration of MC use 2.91 [3.26] years). On average, patients reported trying 4.14 (SD = 1.82) different MC administration methods, and there were no differences in the total number of methods tried across the primary conditions. Patients reported trying and preferring: oral MC (Ever Tried: 86.2%; Preferred: 20.9%), tinctures (37.0%; 3.1%), combustibles (89.8%; 54.8%), vaporized concentrates (67.8%; 11.6%), vaporized dried bud (61.0%; 6.8%), raw/juiced MC (30.8%; 1.7%), and topicals (41.2%; 1.1%). There were no significant differences in preferred administration method by primary condition. Most patients (74.5%) reported that they were able to obtain their preferred MC administration method often or always. Conclusions: Irrespective of primary condition, the majority of MC users reported preferring combustible MC to other routes of administration. Thus, individuals with chronic pain, psychopathology, or a sleep disorder were equally likely to prefer combustible MC. These findings run contrary to the notion that non-combustible (and possibly healthier) methods of MC administration are being adopted by individuals with particular medical conditions. With regard to MC access, most users reported being able to obtain MC products aligning with their desired route of MC administration. These findings suggest that patients' subjective treatment needs (with regard to MC administration method) largely are being met. Future research should explore why combustible MC continues to be the administration method of choice for treating a wide range of conditions despite the availability of potentially healthier routes of administration.

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Regulatory Focus and Hazardous Marijuana Use

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Marijuana use among college students is at an all-time high, with roughly 38% reporting annual use and 20% reporting monthly use. This trend is particularly concerning, given that increased cannabis use is associated with greater marijuana-related negative consequences. Given the volume of use, the frequency of negative consequences, and the expectation that consumption will likely increase as more states legalize recreational use, it behooves researchers to improve our understanding regarding factors that impact, maintain, and influence the use of marijuana and the related negative consequences.

Self-regulation is one factor that has recently been examined in the context of marijuana use. Specifically, Dvorak and Day (2014) found that greater behavioral self-regulation characteristics (e.g., self-control, sensation-seeking) significantly predicted less marijuana consumption. Additionally, authors found that emotional self-regulation characteristics (e.g., affect, distress tolerance) significantly predicted marijuana-related consequences, but the directionality depended upon the type of emotional regulation. These results suggest that self-regulation may play an important role in one's marijuana use and experience of consequences. One relatively unexplored dimension of self-regulation that may also be related to marijuana use is regulatory focus. Regulatory focus theory posits that individuals regulate behaviors through two types of motivational systems: promotion and prevention. While a promotion focus is concerned with more risk-taking to obtain pleasure and positive outcomes and seeing goals as opportunities or advancement, a prevention focus is associated with avoiding discomfort, preventing negative outcomes and seeing goals as meeting responsibilities and staying safe. Although regulatory focus theory has never been examined with marijuana use, previous research has found promotion regulation focus to significantly moderate the relationship between parenting style and drinking behaviors. Given the recently discovered link between promotion regulatory focus and other substance use behaviors, more exploration of the associations among marijuana and regulatory foci is warranted. The purpose of the current study was to examine the relationships of promotion and prevention self-regulation with marijuana use, particularly hazardous marijuana use. Hazardous marijuana use is measured by the Cannabis Use Disorder Identification Test (CUDIT), which accounts for both excessive cannabis use and marijuana-related consequences. We expected that greater endorsement of promotion and prevention self-regulatory focus would predict less hazardous marijuana use. A sample of 100 college students (M=20.21; SD=1.49) that reported marijuana use at a mid-sized, Southeastern university completed the Regulatory Focus Questionnaire (RFQ) and the CUDIT. Multiple regression analysis indicated that a promotion-oriented regulatory focus significantly predicted CUDIT scores [ß= -.229; t (2, 83) = -2.17; p< .05], such that lower promotion self-regulation predicted more hazardous marijuana use. This suggests that individuals who report less regulation aimed obtaining positive outcomes are more likely engage in hazardous marijuana use. Prevention-oriented regulatory focus did not significantly predict CUDIT scores. Implications, limitations, and future research directions will be discussed.

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Examining the Non-Linear Relationship between Conformity Motives and Marijuana Use

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Marijuana is one of the most widely used substances in the US, particularly among emerging adult college students. Understanding motives for marijuana use is an important step towards developing tailored interventions. Although findings have varied considerably across studies as to whether a single motive is most strongly associated with problems (e.g., Coping, Social/Enhancement), many have evidenced positive associations between frequency of use and marijuana-related problems. The exception is Conformity motives, which are often unrelated, or negatively related, to both marijuana use frequency and related problems. It is possible that individuals who use marijuana regularly across several contexts simply endorse more motives overall. However, it is important to note that Conformity motives were initially hypothesized to be salient in the earlier stages of marijuana use, before other motives have been internalized. The inconsistent findings between Conformity motives and marijuana use frequency may be a consequence of their non-linear relationship. The present study compared nonlinear and linear regression models of marijuana motives and use frequency. Coping, Enhancement, and Social motives were expected to have positive linear relationships with marijuana use history. In contrast, Conformity motives were expected to evidence an inverted 'V' shape: individuals reporting moderate marijuana use would endorse the greatest mean level of

Conformity motives compared to both experimental/light users (e.g., 1-2 uses) who use more out of curiosity, and heavy users who may have already internalized other motives (e.g., Coping, Enhancement). Each motive was regressed on lifetime, past year, and 30-day marijuana use frequency using both linear and spline regression, then compared for model fit. The sample included 145 emerging adults (18-25 years) enrolled in a public university. All participants endorsed lifetime marijuana use on an online questionnaire (drawn from Monitoring the Future Survey, 2016) and completed the four-factor Marijuana Motives Questionnaire, where scores on each motive ranged from 5-25. As expected, Conformity motives were predicted best with non-linear spline regressions (R^2 = 7.6% - 17.8%) than linear regressions (R^2 = 0.1% - 2%). Of note, the location of the 'peak' before the positive slope declined occurred at lower use frequency levels when participants were asked about more recent time frames. Specifically, when asked about lifetime use, frequency of use positively predicted Conformity motives until 20-39 times (Conformity M = 10.00) before declining at 40+ uses (Conformity M= 6.89); for past year and 30-day frequency the positive slopes peaked at 10-19 uses (Conformity M=9.41) and 3-5 uses (M=9.55), respectively. In contrast, use frequency best predicted Coping (R^2 = 22-27%), Social (R^2 = 20-26%), and Enhancement (R^2 = 16-31%) motives with positive linear regressions. Findings support the idea that generally more frequent use leads to greater internalization of motives – a key exception is Conformity motives which decline at higher use rates and are replaced by other motives.

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Marijuana Use in the Context of Risk Seeking, Experience Seeking, And Fun Seeking

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The constituents of the behavioral approach system (BAS) and sensation seeking are implicated in the pursuit of rewarding, novel or risky experiences. While both BAS and sensation seeking are associated with marijuana use, the relation between the three elements has yet to be explored. The current study aimed to identify the facets of sensation seeking that are most related to marijuana use, as well as explore the mediating role of BAS in this relation. Mediation analyses indicate that the fun seeking component of BAS plays a crucial role in both the initial decision to use marijuana and the age of first use in conjunction with high experience seeking behavior. Conversely, fun seeking partially contributes to the initial decision to use marijuana but has no significant relation to age of first use in respect to risk seeking behavior. Results indicate that separate aspects of sensation seeking offer a more comprehensive narrative than the construct as a whole in relation to marijuana use.

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Supplemental Materials Here

Spatial Distribution of Cannabinoids, Terpenes and Other Significant Molecules Within Agricultural Cannabis Products: Basic Analytical Science and its Practical Implications

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Cannabis is grown in predominantly a single form commonly referred to as "leaf", "flower", "bud" and a number of other even more colloquial names while it is significantly modified into a wide ranging number of different forms for trade and for eventual consumption. The tracing and tracking of the several significant classes of molecules (analytic chemistry) through this product chain is an extremely important activity that provides key information to scientific

investigators, product formulators, customers and consumers without which informed decisions by any of these parties are impossible. One particular recurring problem is the apparent variation in multiple measurements by either the same or several different laboratories on what is purportedly the same analytic sample. A priori expectations that the raw agricultural materials are intrinsically inhomogeneous drive analysts to utilize larger and larger samples and mechanically homogenize them to draw from and examine. Other problems reside in use of headspace methods in these analyses that are intended to reduce instrument maintenance and have the coincident tendency to increase the complexity of the physical system being studied and providing additional confounding results. This work will report results of the application of analytic methods to map the concentration of several molecule classes (cannabinoids, terpenes, waxes, etc.) in the raw agricultural flower or bud with an eye towards addressing significant recurring questions, including those identified above, that arise in the execution of legally and common sensibly required analysis and reporting.

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"I Use Marijuana to Sleep": Relations to Frequency, Problematic Use, & Sleep Problems in Young Adults

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Marijuana is a popular substance used among young adults with one in five reporting current use nationally and across college campuses. Anecdotally and in emerging research, people report using marijuana to help with sleep and certain strains are marketed as sleep aids (e.g., "Tahoe OG Kush"). In the United States more than a third of the adult population report not getting enough sleep, with estimated economic costs of $411 billion annually. Prescription drugs are avoided because they are less effective over time and have unwanted side effects. However, people looking to use marijuana as a sleep aid contradicts research that using marijuana results in more sleep disturbances and reducing marijuana use improves sleep. While some work has looked at how sleep disturbances affect individuals' abilities to reduce their use, there is a dearth of research in this area. Further, gender differences are important to consider. The present study addresses current research gaps by investigating sleep as a motivation for marijuana use in a diverse sub-sample of 354 young adult college students (68% female; 57% White, 18% Black, 25% Other) at a southeastern university who reported using marijuana in the past year (42% of the total sample). There were no recreational, medical, or decriminalization marijuana laws at the time of data collection. The 4-point Likert item, "I use marijuana to sleep," was added to the Marijuana Motives Measure to capture this phenomenon. Participants also self-reported through an online survey their frequency of use in the past year and 30 days, problematic use, and sleep problems. T-tests revealed that men reported more frequent marijuana use and problematic use in the past 30 days and past year (ts=4.24-4.30, ps<.001; ts=2.47-3.19, ps=.002-.014, respectively), and had less sleep disturbances (t=-3.45, p=.001) as compared to women. However, there were no gender differences in using marijuana to sleep, total sleep problems, sleep latency, daytime dysfunction, sleep quality, needing medications to sleep, and sleep efficiency. Almost half of the sample (44%) reported being motivated to use marijuana to sleep at least some of the time. Using marijuana to sleep significantly predicted frequency of use and problematic use and accounted for 13-29% of the variance in the regression models. Further, using marijuana to sleep predicted total sleep problems and most sleep problem subscales, though it accounted for less of the variance comparatively (1-6%). Interestingly, total sleep problems did not predict frequency or problematic use. Gender was only found to moderate the relations between using marijuana to sleep and problematic use in the past year (ß=-.23, t=-2.10, p=.007) and past 30 days (ß = -.16, t = -2.30, p = .022), with men reporting using marijuana to sleep more as use increased, compared to women. This study highlights the importance of investigating the perceptions and relations between marijuana and sleep in young adult populations. Future work needs to investigate the generalizability of the findings, use objective measures of sleep problems, use longitudinal designs, and get more detailed information about the strains and

method of marijuana ingestion being used for sleep.

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Correlates and Trajectories of Cannabis Withdrawal in Adolescence

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Cannabis withdrawal is frequently reported for adolescents via clinical anecdote, but the validity of these reports and the vulnerability of adolescents to cannabis withdrawal is unclear. The present study investigated the correlates and trajectories of cannabis withdrawal in a high-risk sample of adolescence. 706 adolescents had participated in a treatment study of brief interventions for risky sexual behavior and substance use (ages 14-18, predominantly Hispanic). Substance use and withdrawal were assessed at baseline, prior to the intervention, and again 3, 6, 9, and 12 months following baseline. Latent profile analyses were conducted to distinguish profiles of change on substance use and withdrawal. For cannabis withdrawal, four latent profiles were identified, corresponding to absent (n = 359), mild (n = 241), moderate (n = 76), and severe withdrawal (n = 30). Unexpectedly, there was almost no change in cannabis withdrawal for each profile. That is, trajectories for the four groups were parallel during the study. In contrast, all four groups demonstrated markedly decreased frequency of cannabis use following baseline, suggesting weak associations between cannabis use and withdrawal. Indeed, there was a moderate correlation at baseline (.32) and weak correlations at subsequent assessments (r's < .22). A similar pattern was found for alcohol withdrawal and alcohol use. Unexpectedly, there were strong correlations between cannabis withdrawal and alcohol withdrawal at each assessment (r's = .40 - .55). Subsequently, regression models were conducted to assess other characteristics of cannabis withdrawal. Cannabis withdrawal was associated with polysubstance use (number of other illicit substances used) and emotional lability (anger). In summary, findings suggest that cannabis withdrawal is only weakly associated with severity of cannabis use, with stronger associations with alcohol withdrawal, polysubstance use, and emotional lability. Future research should investigate whether clinical- and self-reports of cannabis withdrawal are more indicative of emotional lability or a general propensity toward coping motives in adolescence. Further, fine-grained data regarding use, such as dosage and mode of administration, may be important for understanding cannabis withdrawal in adolescence.

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Search for Meaning in Life and Difficulty with Impulse Control on Marijuana Use

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With the recent change of legalization of medical and recreational marijuana in certain states, attitudes about marijuana have also begun to change. One of the gaps in the research on marijuana surrounds the interplay of existential (i.e., meaning in life) and personality constructs (e.g., impulsivity) and their influence on marijuana use. Search for meaning is often emerges from an event that caused stress to the individual. However, search for meaning, extends beyond coping with meaninglessness. Search for meaning is a psychological factor with individual differences that occurs in the absence of life events. Moreover, difficulty with Impulse Control is a facet of Emotion Regulation, characterized by the absence of the ability to regulate one's emotions. For the purposes of this study Marijuana use was determined by an individual's reported use over the previous 30 days. The current study set out to examine the relation among search for meaning in life, difficulty with impulse control, and marijuana use. We hypothesized that individuals who are searching for meaning, and lack impulse control, would use marijuana more frequently than individuals searching for meaning with strong impulse control. 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. Data were analyzed using a negative binomial hurdle model. Hurdle models have two parts, a logistic regression examining likelihood of using marijuana in the past 30 days, and a count

regression assessing if they used, how much. An interaction between search for meaning and impulsivity and entered in the model as a predictor of marijuana use. There were no significant main effects or interactions in the count portion of the model. However, the prediction of any marijuana use produced two significant main effects. There was a positive relationship between likelihood of marijuana use and impulsivity for participants who were one standard deviation below the mean on search for meaning. In contrast, there was a negative relationship between likelihood of marijuana use and impulsivity for participants who were one standard deviation above the mean on search for meaning. These results suggest that meaning in life moderates the relation between impulsivity and marijuana use. Specifically, the present study indicates that search for meaning in life, may act as a protective factor for impulsive individuals. The results of this have clinical utility in the role meaning in life plays in the relation between difficulty with impulse control and marijuana use. Individuals high in difficulty with impulse control, may benefit from interventions promoting search for meaning in life, to regulate their marijuana use.

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Biomarker Discovery for Marijuana Use Utilizing Modified Aptamer and Metabolomic Panels

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Aims: Peripheral biomarker discovery of marijuana use. Method: Eight Discordant and four concordant marijuana using twin pairs were queried about their marijuana use. Participants completed a blood draw, urine toxicology testing, as well as questions about past 30 day substance use. 1310 modified aptamers (SomaScan) and 258 metabolomic markers were examined for association with marijuana use. Results: The 24 subjects were all non-Hispanic whites. 66% were female. Median age was 30. Marijuana using subjects reported using marijuana 23.4 out of the past 30 days; mean urine THC level were 688ng/ml. Subjects who did not endorse regular marijuana use reported 0.125 days of use in the past 30 days and had undetectable THC levels. For the somascan analysis, we used a linear mixed model that accounted for differences in relatedness between monozygotic and dizygotic twins to identify proteins with quantitative levels that differed between marijuana users and non-users. The most significant protein, Neurexin-1-beta (NRX1B; p<0.001), was more abundant in marijuana users than non-users. Neurexin 1 has been implicated in several neurological disorders including addiction. Using functional enrichment, we identified several KEGG pathways associated with marijuana use including pathways related to the proteasome, cell adhesion molecules, olfactory/taste transduction, and morphine addiction. Metabolomic analyses utilized partial least squares-discriminant analysis (PLS-DA) showed a clear clustering of controls versus THC groups. The major contributing compounds were maleic acid and D-gluconate and other compounds. A correlation analysis revealed that, 4-aminobutyrate (GABA) and glutathione showed the highest correlation (Pearson) with THC levels. Conclusions This pilot study demonstrated the feasibility of utilizing joint proteomic and metabolomics analysis for marijuana biomarker discovery and identified biomarkers that distinguished marijuana users from non-users. Grants: K24DA032555; DA035804, AG046938.

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When Clients Tell You What They Want To Change, Believe Them: Substance-Specific Effects of Speech

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The technical hypothesis of motivational interviewing (MI) posits that within-session client change talk (i.e., client statements favoring healthier behavior) mediates the relationship between clinician language and intervention outcomes. While there is empirical support for this hypothesis, recent work has suggested that client sustain talk (i.e., statements favoring the status quo) is more important. However, these effects have been observed only among

participants mandated to treatment, who may not express the ambivalence about substance use typical of treatment-seeking participants. It is challenging to directly compare the speech of treatment-seeking and non-treatment-seeking participants, as they differ in important ways. However, polysubstance use involving both alcohol and cannabis is common, making it possible to study participants who use multiple substances but are only seeking treatment for one of them. The goal of the present study, then, was to evaluate client speech about cannabis separately from client speech about alcohol in a sample of participants from Project MATCH, and to evaluate the relationships between speech and outcomes separately for alcohol and cannabis use. A sample of MI/MET sessions from 85 participants (70.2% male, M age=33.1, SD=7.7 years) were rated using the MISC 2.5 and the CACTI coding application, with client speech about alcohol categorized separately from client speech about cannabis. Of this sample, 76.2% reported prior cannabis use at baseline, with a mean of 8.68 cannabis use days during the 90-day baseline period. All were seeking treatment for alcohol use and reported recent alcohol use, with a mean of 61.7 (SD 60.5) drinks per week during the baseline period. Relationships between speech counts and substance use at the 12-month follow-up were evaluated using negative binomial regression, covarying for baseline use. Sustain talk about cannabis predicted cannabis use (b=0.908, p=.025), and change talk about alcohol predicted alcohol use (b=0.019, p=.035). No effects were found relating speech about one substance to use of another substance (all p>.50). In a sample of alcohol- and cannabis-using participants seeking treatment for alcohol use but not for cannabis use, we found that client change talk about alcohol predicted reduced alcohol use, while client sustain talk about cannabis predicted ongoing or increased cannabis use. This supports the notion that neither change talk nor sustain talk has any special inherent predictive power; instead, the intervention focus and the client's ambivalence about it are the determining factors. Cannabis use was not the focus of Project MATCH, and although cannabis use fell during treatment, it increased steadily over the subsequent year of follow-up, and was predicted by cannabis sustain talk. In contrast, alcohol use fell sharply and remained low, and was inversely

associated with change talk. These data support the notion that neither aspect of ambivalence (i.e., change talk or sustain talk) is "special"; instead the effects of client speech are substance-specific, and the relationship between speech and substance use will vary depending upon the client's level of ambivalence about the specific substance.

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Treatment Outcome for Cannabis Use Disorders in Youth referrals from the Justice System

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Objective: Youth with substance use disorders (SUD) referred to treatment from the juvenile justice system (JJS) accounts for approximately half of the treatment admissions nationwide. The objective of this analysis of the results of treatment for cannabis use disorders (CUD) study was to compare retention and outcomes of adolescents referred by the JJS to referrals from the general community. Method: A total of 172 adolescents, 13-18 years of age, 83% males, 70% JJS referrals, diagnosed with DSM-IV CUD, enrolled in this outpatient, randomized, continued care study. Following a 7-session weekly motivational enhancement and cognitive behavioral therapy intervention (MET/CBT-7) only poor responders (defined as failing to achieve abstinence at week seven for any reason) were randomized into a 10-week second phase of either an individualized enhanced CBT or an Adolescent Community Reinforcement Approach (ACRA) intervention. Results: JJS referrals' retention rates were significantly higher than non-JJS referrals retention rate ($\chi^2(1) = 11.21$, p < .01) at the end of Phase I (i.e., week 7). However, there was no difference in abstinence rates between the groups at the end of Phase I, Phase II or any additional follow-up assessment points. Conclusion: Additional research examining how to capitalize on superior retention rates by activating mediators of change in order to improve abstinence among youth JJS referrals is

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Risk Seeking Moderates the Association between Emotion Dysregulation and Marijuana-Related Consequences

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Background. Understanding contributing factors of problematic consequences associated with marijuana use is critical for the reduction of harm. Sensation seeking and emotion dysregulation have been identified as contributing factors, although findings have been mixed. Objectives: The study seeks to clarify relations between sensation seeking, emotion dysregulation, and marijuana-related consequences. Method: Cross-sectional data were gathered from 8,141 undergraduates in 11 states from 2015-2016 by the Marijuana Outcomes Study Team (MOST). Marijuana users (n=2,128) were assessed for sensation seeking (Sensation Seeking Personality Type Questionnaire), emotion dysregulation (Difficulties in Emotion Regulation Scale), and marijuana-related consequences (Marijuana Consequences Questionnaire). Data were analyzed using negative binomial regression within a structural equation model. Results: Results revealed a significant positive association between risk seeking (a facet of sensation seeking) and marijuana-related consequences, as well as between emotion dysregulation and marijuana-related consequences. A significant negative association was observed between experience seeking (another facet of sensation seeking) and marijuana-related consequences. A significant interaction was found between emotion dysregulation and risk seeking, but not experience seeking. Conclusions: Whereas risk seeking appears to be a risk factor for marijuana-related consequences, this was only true at lower levels of emotion dysregulation. At high levels, the effect of emotion regulation superseded that of risk seeking. These findings have implications for the prioritization of clinical concerns in individuals seeking treatment for problematic marijuana use.

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Identifying the Scientific and Clinical Training Practices of Cannabis Dispensaries

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With the proliferation of medical and recreational cannabis dispensaries due to state legalization efforts, little is known about dispensary operating procedures and training practices for staff. In our previous work, we identified that dispensary workers have minimal medical and scientific background. The current study expands upon that research through a qualitative examination of scientific and clinical training for medical cannabis employees. Semi-structured qualitative interviews were conducted with dispensary workers (N=8) from four states (AZ, CA, CO, DC) to better understand the nature of their training and the factors involved in making recommendations to patients. Interview transcriptions were coded in NVIVO for Mac (Version 11) by two independent raters (D.K. and K.J.) and evaluated by a third rater (S.S.) using an iterative process. Themes were identified from interview content using a grounded theory approach. Participants described several training methods that varied widely across dispensaries: On-site, online/webinars, onboarding and ongoing (e.g., new products, delivery methods). Notably, training may be informal, and include content such as reading materials from supervisor or other staff, state-mandated information, policy manuals and budtender certification programs. Dispensary staff highlighted several barriers to consistent training, such as time, cost, high employee turnover, education, stigma, understaffing, changing regulations and administrative approval. A prominent theme emerged around the role and identity of dispensary staff workers. Roles included being a "budtender" or customer service specialist on the

front line dispensing cannabis to patients, an expert on various aspects of cannabis (e.g., delivery methods, products, dosing), and a business-oriented function, which involves increasing sales and reducing inventory. Consistent with a non-medical identity, staff typically reported they did not screen patients for history of psychiatric disorders or addiction; nor did they assess current medication regimens. In conclusion, there is significant variation in training protocols across dispensaries and major obstacles to implementation. Dispensary practices are complicated by competing priorities of the cannabis industry. There is confusion among dispensary workers about what their role entails, particularly between providing product recommendations and medical advice. This research provides valuable information to inform the development of a standardized scientific and clinical training protocol for dispensaries to implement in the comprehensive education of cannabis dispensary workers.

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Effectiveness of Brief Interventions Targeting Marijuana Outcomes among Mandated College Students

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Unlike alcohol use, little research has examined the effectiveness of prevention and intervention strategies focused on reducing marijuana (MJ) use and related consequences among college students. As a result, substance use education programs on campuses that are tasked with providing education and brief interventions for MJ to students are often required to develop their own intervention strategies. The current study aimed to examine the effectiveness of two brief MJ interventions adapted from already effective alcohol interventions on various MJ outcomes. Participants were 165 predominantly male (80%) students from a Western university ranging in age from 18 to 53 (M=20.10, SD=3.94). A majority of students were freshman (57%), with all students having been cited for a MJ violation in the past 4 academic years. Participants completed an intake session with a peer educator and

baseline measures of past-month MJ use, including: the number of times they used MJ (frequency), the number of days they used MJ (days), the amount of money spent on MJ, consequences experienced from MJ (consequences), readiness to change MJ use, hours spent under the influence of MJ (hours), and risk for a cannabis use disorder. Next, participants were assigned to one of two interventions based on severity of their MJ use: 1) Marijuana Education Seminar (MES; a one-time group education session for students with less severe MJ use history); or 2) A modified version of Brief Alcohol Screening and Intervention for College Students (BASICS; 2-3 individual sessions of an alcohol intervention adapted for MJ use for students with more severe MJ use history). Outcomes were again assessed 30-days and 60-days post-intervention via online survey. Multivariate tests revealed a significant main effect of time ($F(2,192)=2.08$, $p=.037$, $\eta^2=0.43$), with significant changes in past-month frequency ($F(2,102)=4.32$, $p=.033$, $\eta^2=0.8$), days ($F(2,102)=8.52$, $p=.001$, $\eta^2=0.14$), and hours ($F(2,102)=3.48$, $p=.048$, $\eta^2=0.06$) over time. Specifically, participants reduced their frequency of MJ use from baseline to 60-day follow-up ($p=.020$), reduced their days of MJ use from baseline to 30- ($p=.013$) and 60-day follow-up ($p=.001$), and reduced their hours spent under the influence of MJ from baseline to 60-day follow-up ($p=.002$). In addition, there was a significant main effect of intervention ($F(1,45)=2.23$, $p=.049$, $\eta^2=0.26$), with significant differences in past-month days ($F(1,51)=5.16$, $p=.027$, $\eta^2=.09$), CUDIT ($F(1,51)=5.95$, $p=.018$, $\eta^2=.10$), consequences ($F(1,51)=4.61$, $p=.037$, $\eta^2=.08$), and hours ($F(1,51)=11.16$, $p=.002$, $\eta^2=.18$) between groups. Specifically, participants assigned to BASICS had significantly higher scores than participants assigned to MES on these outcome measures, which is expected given that participants were assigned based on severity of MJ use. Finally, there was no significant interaction between time and intervention type ($F(1,192)=1.49$, $p=.162$, $\eta^2=.36$). Findings from this study can be utilized to inform current substance use education programs on college campuses about the potential effectiveness and limitations of alcohol interventions adapted for MJ use. In addition, this study highlights the need for further research in the area of developing

evidence-based interventions for MJ use on campuses, as well as standardized measures of MJ use similar to the "standard drink".

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Relationships among Marijuana Frequency, Quantity, and Potency Using Based on Retrospective Self-Report and Ecological Momentary Assessment

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National trends suggest that perceived risk of marijuana is declining while the prevalence of use is increasing. Additionally, the prevalence of cannabis use disorders among users has decreased, while the majority of users do not appear to experience significant problems. Given unique considerations of marijuana as a psychoactive substance, greater precision of measurement of consumption is needed. In terms of its psychoactive effects, there is considerable variability in potency based on two main chemical agents, tetrahydrocannabinol (THC) and cannabidiol (CBD). The purpose of the current study was to examine relationships among frequency, quantity, and preferred potency of marijuana use. As part of an ongoing study, regular marijuana users over the age of 21 were recruited from the community (N = 102) in two states with legalized recreational marijuana. At baseline, participants completed a battery of self-report measures, including a 30-day Timeline Followback interview. Participants then completed a 14-day ecological momentary assessment (EMA) protocol using their personal smartphone, providing real-time assessment of marijuana use events. For both assessments, four consumption measures were computed: frequency, quantity, THC potency, and CBD potency. During the baseline assessment, participants completed the Marijuana Dependence Scale (MDS) which yielded a score indicating level of marijuana-related risk. Retrospective self-report frequency was positively associated with quantity, $r = .30$, $p < .01$, and THC potency, $r = .27$, $p < .01$. No significant associations between quantity and potency were observed. A significant association between frequency and THC potency also emerged using aggregated EMA data, $r = .26$, $p < .01$. Frequency and quantity of use were associated across the retrospective and EMA measures, $r = .34$, $p = .001$ and $r = .51$, $p < .001$, respectively. THC and CBD potency also were associated across measures, $r = .38$, $p < .001$ and $r = .44$, $p < .001$, respectively. When the four retrospective consumption variables were entered simultaneously as predictors of MDS score, the model was not significant. The regression model with the four EMA consumption variables as predictors was significant, $R2 = .11$, $F(4, 95) = 2.85$, $p < .05$. The simple effects of quantity, $\beta = .21$, $p < .05$, and THC potency, $\beta = .25$, $p < .05$, were significant. Thus, individuals using more marijuana per use event and those selecting marijuana with higher THC levels reported greater marijuana-related risk. The current research suggests that not all marijuana use measures are equivalent and researchers should make careful consideration of measurement strategies based on their research goals. Further research examining important components of marijuana use may facilitate better understanding of risk levels based on preferred consumption and dosage patterns.

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Daily Use as a Predictor of Marijuana Use Outcomes in Two Legal Recreational States

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Introduction: To laypeople and clinicians alike, use frequency is an important factor when considering substance use risk. Daily use is relatively easy to determine and may be a potentially meaningful risk indicator; however, it is unknown whether daily marijuana (MJ) use is associated with MJ-related outcomes. The present investigation examined whether daily users differed from less frequent users in terms of various MJ outcomes. We hypothesized that daily users would report greater dependency, use motives, craving, quantity, and potency. Method: A community-recruited sample (N = 102; Mage = 35.7 [SD = 11.1] years; 55.4% female; 83.3% White) of recreational and medical users from two

states with legal recreational markets completed a battery of self-report measures. Frequency and quantity measures were collected using a 30-day Timeline Followback interview. The Marijuana Dependence Scale (MDS) was used to establish dependence risk. MJ motives and craving were assessed using the Marijuana Motives Measure (MMM) and Marijuana Craving Questionnaire (MCQ), respectively. Participants indicated MJ potency via single items indicating percent tetrahydrocannabinol (THC) and cannabidiol (CBD) of their preferred marijuana strain. A dichotomous use frequency variable was created; participants reporting use for the past 30 consecutive days were categorized as daily users, and participants reporting abstaining on any of the past 30 days were categorized as non-daily users. For relevant variables, outliers were Winsorized to address violations of normality. Results: In the current sample of 102 participants, approximately half reported daily MJ use (n = 52). Daily users were significantly more likely to be male, $\chi^2(1) = 7.49$, p < .01. Independent samples t-tests revealed no significant differences between daily and non-daily users on MMM scales, MCQ scales, MDS score, or THC and CBD potency. Of note, MCQ-Purpose, t(100) = -1.74, p = .09, and MCQ-Compulsivity, t(100) = -1.96, p = .05, demonstrated nonsignificant trends such that daily users reported greater cravings than non-daily users. Significant group differences were found for average MJ quantity, t(100) = -3.46, p < .001 and for total MJ quantity, t(100) = -4.03, p < .001. Conclusions: In this sample, daily users demonstrated significantly higher average quantity of use than non-daily users, suggesting that the difference in overall consumption may be even greater than frequency alone would suggest. However, no significant differences were found between daily and non-daily users on other measures of MJ outcomes, suggesting that daily use alone may not be a useful indicator of MJ risk level among current users. Establishing relatively simple risk indicator variables is important for clinical and research screening purposes. While the current study did not find many differences between daily and non-daily MJ users, continuous measures of frequency may yield different results. Additionally, future research should examine whether different frequency cutoffs (e.g. weekly

vs. non-weekly, daily vs. weekly vs. monthly) are associated with MJ-related risk.

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Medical Cannabis Patients' Perceptions of Cannabis- and Alcohol-Induced Driving Impairment

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Background. Research indicates that both adult and adolescent recreational cannabis users perceive cannabis as less impairing than alcohol in terms of operating a motor vehicle. However, it is unclear whether medical cannabis (MC) patients share similar risk perceptions. In the current study, MC patients reported on how impairing they perceive MC to be on their own driving ability and on other's driving ability. They also reported on perceptions of alcohol-induced driving impairment. Finally, we examined whether patients' perceptions of MC-related risk to their own driving was associated with the frequency of driving after MC use. Method. Participants included 373 MC patients from 19 MC states who completed an online survey (65.1% female; 82.3% White; mean age 33.0 [SD = 10.4] years). A series of paired-samples t-tests was run to compare the following risk perceptions: 1. MC [own driving] versus MC [others' driving]; 2. Alcohol [own driving] versus alcohol [others' driving]; 3. MC [own driving] versus Alcohol [own driving]; 4. MC [others' driving] versus Alcohol [others' driving]. A univariate GLM model subsequently was run to determine whether MC risk perceptions were associated with driving after MC use. Model covariates included sex, race, age, and duration of MC use. Results. MC patients believed that MC or alcohol use would produce less impairment in their own driving compared to others' driving: MC (own driving: M = 2.54, SD = 1.32) vs. MC (others' driving: M = 2.86, SD = 1.24, t(372) = -6.83, p=.001); Alcohol (own driving: M = 4.36, SD = 0.99) vs. Alcohol (others' driving: M = 4.48, SD = 0.90, t(372) = -4.33, p < .001). However, MC patients reported that, compared to alcohol, MC use would produce less driving impairment irrespective of who was driving: MC (own driving: M = 2.54, SD = 1.32) vs. Alcohol (own driving: M =

4.36, SD = 0.99, t(372) = -23.87, p < .001); MC (others' driving: M = 2.86, SD = 1.24) vs. Alcohol (others' driving: M = 4.48, SD = 0.90, t(372) = -23.25, p < .001). The univariate GLM model accounted for 8.5% of the variance in driving after using MC. Neither sex, age, nor race were associated with driving after using MC. However, using MC for a longer duration (η_p^2 = 0.02, p = .02) and perceiving MC to confer lower driving-related risk (η_p^2 = 0.06, p < .001) were associated with more frequent driving after using MC. Conclusions. The current study suggests that MC users perceive similar driving risk associated with cannabis use as do recreational cannabis users. Consistent with prior research, MC users perceived MC to impair their own ability to drive less than others' ability to drive. Of note, MC patients universally perceived MC as less impairing than alcohol use. Importantly, risk perceptions were linked to driving behavior such that MC patients who perceived MC to be less impairing to their own driving were more likely to report driving after using MC.

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One-Year Trajectory of Marijuana Use in a College Student Sample: Sensation Seeking and Impulsivity as Risk Predicators

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Introduction: Though marijuana use among U.S. college students has received substantial attention in the past decades, research on patterns of marijuana use has tended to focus on average use in the population, which obscures individual heterogeneity in marijuana use over time. The current study sought to use person-centered approach to identify subpopulations of marijuana users in a large college students sample. Furthermore, the current study aimed to detect the most salient factors of risky personalities such as sensation seeking and impulsivity that distinguished different subpopulations of marijuana users. Method: A sample of 1401 college students was recruited (Mean age=19.73, SD=2.12, 48% male), participants were asked to report their marijuana use in the past 12 months, 6 months and past month. With risky personalities were examined as predictors of the latent class of marijuana use, a three-step approach was used instead of the conventional way of combining the latent class and regression model into a joint model, which has several drawbacks. In this approach, latent class analysis is utilized in the first step to identify latent groups of marijuana users, based on the fit indices of BIC, entropy and LMR-p value. The mostly likely class variable is obtained in the second step and is regressed on predictor variables in the third step with the misclassification taken into account. Results: LPA yielded a three-class solution. Class 1 comprised 55% of the sample, youth in this class had significantly lower levels of marijuana use in past year, past six months and last month compared to Class 2 and Class 3. Class 2 comprised 35% of the sample, the level of marijuana use in past year, past six months and last month were intermediate to those of Class 1 and Class 3. Class 3 comprised 10% of the sample, youth in which evidenced higher level of marijuana use in past year, past six months and last month compared to Class 1 and Class 2. Youth in Class 1 had significantly older onset age of marijuana use and lower level of risk seeking compared to those of Class 2 and Class 3; However, Lack of premeditation was significantly higher in Class 1 members than those in Class 2 and Class 3. Furthermore, higher level of Negative urgency and Positive urgency were observed in youth in Class 2 compared to those in Class 1 and Class 3. Conclusions: Our results suggested three subgroups of marijuana users, low-, medium- and high groups. Additionally, earlier onset ages and higher level of risk seeking were observed in medium and high marijuana users. While urgency traits of impulsivity were mostly salient for medium level of marijuana use. The overall results help to increase the effectiveness of person-targeted intervention programs of marijuana use.

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Collegiate Athletes' Psychological Health and Marijuana Use Related to Sports Injuries

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Considerable progress has been made in the physical treatment of collegiate athletes' injuries; however, there is less understanding of post-injury psychological health repercussions. Among athletes' post-injury behaviors related to psychological health may be marijuana use, an activity that can have deleterious effects not only on recovery from injury but on other factors such as school performance. Following an injury, athletes can experience symptoms such as depression and anxiety, as well as pain associated with the injury. Some athletes may use substances such as alcohol or marijuana to self-medicate in response to these symptoms. We sought to identify associations between sport-related injuries, psychological health problems and marijuana use among collegiate athletes. We compared injured and uninjured athletes to identify differences in the frequency of marijuana use and the prevalence and types of post-injury psychological symptoms. A sample of 333 collegiate athletes from a Midwestern Division III institution responded to a sports injury and substance use survey. The survey participants were 54% (n=178) male, mostly in the 18-20 age group (n=239, 73%), and predominantly White (n=271, 81%). Other race/ethnicity represented in the sample were Asian (11%), Black (6%), and Hispanic (5%). Respondents were participating in either cross country, soccer, swimming, track, tennis, football, or baseball, with at least 10% of respondents involved in each sport. A total of 86 (25.8%) of respondents reported using marijuana, with two-thirds (n = 54) reporting use 1 day/week, 17% reporting use 2-3 days/week, and 20% reporting use 4-7 days/week. We compared the prevalence of marijuana use in the past 30 days in those with and without a sports injury in the past 30 days and found a significantly greater proportion of those with a sports injury using marijuana (37.1% vs. 24.1%; Pearson chi-square p=0.036). The odds ratio of marijuana use for those with sports injury was 1.86; (95% CI: 1.03, 3.35). Since marijuana use may be associated with the presence of pain, we stratified our comparison of marijuana use by pain in the last 30 days. Among athletes reporting pain, a higher proportion of those with an injury reported marijuana use than those without an injury (p=0.012), while no difference was found among athletes not reporting pain. Also, we found no significant difference in psychological symptoms between those with and without sports injury (p=0.284). Findings such as ours provide foundational knowledge for developing and testing comprehensive injury prevention programs that can address psychological health issues, including marijuana use, related to sport injuries.

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Pain Patients' Experiences using Medical Cannabis

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Background: Although research indicates that medical cannabis (MC) is an effective treatment for chronic/severe pain (Whiting et al., 2015), opioids remain the most commonly prescribed pharmacological intervention. Of note, few studies have examined the intersection of pain, MC, and opioids. Extant research indicates that adding MC to opioid pain management decreases opioid-related side effects and increases analgesia, decreases the need for opioids, and improves quality of life. Method: We examined a range of MC patient experiences including common co-occurring conditions for which pain patients also use MC; duration of MC use; satisfaction with medical dispensaries and physicians; use of and preferences for different MC products (e.g., tinctures, combustible) and alternative pain treatments (e.g., yoga, exercise); changes in opioid use since starting to use MC; and perceived effectiveness of MC versus opioids for pain management. Participants included 199 pain patients (58.8% female; 35.30 (10.24) years old; 87.4% White) from 19 MC states who completed an online survey. Results: Patients reported using MC for an average of 3.03 (3.18) years to treat 1.84 (0.99) conditions (pain [100%], mental health [30.7%], neurological [10.1%], appetite [14.1%], sleep [30.2%]). The majority of

patients (55.8%) reported using MC on a regular basis to manage pain compared to using MC an as-needed basis. Patients reported that their physicians and medical dispensary staff workers were "knowledgeable" to "very knowledgeable" about MC (Physician: 4.12[0.94] out of 5; Dispensary: 4.01[0.85]) and about their pain condition (4.16[0.93]; 3.31[1.07]). Patient satisfaction was "high" to "very high" (4.50[0.80]; 4.52[0.70]). Participants had tried 4.20(1.85) routes of cannabis administration, but most preferred smoking MC (Oral [Tried: 83.9%; Preferred 19.1%], tinctures [40.7%; 3.5%], combustibles [91.0%; 55.8%], vaping concentrates [67.3%; 11.1%], vaping bud [61.3%; 7.5%], raw cannabis [30.7%; 1.0%], topical [45.7%, 2.0]). Patients reported trying 5.33(2.13) pain treatments, with the majority indicating that MC was most effective: MC (Tried: 100%; Most Effective: 81.4%), opioid pain management (85.4%; 10.6%), therapy/counseling (55.3%; 1.5%), yoga/meditation (55.3%; 2.0%), acupuncture (38.2%; 0.5%), physical therapy (64.3%; 1.5%), exercise (75.4%; 1.5%), and dieting (60.3%; 1.0%). Patients reported trying numerous opioid pain medications, but hydrocodone (44.7%) and oxycodone (48.2%; [Percocet 25.1%; Oxycontin 23.1%]) were most common. Since starting to use MC, 65.0% of patients reported that they had completely stopped taking opioids, 32.1% reported reduced opioid intake, and 2.9% reported no change in their opioid intake; no patients reported increased opioid intake. Most patients reported that MC was more effective (43.6%) or dramatically more effective (33.6%) than opioids at managing their pain; only 6.4% reported that MC was less effective. Patients reported corresponding increases (63.3%) or dramatic increases (26.6%) in quality of life since starting to use MC for pain management. Conclusions: The current study provides further evidence that MC is an effective treatment for pain. In light of the current opioid epidemic, the fact that 77% of patients reported that MC was superior to opioids in managing their pain and that 65% stopped using opioids entirely is encouraging.

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Examining the Relationship of Habit to Cannabis Use: The Self-Report Habit Index

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Prior research indicates that substance use is driven by both intentional and habitual processes. Habitual behaviors have a history of repetition and efficiency (automaticity), and they occur in response to stable environmental cues. Given that habitual processes are an integral part of how individuals organize their everyday lives, habitual behaviors also may reflect an individual's sense of identity. The Self-Report Habit Index (SRHI) has been used to examine key features of habit in varying behavioral contexts, namely repetition, automaticity, and expressing identity. However, the concept of habitual cannabis use has not been well-studied. The current study was designed to validate the SRHI for assessing habitual cannabis use (SRHI-C). This measure initially was developed to assess habitual engagement in non-substance-related behaviors. Since its inception, the scale has been adapted to assess habitual alcohol use, although the psychometric properties have not been evaluated formally. In the current study, we examined the psychometric properties of the SRHI-C within 522 young adults who reported past-year cannabis use on a survey conducted in 2015 and 2016. A confirmatory factor analysis conducted within a randomly selected 50% of our data indicated that the original 1-factor, 12-item latent factor solution did not fit the data. Ultimately, a 6-item, single-factor latent solution evidenced good fit within the remaining 50% of the data (CFI = .979, RMSEA = .077, SRMR = .021), and this model had excellent internal consistency (α=.90). Furthermore, the SRHI-C evidenced measurement invariance within multiple groups of interest (e.g., sex, race), permitting mean-level comparisons of habitual cannabis use within these groups to be conducted with a sufficient degree of statistical confidence. Differences in habitual cannabis use were observed by sex, such that women endorsed significantly higher habitual use than did men. There were no significant differences in habitual

use by race. Finally, providing evidence of test-criterion validity, the SRHI-C evidenced a concurrent relationship with cannabis use frequency above and beyond sex, age, race, and college GPA (all of which were associated with cannabis use frequency). These results suggest that the SRHI-C is a psychometrically sound assessment of habitual cannabis use for use with young adults who are enrolled in college; the SRHI-C can detect between-groups differences in habitual use by sex and is associated strongly with cannabis use. Beyond having utility in a research context, this brief scale could be administered as part of screening procedures in university clinics to identify cannabis users who may be at risk for negative consequences associated with their use. Further research is needed to determine whether the SRHI is appropriate for use with a more diverse group of cannabis users. Funding source: NIDA K12 DA000167; NIAAA 1K01AA024160-01A1; Burton Family Foundation

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Medical Marijuana Legalization and Marijuana Use among Youth in Oregon

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Legalization of marijuana for medical and recreational use raises concerns about possible effects that resulting increases in availability may have on adolescents. We examined the associations between numbers of registered medical marijuana patients and licensed growers per 1,000 population and the prevalence of marijuana use among youth in 32 Oregon counties using data from 2006 to 2015. Data on registered medical marijuana patients and growers were obtained from the Oregon Medical Marijuana Program and data on youth marijuana use, perceived parent disapproval, and demographic characteristics were obtained from the Oregon Healthy Teens Survey. Multi-level analyses indicated that the prevalence of marijuana use among adolescents was significantly higher in counties with more marijuana patients and growers, controlling for youth demographic characteristics. Conversely, marijuana patient and grower rates were inversely associated with perceived parent disapproval of marijuana use, which attenuated their relations with youths' use. Changes in patient and grower rates across time were not associated with changes in the prevalence of marijuana use. Overall, these findings suggest that although greater numbers of registered marijuana patients and growers are associated with a higher prevalence of marijuana use among youths, these associations are likely attributable to broader norms favorable towards marijuana use.

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Self-Generated Protective Strategies Have Predictive Value Over and Above a Standard List of Strategies.

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Protective Behavioral Strategies (PBS) are a putative mechanism of behavior change. PBS are strategies individuals can use before, during, or instead of using substances to aid in cessation efforts or efforts to moderate use. By definition, effective use of strategies will result in reduced substance use. Much research has established a negative relationship between PBS use and alcohol outcomes, and research is growing to establish this relationship with marijuana outcomes. One limitation to the research on PBS is that PBS are measured using a predefined list of strategies. This is problematic because participants may choose to use a strategy that is not on the list, which would lead researchers to believe that the participant did not use strategies. The goal of the present study was to examine the added predicted value of allowing participants to write in strategies in addition to completing a validated measure of marijuana PBS. Participants were college students recruited from Psychology Department Participant Pools at 6 participating universities in the United States. Participants completed an online survey examining the correlates of marijuana use among college students. Participants completed the

Protective Behavioral Strategies for Marijuana (PBSM) modified to allow for up to three write-in strategies, Modified Daily Drinking Questionnaire applied to marijuana use, and the Marijuana Consequences Questionnaire (MACQ). For the present study, only data from students that consumed marijuana at least one day in the previous month and reported their gender (n=531) were included in the final analysis from a larger sample (n=1,942). Among college student marijuana users, the majority of participants identified as being either White, non-Hispanic (n=335; 63.09%), or of Hispanic/Latino ethnicity (n=111; 20.90%), were female (n=369; 69.5%), were freshman (n=262; 49.3%), and reported a mean age of 20.16 (SD=3.15) years. Hierarchical regression analyses controlling for gender and typical marijuana use quantity (i.e., Step 1 predictors) revealed that higher marijuana PBS use assessed with the PBSM (Step 2 predictor) was uniquely significantly associated with lower reports of marijuana negative consequences (β = -.23, p <.001). When examining the effects of the PBSM written items (Step 3 predictors), greater frequency of using those written protective strategies was uniquely significantly associated with fewer marijuana negative consequences (β = -.15, p = .033) over and above marijuana use, gender, and PBSM strategies. This study provides initial evidence that allowing participants to write in their own self-generated strategies helps to overcome one of the measurement issues in the PBS literature.

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Craving and Motives for using Marijuana: Associations with Problem Use in College Students

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Background: Marijuana use is common among college students, with over half reporting marijuana use in their lifetime and approximately one-fourth reporting use in the last month. Past research has demonstrated that marijuana use and consequences are associated with coping and enjoyment motives, as well as using for social facilitation. Additionally, craving for marijuana has been shown to predict greater marijuana use and may play a role in treatment outcomes. Based on past work, we examined whether specific motives for marijuana use (coping, social anxiety, and enjoyment) were related to problem marijuana use among college students who tested positive for marijuana. Method: Participants. College-students (N=300) were recruited through a psychology participant pool at a mid-sized western university and received course credit. Participants completed a range of measures. Days of marijuana use over the last month was based on self-report and a marijuana urine screen assessed recent use. A subset of students (n = 79) who endorsed marijuana use over the last 30 days and had a positive urine screen were included in the current analyses. Measures: The Rutgers Marijuana Problem Index was used to examine problem use over the last year (α = .91). The Purposefulness Subscale of the Marijuana Craving Questionnaire-Short Form was used to measure desire or craving to use (α = .81). Three subscales from the Marijuana Motives Measure were used to assess specific reasons for using marijuana, including Coping (α = .85), Social Anxiety (α = .77), and Enjoyment (α = .81). Results: We used hierarchical multiple regression analyses to address associations with problem use for those who had positive urine screens. We first controlled for frequency of marijuana use over the last 30-days. At the next two steps, we included craving (step 2) and the three motives subscales (coping, social anxiety, and enjoyment; final step).

The model was significant and explained 30% of the variance in problem use. Step one, frequency of marijuana use, was not significant (β = .168, p = .140). At step two, craving was positively associated with problem use (β = .259, p = .048). At step three, enjoyment (β=.433, p = .002) and coping (β = .292, p = .012) motives (but not social anxiety motives) were associated with problem marijuana use. Conclusion: We were interested in determining whether specific marijuana use motives were related to problem marijuana use after considering craving or desire to use. Results showed that two motives, enjoyment and coping, were most associated with problem marijuana use even after accounting for marijuana use frequency and craving to use. These findings have implications for treatment, as high craving, as well as using marijuana to cope versus using for enjoyment, could influence the type of treatment a high-risk marijuana user may need (e.g., treatment for co-morbid psychological disorders, mindfulness for urges, etc.).

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APIS Expands Coverage for Recreational Use of Cannabis

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The first states to legalize recreational cannabis use were Colorado and Washington, which did so in 2012. They were followed by Alaska, Oregon, and Washington, D.C. In 2016, Maine, Massachusetts, California, and Nevada adopted ballot measures of their own, bringing the number of jurisdictions allowing recreational cannabis use to nine. With legalization comes the need for data to illuminate the effects of these laws. This poster presentation informs researchers of the recent expansion of the Alcohol Policy Information System (APIS) to include state-level policy data on the legalization of recreational cannabis use. In 2003, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) introduced APIS as a resource providing scholars with user-searchable access to authoritative, detailed, and comparable information on alcohol-related policies in the United States, at both state and federal levels. In 2016, APIS introduced the Recreational Use of Cannabis policy topic. The APIS coverage of cannabis currently includes historical background, definitions, charts and other graphics, and user-searchable data tables comparing ten key state recreational cannabis laws, including: legalization of the purchase, possession, or consumption of recreational cannabis use by adults, the regulatory agency with authority in the jurisdiction, the products permitted for use, cultivation restrictions, retail sales permitted, pricing controls imposed, taxation, underage restrictions, impaired driving prohibitions, and local authority to opt out or permit restrictions additional to state regulation. APIS coverage also includes the Cannabis Policy Taxonomy, an inventory and taxonomy of cannabis policies organized in policy areas under nine broad categories. APIS policy coverage for Recreational Use of Cannabis begins on January 1, 2012. This poster presentation displays the APIS Recreational Use of Cannabis data table as of January 1, 2016. It also displays an outline of ten new policy variables that are in the process of being developed for 2017. APIS is found at this URL: https://alcoholpolicy.niaaa.nih.gov/ . The project is funded with federal funds from the National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Department of Health and Human Services, under Contract No. HHSN275201300002C.

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Marijuana Attitudes and Norms: The Moderating Role of Impulsivity-Like Facets among College Students

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Cannabis is the most commonly used illicit drug among college students in the United States, and there is evidence to suggest that peers play an influential role in their cannabis use. Although emerging research has demonstrated significant associations between attitudes, descriptive norms (i.e., perceived peer cannabis use), and injunctive norms (i.e., perception of peer approval of

cannabis use) and cannabis use, research examining possible moderators of these relations is in its nascent stages. Thus, the current study sought to examine the potential moderation of impulsivity-like facets (i.e., negative positive urgency, lack of planning, lack of perseverance, and sensation seeking) as assessed by the UPPS-P Impulsive Behavior Scale to predict cannabis use. Undergraduate participants (N = 718; 68% White; 66% female; 26% Hispanic; M age = 19.00) completed a battery of self-report assessments, including the UPPS-P and the American Drug and Alcohol Survey (ADAS) to assess attitudes, norms, and past-year cannabis use. Ordinal logistic regression was used to examine both main effect and interactions models. All models were adjusted for age and gender. Cannabis attitudes, descriptive norms, and injunctive norms, separately, were predictive of past-year cannabis use, such that more positive attitudes towards cannabis use (B = .90, p < .01), higher levels of descriptive norms (B = .93, p < .01), and higher levels of injunctive norms (B = .87, p < .01) were predictive of increased endorsement of cannabis use. Further, positive urgency significantly moderated the relation between injunctive norms and cannabis use (B = -.21, p < .01), such that the relation between injunctive norms and cannabis use was amplified for individuals lower in positive urgency. In other words, individuals higher in positive urgency and lower in injunctive norms endorsed increased cannabis use compared to those lower in both positive urgency and injunctive norms. Similar patterns of moderation were found for lack of planning and injunctive norms (B = -.23, p < .01), lack of perseverance and injunctive norms (B = -.23, p < .01), lack of perseverance and descriptive norms (B = -.11, p < .01), positive urgency and attitudes (B = -.17, p < .01), lack of perseverance and attitudes (B = -.19, p < .01), and lack of planning and attitudes (B = -.21, p < .01). Findings from the present study indicate that cannabis norms and attitudes seem to be the most predictive of cannabis use for individuals who are lower in some facets of impulsivity. Interestingly, findings also revealed that individuals higher in attitudes and norms endorsed similar rates of past-year cannabis use, regardless of impulsigenic trait endorsement (i.e., reached equifinality). Future directions include using more refined measures of attitudes, norms, and cannabis use (e.g., modified Daily Drinking Questionnaire), as this is a limitation to the present study. Although, to our knowledge, this is the first study to examine differential relations among attitudes and norms, impulsivity-like facets as assessed by the UPPS-P Impulsive Behavior Scale, and cannabis use among college students.

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An Investigation of Reported Daily Activities in College Marijuana Users: Findings from EMA and Content Analysis

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Background: Marijuana is the most commonly used illicit drug in the U.S. among young adults, with high rates found in states with legal recreational use, such as Colorado. We investigated different life events as reported by heavy marijuana users throughout the day via a smartphone app using ecological momentary assessment (EMA). EMA employs momentary data collection by prompting participants over a defined interval of time. One major advantage of EMA over retrospective responses is a reduction in recall bias, which is particularly beneficial in self-report of addictive behaviors and ephemeral psychological states. We sought to examine life events captured during signal-contingent EMA and were interested in how many instances of marijuana use we would capture throughout the day. Method: Participants and Procedures. Participants (N = 27, 48% female) were screened and underwent an initial baseline assessment involving cognitive testing, marijuana use, psychological problems, and academics. Self-reported last 30-day marijuana use during baseline was consistent with heavy use (M=23.85, SD=7.08). Following the baseline assessment, participants were trained on the EMA protocol and randomly prompted three times daily (time 1=8:00am-12:00pm, time 2=12:30-4:30pm, and time 3=5:00-10:00pm) over the next 14 days using a smartphone app. Though participants completed a series of EMA questions, the current proposal focuses on the first open-ended question

in the protocol regarding the activity participants were currently engaged in when prompted. Content Analysis: Research assistants coded responses to the open-ended activity question. In the first pass, interrater agreement (Fleiss' κ=.80) was determined, raters discussed the categories, and a final set of categories were established. The following activity codes were finalized and used for the analysis: using marijuana, school-related, work-related, drinking alcohol, exercising, eating, errands/chores/personal hygiene, leisure, in transit, sleeping, and indiscernible. Four coders had sufficiently high agreement (Fleiss' κ=.94). During a consensus meeting, 100% agreement was achieved after evaluating disagreements. Results: We captured 886 responses (78% response rate) to the current activity question across the 14-day timeframe and evaluated the categories across the three time blocks. Overall, roughly a quarter of the participants' time was related to school-related activities with slight variations based on time of day (range 18-26%). When looking descriptively at captured responses across all time points, instances of exercise were less than or equal to instances of marijuana use in our sample. Overall, participants reported current marijuana use when prompted approximately 5% of the time. Reports of marijuana use increased throughout the day (2% for time 1, 4% for time 2, and 8% for time 3). The most highly endorsed activity during the first time period was sleep (33%). Leisure activity was also high (14, 26, and 36%, respectively) over the 3 time periods. Conclusions: This study provides insight into the average day of a college-aged marijuana user. Across a two-week period using signal-contingent EMA, we captured participants currently using marijuana a small percentage of the time. Thus, if researchers are interested in deeper understanding of a marijuana event in the exact moment, they should consider the use of event-related prompts.

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Sleep Difficulties and Duration Predicted Marijuana Use and Related Problems in Adolescents

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Previous research found that poor sleep prospectively predicted alcohol- and other drugs-related problems in adolescents. Individuals with trouble sleeping and those with shorter sleep duration were more likely than others to report problems such as driving under the influence of substances, getting into an argument or a physical fight due to substance use. This study focused on examining the concurrent and prospective relationship between sleep difficulties/duration and marijuana use, especially marijuana use under high risk circumstances, i.e., consuming marijuana before engaging in sexual intercourse and getting into a physical fight while using drugs. Study participants were 6504 adolescents from the National Longitudinal Study of Adolescent Health (ADD HEALTH). 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?" Responses were given on a five-point scale - 0=never, 1=a few times, 2=once a week, 3=almost every day, 4=every day. Sleep duration was measured by one question, "How many hours of sleep do you usually get?" A higher score represents more sleep. Lifetime marijuana use was examined by the question, "During your life, how many times have you used marijuana?" Responses were recoded into dichotomous variables (0=no; 1=yes). Data were analyzed by logistic regression. In all analyses, we used T1 sleep problems and duration to predict marijuana use in T1 and T2, while controlling for demographic variables that have been known to associate with substance use -- sex, age, school grade, poverty, and chronic health problems. In T1, sleep difficulties (OR = 1.23, p<.001) but not sleep duration (OR = .967, p=.253) were associated with lifetime marijuana use. One unit increase in sleep difficulties were associated with 23% increase in the odds of marijuana use.

Controlling for T1 marijuana use and demographics variables, T1 sleep duration significantly predicted T2 marijuana use (OR = .92, p<.01). An additional hour of sleep in T1 was associated with 8% decrease in the odds of marijuana use. T1 sleep difficulties had no relationship with T2 marijuana use. T1 sleep duration predicted the odds of using drugs during the most recent sexual activity at T2 (OR = .86, p<.05). Among those who used drugs during sexual activity, 93% used marijuana. T1 sleep duration was significantly associated with the odds of getting into fights when using drugs at T1 (OR = .78, p<.01) but not T2 (OR = .85, p=.11). Among those who got into fights while using drugs, 88% used marijuana. Both sleep difficulties and duration were concurrently and longitudinally associated with marijuana use and related problems. The impact of sleep on marijuana use in adolescence will be discussed. Future studies need to identify the mediators and moderators of this relationship.

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SYMPOSIA

Symposium: A Controlled Pilot Study of the Marijuana eCHECKUP To Go Protocol

Chair: Bradley T. Conner
Colorado State University

Marijuana use is quite common among college students in the United States, with 34% percent of students reporting past-month use and daily use at its highest level in the last 30 years. With changing legislation, we have seen changing patterns in use, for instance, Colorado, one of the first 2 States to legalize recreational marijuana use, now ranks first in cannabis use among young adults. A review of the cannabis prevention literature reveals few controlled trials for interventions that reduce problematic marijuana use among college student populations, with even fewer interventions considered "evidence-based." Marijuana eCHECKUP TO GO (e-TOKE), a fully customizable online program designed to reduce marijuana use among college students is modeled on the evidence-based Alcohol eCHECKUP TO GO and has recently been developed for licensing by colleges/ universities. There are currently 2 published studies by one research lab that support the efficacy and effectiveness of the e-TOKE intervention. This symposium will present data from a controlled trial of the e-TOKE program in a college sample in the State of Colorado. The initial presentation will introduce the study and the e-TOKE program. The second presentation will present primary study findings on the intervention. Our third talk will present results of mediational analyses. Finally, we will present data on dose-effects associated with multiple administrations of the e-TOKE protocol. The Implications of these findings and future directions of the research will be discussed.

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Reducing College Student Marijuana Use: Testing a Personalized Normative Feedback Intervention

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Previous research has indicated interventions aimed at correcting normative perceptions through personalized normative feedback (PNF) are effective at reducing alcohol use and related harms. Limited research has been conducted examining PNF interventions on marijuana use, with findings yet to yield significant results. However, these studies were conducted in states where marijuana use was illegal. This may have impacted normative attitudes towards marijuana use. In Colorado's fourth year of legalization, normative attitudes are hypothesized to have shifted toward decreased perceived risk of use and increased perceived approval of use. As these norms shift away from being protective factors, PNF interventions may prove more effective at correcting norms, resulting in misuse prevention. Marijuana eCHECKUP TO GO (e-TOKE) is a web-based PNF intervention currently implemented by several universities. The intervention targets correcting descriptive norms, as well as providing education on marijuana use. To date, one previous study has been conducted testing e-TOKE's efficacy. Findings indicated e-TOKE participants experienced reductions in descriptive norms compared to control subjects, however there were no changes in marijuana use frequency, consequences, or injunctive norms. Despite no changes in use patterns, these findings show promise in e-TOKE's ability to alter normative attitudes. This effect may be stronger among participants with more tolerant/accepting attitudes towards legalization of marijuana use. The present study was a controlled pilot test of e-TOKE program among college students in a state with legal adult recreational marijuana use. Students who reported typical marijuana use, at least twice weekly, were recruited through on-campus housing, fraternity and sorority life, and social media (i.e., Facebook, Instagram). A total of 298 participants were recruited, with 143 assigned to the PNF condition. Participants were 51.0% male, approximately 19.97 years of age (SD = 2.02), 85.6% White, and 13.8% Hispanic or Latino. At baseline, participants reported an

average of 34.89 use episodes in the past month (SD = 39.84). Data was collected across three time points in 6-week intervals. At the first time point, PNF condition participants received PNF and marijuana education while control participants received general stress reduction techniques. At the second and third time points, all participants received PNF. Participants were compensated with a $20 Amazon gift card for the first survey, and a $10 gift card for each subsequent survey. Participants were emailed personalized survey links and given a week to complete each survey, with reminders sent to those who did not complete the survey within five days. 76.2% of the baseline sample completed the second time point and 74.5% completed the final time point. The subsequent presentations in this symposium will present the study findings. A discussion of the e-TOKE protocol and the pilot study will also occur.

Effects of a PNF Intervention for Reducing Heavy Cannabis Use among College Students

Nathanial R. Riggs & Jamie E. Parnes
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Liberalization of cannabis use policies is hypothesized to decrease social norms discouraging use and perceptions of harm resulting from use, both of which are protective factors against cannabis misuse. Consequently, social norms and perceived harm represent targets for college student cannabis misuse interventions. This pilot study tested direct and moderated (by gender) program effects of e-Toke, a web-based cannabis misuse preventive intervention providing university-specific personalized normative feedback (PNF) and research-supported cannabis misuse consequences and protective behavioral strategies (PBS) to students attending a university in a state with legalized adult recreational marijuana. It was hypothesized that e-Toke participants would report significantly more accurate descriptive and injunctive cannabis use norms and consequences of misuse, increased marijuana misuse PBS, and decreased own use, than participants assigned to a healthy stress management (HSM) comparison condition. Participants were recruited based on self-reports of heavy use (approximately twice weekly) in the fall 2016 semester. Half of the 300 recruited students were randomly assigned to the e-Toke condition. Intervention participants immediately received individual PNF based on responses to a survey asking about their cannabis use, typical university student use, perceived and actual descriptive and injunctive norms for and consequences of cannabis use, and cannabis misuse PBS. HSM participants received stress management techniques equivalent in length to PNF. Two hundred and twenty-seven participants (76% of the baseline sample; male = 107, female = 120) completed the same survey at 6-weeks post-intervention and represent the study sample. General linear models (GLMs) with intervention condition as the independent variable tested direct program effects on study outcomes. Multi-group GLMs with gender as the class variable then tested the moderating effect of gender on e-Toke intervention effects. Results demonstrated that e-Toke participants reported fewer weeks of use per month ($b = -.45$, $SE = .12$, $p < .001$), greater number of days since last use ($b = 2.03$, $SE = .99$, $p < .05$), fewer time periods high per week ($b = -1.17$, $SE = .58$, $p < .05$), decreased estimates of campus-specific others' past 30-day use ($b = -9.05$, $SE = 2.87$, $p < .01$), increased estimates of campus-specific others' past 30-day non-use ($b = 6.03$, $SE = 2.62$, $p < .05$), and greater PBS engagement ($b = .17$, $SE = .74$, $p < .05$). Gender moderated e-Toke effects on number of days since last use, total number of time periods high per week, hours high per week, decreased estimates of campus-specific others' past 30-day use, increased estimates of campus-specific others' past 30-day non-use, frequency of PBS engagement, number of PBS endorsed, and average helpfulness of endorsed PBS, such that females benefitted from the intervention more than males. Results demonstrate preliminary support for e-Toke in reducing personal use and increasing protective factors against misuse, particularly in females. Future research should test the sustainability of program effects over time and adapt e-Toke to increase efficacy for males.

Mechanisms of Change Following the e-TOKE PNF Intervention among College Student

Melissa W. George & Mark A. Prince
Colorado State University

With the changing legal and social acceptance of marijuana nationwide there is a need to evaluate marijuana-specific interventions that are relatively inexpensive and easy to disseminate. E-Toke is a web-based marijuana specific intervention that uses personalized normative feedback to encourage individuals to reduce their marijuana use and risk for negative marijuana-related consequences. In addition, strategies are offered that may be helpful in reducing marijuana use and consequences. The premise of the e-Toke intervention is that if students' normative perceptions (i.e., descriptive and injunctive norms) are modified to better match reality and if they are equipped with effective strategies for moderating use, then they will choose to moderate their use. The current study sought to examine these mechanisms of change following participation in either e-Toke or a control condition in a sample of weekly marijuana using college students, examining sex differences in mechanisms as well. Data are from 272 students (76% of baseline sample; male = 107). Participants were recruited and randomized to receive the e-Toke intervention or a stress reduction comparison intervention. Participants completed a baseline survey that included demographics, marijuana use frequency, descriptive and injunctive norms, and protective behavioral strategy use. Participants then received the e-Toke intervention and received personalized normative feedback or the control condition with stress reduction and healthy living feedback Six weeks post intervention, they completed the same baseline survey to measure change at the follow-up. Analysis Plan. A multi-group path analysis was used to examine (a) the effect of the e-toke intervention on marijuana use frequency, (b) whether changes in marijuana use frequency were mediated by changes in normative perceptions and strategy use, and (c) whether the direct or indirect effects varied by sex. The product of coefficients method was used to calculate indirect effects and bias-corrected bootstrapped confidence intervals that did not include 0 were considered statistically significant. In the model building

procedure, there was a direct effect from e-Toke intervention condition to marijuana use frequency, such that those in the treatment condition reduced their marijuana use frequency more than those in the control group. This effect was substantially stronger for females. Descriptive norms mediated the treatment-marijuana use relationship for males, and injunctive norms mediated this relation for females. Protective behavioral strategy use did not mediate this relation for either group. However, the indirect effects showed evidence of a strong suppression effect, likely because the direct effect of treatment on marijuana use was much stronger than the total indirect effect for both descriptive and injunctive norms. Findings suggest e-Toke is an effective brief intervention for college student marijuana users with descriptive and injunctive norms promising as potential mechanisms through which intervention feedback reduces use; however, replication studies with a longer follow-up period are needed to better assess mechanisms of change. Similarly, effects of protective behavioral strategies might be limited by the short follow-up period.

Examination of Dose Effects of the E-Toke Personalized Normative Feedback Intervention

Bradley T. Conner
Colorado State University

The last talk will present data on repeated administrations of the e-Toke platform. As reported in previous talks, in addition to seeing an overall significant effect of the intervention on marijuana use and consequences, we see differences based on sex. Implementation of the e-Toke protocol in this study relied on a pseudo-waitlist control, whereby those in the control condition received general information about reducing stress and improving health rather than receiving personalized normative feedback (PNF). At time 2 those in the control condition received PNF as did those in the treatment condition. As part of the ongoing data analyses for the e-Toke study we are currently processing Wave 3 data. Wave 3 data will be used to test hypotheses around dose effect and sex differences based on any dose effects. We expect that those in the experimental condition will continue to show significant reductions in marijuana use and

consequences and a better understanding of injunctive and descriptive norms. We expect that those in the control condition, having now received PNF, will show similar significant reductions in marijuana use and consequences and a better understanding of injunctive and descriptive norms compared to these variables at time 2. We expect that significant differences between the two groups seen at time 2may still be present at time 3 given that all participants have now received PNF but that the magnitude of those differences will be significantly reduced. Finally, we expect to see significant differences on the dependent variables in both males and females for those in the experimental group but not for those in the control group. We make this last hypothesis based on the notion that the repeated dosing will eliminate significant differences between males and females. The implications of the dose effects will be discussed. Additionally, optimal implementation of the e-Toke protocol will be discussed.

Symposium: Neuropsychological Performance in Chronic Cannabis Users: Seeing Through the Smoke

Chair: Rayna Hirst
Palo Alto University

In the last decade, research addressing the cognitive effects of adult-onset chronic cannabis use has advanced greatly. However, the proliferation of cannabis-related literature has produced more questions than answers. In particular, due to equivocal research findings, the extent to which chronic cannabis use affects adult cognitive functioning remains unclear - some studies show small effects, while others, including recent meta-analyses, show none. In this symposium, to clarify the literature, the authors will present several studies investigating compelling factors that may explain the conflicting research findings: effort/motivation to perform well on neuropsychological testing and experimenter expectancy effects. First, we will present a study in which chronic cannabis users received a motivation enhancing statement prior to testing (i.e., a reminder of the research's contribution to marijuana legislation), which resulted in significantly better performance on learning, memory, and effort tests. We will then explore effort as a mediator between cannabis-use variables and learning/memory performance, presenting findings that effort mediates the relationship between frequency of cannabis use and learning/memory performance. Regarding expectancy effects, we first demonstrated that neuropsychologists can differentiate between users and non-users based on a photograph alone. Further, we will present results showing that the examiners in our studies, despite being blind to user status, were able to guess participants' user status with up to 75% accuracy. Importantly, those judged as users performed worse on cognitive testing, even after controlling for actual user status. The implications of these findings and future directions of the research will be discussed.

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Enhancing Neuropsychological Performance in Chronic Cannabis Users: The Role of Motivation

Rayna Hirst
Palo Alto University

Objective: This study sought to determine whether cannabis users demonstrate differential effort during neuropsychological assessment compared to nonusers, and whether better performance can be induced in participants with a motivational statement prior to testing. Method: Participants included cannabis users (n = 62) and non-users (n = 48) from an undergraduate university. To qualify as a cannabis user, individuals must have used cannabis at least four days per week for the past year. Non-users must have tried cannabis at least once, but no more than five times in their lives and not within the past 30 days. Prior to neuropsychological testing, individuals were randomly administered either a motivational or a neutral statement. The motivational statement consisted of a reminder of the study's importance to legislation on marijuana policy; the neutral statement simply informed the participant that they would now began the series of cognitive tasks. Results: Users who received the motivational statement performed nearly one standard deviation better on learning and memory tests than users who received the neutral statement (CVLT-II Sum of Trials 1–5 [Cohen's d = 0.58]; Short Delay Free Recall [Cohen's d =

0.84], and Long Delay Free Recall [Cohen's d = 0.80]). Thus, within the neutral statement condition, users performed nearly one standard deviation lower than the non-users on a test of verbal learning and memory (CVLT-II Long Delay Free Recall [Cohen's d = 0.60]). However, within the motivational statement condition, users and non-users did not differ in their performance (p>.05). Conclusions: Results suggest that a statement designed to enhance motivation may improve the performance of cannabis users, eliminating user and non-user differences on a measure of learning and memory. These findings indicate that deliberate motivation may lead to better performance in cannabis users, compared to their non-motivated user counterparts. Ultimately, the lower learning and memory performance sometimes seen in chronic cannabis users may be due to motivational factors rather than true physiological damage secondary to cannabis use. A motivational statement may provide a research tool to address deflated neuropsychological performance in cannabis users, allowing for a more valid and accurate measurement of their cognition.

Trying to Remember: Effort Mediates Relationship between Frequency of Cannabis Use and Memory

Alexis Rosen
Palo Alto University

Objective: While many studies suggest that regular cannabis use leads to deficits in cognitive functioning, particularly in memory, few have measured effort put forth during testing, and none have examined this factor as a potential mediator. Both age of onset of regular cannabis use and frequency of use have been linked to increased risk of memory deficits in cannabis users. The present study sought to determine whether effort mediated the relationship between frequency or age of onset of cannabis use and learning and memory performance. Method: 62 participants (74% male, mean age = 19.25 years) who met criteria for chronic cannabis use (four or more days per week for at least 12 months) completed a neuropsychological battery after 24 hours of abstinence. The battery included the California Verbal Learning Test-II (CVLT-II) and the Rey Complex Figure (RCF) as measures of learning

and memory, and the Word Memory Test (WMT) as a measure of effort put forth during neuropsychological assessment. Results: Participants who used cannabis more frequently exhibited poorer effort (as measured by WMT performance; p<.01). Bootstrapping yielded 95% confidence intervals for indirect effects and revealed that effort significantly mediated the relationship between frequency of cannabis use and CVLT-II Learning (Sum of Trials 1–5), CVLT-II Delayed Recall, and RCF Delayed Recall, but not RCF Immediate Recall. Age of onset of cannabis use was not significantly related to effort. Conclusions: Findings indicate that effort mediates the relationship between frequency of cannabis use and performance on learning and memory measures. These results raise the possibility that previous findings that greater frequency of cannabis use produces cognitive impairments may in fact be attributable to variability in effort put forth during testing. Given that effort may account for cognitive differences between frequent cannabis users and nonusers, future research should measure and control for effort performance.

The Myth of the "Jay-Dar": Identifying Cannabis User Status from a Photograph and Memory Stereotypes

Dylan Vaughn
Palo Alto University

Objective: With increasing legalization of marijuana, cannabis use has risen globally. While individuals may choose not to disclose their cannabis use, if others can accurately guess cannabis user status based upon appearance, these perceptions could influence educational, employment, and social interactions, given common negative stereotypes about cannabis effects. Additionally, few studies examining cannabis's cognitive effects utilize research designs where examiners are blind to user status. Even so, researchers may be able to guess participants' user status, leaving these studies vulnerable to the expectancy effect confound. This series of studies examined the ability of individuals in general, and neuropsychologists specifically, to determine cannabis user status from a photograph. We also explored the memory impairment stereotype in actual and perceived

cannabis users. Method: Study 1 examined individuals' ability to discriminate between cannabis users and non-users, based upon photographs. Undergraduates (N = 244, 70% female, mean age = 21.0 years) rated 21 photographs (12 cannabis users, 9 non-users) on the likelihood that the photographed individuals use cannabis. Study 2 examined the same ability in neuropsychologists, the very professionals who would conduct research on cognition in cannabis users. Neuropsychologists (N = 84, 60% female, mean age = 41.4) rated 25 photographs of individuals (12 cannabis users, 13 non-users) on the likelihood that the photographed individuals use cannabis. Study 3 examined whether actual or perceived cannabis user status related to ratings of perceived learning and memory performance, based upon photographs. Undergraduates (N = 218, 64.7% female, mean age = 25.2) viewed the same photos and rated how well they thought each individual would perform on a test of learning and memory (Perceived Memory Performance Ratings), despite raters having no knowledge of cannabis user status. Results: In Study 1, photographs of users received higher ratings than non-users on the Marijuana Use Likelihood Index. Similarly, neuropsychologists in Study 2 rated cannabis users' photographs higher than non-users on the same Index. Across both studies, males received higher ratings than females, regardless of user status. Cannabis use explained approximately 40% of the variance in cannabis use likelihood ratings. Results for Study 3 indicate actual user status was unrelated to Perceived Memory Performance Ratings (PMR), perceived user status was negatively related to PMR. Results suggest a potential stereotype against individuals who "look like" cannabis users, as those who had been previously perceived as likely to be cannabis users were presently rated as less likely to perform well on a complex task of verbal learning and memory, independent of their actual user status. These findings suggest that, irrespective of actual cannabis use, individuals who 'look like' cannabis users may appear to others to be less likely to perform well on learning and memory tasks. Conclusions: These findings have important implications, not only for social and achievement factors such as potential stigma, but also for research on chronic cannabis use effects. Moreover, the results demonstrate the possible negative influence of stereotype perceptions regarding cannabis use on educational, employment, and social interactions, as well as empirical studies of cannabis effects utilizing a blind research design.

Examiner Expectancy Effects: Judgments of Cannabis Use Status Predict Neuropsychological Performance

Rayna Hirst
Palo Alto University

Objective: Previous research suggests examiner beliefs about the effects of acute caffeine administration impact examinee cognitive performance and physiological response. However, this phenomenon of the expectancy effect confound remains largely unexplored in neuropsychological research. Hirst and colleagues found neuropsychologists can discriminate cannabis users from non-users based upon photograph appearance alone. Therefore, this population may be especially vulnerable to the expectancy effect confound in neuropsychological research, if examiners can guess participants' user status. The present study investigated whether examiner beliefs of cannabis user status predicted cognitive performance on a neuropsychological battery. Method: Participants included 41 users and 20 non-users (N = 61, 59.70 % male, mean age = 21.89). Prior to testing, examiners who were blind to participant user status privately rated whether they believed the examinee was a cannabis user or non-user. Examiners then administered a battery of neuropsychological tests assessing core cognitive domains. The neuropsychological tests administered included the Rey Complex Figure, California Verbal Learning Test-II, subtests of the Wechsler Adult Intelligence Scale-III, Trail Making Test, Word Memory Test, and Test of Memory Malingering. A series of regressions compared neuropsychological performance between the two groups. Results: Examinees who were judged as cannabis users scored lower than those judged as non-users on four of eight tests in the battery, including California Verbal Learning Test-II, Word Memory Test, Wechsler Adult Intelligence Scale-III Coding subtest, and Trail Making Test (p < .05). While group differences were not significant on the remaining tests, the trend remained that those perceived as users

received lower scores than those perceived as non-users. Findings remained consistent after controlling for gender and actual user status. Conclusions: Results of this study suggest that test examiners' beliefs of an individual's cannabis user status may affect performance on neuropsychological tests, due to experimenter expectancy effects - even when examiners are blinded to actual user status. These findings have important implications for valid and accurate measurement of neuropsychological performance in both research and clinical settings, as test scores may partially reflect the examiners' beliefs regarding the effects of marijuana use rather than participants' true cognitive abilities.

Discussant: Staci Gruber
Harvard Medical School

Symposium: Flower, Vapor, and Dabs (Oh My): Acute and Short-Term Effects of Cannabis in the Real World

Chair: Kent Hutchison
University of Colorado Boulder

This symposium features four talks that address the acute and short term effects of different forms of cannabis across a range of important outcomes that are highly relevant to public health, including driving ability, motor control, cognition, and mental and physical health effects. Given the increasing prevalence of marijuana recreational and medicinal and changing legal policies, understanding the acute effects of different forms of marijuana is an increasingly important topic. This symposium will examine the acute neurocognitive and public health effects of cannabis in recreational and medicinal users. Dr. Bidwell will present on the use of a mobile laboratory to collect data on the acute intoxicating and cognitive effects of forms of marijuana available on the legal market, such as high potency flower and dabs. Dr. Tracy will present on the use of a mobile laboratory to collect data on the acute effects after self-administration of high potency legally-marketed marijuana products on measures of motor control and balance that may impact marijuana-related driving-impairment. Dr. Pearlson will describe the impact of different potencies of vaporized cannabis on driving behavior and neurocognitive processing using an

fMRI-based simulated driving paradigm. Dr. Gruber will discuss how health and brain functioning are affected after medicinal users initiate medical marijuana use. Dr. Hutchison, the discussant and chair, will integrate the presentations, discuss the public health implications of these findings, and consider the path forward for conducting rigorous and meaningful

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A Novel Observational Method for Assessing Acute Responses to Cannabis: Preliminary Validation Using Legal Market Products

L. Cinnamon Bidwell, Sophie York Williams, Raeghan Mueller, Sarah Hagerty, Angela D. Bryan, & Kent E. Hutchison
University of Colorado, Boulder

Over the last several years, there have been enormous changes concerning the public acceptance of marijuana. Thus, the scientific data that can inform marijuana public policy and consumer decisions are critically needed. Our research program seeks to study the effects of commonly used marijuana strains and products, as they are used in everyday life, as opposed to relying solely on testing the effects of U.S. government grown, lower potency marijuana in controlled laboratory experiments, which may underestimate effects of tetrahydrocannabinol (THC) and may ignore the effects of other major cannabinoids, such as cannabidiol (CBD). In one study, we examined the effects of two common commercially available strains, one with the average potency of THC in Colorado and one strain that had lower THC and higher CBD on measures commonly associated with the potential for harm and the potential health effects of marijuana. In a second study, we study the impact of high potency THC flower and concentrates on these same measures. In the first study, 23 regular marijuana users were asked to switch from their normal high THC (~18%) strain to a common strain with high THC similar to what they normally use (THC ~ 18%; CBD <= 1%) or to a strain with lower THC but high CBD (THC ~ 9%; CBD ~12%). With 15 minutes of marijuana self-administration, users in the two strain groups were given a blood draw for an objective measure

of THC and its primary metabolites, THC-COOH and THC-OH, followed by measures relevant to harm reduction and health following cannabis use. Results revealed significant interactions between strain type and our harm reduction measures. At the average THC level, use of high CBD strain is associated with a lower desire to smoke ($p<.05$; $\eta_p^2= .194$), with a feeling less mentally stoned ($p<.005$; $\eta_p^2 = .394$), and, at trend level, with fewer verbal memory errors ($\eta_p^2= .105$), than use of the high THC strain. In addition, although the groups did not differ at baseline, the CBD strain group had significantly lower average circulating cytokine expression than the THC strain group ($p = .017$). In our second study, individuals who have experience with high potency THC products (flower and concentrates) will be assessed on these same measures immediately before and immediately after use. This study is ongoing (current n=2) and will provide the first data on the impact of legal market high potency THC products on important measures relevant to public health and marijuana harm-reduction. Although these pilot studies are not adequately powered to provide a comprehensive test of the effect of different strains of marijuana, the data suggest strong effect sizes and provide preliminary evidence that strains with higher CBD may mitigate some of the harmful effects of marijuana. Clearly, more research on commercially available strains is needed to inform the public policy makers about strains that may have less potential for harm.

A Smartphone-Based Mobile Motor Battery for Acute Cannabis Intoxication: There's an App for That

Brian L. Tracy
Colorado State University

In studies of acute cannabis intoxication and motor function, it can be impractical to bring subjects into a university-based movement lab setting, or to bring bulky, expensive testing equipment into "real world" mobile settings. Yet crude field measures lack precision and sophistication. Modern smartphones are ubiquitous, easy to use, and contain triaxial accelerometers and gyroscopic rotation sensors of remarkable sensitivity. Therefore, the smartphone, properly employed, can be a "mobile movement lab" for field settings. An App can be used to sample data from onboard sensors at up to 100 samples per second while the device is attached to a human subject during an experimental motor task. Movement data is stored as a text file and easily wirelessly transmitted to the lab for storage and subsequent analysis. In a novel collaboration with Drs. Hutchison and Bidwell at the CU Change Lab, we have developed an entirely smartphone-based quantitative battery of motor function that can be carried out in a mobile testing van. We are currently employing the motor battery in two studies, 1) acute intoxication effects of smoking cannabis flower, and 2) acute intoxication effects of "dabbing" cannabis. Both studies are tracking subjects before, immediately after, and 60 min after exposure. The equipment is an iPod Touch and a set of Velcro straps. The 15-min battery, some of which relates to driving ability, consists of instrumented tests of 1) standing postural stability, 2) simple neuromotor speed (finger tapping), 3) ballistic leg withdrawal reaction time, and 4) ballistic arm extension reaction time. 1) Standing balance is measured with eyes open, eyes closed, and eyes closed/head tilted back. The front-to-back and side-to-side fluctuations in acceleration is measured from the hip-mounted iPod. Values from eyes closed and head tilt conditions can provide information about reliance on proprioception and vestibular inputs. An expectation is that acute intoxication will impair balance during all conditions but with greater impairment during eyes closed and head tilt. 2) Finger tapping involves 20s of maximal speed simple index finger tapping with the forearm and iPod resting on a table. The corner of the iPod is tapped and the accelerometer will register each tap. The time of each tap is measured and the intertap interval quantified over the 20 s task. We hypothesize that with acute intoxication the mean tapping rate will be reduced and the tapping rate will decrease more rapidly over 20 s compared with the pre-dabbing test. 3) The ballistic leg test has the seated subject lift the foot from the ground as rapidly as possible when a sharp tap to the shin-mounted iPod/leg is sensed. The latency from tap to initiation of lift is measured, as well as the peak acceleration of the foot lift. We hypothesize that the reaction time will be impaired and the movement speed reduced with acute cannabis intoxication. 4) The ballistic arm test has the

seated subject perform a ballistic "punch" of the forearm when they sense a sharp tap to the iPod/distal forearm. The latency from tap to movement and the peak outward acceleration is measured. It is expected that intoxication will increase the reaction time and reduce the peak movement speed. The goal of the presentation will be to introduce the audience to the utility of mobile, smartphone-based measures of human movement in the acute intoxication paradigm.

Discussant: Kent Hutchison
University of Colorado Boulder

Symposium: Driving Under the Influence of Cannabis: Theoretical Issues, Impact, and Methods of Detection

Chair: Godfrey Pearlson
Yale University

Because of increasing legalization/ decriminalization of cannabis and widespread use of medical cannabis, the rate of cannabis-intoxicated driving will rise significantly. Although cannabis-impaired driving is recognized as a potential public health challenge, public policy on this issue is neither well-rooted scientifically, nor consistent. Currently there are few guidelines to assess cannabis-related driving impairment reliably, and few facts to guide authorities or users. The symposium will provide an update on cannabis-impaired driving. Topics will include a) approaches to assessment of cannabis-impaired driving using driving simulators, b) relationships between intoxicated simulated driving and functional MRI-related acute drug challenges, and c) methods for detecting cognitive changes that might affect driving performance (laboratory-based measures, roadside field sobriety tests). Topics addressed will include the duration of impairment following acute drug exposure, effects of dose and cannabis use experience on performance, the relationship of impairment to blood and saliva levels of THC and its metabolites, subjective awareness of impairment, willingness to drive when intoxicated, and the effects of alcohol/cannabis interactions. Drs. Pearlson and Marcotte will focus on driving simulation (including during functional MRI) and considerations in constructing field sobriety tests. Dr. Stevens will

focus on THC-related cognitive impairment and its assessment. Dr. Ranganathan will speak about differential effects of THC and CBD on driving-related cognition and discuss pilot data on effects of THC and alcohol on simulated driving. Dr. Ward will cover cultural factors of decision making to drive after using cannabis, and what cognitions influence a person's decision to drive under the influence of cannabis.

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The Challenge of Assessing Driving Under the Influence of Cannabis

Thomas D. Marcotte
University of California, San Diego

Driving under the influence of cannabis is of increasing public health concern, particularly given recent trends in legalizing medicinal and recreational cannabis. Although experimental studies have often shown decrements in driving related abilities, epidemiologic findings have been mixed. This presentation will briefly review what is known about the impact that cannabis has on driving performance, as well as the limitations of research to date. Topics to be addressed include 1) experimental and epidemiologic findings regarding the relationship between cannabis use, driving performance and real-world crashes (including the effects of concurrent alcohol use), 2) studies examining current field sobriety tests and drug recognition expert (DRE) evaluations for the detection of cannabis-impaired driving, and 3) the use of bodily fluids (blood, saliva, breath) to determine impairment and cannabis use recency. Lastly, an overview of two recently initiated projects to assess the effects of smoked cannabis and oral THC on driving abilities, as well as possible approaches to validating and enhancing field sobriety tests, will be presented.

Optimal Design Considerations for Cannabis Intoxicated Driving Research

Godfrey Pearlson
Yale University

A large number of practical considerations influence the design of successful cannabis-intoxicated driving experiments. One initial key

choice is how best to maximize naturalistic aspects of such studies. Some of these important initial decisions include whether to administer marijuana in smoked or vaporized form versus IV delivery, and the validity of virtual motor vehicle operation compared to actual on-road driving. In designing the latter, Virginia Tech's "Smart Road" and the National Advanced Driving Simulator provide useful resources to validate "real world" aspects of driving simulations. The design of the individual simulated driving measures also involves assessing the extent to which strategic, tactical and operational levels of driving need to be quantified and incorporated in the research design. Another important design aspect involves maximizing immersive (and minimizing video-game-like) subject responses to simulated driving. Strategies to increase realism include provision of safe-driving bonuses, penalties for exceeding speed limits etc. as well as designing detailed instructions to subjects and non-intrusive reminders of rules. Design of in-MRI functional driving tasks involves additional practical constraints and training issues. Some of these include the need for adequate out-of-scanner behavioral training to asymptote performance with subjects lying supine, in addition to seated desktop simulator rehearsal, redesigning driving manipulanda used in-scanner to be compatible in high-strength magnetic fields, limiting the number of behavioral events that can be feasibly presented during task scenarios in event-related designs, and designing multiple alternative task versions. We will present practical "how to" design lessons illustrated by examples to illustrate the above points.

Neurocognitive Evidence that Guides Research of Driving Under the Influence of Cannabis

Michael C. Stevens,
Olin Neuropsychiatry Research Center IOL

There is a long history of experimental research that has tested the effects of cannabis use on how well people perform on laboratory tests of cognition and behavior. Such tests are useful because by design they isolate specific abilities that are grounded in the function of particular neural systems of the brain. The most consistent, strongest evidence for cannabis-induced impairments come from tests that assess executive cognitive abilities (e.g., divided attention, set shifting and others), time estimation, and visuomotor tracking. For research studies of cannabis' effect on driving, these tests can be useful to validate the presence and extent of dose-related cognitive impairment. Moreover, because these abilities are relevant to optimal driving performance, "real world" driving analogues of these abilities can be built into simulations to observe the effect of cannabis use on these specific cognitive processes during driving. This presentation will review and summarize the results of laboratory cannabis challenge neurocognitive studies, then describe how some of these tasks have been translated into formats that are compatible with using brain functional neuroimaging methods (fMRI). Neuroimaging methods provide valuable information to the question of driving-related impairment by characterizing how any cognitive or driving decrements that are detected are related to altered function of specific neural systems of the brain. The presentation will summarize available fMRI studies of cannabis' effects on brain dysfunction, including emerging evidence from our studies of driving-relevant fMRI task probes during cannabis challenge studies.

Interactive Effects of THC with CBD and ETOH on Cognition and Driving Performance

Mohini Ranganthan
Yale University

Given the high rates of cannabis use, the varying concentrations of the delta-9-tetrahydrocannabinol (THC) and Cannabidiol (CBD), the two main components in cannabis, and the increasingly common practice of using ethanol (ETOH) and cannabis together, there is a need to systematically characterize the interactive effects of THC and CBD in cannabis and their effects in combination with ETOH on cognitive processes relevant to driving as well as driving performance. We will present data from a series of studies in healthy humans examining 1) the interactive effects of THC and CBD, on driving related cognitive tasks and 2) the interactive effects of ETOH and low dose THC using a simulated driving task. We find that THC reduced the amplitude of the event related potential, P300 on

a sustained attention task. CBD had no effects on P300 amplitude by itself, but attenuated the THC induced reduction in amplitude. Further, our preliminary data suggest that while low dose ETOH clamped at blood alcohol concentrations below the legal limit (0.04 BAC) and low dose THC alone had minimal effects on driving performance measured as the Standard Deviation of Lateral Position (SDLP), the combination of the two produced significant alterations in driving outcomes (increased SDLP and speed).

The Cultural Basis for Deciding to Drive Under the Influence of Cannabis (DUIC)

Nicolas Ward
Montana State University

Driving under the influence of cannabis (DUIC) is a choice. It does not happen by "accident". And so, cannabis would not be debated as a crash factor if drivers never chose to drive after consuming it. Although this appears to be an obvious and simplistic assertion, it does represent an important perspective on cannabis and traffic safety. Even after we understand the effects of cannabis, we still need to understand the determinants of the decision to drive after using this drug. As inconsistent with safe driving as cannabis effects might be, they would be irrelevant to traffic safety if users shared a culture that prohibited driving while stoned. As social beings, our choices are influenced by our social environment. We are motivated to make decisions that that are consistent with the culture we perceive to represent the groups with which we identify. Our motivation is to reinforce our membership in those groups and avoid rejection. In this context, "traffic safety culture" can be defined as the values and beliefs shared among groups of road users (and stakeholders) that influence their decisions to behave in ways that improve traffic safety. So what are the relevant factors of traffic safety culture amongst cannabis users that impact their intention and willingness to DUIC? This presentation will summarize the results of three separate studies that used survey methods based on a model of that operationalized traffic safety culture and predicted its influence on DUIC intention and willingness. Across these studies, several cultural factors consistently influenced both DUIC intention and willingness

including values, behavioral beliefs, attitudes, and norms. By identifying these predictive factors, it is then possible to develop strategies to transform culture and reduce the intention and willingness to DUIC. Accordingly, this culture-based paradigm is an important component of a strategy plan to reduce DUIC behavior and cannabis-related traffic fatalities.

[Supplemental Materials Here]

Symposium: Use of Marijuana Protective Behavioral Strategies by Young Adults

Chair: Eric Pedersen
RAND

Given recent state legalization of recreational marijuana use and majority popular opinion favoring these laws, it is important to identify strategies that may mitigate harms related to marijuana use among those young people who choose to use the drug. In this symposium, we feature four researchers who have examined the use of marijuana protective behavioral strategies – behaviors that one engages in before, during, after, or instead of using marijuana to reduce the harms of use – among young adult college students and veterans. Using large and diverse samples of young adults, researchers examined how use of these strategies mitigates harms through several different pathways and among individuals with various mental health symptoms, motives for marijuana use, and personality traits, as well as how perceived effectiveness of these strategies and timing of strategy use impacts experience of negative marijuana outcomes. Findings suggest that use of marijuana protective strategies may moderate the effects of mental health symptoms on negative consequences among young adult veterans and they may buffer the effects of risk factors and enhance the effects of protective factors on marijuana-related outcomes among college students. Findings also demonstrate that college students are more likely to use marijuana protective behavioral strategies if they perceive them to be effective, that the protective effect of strategy use is strongest among students who perceive them to be effective, and students experience less harm from their marijuana use on days which they use a higher number of protective

strategies. Clinical and research implications will be discussed.

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Use of Protective Behavioral Strategies among Young Adult Veteran Marijuana Users

Eric R. Pedersen, Margo Villarosa-Hurlocker, Mark A. Prince
RAND, University of New Mexico, & Colorado State University

Veterans are a population that are at risk for heavy marijuana use and resulting cannabis use disorder. Though actual prevalence rates are not well reported, it estimated that approximately one-fifth to one-quarter of veterans in the VA and in the community report past year marijuana use. Cannabis use disorder is somewhat prevalent in the population and has been found to be significantly underdiagnosed in the Veterans Health Administration compared to other substance use disorders. Veterans are particularly at risk given their tendency to experience more severe medical problems and psychiatric difficulties compared to the general population and marijuana use has been linked to risk for posttraumatic stress disorder (PTSD) in particular. Many veterans believe marijuana helps reduce negative mental health symptoms and researchers have found an exacerbation of symptoms among veterans using marijuana to cope. The present study was designed to examine how protective strategies used before, during, after, or instead of using marijuana (e.g., take periodic breaks if it feels like you are using marijuana too frequently, limit the amount of marijuana you smoke in one sitting, avoid using marijuana before work or school) moderated the effects of mental health symptoms on marijuana use and consequences among a sample of 180 young adult veteran marijuana users. In addition to a 17-item brief version of the Protective Behavioral Strategies Scale for Marijuana (PBSM-17), veterans aged 19-34 recruited through the Internet completed online measures of demographics, mental health symptoms of PTSD, and marijuana use and consequences. More frequent use of marijuana protective strategies associated with less frequent marijuana use and fewer negative consequences.

Those screening positive for PTSD experienced more consequences from use but that effect was moderated by their use of protective strategies, such that those with a positive PTSD screen who used protective strategies more frequently experienced fewer consequences than those with a positive PTSD screen who used protective strategies less frequently. Findings expand on the college student studies indicating greater frequency of protective strategies associates with less frequent marijuana use and fewer consequences by replicating these findings among veterans. In addition, this study adds to the literature on mental health and substance use among veterans by documenting a moderating effect of protective strategies use on negative marijuana outcomes. Findings suggest that use of protective strategies may be important for young veterans who choose to use marijuana, in particular for those who may use marijuana to cope with symptoms of PTSD.

Marijuana Protective Behavioral Strategies as a Moderator and Mediator of the Effects of Risk/Protective Factors on Marijuana-Related Outcomes

Adrian J. Bravo, Mark A. Prince, Matthew R. Pearson, & The Marijuana Outcomes Study Team
University of New Mexico & Colorado State University

Given the high prevalence of marijuana use among college students, it is imperative to determine the factors that may reduce risk of problematic marijuana use and/or the development of cannabis use disorder. From a harm reduction perspective, the present studies examined whether the use of marijuana protective behavioral strategies (PBS) mediates or moderates the effects of several distinct risk and protective factors that have been shown to relate to marijuana-related outcomes (i.e., use frequency and consequences). Specifically, we examined marijuana PBS use as a mediator and moderator of the effects of gender, age of first use, impulsivity-like traits, and marijuana use motives on marijuana use frequency and marijuana-related consequences in a large sample of college students (n = 2,093 past month marijuana users across 11 universities). In all

models, marijuana PBS was identified as a robust negative predictor of marijuana use frequency and marijuana-related consequences. Further, marijuana PBS use fully or partially mediated the effects of gender, premeditation, perseverance, coping motives, enhancement motives, conformity motives, and expansion motives on marijuana outcomes. Among interactions, we found: 1) unique significant interactions between specific impulsivity-like traits (i.e., premeditation, perseverance, and sensation seeking) and marijuana-PBS use on marijuana consequences, 2) unique significant interactions between each marijuana use motive and marijuana-PBS use on marijuana use frequency, and 3) that using marijuana-PBS appears to buffer the risk associated with male gender across both marijuana outcomes. Taken together, our results suggest that marijuana-PBS use can buffer the effects of risk factors and enhance the effects of protective factors on marijuana-related outcomes among marijuana using college students. Further, our results suggest that marijuana PBS use is a good candidate to be considered as a mechanism by which marijuana users moderate their marijuana use and attenuate their risk of experiencing marijuana-related consequences. Overall, the current studies provide evidence that marijuana-PBS use is associated with less marijuana use frequency and marijuana related consequences among college students. Thus, there is a need for a marijuana-PBS use focused intervention targeting college student marijuana users. Future research is needed to understand context-specific factors and individual-level factors that may make marijuana-PBS use more effective.

Perceived Effectiveness of Marijuana Protective Behavioral Strategies and Marijuana-Related Outcomes

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A large literature demonstrates that use of alcohol protective behavioral strategies (PBS) is related to less alcohol use and the experience of fewer alcohol-related problems. A small number of studies have begun to establish that marijuana PBS use is related to less marijuana use and negative marijuana-related consequences. In the alcohol field, two studies have examined the role of perceived effectiveness of PBS treating perceived effectiveness as an antecedent of PBS use (i.e., antecedent model). The assumption these researchers made was that individuals would choose strategies they believed to be effective. However, in some of our previous work we have found some support for an alternative model (i.e., mediation model) such that perceived effectiveness of PBS mediates the effects of PBS use on alcohol-related outcomes. Another reasonable alternative model that has yet to be tested would presume that the effects of PBS use on outcomes may depend on the perceived effectiveness of PBS use (i.e., moderation model). To date, none of these models have been tested in the context of marijuana use. Using data from a large, multi-site (k = 11) online ongoing study of marijuana use among college students (Marijuana Outcomes Study Team), we examined the evidence for three alternative models: 1) an antecedent model (perceived effectiveness of PBS use→PBS use marijuana consequences), 2) a mediation model (PBS use perceived effectiveness of PBS use→marijuana consequences), and 3) a moderation model (PBS use X perceived effectiveness of PBS use→marijuana consequences). Although this study is ongoing (projected total n ~ 10,000; ~ 2,600 users), we conducted preliminary analyses using 271 past month marijuana users from 3 sites (total current n = 937). Based on our preliminary analyses, we have found support for the antecedent model (i.e., PBS use fully mediating the effect of perceived effectiveness of PBS use on marijuana consequences), no support for the mediation model (perceived effectiveness did not have a protective direct effect on marijuana consequences when controlling for PBS use), and support for the moderation model (interaction effect accounted for an additional 5.2% of the variance in marijuana consequences beyond the component main effects). Our results suggest that individuals are more likely to use PBS if they perceived them to be effective, and that the protective effect of PBS use is strongest among individuals who perceived PBS to be highly effective. Although preliminary, these results have important clinical implications. Specifically, our results suggest that clinicians need to

carefully discuss specific PBS with clients to determine which strategies the client perceives will be most effective for them. To the extent that a client perceived PBS to be ineffective at reducing harm, PBS-based interventions would benefit from including an educational component to demonstrate that these strategies are effective for many individuals.

Reducing Harms from Marijuana: A Daily Diary Examination of Marijuana Protective Behavioral Strategies among College Students

Adam D. Wilson, Matthew R. Pearson, Adrian J. Bravo, Bradley T. Conner, & Jamie E. Parnes
University of New Mexico & Colorado State University

Marijuana protective behavioral strategies (PBS) are cognitive behavioral strategies used before, during, after, or instead of marijuana use to reduce marijuana use, intoxication, and/or consequences. We examined the interindividual (between-subjects) and intraindividual (within-subjects) effects of using marijuana protective behavioral strategies on various marijuana-related outcomes. Forty-three college student marijuana users from three different, large U.S. universities located in Virginia, New Mexico, and Colorado completed daily brief surveys (<10 minutes) over a 12-day (April 15th- April 26th, 2016) period assessing use of protective behavioral strategies and marijuana-related outcomes (i.e., number of unique marijuana use sessions, subjective high/intoxication while under the influence of marijuana, number of grams of marijuana consumed, and marijuana related-consequences). Between 49% (PBS item 11: "Limit the amount of marijuana you smoke in one sitting") and 63% (PBS item 7: "Only use when you know you have nothing important to do for the rest of the day/night") of the variance in marijuana PBS use items was at the within-subject level (average ICC = 0.566). For the PBS total score, 34% of the variance was at the within-subject level (ICC = 0.655). Between 40% (subjective high) and 59% of the variance in marijuana outcomes was at the within-subject level (number of sessions: ICC = 0.41, grams consumed: ICC = 0.52, subjective high: ICC = 0.60, negative consequences: ICC = 0.48). At the within-subject level, marijuana PBS use (total score) was associated with lower subjective high (β = -.23) and less number of sessions (β = -.18). At the between-subject level, marijuana PBS use (total score) was associated with lower subjective high (β = -.40), less number of sessions (β = -.64), and lower negative consequences (β = -.40). We also examined specific PBS items as they related to these outcomes at both within-subject and between-subject analyses. We found evidence that not only does PBS use have protective effects on marijuana-related outcomes at the between-subject level, but also at the within-subject level. Exploratory analyses further revealed that college student marijuana users are less likely to use PBS (specifically "avoid using marijuana early in the day", "avoid buying marijuana", and "using enough to only achieve a slight buzz") on 4/20 (an event-specific marijuana use day) compared to other days. These findings suggest that an individual may experience less harm from their marijuana use on days on which they used a higher number of PBS. Several specific PBS items predicted specific marijuana-related outcomes, further validating the daily assessment of PBS use. We discuss how the within-subject analyses using ecological momentary assessment data can be used to inform clinical interventions.

Symposium: Using EMA and Daily Process Methods to Examine Marijuana Motives and Craving among Young Adults

Chair: Kristina T. Phillips
University of Northern Colorado

Retrospective reports of marijuana use and associated behaviors can be problematic due to issues with memory recall and patterns of bias in estimating behavior. To improve on such limitations, ecological momentary assessment (EMA) and daily diary methods are being used increasingly to assess complex behaviors closer to the moment. This symposium will provide an introduction to these methodologies and will discuss findings from four studies focused on young adults, with a focus on implications for intervention. First, Phillips will provide a brief introduction to intensive longitudinal methods and applications to marijuana research. She will discuss preliminary data from an EMA study focused on the role of craving and mood on marijuana use among college students in-the-

moment. Second, Bonar will report on daily diary data from a community sample that examines associations between motives and quantity of marijuana consumed. Bravo will present on daily diary data with college students that examines day-to-day variability in marijuana use motives and their associations with marijuana-related outcomes. Finally, Prince will discuss EMA data with young adults from a community sample and will examine episode-level motives and craving related to marijuana use during and after an intervention. Collins will close as Discussant with a summary and interpretation of the presented findings. All speakers will discuss the implications of these findings for interventions with young adults in future research, including those that focus on the real-world context.

Marijuana Use, Mood, and Craving: A Study using EMA with College Students

Kristina T. Phillips, Michael M. Phillips, & Trent L. Lalonde
University of Northern Colorado

Background: Heavy marijuana use is associated with a number of negative consequences, including addictive behaviors and emotional difficulties. Past research has demonstrated that heavy marijuana users are more likely to experience depression and anxiety and that craving for marijuana may lead to greater use. However, it is unclear how certain substance use dynamics and mood might impact marijuana use in-the-moment, thus providing important information for the design of new interventions. The current presentation will provide an introduction to EMA and daily process research and discuss preliminary data from a new study examining the impact of a range of complex factors on marijuana use among young adults in the college environment. Method: College-students (n = 53) who used marijuana at least weekly or greater were recruited from a mid-sized western university and completed a baseline assessment and training on a two-week EMA protocol. Participants were sent questions through a smartphone application, three times per day for two weeks. For the current analyses, marijuana craving and mood were assessed on 0-10 scales (low to high), while marijuana use was assessed two ways: 1) the number of marijuana

use instances and 2) the time spent (in minutes) using marijuana since the last prompt. We used four time-lagged hierarchical (mixed-effects) models (controlling for day of the week) to examine whether craving and mood predicted subsequent marijuana use at the next time point. Results: Participants averaged 20.02 (SD = 1.49) years of age, were 57% female, and 76% Caucasian/non-Latino. Average marijuana use over the last month from baseline self-report was 23.6 days, characterizing the sample as daily or near-daily users. Two mixed-effects models were used to assess the impact of craving, adjusting for day of the week and time of the study. Model 1 showed that craving significantly predicted the amount of time participants spent using at the next assessment point (β = 1.43, p < 0.001). Similarly, Model 2 showed that craving also positively predicted the number of times participants used at the next time assessment (β = .064, p < 0.001). Two additional time-lagged models examined whether EMA mood predicted marijuana use (minutes spent smoking and the number of times smoked). Neither model was significant. Conclusions: A temporal association between craving and marijuana use was found, where greater momentary craving positively predicted greater marijuana use assessed through time spent using and the number of use instances. Mood was not associated with marijuana use among participants, though this will be further assessed with more participants and as a potential mediator in future analyses. These findings have implications for future work with college student marijuana users. Interventions that consider these factors in real-time, such as ecological momentary interventions or Just-in-Time Adaptive Interventions, may be useful in targeting behaviors that impact marijuana use in the real-world context.

Daily Relationships between Marijuana Motives and Marijuana Consumption

Erin E. Bonar, Jason E. Goldstick, James A. Cranford, Rebecca M. Cunningham, & Maureen A. Walton
University of Michigan

Background: Marijuana use among emerging adults (ages 18-25) is associated with varied

individual and public health consequences. There is a need for greater understanding of the determinants of marijuana use among emerging adults, given its prevalence and potential for adverse effects, particularly in the context of increasing access to legal recreational marijuana. Daily and event-level data can provide finer-grained detail on the proximal factors influencing marijuana use, which may prove useful in developing personalized, tailored, and/or just-in-time adaptive interventions to reduce marijuana use and its related consequences. Motives are an important individual-level influence on consumption and potentially an important intervention target because they have been shown to change as a result of interventions. Method: Patients aged 18-25 were recruited from an urban Emergency Department to participate in a 28-day prospective, text message-delivered assessment study of drug use and sexual risk behaviors. Study inclusion criteria were: past 4-week drug use, past 4-week sexual intercourse without a condom, and having a cell phone with text messaging. Participants were trained to use a standardized method for estimating daily quantity of marijuana use. Daily text-based assessments included questions pertaining to marijuana use and motives, other substance use, and sexual behaviors. The present analyses focus on motivations for daily marijuana use as related to predicting daily quantity consumed on days when participants reported using any marijuana. Using a mixed effects linear regression model, we examined the relationships between daily motives ratings (enhancement, social, conformity, coping, and expansion; rated from 1=not at all to 4=a great deal) and quantity of marijuana consumed (rated from 1=<0.5g/<1 joint to 6=2.5g+/5+ joints). Results: N = 95 participants reported marijuana use on at least one daily text survey. Demographically, they were 48.4% male and 45.3% African American with a mean age of 22.0 (SD = 2.2). Participants reported using marijuana on a total of 1,086 daily surveys during the 28-day period and provided complete motives data on 1,049 days. Examining a multi-level linear regression analysis (where day was clustered within individual) that controlled for gender, race, and public assistance, (Model R^2=.50) we found that daily use of marijuana for enhancement (to enjoy the feeling, ß=.27, p<.001), coping (to feel less depressed/nervous, ß=.15, p<.001), and/or

social motives (to make a social gathering more fun; ß=.34, p<.001) was related to higher self-reported quantities of daily marijuana use. Relationships for expansion (to increase awareness; ß=.08) and conformity motives (to fit in, ß=-.03) and conformity were non-significant. Conclusions: This present analysis demonstrates the occurrence of significant daily relationships between three motivations for marijuana use and daily quantity consumed. Interventions tailored to help emerging adults address enhancement, social, and coping motives should be considered. Future research should examine a broader range of motivations for marijuana use (e.g., boredom, habit, sleep) in relation to daily quantities of marijuana use to better inform interventions. **This abstract represents work that was subsequently published: Drug & Alcohol Dependence, Vol. 178, p136–142, Published online: June 15, 2017

Why I Get High: A Daily Diary Examination of Marijuana Use Motives among College Students

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Objective: Given that marijuana use among college students is prevalent and chronic marijuana use is associated with various health problems, it is important to identify risk factors associated with heavy and problematic (i.e., associated with negative consequences) marijuana use. Motivation models of marijuana use (for an overview, see Cooper et al., 2016) posit that marijuana use motives are the most proximal antecedent to marijuana use involvement. Based on multivariate analyses across several studies, internally motivated motives (i.e., enhancement, expansion, and coping) are mostly strongly related to marijuana use and negative consequences, social motives are generally only modestly related to marijuana use (not strongly related to negative consequences), and conformity motives are largely unrelated to marijuana-related outcomes. Although these relationships have been thoroughly examined concurrently (i.e., cross-sectionally), less research has examined the effects of marijuana use motives prospectively and little is known about day-to-day variability in

marijuana use motives and their associations with marijuana-related outcomes. Method: Forty-three college student marijuana users from three different, large U.S. universities located in Virginia, New Mexico, and Colorado completed daily brief surveys (<10 minutes) over a 12-day period assessing prior-day marijuana use motives (i.e., coping, conformity, enhancement, social, and expansion), marijuana use (i.e., number of unique marijuana use sessions, subjective high/intoxication while under the influence of marijuana, and number of grams of marijuana consumed), and marijuana related-consequences. Results: At the within-subject level, enhancement motives were significantly associated with more grams consumed ($\beta=.15$), higher subjective high ($\beta=.23$), and more negative consequences ($\beta=.36$). Conformity motives were significantly associated with lower grams consumed ($\beta=-.33$) and expansion motives were associated with lower negative consequences ($\beta=-.09$). At the between-subject level, enhancement motives were uniquely associated with higher subjective high ($\beta=.46$) and coping motives were strongly associated with negative consequences ($\beta=.86$). Conformity motives were associated with lower negative consequences ($\beta=-.59$). Exploratory analyses further revealed that college student marijuana users are less likely to use coping and expansion motives on 4/20 (an event-specific marijuana use day) compared to other days. Conclusions: These preliminary findings suggest that we may be able to predict, prior to marijuana use, how individuals might use marijuana differently and what consequences they may experience simply by measuring their motives for using marijuana. Further, we found that mood-regulatory motives (i.e., enhancement and coping) were the most robust predictors of outcomes, providing additional empirical support for affect regulation models of substance use. From a clinical perspective, these results suggest that it may be prudent for interventions to address the use of marijuana to regulate one's mood, whether one is focused on diminishing negative affect or enhancing positive affect. Additional work is needed to examine the contextual factors that may enhance or diminish the effects of these specific marijuana use motives on marijuana-related outcomes.

Physical Activity may buffer the Relation between Episode-Level Motives and Marijuana Use

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Colorado State University & University at Buffalo, State University of New York

Background: There are positive associations between marijuana use motives (MUM; i.e., reasons for use) and marijuana consumption. Two of the most common MUMs involve enhancement (i.e., to enjoy experiences) and coping (i.e., to forget problems); each has been linked to increased marijuana use. Craving also is a contributor to marijuana use, particularly among users seeking treatment. Research typically examines cross-sectional relations among these variables. However, it is important to understand situational (i.e., episode level) variation in contributors to marijuana use, particularly in the context of intervening to reduce marijuana use. In the current study, we examined episode-level motives and craving as related to marijuana use during and after an intervention. Method: We developed and tested two Motivational Interviewing-based marijuana-reduction conditions (MI) that involved learning cognitive and behavioral strategies. The key difference between the conditions was that one included promotion of physical activity (PA) as a positive alternative to using marijuana (MI+PA condition) and the other did not (MI only condition). All participants (N = 37; n MI+PA = 18, n MI = 19) were regular marijuana users (> 3 time/week), interested in reducing their use. They used a smart-phone app to provide episode-level ecological momentary assessment data on the variables of interest during the 4-week intervention and at 2-week periods during follow-ups at 1-, 3-, and 6-months. We sought to examine the impact of treatment condition on the relationships among two MUMs (i.e., enhancement, coping), craving, and quantity of marijuana use, each reported at the episode level. Because PA was promoted as a way to enhance experiences, we hypothesized that treatment condition would moderate these relationships such that those in the MI + PA condition would have a weaker relation among motives, craving, and marijuana use. We used the Random

Coefficient Prediction (RCP) method to conduct a multilevel SEM to test the hypothesis. The RCP method involves creating a random slope, which is predicted by the moderating variable. It is particularly useful for modeling cross-level interactions. Random slopes were calculated for the relations among the MUMs (i.e., coping, enhancement), craving and marijuana use; treatment condition was entered as a predictor of the random slopes on the between level. Results: Results supported an overall positive relationship between enhancement motives and quantity consumed in a given episode. This relationship was moderated by treatment condition, such that those in the MI + PA condition had a weaker relation between the enhancement motive and marijuana use. Episode-level relations among craving, coping motives, and quantity of marijuana use were not significant. Conclusions: Our findings suggest that including PA in efforts to reduce marijuana use buffer the relationship between episode-level enhancement motives and marijuana use. It is possible that engaging in PA lessened the desire to use marijuana to enjoy oneself. Surprisingly, once we controlled for motives, there was not a direct relation between episode-level craving and marijuana use, following the intervention.

Discussant: R. Lorraine Collins, University at Buffalo, State University of New York

Symposium: Predictors, Consequences, & Protective Behavioral Strategies for Marijuana Use with College Students

Chair: Joey K. Smith
Colorado State University

There is growing research on the relations between marijuana and a range of individual characteristics, e.g., personality traits, mental health diagnoses, and simultaneous poly-substance use. With increased availability and use of marijuana, the number of individuals enduring marijuana-related consequences may also increase. One intervention that has been shown to alter marijuana use and consequences is Protective Behavioral Strategies (PBS). PBS consists of behaviors that individuals engage in that can reduce substance use and consequences. This symposium will present research from

investigators primarily interested in predictors and consequences among college students; as well as what strategies can be used to reduce marijuana use and consequences. The first presentation will present a latent profile analysis of social anxiety and personality traits to examine if personality variables moderate the relation between social anxiety and marijuana use. The second presentation will demonstrate how simultaneous use of marijuana and alcohol moderates the relation between marijuana use and marijuana consequences. The final two presentations examine the mediating role of PBS in the relation between personality and marijuana consequences, as well as the relation between marijuana use motives and marijuana consequences experienced. Furthering our understanding of personality traits, mental health diagnoses, and simultaneous marijuana and alcohol use allows for appropriate planning and intervention for these individuals. Additionally, bolstering the literature with the moderating effects of PBS allows greater insight into successful strategies to reduce marijuana use and consequences.

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Examining the Relations between Social Interaction Anxiety and Marijuana Use among College Students

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Social anxiety disorder is a common psychological diagnosis with a lifetime prevalence rate of 12%. Research has shown that nearly 30% of people with cannabis use disorder also meet diagnostic criteria for social anxiety disorder. Additionally, previous research has shown that those diagnosed with social anxiety disorder may use marijuana as a means for avoiding social interactions. College students with social anxiety are vulnerable to marijuana-related problems. Despite this, findings as to whether social anxiety relates to increased marijuana use are mixed. Additionally, factors that may affect the relation between social anxiety and marijuana use, such as the roles of personality traits that relate to increased substance use, are not well known. To better

understand the relation between social anxiety and marijuana use, we assessed social interaction anxiety, a facet of social anxiety disorder pertaining to interpersonal interactions with others; sensation seeking; urgency, emotion dysregulation; behavioral inhibition, and behavioral approach. We also measured frequency of marijuana use in the average week, past 30 days, and past six months. Participants were 1003 undergraduate students in a state in which recreational marijuana is legal for individuals over the age of 21. We used finite mixture modeling to identify profiles of social interaction anxiety and all included personality traits. We hypothesized we would discern distinct classes of social interaction anxiety and all included personality traits. We also hypothesized that the discerned classes would differentially predict marijuana use. A four-class solution best fit the data based on multiple fit indices. Of interest to this study were two high social interaction anxiety classes most distinguished by levels of urgency, emotion dysregulation, and risk seeking, such that one class was high in these traits (labeled high social interaction anxiety, high urgency) and one class low in these traits (high social interaction anxiety, low urgency). The high social interaction anxiety, high urgency class was significantly more likely to report using marijuana more frequently at all time points. These results allow us to better understand the relation between social interaction anxiety and, more broadly, social anxiety, and marijuana use. Further, because individuals who engage in substance use and other risky behaviors may be excluded from diagnosis, results can help clinicians more accurately diagnose individuals with symptoms of social anxiety who engage in these behaviors. Accurately diagnosing individuals who present with symptoms of social anxiety can help clinicians and researchers design interventions tailored to individuals who are using marijuana as a coping mechanism. For example, the first step would be to have clinicians assess for co-occurring cannabis use disorder and social anxiety disorder. If both are present, the clinician could treat both simultaneously so that reduction in one do not lead to exacerbation of the other.

Relation of Marijuana-Related Consequences with Simultaneous Alcohol and Marijuana Use

Joey K. Smith, Jamie E. Parnes, & Bradley T. Conner
Colorado State University

Marijuana and alcohol are commonly used by many young adults. Previous studies have suggested that past-year prevalence rates of marijuana have doubled over the past ten years, and the rates of alcohol-use disorder continued to grow during the same period. The increased prevalence is also found in the simultaneous use of alcohol and marijuana. Simultaneous polysubstance use is the ingestion of two or more substances within the same period, such that they interact in an additive or synergistic manner. These simultaneous users may be at increased risk of experiencing negative consequences, but no studies have examined this relation. We examine how simultaneous use of marijuana and alcohol moderate the relation of marijuana and alcohol use frequency on consequences experienced. Data collection is ongoing at a large western state university, and currently includes 252 students (50.0 % female, 81.5% White, M = 20.7 years). To better understand how simultaneous poly-substance use interacts with consequences, we assess frequency of past-week marijuana use on the average severity of consequences experienced. We also examined the effect of past-week marijuana use on the total number of consequences experienced. To assess how frequency of alcohol use may be related, we assess number of days per week alcohol is typically consumed on the average severity of consequences experienced. We also examined the relation of number of days per week alcohol is consumed on the total number of consequences experienced. We hypothesize that simultaneous use of marijuana and alcohol will significantly moderate the relation of marijuana and alcohol frequency with the number of marijuana-related consequences experienced. Due to the count-nature of the severity of consequences outcome, negative binomial regression will be utilized. We also hypothesize that simultaneous use of marijuana and alcohol will significantly moderate the relation of marijuana and alcohol frequency with perceived severity of consequences. The average severity of consequences will be analyzed using

hierarchical linear regression. Preliminary analyses indicate that the simultaneous use of marijuana and alcohol significantly moderates the relations of substance use frequency and consequences experienced. Furthering the understanding of how substance use is related to consequences among simultaneous marijuana and alcohol users will provide insight into the development of substance-related issues. This could also lead to advances in new interventions and strategies to assist those who are experiencing distress from their marijuana-related consequences. This would be especially helpful to those who are simultaneous poly-substance users who are experiencing negative outcomes.

Protective Behavioral Strategies Mediate Sensation Seeking & Marijuana-Related Consequences Relation

Ryan T. Neugebauer, Mikdalia J. Oh, Mark A. Prince, Bradley T. Conner & The Marijuana Outcomes Study Team
Colorado State University

Given the recent increase in legal and social acceptability of marijuana access in the US, there is a growing need to understand risk and protective factors related to marijuana-related consequences (MRC). Recent research found 30.1% of marijuana users reported having 4 to 8 negative MRC in the past month. One consistent predictor of marijuana use is sensation seeking, with previous research demonstrating that greater sensation seeking leads to greater use; however, no research to date has examined the link between sensation seeking and MRC. Further, Protective Behavioral Strategies (PBS) are behaviors that individuals can engage in to reduce their consumption of a given substance and/or attenuate consequences. Bravo et al. showed that PBS can be effective in lowering both the frequency of marijuana use and MRC. We hypothesize that (a) those higher in risk seeking are less likely to use PBS and more likely to experience MRC, (b) that those who are high in experience seeking are more likely to use PBS and less likely to experience MRC, and (c) that PBS will mediate both relations between sensation seeking indices and MRC. Method. The current study is a secondary data analysis of the initial

Marijuana Outcome Study Team data collection. Analysis Plan. A path analysis was conducted to assess for indirect effects from both risk and experience seeking to MRC via frequency of PBS use. MRC were modeled as a negative binomial count variable due to high positive skew. Indirect effects were tested using the product of coefficients method and Monte Carlo Confidence Intervals. Results. As predicted, we found negative relations between both experience seeking and PBS and MRC and a positive relation between risk seeking and MRC. Further, PBS mediated the relations between both risk and experience seeking and MRC. One index of effect size is the ratio of the indirect effect to the total effect (i.e., Pm). Our analyses showed that Pm for the risk-seeking-PBS-MRC path was .58, and for the experience-seeking-PBS-MRCH path was .68. Discussion. Results from the present study suggest that PBS is a strong mediator of the sensation seeking-MRC relation, with the indirect effect explaining half to two-thirds of the direct effects. Moreover, we suggest that clinicians promote use of PBS with clients who are high in risk seeking. This recommendation follows from our findings that risk seekers are less likely to use PBS and that PBS are effective in reducing MRC. In addition, clinicians should support PBS use among experience seekers. PBS will help experience seekers have the experiences they are seeking with less risk.

Item-Level Protective Behavioral Strategies Mediates Marijuana Use Motives and Consequences Relation

Kirstyn N. Smith-LeCavalier, Elaina L. Keegan, Mark A. Prince, & The Marijuana Outcomes Study Team
Colorado State University

With the changing legal and social acceptance of marijuana use across the nation and resultant increases in prevalence of marijuana use, there is a need to add to the intervention tools available to clinicians. Over the past two decades, marijuana researchers have shown a positive association between marijuana use motives (MUM; i.e., individuals' reasons for using marijuana) and the amount of marijuana consumed as well as the number of marijuana-related consequences experienced. Simons et al. identified 5 distinct

MUM (i.e., social, coping, enhancement, expansion, conformity) which each uniquely predict marijuana use outcomes. More recently, Pedersen et al. developed a measure for marijuana protective behavioral strategies (PBS), which was shown to be negatively related to marijuana use and related consequences. PBS, in this context, are behaviors that individuals can use to reduce their marijuana use or reduce their risk for consequences. Pedersen and colleagues recently reduced the 50-item marijuana PBS scale down to 17 items. The current study examined the mediating role of each marijuana-PBS item in the MUM-marijuana consequences relation. Method. The current study is a secondary data analysis of the initial Marijuana Outcome Study Team data collection. Analysis Plan. A series of 17 path analyses were conducted to assess for indirect effects from each of the 5 MUM to marijuana-related consequences via each individual marijuana-PBS item from the revised PBSM. Marijuana-related consequences were modeled as a negative binomial count variable due to high positive skew. Indirect effects were tested using the product of coefficients method and Monte Carlo Confidence Intervals. Results. Three strategies mediated all five MUM (i.e., avoiding marijuana use to cope with emotions such as sadness or depression, limiting use to weekends, and avoiding using marijuana habitually which is multiple times a week). In addition, some specific strategies only served as mediators of certain MUM. For social motives, avoiding mixing marijuana with other drugs had the largest effect size. For coping motives, avoiding using marijuana to cope with emotions such as sadness or depression had the largest effect size. For enhancement motives, avoiding methods of marijuana use that can make an individual more intoxicated than they would like had the largest effect size. For conformity motives, only purchasing marijuana from a trusted source had the largest effect size. Finally, for expansion motives, avoiding using marijuana habitually had the largest effect size. Discussion. Results from the current study can help clinicians identify specific strategies that will be most successful for clients who report using for each type of MUM or for a combination of MUM. In summary, screening clients for their MUM can identify the primary MUM for an individual, and then the clinician can suggest the client try the strategy with the biggest effect size for that specific MUM. Alternatively, clients are unable to identify their most common MUM, then clinicians might recommend one of the three protective behavioral strategies that mediated all MUM