EXPLORING RELATIONSHIPS AMONG NEGATIVE URGENCY, MARIJUANA USE MECHANISMS, AND MARIJUANA USE BEHAVIORS ACROSS MEN AND WOMEN

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ABSTRACT

VanderVeen, John Davis. Ph.D., Purdue University, August 2018. Exploring Relationships Among Negative Urgency, Marijuana Use Mechanisms, and Marijuana Use Behaviors Across Gender. Major Professor: Melissa A. Cyders.

Marijuana use is associated with many health risks, but is increasingly becoming more accepted; thus, use rates, as well as negative consequences, are growing. There is a need to better understand marijuana use behaviors so as to reduce its negative effects. The current study sought to test the viability of applying urgency theory to marijuana use behaviors by examining several pathways among negative urgency, marijuana-related attentional bias, coping motives, and marijuana use behaviors, across men and women. Participants (n=120, mean age= 26.61 years (SD=9.28), 50% women, 63% White/Caucasian) were recruited from the Indianapolis, IN area to participate in a cross-sectional study in which they completed self-report measures and a visual-probe computer task with eye-tracking following negative mood induction. Regression analyses and the PROCESS macro were used to examine study hypotheses. Several pathways were supported: Negative urgency was significantly associated with coping motives (β=0.24, p=0.01), coping motives were significantly associated with marijuana use behaviors (ΔR^2= 0.55, p<0.01), and a serial mediation model was supported, in which the relationship between negative urgency and negative marijuana consequences was

mediated by coping motives and then by marijuana use frequency (*c'* = 0.20, 95%CI= 0.06 to 0.50). Competing models were examined and not supported. There were no statistically significant pathways involving the attentional bias measures; although there was a pattern of small effect sizes demonstrating that attentional biases may relate to marijuana use behaviors in men and not in women. Findings from the current study serve as preliminary support for applying urgency theory to marijuana use behaviors. Overall, these findings suggest that negative urgency is a distal risk factor that influences the development of other, more proximal, predictors of marijuana use and negative marijuana consequences. Future studies should examine the time order of these relationships longitudinally to replicate and provide more confidence in the causal order of the model supported in the present study.

INTRODUCTION

Marijuana use is associated with many health risks including depression, anxiety, suicidal thoughts, impaired memory, decline in cognitive function, lung cancer, and heart attacks (Hall, 2009; Hall & Degenhardt, 2009; Meier et al., 2012). With the growing attitudes of acceptance towards marijuana use (Johnston et al., 2014; SAMHSA, 2014), the expanding legislation (NCSL, 2016), the increase in marijuana use prevalence (Carliner et al., 2017), and the limitations of current prevention and intervention efforts (Conrod et al., 2010; Palmgreen et al., 2007; Peters et al., 2013; Stephenson & Palmgreen, 2001), it is particularly important that we understand factors associated with its use.

Urgency theory (Cyders & Smith, 2008) may allow for a better understanding of marijuana use behaviors. This theory posits that those high in trait emotion-driven tendencies towards rash action are more likely to have problematic levels of substance use. Negative urgency (the tendency to act rashly when experiencing an extreme negative mood) has recently been shown to have a significant association with marijuana use behaviors (VanderVeen et al., 2016a). This theory also suggests that these personality traits help to shape other tendencies that are more proximal predictors of substance use behaviors, including the tendency to use substances to cope with strong emotions (Doran et al., 2013; Settles, Cyders, & Smith, 2010) and attentional bias towards substance-

related stimuli (Corbin, Iwamoto, & Fromme, 2011; see Coskunpinar & Cyders, 2013 for review).

The current study is the first step in a program of research seeking to examine the validity of applying urgency theory to marijuana use behaviors. It explored the relationships among negative urgency, marijuana coping motives, marijuana-related attentional bias, and marijuana use behaviors and assessed whether this model applies similarly across men and women (as suggested by VanderVeen et al., 2016a). If supported, the proposed study would provide a conceptual model through which marijuana use behaviors can be better understood.

A Conceptual Model

Urgency theory emerged out of research on impulsivity- a complex trait broadly defined as a disposition towards rash action. Impulsivity has been conceptualized as a multidimensional construct comprised of multiple separate, though related, tendencies towards rash action (Evenden, 1999). Based on one such multidimensional model, the UPPS-P Model of Impulsive Behavior was developed (Whiteside & Lynam, 2001; Lynam et al., 2006), which includes two emotion-driven impulsive personality traits that represent the tendency to act rashly when experiencing extreme positive (called *positive urgency*) or negative (called *negative urgency*) emotions. Research has shown that these emotion-driven tendencies towards rash-action are the most strongly associated with problems related to many different risk-taking behaviors, particularly substance use (see Berg et al., 2015; Stautz & Cooper, 2013; VanderVeen et al., 2016a for meta-analytic reviews). Recent work on urgency theory has shown evidence that the urgency traits

shape psychosocial learning processes, influence attentional processes, relate to functional brain systems, are associated with variability in differing neurotransmitter levels, increases throughout adolescence, and ultimately contribute to a range of addictive behaviors, including substance use (Cyders & Smith, 2008; see Smith & Cyders, 2016 for review).

The present study explored the viability of applying urgency theory to marijuana use behaviors. I propose a causal model of urgency theory can be applied to marijuana use behaviors whereby gene polymorphisms contribute to the development of negative urgency, which in turn influences learning processes leading to marijuana use to cope with strong emotions, biases ones attention towards marijuana-related stimuli, relates to functional brain systems, and impacts marijuana use frequency, and ultimately negative marijuana use consequences (see Figure A1 for complete conceptual model). I used a cross-sectional design to assess the viability of several specific pathways, including those between negative urgency, marijuana coping motives, marijuana-related attentional bias, and marijuana use behaviors, and examined if these specific pathways are viable amongst both men and women.

I aimed to assess several specific pathways involved in urgency theory: 1) How negative urgency relates to mechanisms of marijuana use behaviors (i.e., marijuana coping motives and marijuana related attentional bias) and 2) How mechanisms of marijuana use behaviors relate to separable marijuana use behaviors (i.e., marijuana use and negative marijuana consequences). These aims are outlined in Figure A2.

The present study expands upon urgency theory in several ways. First, it applies the model to marijuana use behaviors. As marijuana use, and inevitably its consequences,

becomes more widespread, it is increasingly important to have a theoretical model through which the behavior can be understood and treated. Second, this cross-sectional study explored the unique role of gender within the model by elucidating gender-specific effects in how negative urgency relates to the proposed mechanisms and marijuana use behaviors. This is an important step in demonstrating how urgency theory might be able to explain gender differences in rates of substance use behaviors and problems. Third, as the first study to apply urgency theory to marijuana use behaviors, this is a critical first step in a program of research that can inform future prospective, experimental, and intervention work to better understand and reduce the damaging effects of marijuana.

Marijuana Use Behaviors: Use and Consequences

The study of marijuana use behaviors has utilized many different constructs, which has led to inconsistency across studies and research findings, making it difficult to interpret results. For instance, marijuana use has been studied by asking yes or no questions about lifetime use (Martin et al., 2002; Stephenson & Helme, 2006), timeline follow back calendars (Robinson, Ladd, & Andersen, 2014), and with rating scales for frequency of use (Baskir, 2006; Castellanos-Ryan et al., 2013). On the other hand, negative marijuana consequences have included questionnaires asking about types of marijuana-related problems experienced (Hendershot et al., 2011) and the likelihood of having a dependence diagnosis (Caspi et al., 1997; Churchwell et al., 2010; see Table A1 for different measurement tools of marijuana use and negative marijuana consequences).

Much of the literature to date has focused on either marijuana use or negative consequences, which limits our ability to discern risk factors that impact both of these

behaviors. This is an issue because measurements that combine marijuana use and consequences into a single outcome likely mask or water down the effects of either variable (Smith, Fischer, & Fister, 2003). For instance, one impulsivity-related personality trait, sensation seeking (the tendency to seek out new and exciting experiences and sensations) has been widely studied in relation to marijuana use behaviors. However, despite the popularity of examining sensation seeking for marijuana use behaviors, sensation seeking has a modest association with marijuana use, but a weak association with negative marijuana consequences (VanderVeen et al., 2016a), making it a potential treatment target for use, but not a powerful one for negative consequences. Interventions to reduce marijuana use behaviors have often targeted high sensation seekers, but have resulted in minimally effective sustained changes in either marijuana use or negative marijuana consequences (Palmgreen et al., 2007; Stephenson et al., 1999; Stephenson & Palmgreen, 2001), likely because sensation seeking is not a robust predictor for both of these behaviors.

Because risk factors for marijuana use and negative marijuana consequences are likely different, I measured both of these behaviors to better capture specific and common risks across these two outcomes. I use the term marijuana use behaviors when referring to both marijuana use and negative marijuana consequences. Marijuana use is defined as lifetime use and frequency of use, whereas negative marijuana consequences is defined as marijuana-related problems (e.g., trouble at home or work) and marijuana dependence (VanderVeen et al., 2016a).

Negative Urgency and Marijuana Use Behaviors

Negative urgency is a prime candidate to study in relation to marijuana use because of the strong role negative emotions play in marijuana use behaviors (Arendt & Munk-Jorgensen, 2004; Bonn-Miller et al., 2010; Bovasso, 2001; Simons et al., 2005). These studies have shown that experiencing more negative emotions is a risk factor for more frequent marijuana use and for experiencing more negative marijuana consequences. In fact, a diary study of marijuana use reported that individuals are more likely to use marijuana when experiencing a negative mood (Lex et al., 1989). The effects of negative mood on marijuana use behaviors suggest negative urgency likely imparts strong effects on marijuana use behaviors. A study of adult marijuana users showed that participants reporting higher levels of negative urgency also reported the highest levels of negative marijuana consequences (Dvorak & Day, 2014). A recent meta-analysis examined the relationships between individual traits of impulsive behavior and marijuana use behaviors (VanderVeen et al., 2016a) to better understand the roles of multiple impulsivity traits in young adults. Although sensation seeking was the most thoroughly examined impulsivity trait, negative urgency also had a robust association with marijuana use behaviors (see Table A2 for effect sizes).

Although it certainly is possible and likely that marijuana use behaviors could affect personality changes (Ewing et al., 2015; Flory et al., 2002), I propose that negative urgency is a pre-existing risk factor for increases in marijuana use and consequences. There are three reasons for this: 1) Negative urgency develops younger in life than typical marijuana use onset (Shulman et al., 2016; Steinberg, 2008), 2) Negative urgency has been shown to longitudinally predict onset and increases in substance use across youth

and adults (Smith & Cyders, 2016; Smith, Guller, & Zapolski, 2013), and 3) Negative urgency has also been shown to increase mechanisms underlying a wide range of substance use, including those proposed in the current study (Adams et al., 2012; Jones et al., 2014; Settles et al., 2010).

Therefore, the present study focused on negative urgency because: 1) Research supports negative urgency as having robust associations with marijuana use behaviors (VanderVeen et al., 2016a), 2) Negative affectivity (a component of negative urgency) strongly influences marijuana use behaviors (e.g., Bonn-Miller et al., 2010; Simons et al., 2005), and 3) Negative urgency is an important pre-existing risk factor for substance use and mechanisms increasing such use (Shulman et al., 2016; Smith & Cyders, 2016; Steinberg, 2008).

Gender, Marijuana Use Behaviors, and Negative Urgency

There are notable differences in marijuana use behaviors across men and women, such that men use marijuana more frequently (Evans-Polce, Vasilenko, & Lanza, 2015; Johnson et al., 2015) and initiate use earlier (Kosterman et al., 2000; Johnson et al., 2015) than women. Men are also more likely to experience negative marijuana consequences, such as problems in work and school, with family, and dependence as compared to women (Ames et al., 2005; Hasin et al., 2015; Juon et al., 2011; Simons & Carey, 2002). Differences in mean levels of marijuana use behaviors could result from differences in risk factors, such as negative urgency, associated with marijuana use. However, despite men using marijuana more frequently, a recent study reported no negative urgency differences between men and women (e.g., Argyriou et al., *under review*) and several

have found that women report higher levels of negative urgency than men (Cross, Copping, & Campbell, 2011; Cyders, 2013). Importantly, these differences don't appear to be explained by gender differences in emotional responding (e.g., Cyders, 2013; VanderVeen et al., 2016a).

Because gender differences in mean levels of negative urgency do not directly explain gender differences in marijuana use behaviors, it is important to consider an interactive effect between gender and negative urgency, whereby risk factors differentially relate to marijuana use behaviors in men and women (see Cyders, 2013 for review). A recent meta-analysis found that impulsivity traits were more robust predictors of marijuana use behaviors for men than women (VanderVeen et al., 2016a), though this finding is not consistently found with other substance use behaviors, including alcohol use (Cyders, 2013) and polysubstance use (Argyriou et al., *under review*). The vast gender differences in marijuana use behaviors, negative urgency, and how they are related has important implications. Research may need to apply different risk models to men and women. Clinically, this suggests that treatments may need to target different risk factors based on gender.

Potential Mechanisms

The current study examined two prime mechanisms through which negative urgency may impart its risk for marijuana use behaviors: coping motives for marijuana use and attentional bias towards marijuana-related cues. Coping motives and attentional bias influence marijuana use and consequences (Asmaro, Carolan, & Liotti, 2014; Buckner, Zvolensky, & Schmidt, 2012; Fox et al., 2011). However, although negative

urgency is associated with increased risk of developing substance use coping motives (Adams et al., 2012; Jones et al., 2014) and attentional bias towards substance cues (Field & Cox, 2008), there is currently a gap in our understanding of how these mechanisms might mediate the relationship between negative urgency and marijuana use behaviors.

Coping Motives

Many models of marijuana use posit that knowing one's motives to use is central to understanding the nature of the behavior (Mitchell et al., 2007). This approach recognizes that there are several distinct motives for using marijuana that may vary both between and within individuals (Cooper, 1994). The Marijuana Motive Measure (MMM; Simons et al., 1998) established six motives for using marijuana: *coping* (marijuana use to alleviate negative emotions), *enhancement* (marijuana use to amplify positive emotions), *social* (marijuana use to increase sociability), *conformity* (marijuana use to fit in), and *expansion* (marijuana use to experience the world differently). There is substantial evidence supporting different patterns of marijuana use behavior based on the motivations to use; and, importantly, coping motives have consistently been related to both increased marijuana use and experiencing more negative marijuana consequences (Bujarski, Norberg, & Copeland, 2012; Mitchell et al., 2007; Simons et al., 1998).

Coping motives have been linked to increased affective vulnerability (Bonn-Miller, Zvolensky, & Bernstein, 2007) and an absence of alternative, more adaptive, coping methods (Comeau et al., 2001; Mitchell et al., 2007). The avoidance-oriented coping theory (Cook, 1985; Hayes et al., 1996) would suggest that those prone to experiencing negative moods would be likely to use marijuana in order to alleviate such

moods, and thus avoid having to manage the emotion. While this claim has not been examined in the marijuana use literature to date, there is ample evidence supporting a connection between negative urgency and coping motives for alcohol use (Adams et al., 2012; Keough et al., 2016) and more general substance use (Adams et al., 2012; Jones et al., 2014). Importantly, this work has established that negative urgency increases the likelihood of one developing coping motives for substance use, rather than the presence of such motives affecting negative urgency development, which prospectively increases the risk for increased substance use (e.g., Settles et al., 2010). Therefore, the current study examined the pathways in urgency theory between negative urgency and marijuana coping motives and between marijuana coping motives and marijuana use behaviors (Figure A2).

Attentional Bias

Attentional bias is the likelihood to attend to stimuli-related cues in the environment (e.g., marijuana images) and is comprised of two separate, though related, components: *initial orientation* (shifting attention towards stimuli) and *delayed disengagement* (difficulty in shifting attention away from stimuli) (Cisler, Bacon, & Williams, 2009). Attentional bias can be measured through both indirect measures and more direct measures (Field & Cox, 2008). With indirect measures (e.g., Stroop tasks), attentional bias is inferred through participants' timed performance on a primary task (e.g., color-naming) when a substance-related stimulus is presented (e.g., substance-related words). With more direct measures (e.g., eye-movement monitoring), attentional bias is inferred through observing eye-movements. Two eye-tracking variables include

initial orientation, which can be measured through the proportion of initial eye movements towards substance-related stimuli and *delayed disengagement*, which can be measured through participants' gaze duration on substance-related stimuli compared to control stimuli (Field, Mogg, & Bradley, 2004; 2005). Because eye-tracking assumes that the participant is attending to the area of the visual field that is being focused on and because there is a slight delay between stimulus presentation and optic sensation (Field, Munafò, & Franken, 2009; Kowler, 1995), it is not a perfect measure of attention. However, indirect measures, such as reaction time, are highly influenced by anticipatory effects, have poor reliability and validity with other estimates of attentional bias, and are more influenced by individual differences in reaction time rather than differences in attentional bias (Miller & Ulrich, 2013; Wachter & Stolz, 2015). Therefore, I only used eye-tracking measures of attentional bias.

Attentional bias' relation to substance use is best understood through a combination of classical conditioning and the incentive-sensitization theory (Robinson & Berridge, 1993, 2000). According to incentive-sensitization theory, repeated exposure to substances leads to sensitized dopamine activity in the nucleus accumbens and associated structures within the mesolimbic dopamine system, which causes an increase in the incentive value of the substance. Through classical conditioning, substance-related environmental cues become associated with this dopamine system hyperactivity, which causes these cues to develop conditioned incentive properties. In this way, the substance cue grabs a person's attention, becomes desirable, and guides behavior to the incentive, or substance use (Field et al., 2006; Robinson & Berridge, 1993). While the association between attentional bias and substance use behaviors is well established for alcohol

(Coskunpinar, 2015; Cox et al., 2002; Robbins & Ehrman, 2004) and cigarettes (Chanon, Sours, & Boettiger, 2010; Mogg et al., 2003), there is less available research on the relation to marijuana use behaviors.

Preliminary evidence for attentional bias in marijuana use is consistent with other substances, in that marijuana users display greater delayed disengagement towards marijuana-related images than non-users (Field et al., 2006). Because impulsivity has been shown to bias one's attention towards the rewarding properties of substance use (e.g., Corbin et al., 2011; Settles et al., 2010), negative urgency is the impulsivity trait most strongly related to problematic substance use (Coskunpinar & Cyders, 2013; Cyders, Coskunpinar, & Vanderveen, 2017; Stautz & Cooper, 2013), and negative affect (a component of negative urgency) narrows ones attentional capacity (Cisler & Koster, 2010; Gable & Harmon-Jones, 2010; Moriya & Nittono, 2011), it follows that negative urgency could be associated with attentional bias towards marijuana-related cues. Specifically, although attentional biases could contribute to personality change, I propose that negative urgency is a risk factor for the development of attentional biases because negative urgency develops before the typical onset of marijuana use and attentional bias development, through affecting classical conditioning processes and dopaminergic responses (Field et al., 2006; Robinson & Berridge, 1993; Shulman et al., 2016; Steinberg, 2008). Therefore, in order to assess the viability of urgency theory in marijuana use behaviors, I examined the pathways between negative urgency and marijuana-related attentional bias and between marijuana-related attentional bias and marijuana use behaviors (Figure A2).

Gender Differences in Potential Mechanisms

While there is limited evidence for mean differences in coping motives and attentional biases across gender, there is evidence that there are differential relationships in how these mechanisms relate to both negative urgency and substance use behaviors based on gender. The evidence is mixed on the direction of these relationships. For example, Foster and colleagues (2014) found that gender moderated the relationship between negative affectivity and drinking coping motives, such that there was a more robust relationship in men than in women. However, Bilsky and colleagues (2016) found the relationship between anxiety sensitivity and coping motives for cigarette smoking was more robust in women than in men. Additionally, there is evidence that gender moderates the relationship between negative urgency and alcohol-related attentional bias, such that there is a more robust relationship between negative urgency and alcohol-related attentional bias among men than women (Coskunpinar & Cyders, 2013).

There is also mixed evidence of the relationship between these mechanisms and marijuana use behaviors across men and women. Buckner and colleagues (2012) found evidence that the relationship between marijuana coping motives and negative marijuana consequences was more robust in men than in women; while Bujarski and colleagues (2012) found evidence that the relationship between marijuana coping motives and marijuana use behaviors is more robust in women than in men. Furthermore, attentional bias for alcohol cues appears to be a more robust predictor of alcohol use among men than women (Emery & Simons, 2015; Willem et al., 2013).

Given these unique, gender-based differences, it is important to consider how gender affects not only mean differences in negative urgency and marijuana use

behaviors, but also the relationship among negative urgency, these potential mechanisms, and marijuana use behaviors in order to develop more effective, individually-tailored interventions.

Age and Race

There is ample evidence that impulsive personality traits change with age (e.g., Littlefield et al., 2016; Romer & Hennessy, 2007; Steinberg, 2008), with impulsive traits increasing during adolescence and then declining into young adulthood. There is less evidence on impulsivity traits later in life. A recent review examined the scant literature on impulsive personality traits in middle-to-older adulthood (Argyriou et al., *under review*), which showed mixed evidence for the "maturing out" phenomenon whereby risk for drug use declines in conjunction with the adoption of adult roles (Littlefield & Sher, 2016; Vergés et al., 2012), increases in agreeableness and self-control, and decreases in neuroticism and impulsivity (Caspi et al., 2005; Littlefield, Sher, & Wood, 2009). While there are general population trends for the "maturing out" phenomena for marijuana use (White, Beardslee, & Pardini, 2017; Keyes et al., 2015; Terry-McElrath et al., 2017), these findings are not uniform across individuals, and many individuals continue with problematic substance use patterns throughout the lifespan (Fillmore, 1988; Littlefield et al., 2009, Heyman, 2013). Those who do not "mature out" of problematic substance use do not experience the personality changes observed in others. Factors related to such personality changes remain unknown, although it is likely that there is a combination of excessively high trait personality factors (e.g., negative urgency), environmental factors, and life transitions (as suggested by Argyriou et al., *under review*).

There are notable differences in levels of impulsivity and marijuana use behaviors reported between Black and White adolescents. For instance, White adolescents tend to have higher levels of sensation seeking (e.g., Parker & Morton, 2009; Lynne-Landsman, Graber, Nichols, & Botvin, 2011; Pedersen et al., 2012), but lower levels of urgency traits and fewer deficits in conscientiousness (e.g. Pedersen et al., 2012; Ames et al., 2007). Additionally, negative marijuana consequences are more prevalent in Black Americans compared to other races across developmental stages (Johnston et al., 2014; Johnson et al., 2015; Pacek, Malcom, & Martins, 2012), although use rates in Black Americans are comparable with other races (Gerra et al., 2004; Keyes et al., 2015; Martin et al., 2002). Because of the differences in both marijuana use and impulsivity across the lifespan and by race, the current study used age and race as covariates in all analyses.

Effect of Negative Mood

The current study examined the role of negative urgency in the context of negative mood for two reasons: First, negative mood is a strong predictor of marijuana use. Studies consistently find that experiencing more negative moods is a risk factor associated with increased marijuana use (Bonn-Miller et al., 2010; Simons et al., 2005) and negative marijuana consequences (Arendt & Munk-Jorgensen, 2004; Bovasso, 2001). Because negative mood seems to influence marijuana use behaviors, it is particularly important to understand potential mechanisms of use in the context of negative mood.

Second, the combination of negative mood and poor behavioral control is a hallmark of negative urgency and urgency theory, and it is likely that the association between negative urgency and both mechanisms and marijuana use behaviors is

strengthened in the context of negative mood compared to other mood states. Thus, in order to have adequate power to examine such relationships in this cross-sectional study, measuring these factors during a negative mood is important. For instance, the combination of negative affectivity and poor behavioral control is strongly related to coping motives and subsequent marijuana use (Bonn-Miller, Vujanovic, & Zvolensky, 2008; Zvolensky et al., 2009). Although negative urgency likely influences the development of marijuana coping motives, it is unlikely that either negative urgency or coping motives would influence marijuana use behavior when not in a negative mood. There is some evidence to support this in the alcohol literature, as coping motives moderate the relationship between mood and alcohol use frequency, such that there is a more robust relationship between negative mood and alcohol use when a person has strong coping motives (Armeli et al., 2008; Hussong, Galloway, & Feagans, 2005). Thus, negative mood is a period of vulnerability whereby coping motives are activated leading to substance use. While there is less available research connecting negative mood to attentional bias towards marijuana cues, evidence from other problematic behaviors suggests a strong connection. For example, attentional bias is increased when in negative mood compared to other mood states for food cues in problematic eaters (Frayn, Sears, & von Ranson, 2016; Hepworth et al., 2010) and for smoking cues in cigarette users (Fucito, 2009). Importantly, the relationship between attentional bias towards cues and subsequent behavior is more robust in negative mood states. Taken together, these findings suggest that negative urgency has a more robust effect on marijuana use behaviors in negative mood, and therefore, mechanisms should be examined in the context of negative mood.

The Current Study

Based on the findings discussed above, the overarching goal of the present study was to examine how negative urgency relates to marijuana use behaviors through coping motives and attentional biases in the context of negative mood and across men and women. I propose a model whereby negative urgency influences learning processes leading to marijuana use to cope with strong emotions, biases ones attention towards marijuana-related stimuli, and impacts marijuana use behaviors (see Figure A2 for study-specific hypotheses).

There were two specific aims:

Aim 1

Understand the relationship between negative urgency and mechanisms of marijuana use (i.e., coping motives and attentional bias) and how this relationship varies across men and women (see Figure A2).

Hypothesis 1. Negative urgency will be positively related to coping motives of marijuana use (Adams et al., 2012; Jones et al., 2014). *Hypothesis 1a.* Gender will moderate the relationship between negative urgency and coping motives of marijuana use, such that the relationship will be more robust in men than women (Foster et al., 2014).

Hypothesis 2. Negative urgency will be positively related to attentional bias measures of marijuana use (Coskunpinar & Cyders, 2013). *Hypothesis 2a.* Gender will moderate the relationship between negative urgency and attentional bias measuers of marijuana use, such that the relationship will be more robust in men than women (Coskunpinar & Cyders, 2013).

Aim 2

Understand the relationship between mechanisms of marijuana use (i.e., coping motives and attentional bias) and marijuana use behaviors (i.e., marijuana use and negative marijuana consequences) and how these relationships vary across men and women (see Figure A2).

Hypothesis 3. Coping motives of marijuana use will be positively related to marijuana use behaviors (Mitchell et al., 2007; Simons et al., 1998). *Hypothesis 3a.* Gender will moderate the relationship between marijuana coping motives and marijuana use behaviors, such that the relationship will be more robust in women than in men (Bujarski et al., 2012).

Hypothesis 4. Attentional bias measures of marijuana use will be positively related to marijuana use behaviors (Field et al., 2006). *Hypothesis 4a.* Gender will moderate the relationship between attentional bias towards marijuana-related images and marijuana use behaviors, such that the relationship will be more robust in men than in women (Emery & Simons, 2015; Willem et al., 2013).

METHOD

Participants

Participants (*n*=120: *n*=60 women, *n*=60 men) were marijuana using, community-dwelling adults living in the Indianapolis, IN area. All participants were over 18 years old, had used marijuana at least 1 time in the past year, had normal or corrected to normal vision (not with glasses), and were able to understand and complete questionnaires in English. Exclusion criteria included being under the influence of marijuana, alcohol, or any other drug (determined by standardized field sobriety test; Porath-Waller & Beirness, 2014; Stuster & Burns, 1998; see Table B1) or at medium to high risk for suicide (determined by Suicide Assessment Five-step Evaluation and Triage (SAFE-T); Jacobs, 2011; SAMHSA, 2009; see Table B2) at the time of the interview. Participants reporting low suicide risk were given the 24-hour crisis line for Eskenazi Health. Potential participants reporting moderate suicide risk (*n*=2) were given an outpatient referral, a 24-hour crisis line, and were disqualified from the study. No potential participants met criteria for high suicide risk. See Figure B1 for description of exclusion criteria and associated assessment tools.

Measures

Demographics

The proposed study collected information on participants' age, gender, and race (Table B3).

Mood Induction Tools

The Velten Mood Induction Procedures (Velten, 1968) are two series of 58 self-referent statements designed to induce either a negative or positive mood (Figure B2).

The Negative Velten mood induction procedure is a task that induces a negative mood by having participants read 58 self-referent statements that are progressively more depressing, beginning with "Today is neither better nor worse than any other day" and ending with "I want to go to sleep and never wake up". The negative Velten mood induction procedure has been used extensively in research, with consistent findings that the procedure reliably lowers self-reported mood independent of current or past depression or anxiety (Kenealy, 1986; Scherrer & Dobson, 2009; Scherrer & Dobson, 2015). The current study used the negative Velten mood induction procedure to induce a negative mood before completing measures of the dependent variables.

The Positive Velten mood induction procedure is a task that induces a positive mood by having participants read 58 self-referent statements that are progressively more elated, beginning with "Today is neither better nor worse than any other day" and ending with "Wow, I feel great!" The positive Velten mood induction procedure has been widely used to elicit a positive mood state, but also to ameliorate the effects of the negative

Velten mood induction procedure (Frost & Green, 1982; Scherrer & Dobson, 2009). The current study used the positive Velten mood induction procedure at the end of the study session to eradicate any negative emotions that may persist.

Questionnaire Measures

The UPPS-P Impulsive Behavior Scale-Revised (UPPS-P; Lynam et al., 2006) is a 59 item self-report scale, with responses ranging from 1 (agree strongly) to 4 (disagree strongly). The UPPS-P is designed to measure five sub-facets of trait impulsivity: sensation seeking, premeditation, perseverance, positive urgency, and negative urgency. The present study only used the negative urgency subscale from the UPPS-P, which had adequate reliability ($\alpha = 0.84$). Items were coded so that higher mean scores represented higher levels of negative urgency (Table B4).

Marijuana Use Frequency was measured using a 9-item rating scale asking 'How often did you use cannabis in the last 6 months?': 0 (no use), 1 (less than once a month but at least once in the last six months), 2 (once a month), 3 (2-3 times per month), 4 (once or twice per week), 5 (3-4 times per week), 6 (nearly every day), 7 (once a day), and 8 (more than once a day). This frequency scale has been used by several research groups that have shown test-retest reliability ranging from 0.82 to 0.89 (Simons et al., 1998; Chabrol et al., 2012) (Table B5).

The Rutgers Marijuana Problem Index (RMPI; Johnson & White, 1989; White & Labouvie, 1989) is a 23-item self-report scale, with responses ranging from 0 (never) to 4 (more than 10 times). However, recent studies show that using dichotomously scored items with a No=0 and Yes=1 produces a more reliable and valid measure (Dick et al.,

2011; Martens et al., 2007). The RMPI is designed to measure the marijuana-related problems an individual has experienced in the previous 6 months. Past test-retest reliability has ranged from 0.81 to 0.96 (Simons & Carey, 2006). Items include statements such as “not able to do homework or study for a test” and “kept smoking marijuana when you promised yourself not to” (Table B6).

The Marijuana Motives Measure (MMM; Simons et al., 1998) is a 25 item self-report scale, with responses ranging from 1 (almost never/never) to 5 (almost always/always). The MMM is designed to measure five marijuana use motives: *coping* (marijuana use to alleviate negative emotions), *enhancement* (marijuana use to amplify positive emotions), *social* (marijuana use to increase sociability), *conformity* (marijuana use to fit in), and *expansion* (marijuana use to experience the world differently). The present study only used the coping motive subscale, which had adequate reliability (α= 0.87). Items were coded so that higher mean scores represented higher coping motivation levels (Table B7).

Measures of Attentional Bias

Attentional bias was assessed by a visual probe task using E-Prime software (Schneider, Eschman, & Zuccolotto, 2002) for stimuli presentation, D6 Optics Module to track eye-movements (Applied Science Laboratories, Bedford, MA), and the ASL Eye-Trac 6 software (Applied Science Laboratories, Bedford, MA) to record eye-movement data. All images used in the visual probe task (see Figure B3) have been used in previous studies of attentional biases (Eastwood et al., 2010; Field et al., 2006; Metrik et al., 2015).

Initial Orientation is the proportion of initial eye movements directed towards marijuana-related stimuli (Field et al., 2005; Mogg et al., 2003). A higher proportion of initial eye movements towards marijuana-related stimuli indicates stronger attentional bias. The percentage of first eye-movements towards marijuana pictures were calculated for each participant by considering the number of trials when gaze was directed initially at the marijuana-related picture and the total number of trials in which a fixation was made on either the marijuana-related or control picture (Field et al., 2004; Schoenmakers, Wiers, & Field, 2008).

Delayed disengagement is the duration of time that a participant spends fixated (gaze dwell time) on the marijuana-related stimuli. Prolonged gaze dwell time on marijuana-related pictures indicates greater delayed disengagement and stronger attentional bias for marijuana-related stimuli. Gaze dwell time on marijuana and control pictures were computed using ASL "Results" software (Applied Science Laboratories, Bedford, MA) by summing the total amount of time that fixations were directed at the regions of the screen occupied by the marijuana pictures and control pictures, respectively. This method has been previously used to assess the duration of eye fixations to specific areas of interest in visual probe tasks and has good concurrent validity with other measures of attentional bias (Field et al., 2004; Mogg et al., 2003). Both initial orientation and delayed disengagement are robust predictors of substance seeking and relapse risk (see Coskunpinar & Cyders, 2013 for review).

Procedure

All study documents and procedures were approved by the Indiana University Institutional Review Board and Human Subjects Office. Informed consent was obtained before any study procedures began. Participants scheduled an in-person visit to complete all study questionnaires (approximately 45 minutes). Participants were given $15 for completion of the study.

Phone Screen

Participants were recruited through online public forums (e.g., craigslist, IU Classifieds, reddit), an existing research database (Neural Systems Laboratory in the Alcohol Research Center of the Indiana Clinical and Translational Sciences Institute), flyers distributed in public places in the community (e.g., campus, tobacco-shops, liquor stores, etc.), and word of mouth. Participants completed a phone screening interview asking about age, sex, race, marijuana use, and vision (see Table B3). If qualified after the phone screen interview (report having used marijuana within the last year, able to understand/complete questionnaires in English, over 18 years old, have normal or corrected-to-normal vision), participants were invited to complete the in-person session at the Impulsivity Neuroscience Lab on the campus of IUPUI.

In-Person Session

Participants provided informed consent before any study procedures began. Order of procedures was counter-balanced and participants were randomly assigned to complete either the mood induction and eye-tracking tasks first (then questionnaires) or the

questionnaires first (then mood induction and eye-tracking tasks). The procedure for participants undergoing the mood induction and eye-tracking tasks first is described below. Participants were seated at the computer for the visual probe task and completed an Affect Grid. They were seated roughly 24 inches (but between 20-30inches) from the 19" monitor with the D6 Optics Module positioned directly under the monitor and so that participants' visual field spans less than 30 degrees from the module. Participants' distance from the monitor was held stable by participants placing their heads on an apparatus with chin and forehead rests. This apparatus was sterilized with an alcohol wipe before and after each participant. The experimenter was separated from the participant by sitting in an adjacent room with a two-way mirror (see Figure B4 for experimental room setup).

Next, the eye tracker was calibrated using a 9-point target pattern. To do this, participants looked at a set of visual target points while the Eye-Trac 6 software detects eye-movements (see Figure B5 for target point map). After calibration, participants completed the practice for the visual probe task. Participants had 10 practice trials of the visual probe task, consisting of 10 novel picture pairs not included in the experimental stimuli. Each trial began with a central fixation cross, presented for 1000ms. This was followed by a picture pair (one marijuana-related, one neutral) for 1000ms. The inner edges of the pictures were 30mm from the center of the screen, with one picture on the left and one picture on the right of the screen. After 1000ms, a small visual probe (arrow pointing either up or down) appeared on either the left or right side of the screen. Participants were instructed to respond to the probe as quickly and as accurately as possible by pressing the "u" key for arrows pointed up and the "d" key for arrows pointed

down. As soon as participants responded to the probe, the screen went black. The next trial began after 500ms (see Figure B6). Participants' eye movements were recorded from 500ms after fixation cross onset until making a manual response to the probe. I added the sentence "This is NOT a reaction time task, so feel free to look around the screen rather than anticipate where the arrow will be" to the instructions after the first 44 participants upon consistent feedback from participants that they did not look at any of the images so they could respond to the probe more quickly. This decision improved participant engagement in the task, as there was a significantly larger proportion of participants included in the study after adding this instruction (n= 44 (58%)) than before this instruction (n=13 (30%); χ^2= 8.98, df=1, p< 0.01).

Then, participants completed the negative Velten mood induction procedure. They were instructed, "Read each statement and try to feel the mood that each suggests". The mood induction took roughly 10 minutes. This administration follows the format originally outlined by Velten (1968) and has been shown to be effective in more recent mood induction research (Scherrer & Dobson, 2009; Scherrer, Dobson, & Quigley, 2014). Participants completed an affect grid after reading all statements of the negative Velten mood induction procedure.

After completing the negative Velten mood induction procedure, participants completed the visual probe task with 72 experimental trials (72 trials x 2.5s= 180s), in which marijuana-neutral picture pairs were presented. Each of the 18 marijuana-neutral picture pairs were presented four times in random order, with each marijuana picture appearing on both the left and ride sides of the screen twice. Probes replaced marijuana and neutral pictures with equal frequency. After completing the visual probe task,

participants completed the positive Velten mood induction procedure and completed an affect grid, as this has been shown to be effective in ameliorating the depressive effects of the negative Velten mood induction procedure (Frost & Green, 1982; Scherrer & Dobson, 2009).

After completing the positive Velten mood induction procedure, participants completed an affect grid. The Marijuana Motives Measure- Coping Motives Scale, the UPPS-P- Negative Urgency Scale, and the Rutgers Marijuana Problems Index were then administered using Qualtrics. This data was exported into SPSS for analysis. At the end of the session, participants were given $15 and a parking validation for participating in the study, and were dismissed.

Hypothesis Testing Plan

All hypotheses were examined using the entire sample, with age and race as covariates.

Aim 1

For analyses in Aim 1, a Bonferroni correction for 4 analyses (α=0.05/5= 0.01) was used to determine significance.

Hypothesis 1: Negative urgency will be related to coping motives of marijuana use. To test this hypothesis, I conducted a multiple regression entering coping motives as the dependent variable, with age, race, and gender as covariates, and negative urgency as the independent variable. In addition to interpreting significance with a *p*-value less than 0.01, the standardized regression coefficient (*β)* for negative urgency was also interpreted

based on Cohen's (1992) guidelines for small (β =0.20), medium (β=0.50), and large (β =0.70).

Hypothesis 1a. Gender will moderate the relationship between negative urgency and coping motives of marijuana use, such that the relationship will be more robust in men than women. To test this hypothesis, I conducted a moderation analysis using the PROCESS macro by Hays (2007). To do this, the PROCESS macro takes a random sample of cases from the original data, samples them with replacement, and estimates the conditional effects of the product of the regression coefficients generated to test the direct effects. This was repeated 10,000 times. Then, these effects were sorted from lowest to higher. The 2.5th percentile and 97.5th percentile conditional effects regression coefficients was used to estimate the indirect effects confidence interval. Negative urgency was the independent variable, coping motives was the dependent variable, gender was the moderator, and I controlled for age and race. A conditional effects coefficient for gender that had a 95% confidence interval not containing zero was used to determine a significant moderation effect.

Hypothesis 2: Negative urgency will be related to attentional bias measures of marijuana use. To test this hypothesis, I conducted two linear regression analyses: one in which initial orientation was the dependent variable and one in which delayed disengagement was the dependent variable. I entered negative urgency as the independent variable with age, race, and gender as covariates. In addition to interpreting significance with a *p*-value less than 0.01, the standardized regression coefficient (β) for negative urgency was also interpreted based on Cohen's (1992) guidelines for small (β= 0.20), medium (β =0.50), and large (β =0.70).

Hypothesis 2a. Gender will moderate the relationship between negative urgency and attentional bias measures of marijuana use, such that the relationship will be more robust in men than women. To test this hypothesis, I conducted two moderation analyses using the PROCESS macro by Hays (2007). I used the bootstrapping approach with 10,000 iterations to create the 95% confidence interval for the conditional regression coefficient. For each analysis, negative urgency was the independent variable, gender was the moderator, and I controlled for age and race. I entered (1) initial orientation and (2) delayed disengagement as dependent variables in separate analyses. A conditional effects coefficient for gender that had a 95% confidence interval not containing zero was used to determine a significant moderation effect.

Aim 2

For analyses in Aim 2, a Bonferroni correction for 7 analyses (α=0.05/7= 0.0071) was used to determine significance.

Hypothesis 3. Coping motives of marijuana use will be related to marijuana use behaviors. To test this hypothesis, I conducted two linear regressions: one with marijuana use frequency as the dependent variable and one with negative marijuana consequences as the dependent variable. For both analyses, I entered coping motives as the independent variable with age, race, and gender as covariates. In addition to interpreting significance with a *p*-value less than 0.007, the β values for each independent variable were also interpreted based on Cohen's (1992) guidelines for small (β = 0.20), medium (β =0.50), and large (β =0.70).

Hypothesis 3a. Gender will moderate the relationship between marijuana coping motives and marijuana use behaviors, such that the relationship will be more robust in women than in men. To test this hypothesis, I conducted two moderation analyses using the PROCESS macro by Hays (2007). I used the bootstrapping approach with 10,000 iterations to create the 95% confidence interval for the conditional regression coefficient. For both analyses, coping motives was the independent variable, gender was the moderator, and I controlled for age and race. Marijuana use was the dependent variable in the first analysis, and negative marijuana consequences was the dependent variable in the second analysis. A conditional effects coefficient for gender that had a 95% confidence interval not containing zero was used to determine a significant moderation effect.

Hypothesis 4. Attentional bias measures of marijuana use will be related to marijuana use behaviors. To test this hypothesis, I conducted four linear regression analyses: two with initial orientation as the independent variable and two with delayed disengagement as the independent variable. I also had two analyses with marijuana use frequency as the dependent variable and two analyses with negative marijuana consequences as the dependent variable. Age, race, and gender were covariates in all analyses. In addition to interpreting significance with a *p*-value less than 0.007, the standardized regression coefficient (β) for each independent variable were also interpreted based on Cohen's (1992) guidelines for small (β = 0.20), medium (β =0.50), and large (β =0.70).

Hypothesis 4a. Gender will moderate the relationship between attentional bias towards marijuana-related images and marijuana use behaviors, such that the relationship will be more robust in men than in women. To test this hypothesis, I

conducted four moderation analyses using the PROCESS macro by Hays (2007). I used the bootstrapping approach with 10,000 iterations to create the 95% confidence interval for the conditional regression coefficient. Marijuana use and negative marijuana consequences were each used as dependent variables for each dependent variable. In the first two analyses, initial orientation was the independent variable, gender was the moderator, and I controlled for age and race. In the next two analyses, delayed disengagement was the independent variable, gender was the moderator, and I controlled for age and race. For all analyses, a conditional effects coefficient for gender that had a 95% confidence interval not containing zero was used to determine a significant moderation effect.

RESULTS

Data Cleaning Procedures

All analyses were conducted using SPSS 23.0. Due to different data collection methods used (e.g., Qualtrics, Eye-trac software), there were two types of data files that needed to be cleaned before they could be analyzed.

Qualtrics

There were no cases of missing data from the Qualtrics questionnaire. I examined the data for outliers, using an absolute value z-score greater than 3.0 (Kline, 1998). There was 1 outlier on the Rutgers Marijuana Problems Index, in which the participant responded "yes" to 20 out of the 23 items (z= 3.43). The participant with the next highest score on this measure responded "yes" to 17 items. All analyses were conducted with and without this outlier. Because the outlier did not affect the interpretation of any analyses, only analyses with the outlier included are reported.

ASL Eye-Tracking

Eye-trac software collected eye-movement data from each participant. The following steps were completed for each participant file. After opening each file with the ASL Results program, I parsed "Events"; these were sections of eye movement data that were pre-set in the software. XDAT values were used, which marked the data set to

determine when the participants were seeing the visual probe pictures, versus anything else that was in the program. Therefore there were 72 events for each participant that were analyzed for initial orientation and delayed disengagement. Then, I configured two backgrounds, which were used to define the areas of interest (AOIs). One of the backgrounds had the marijuana picture on the left and the other had the marijuana picture on the right side. After each *event* was configured with the appropriate background based on the XDAT value, I created the AOIs, which defined the parameters of the marijuana and the neutral picture that the participants saw during the visual probe task. Then, the initial orientation and delayed disengagement attentional bias values were calculated.

Initial orientation and delayed disengagement data were analyzed at both the event level and the participant level. At the event level, ASL Results calculated fixations based on the criteria I entered based on guidelines from Komogortsev and colleagues (2010) for the highest quality eye-tracking data: (1) at least 3 consecutive saccades, (2) within 2 degrees of visual angle, and (3) lasting at least 100ms.

At the participant level, I first examined the number of events in which any eye-tracking data were collected for each participant. Komogortsev and colleagues (2010) recommend that high quality eye-tracking data includes data from at least 75% of the time in which stimuli was presented. The current study had 60 participants with at least 54s (72s x 75%= 54s) in which eye-tracking data was obtained. In order to determine the degree to which participants engaged in the experimental task, I computed the total number of events in which each participant had a fixation within one of the AOIs (marijuana or neutral image). I examined several indicators of data quality (e.g., AOI fixation percentage and AOI dwell percentage) to determine the appropriate cut point for

both inclusiveness and quality of the data (see Table C1 for repeated measures ANOVA results). There were no significant differences in data quality variables across cut-points (all *p*'s >0.50). I then examined demographic and study variable data to see if these varied across the cut-points (see Table C2 for repeated measures ANOVA results). There were no significant differences in any study variables across these cut-points (all $F<0.20$; all *p*'s >0.50).

Participant eye-tracking data was excluded from analysis if there were fewer than 36 trials in which they fixated within one of the AOIs. This was selected as the cutoff because it represents 50% of the events and having less than 50% of possible data may not adequately represent attentional bias to stimuli presented multiple times, on separate sides of the screen, in random order. This left a total of 57 participants with both 54s in which eye-tracking data was obtained and with at least 36 events in which a fixation was made within an AOI remaining. As a sensitivity analysis, I ran all analyses using cut-points for events with a fixation in an AOI at 18 (25%) and 54 (75%). Table C3 shows the effect sizes of all analyses involving attentional bias measures at each of these cut-points. The pattern of results, and thus interpretation of data, was unchanged across these cut-points. Because the pattern of results did not differ and the sample was not biased based on these cut-points, I chose to use the 50% cut-point because it retains the most data while ensuring participants were reasonably engaged in the task.

Initial orientation and delayed disengagement data were considered outliers and thus removed if they exceeded more than 3 standard deviations above the mean for each participant (Eastwood et al., 2010). There were no instances of outliers for either initial orientation or delayed disengagement.

Preliminary Analyses and Data Screening

Next, I determined normality of 1) negative urgency, 2) marijuana use frequency, 3) negative marijuana consequences, 4) marijuana coping motives, and 5) attentional bias measures by examining skewness, kurtosis, and the Shapiro-Wilk test of normality. Using an absolute value of less than 3.0 for skewness and less than 10.0 for kurtosis (Kline, 1998), no variables met criteria for non-normal distribution (all $|W| < 1.50$; all $|Kurt| < 6.00$). I also used correlation and regression analyses to assess for excessive correlation ($r \geq 0.70$; Kline, 1998) between all variables. No variables had excessive correlation (all $|r| < 0.50$).

Study Sample

The final sample consisted of 120 participants, with an equal number of men and women. The sample ranged in age from 18-63 with an average age of 26.61 years (SD= 9.28) and was representative of the population of Indianapolis, IN (63.3% White/Caucasian, 20% Black/African American, 7.5% Hispanic/Latino, 3.3% Asian, 3.3% Multiracial, 2.5% Other). On average, participants reported using marijuana multiple times per week (M= 5.70, SD= 2.34; range: 0 times to multiple times daily) and experiencing 4.8 negative marijuana consequences (SD=4.06; most endorsed items were: Trying to control marijuana by trying to use only at certain times or in certain places (n=65), Tried to cut down or quit marijuana use (n=58), Went to work or school high (n=56)) within the last 6 months. There were no differences between participants whose eye-tracking data was included or excluded on any demographic (see Table D1) or study

variables (see Table D2). There were no gender differences in mean values of any demographic or study variables (see Table D3).

Effectiveness of Mood Induction

I conducted a one-way repeated measures analysis of variance (RMANOVA), entering the valence rating for each participant before the negative mood induction, after the negative mood induction, and after the positive mood induction. I entered age, race, and gender as covariates. Results of this analysis showed the negative mood induction had a significant effect on mood valence rating, such that affect rating was significantly reduced following the negative mood manipulation (meandiff = -1.56 (SE= 0.29), $p<0.01$). This analysis also showed that following positive mood induction, mood valence rating was not different than before negative mood induction (meandiff= 0.20, (SE= 0.23), $p= 0.39$) and was significantly higher than following negative mood induction (meandiff= 1.73 (SE= 0.26), $p<0.01$). There were no significant effects of any of the covariates (all p's >0.15).

Model Replication

As a study and data quality check, I examined the relationship between negative urgency and marijuana use behaviors. To do this I conducted two linear regression analyses, using negative urgency as the independent variable and entering age, race, and gender as the covariates. In the first analysis, I entered marijuana use frequency as the dependent variable. Negative urgency was not associated with marijuana use frequency ($R^2< 0.01$, $F(1,115) <0.01$, $p= 0.58$). In the second analysis, I entered negative marijuana

consequences as the dependent variable. Negative urgency was significantly associated with negative marijuana consequences (R^2= 0.15, F(1,115)= 21.82, p<0.01). These results replicate findings from a recent meta-analysis showing that negative urgency is weakly associated with marijuana use frequency and more robustly associated with negative marijuana consequences (VanderVeen et al., 2016a).

Study Specific Hypotheses

Aim 1

I first tested hypothesis 1: *Negative urgency will be positively related to coping motives of marijuana use*. Results of the regression analysis showed a small and significant effect size, such that negative urgency was positively related to coping motives of marijuana use (ΔR^2= 0.09, F(1, 115)= 7.07, p=0.01; see Table D4).

Next, I tested hypothesis 2: *Negative urgency will be positively related to attentional bias measures of marijuana use.* Results of the regression analyses showed negative urgency was not significantly related to either initial orientation (ΔR^2< 0.01, F(1, 52)= 0.80, p= 0.53) or delayed disengagement (ΔR^2< 0.01, F(1, 52)= 0.45, p= 0.77; see Table D5). Each of these effect sizes fell short of being small based on Cohen's (1992) guidelines.

Aim 2

I then tested hypothesis 3: *Coping motives of marijuana use will be positively related to marijuana use behaviors*. Results of the regression analyses showed coping motives were significantly related to both marijuana use frequency (ΔR^2= 0.35, F(1, 96)=

2.62, p=0.001) and negative marijuana consequences (ΔR^2= 0.29, F(1, 96)= 1.94, p=0.005; see Table D6). Both of these effect sizes are considered small based on Cohen's (1992) guidelines.

Then, I tested hypothesis 4: *Attentional bias measures of marijuana use will be positively related to marijuana use behaviors.* Results of the linear regression analyses showed that neither initial orientation (ΔR^2< 0.01, F(1, 52)= 0.05, p=0.82) or delayed disengagement (ΔR^2< 0.01, F(1, 52)= 0.45, p=0.51; see Table D7) were significantly associated with marijuana use frequency. The effect sizes between measures of attentional bias and marijuana use frequency (initial orientation: β= -0.03; delayed disengagement: β=0.09) were short of being considered small based on Cohen's (1992) guidelines. The regression analyses also showed that neither initial orientation (ΔR^2< 0.02, F(1, 52)= 0.87, p=0.36) or delayed disengagement (ΔR^2< 0.04, F(1, 52)= 2.08, p=0.16; see Table D7) were significantly associated with marijuana use frequency. However, the effect sizes between measures of attentional bias and negative marijuana consequences (initial orientation: β= 0.19; delayed disengagement: β=0.20) did meet criteria for a small effect size based on these guidelines.

Gender Moderation

I examined the effects of gender moderating each of the relationships in Aims 1 and 2. There was no evidence of statistically significant gender moderation in any of these relationships (all p's > 0.10; see Table D8). However, there were several effect sizes that met criteria for being small (β >0.20) based on Cohen's (1992) guidelines, including gender moderating effects such that effect sizes were larger in men than in

women in the relationships between negative urgency and both initial orientation (β= -0.33, p=0.10; men: β=0.33, p= 0.14; women: β= -0.02, p= 0.91) and delayed disengagement (β= -0.18, p=0.40; men: β= 0.15, p= 0.51; women: β= -0.07, p= 0.74), between initial orientation and negative marijuana consequences (β= -0.20, p=0.63; men: β= 0.21, p= 0.31; women: β= -0.01, p= 0.96), between delayed disengagement and marijuana use frequency (β= -0.33, p=0.40; men: β= 0.20, p= 0.34; women: β= -0.10, p= 0.61), and between delayed disengagement and negative marijuana consequences (β= -0.21, p= 0.61; men: β= 0.29, p= 0.15; women: β= 0.03, p= 0.86). I probed the moderation and graphed the results of each of these relationships (see Figure D1) as recommended by Frazier, Tix, and Barron (2004). Visual inspection shows that the relationships between negative urgency and both initial orientation and delayed disengagement may be more robust in men than in women. Examining the graphs also shows that the relationship between delayed disengagement and marijuana use behaviors may be more robust in men than in women.

Exploratory Analyses

Because of the meaningful relationships detected between negative urgency and coping motives, and between coping motives and marijuana use behaviors, I explored the overall model in which coping motives mediates the relationship between negative urgency and marijuana use behaviors. I used the PROCESS macro to conduct two mediation analyses. For both analyses, I used negative urgency as the independent variable, coping motives as the mediator, and controlled for age, race, and gender. I used the bootstrapping approach with 10,000 iterations to create the 95% confidence interval

for the standardized indirect effect, with a 95% confidence interval not containing zero used to determine significance. In the first analysis, I entered marijuana use frequency as the dependent variable. The standardized indirect effect was 0.11, which was statistically significant (95%CI= 0.04 to 0.22). The direct effect of negative urgency on marijuana use frequency was not significant (c= 0.16, 95%CI= -0.33 to 0.04, p=0.08), thus coping motives mediated the relationship between negative urgency and marijuana use frequency (see Table D9).

In the second analysis, I entered negative marijuana consequences as the dependent variable. The standardized indirect effect was 0.09, which was statistically significant (95%CI= 0.03 to 0.17). The direct effect of negative urgency on negative marijuana consequences remained significant (c= 0.30, 95%CI= 0.14 to 0.46, p<0.01), thus coping motives mediated the relationship between negative urgency and negative marijuana consequences (see Table D10).

I also explored the possibility that gender moderated this overall model. To do this, I conducted two separate moderated mediation analyses using the PROCESS macro. In both analyses, I entered negative urgency as the independent variable, coping motives as the mediator, gender as the moderator in the relationship between negative urgency and coping motives and between negative urgency and the dependent variables, and controlled for age and race. I entered marijuana use frequency as the dependent variable in the first analysis, and negative marijuana consequences as the dependent variable in the second analysis. There was no evidence of moderated mediation in either analysis (frequency: ModMedIndex= 0.04 (SE=0.09), 95%CI= -0.14 to 0.21; consequences: ModMedIndex=0.03 (SE=0.07), 95%CI= -0.11 to 0.18).

I then explored feasibility of a causal model whereby negative urgency influences the development of coping motives, which impacts marijuana use frequency, which then leads to more negative marijuana consequences. To do this, I used the PROCESS macro to conduct a serial mediation in which negative urgency was the independent variable, coping motives was the first mediator, marijuana use frequency was the second mediator, negative marijuana consequences was the dependent variable, and controlled for age, race, and gender. This serial mediation model was supported (*c'*= 0.20 (SE= 0.11), 95%CI= 0.06 to 0.50; see Figure D2).

Because of the meaningful effect sizes among negative urgency, measures of attentional bias, and marijuana use behaviors, I also explored the overall model whereby attentional bias measures mediate the relationship between negative urgency and marijuana use behaviors. I conducted four different mediation analyses using the PROCESS macro. For each analysis, I used negative urgency as the independent variable and controlled for age, race, and gender. I used the bootstrapping approach with 10,000 iterations to create the 95% confidence interval for the standardized indirect effect, with a 95% confidence interval not containing zero used to determine significance. In the first analysis, I entered initial orientation as the mediator and marijuana use frequency as the dependent variable. The standardized indirect effect was <0.01, which was not statistically significant (95%CI= -0.04 to 0.03), thus initial orientation did not mediate the relationship between negative urgency and marijuana use frequency. In the second analysis, I entered initial orientation as the mediator and negative marijuana consequences as the dependent variable. The standardized indirect effect was 0.01, which

was not statistically significant (95%CI= -0.02 to 0.07), thus initial orientation did not mediate the relationship between negative urgency and negative marijuana consequences.

In the third analysis, I entered delayed disengagement as the mediator and marijuana use frequency as the dependent variable. The standardized indirect effect was <0.01, which was not statistically significant (95%CI= -0.02 to 0.07), thus delayed disengagement did not mediate the relationship between negative urgency and marijuana use frequency. In the fourth analysis, I entered delayed disengagement as the mediator and negative marijuana consequences as the dependent variable. The standardized indirect effect was 0.02, which was not statistically significant (95%CI= -0.03 to 0.09), thus delayed disengagement did not mediate the relationship between negative urgency and negative marijuana consequences.

Alternative Models

Because of the cross-sectional nature of the present study, I examined several alternative models to verify the order of the relationships proposed. First, I explored the possibility of negative urgency mediating the relationship between coping motives and marijuana use behaviors. I conducted to mediation analyses using the PROCESS macro. For both analyses, I entered coping motives as the independent variable, negative urgency as the mediator, and controlled for gender, age, and race.

In the first analysis, I entered marijuana use frequency as the dependent variable. The standardized indirect effect was -0.03, which was not statistically significant (95%CI= 0.04 to -0.09 to 0.04). In the second analysis, I entered negative marijuana

consequences as the dependent variable. The standardized indirect effect was 0.05, which was not statistically significant (95%CI= 0.-0.04 to 0.12).

Then, I explored an alternative serial mediation model in which marijuana use frequency and coping motives mediated the relationship between negative urgency and negative marijuana consequences. I used the PROCESS macro to conduct a serial mediation analysis. I entered negative urgency as the independent variable, marijuana use frequency as the first mediator, coping motives as the second mediator, and negative marijuana consequences as the dependent variable, controlling for gender, age, and race. This serial mediation model was not supported (*c*'= -0.04 (SE=0.07), 95%CI= -0.20 to 0.10).

Finally, I explored an alternate serial mediation model in which coping motives and negative marijuana consequences mediated the relationship between negative urgency and marijuana use frequency. I used the PROCESS macro to conduct a serial mediation analysis. I entered negative urgency as the independent variable, coping motives as the first mediator, negative marijuana consequences as the second mediator, and marijuana use frequency as the dependent variable, controlling for gender, age, and race. This serial mediation model was not supported (*c*'= 0.02 (SE=0.03), 95%CI= -0.04 to 0.08).

DISCUSSION

The current study tested the viability of applying urgency theory to marijuana use behaviors by examining the feasibility of several key pathways, including those between negative urgency, several prime mechanisms of marijuana use, and marijuana use behaviors, and whether these pathways were equally viable across men and women. Overall, pathways between negative urgency, coping motives, and marijuana use behaviors were supported, while pathways between negative urgency, attentional biases, and marijuana use behaviors were not supported. Coping motives mediated the relationship between negative urgency and negative marijuana consequences in both men and women. There was also a statistically significant serial mediation such that coping motives and marijuana use frequency mediated the relationship between negative urgency and negative marijuana consequences. Although not statistically significant, there were trends for gender differences showing that the relationships with attentional biases may apply to men but not women.

These findings suggest that negative urgency is a distal risk factor that influences the development of more proximal risk factors, elevating the likelihood of marijuana use frequency and subsequent negative marijuana consequences. Although the present study is cross-sectional in nature and thus cannot make causal inferences, the support for this directional model, and lack of support for competing models, suggests the proposed causal direction is the most viable. Such findings expand upon existing research

demonstrating the mediational role coping motives play in the relationship between negative affectivity (e.g., social anxiety, anxiety sensitivity, and negative urgency) and substance use behaviors (Adams et al., 2012; Johnson et al., 2010; Lewis et al., 2008), by showing that such models apply to marijuana use behaviors. Importantly, the present study is the first step in a program of research incorporating negative urgency as a distal risk factor in marijuana use behaviors. Research has begun to explore both the role of negative urgency (see VanderVeen et al., 2016a for review) and coping models (e.g., Bonn-Miller et al., 2007; Johnson et al., 2010; Mitchell et al., 2007; Moitra et al., 2015) as related to marijuana use behaviors, but this is the first study to show that negative urgency may influence coping motives, and subsequently impact marijuana use behaviors. This study provides viability for future studies to assess the causal role of negative urgency and coping motives in marijuana use behaviors, and examine how attentional biases might influence marijuana use behaviors (particularly in men).

There are several explanations for the indirect effects of negative urgency on negative marijuana consequences through coping motives and then through marijuana use frequency. First, a person high in negative urgency is more likely to attend to the rewarding aspects of marijuana use (Corbin et al., 2011; Settles et al., 2010), such as relaxation and lack of worry about obligations (Simons et al., 1998). Through repeated perceptions of positive drug effects, marijuana use then becomes a first response to cope with negative affect, and use persists leading to more negative consequences.

Another explanation is a more longitudinal approach whereby negative urgency increases the likelihood of learning coping motives. In this sense, a person higher in negative urgency likely lacks other, more adaptive, means of managing negative mood

states. Because of this, they are more likely to learn that marijuana may improve a negative mood, either through personal experience or vicariously through others. This can lead to more positive perceptions of marijuana, greater frequency of use (regardless of the presence of a negative mood), and thus more consequences (e.g., acquired preparedness model; McCarthy, Kroll, & Smith, 2001; Smith & Anderson, 2001; Vangsness, Bry, & LaBouvie, 2005).

A third explanation is that people high in negative urgency may misperceive their intentions to use marijuana (as explained with alcohol use in Adams et al., 2012). With this explanation, those higher in negative urgency may act impulsively (i.e., use marijuana) when experiencing a negative emotion, and later view the behavior as an attempt to cope- even if this was not the initial intent during the moment of extreme emotion and also if the marijuana use did not actually alleviate their distress. In this way, a person may use marijuana, continue to have their extreme negative emotion, and that may lead to negative consequences such as trouble in relationships. This explanation may be feasible, as the current study aligns with previous work showing coping motives are associated with more negative marijuana consequences (Bujarski et al., 2012; Johnson et al., 2010; Mitchell et al., 2007). More work is needed to understand the time course through which individuals develop marijuana coping motives, the time course through which negative urgency impacts the development of these motives, if learning more adaptive coping skills can prevent this, and the process through which marijuana use moves from recreational to problematic.

There were also small associations in the pathways between attentional bias measures and negative marijuana consequences. These pathways were not statistically

significant, so it is possible that the null results reflect the true nature of these pathways and that this component of the hypothesized model is not supported. However, because this is a preliminary model, effect sizes met criteria for being small, and the more stringent inclusion criteria I used for eye-tracking data compared to other studies (thus reducing sample size and increasing the likelihood of Type II error; Cohen, 1992), I interpret these associations with caution. Results from the present study suggest that having a tendency for attention to be drawn towards (i.e., initial orientation) and maintained on (i.e., delayed disengagement) marijuana-related stimuli increases the likelihood of experiencing negative marijuana consequences in men but not in women. Because attentional bias measures were largely unrelated to marijuana use frequency, it is important to consider how these biases could relate to negative marijuana consequences without being associated with frequency of marijuana use. Such biases may influence men's behavior in that they are less able to inhibit attention to social cues. This inability to direct attention away from marijuana related cues may put the individual in situations where they are more likely to experience negative outcomes, such as trouble with the police (particularly in areas where marijuana use is illegal, as in the present study). This idea has been explored in the context of alcohol use with the alcohol myopia model (Steele & Josephs, 1990), with men showing more robust effects of attention-narrowing in response to alcohol intoxication (Davis et al., 2007), leading to more problematic outcomes such as aggression, sexual assault, and risky-sexual behaviors (Purvis, Gallagher, Parrott, 2016; see Testa, 2002 for review; Wray, Simons, Maisto, 2015).

The present study found small effects for a more robust relationship between negative urgency and attentional bias measures in men than in women. These preliminary

findings are consistent with recent work in the alcohol literature finding that negative urgency is associated with increases in alcohol seeking in a negative mood state in an experimental lab task (VanderVeen et al., 2016b), and that these effects are more robust in men compared to women (Cyders et al., 2016). Paired with findings that attentional bias measures relate to negative marijuana consequences in men, these findings advance urgency theory by providing preliminary evidence that negative urgency may be a distal risk-factor that influences attentional bias, which is a more proximal predictor of negative marijuana consequences, particularly in men. They also highlight the importance of examining these relationships in the context of negative mood. Future studies should take a longitudinal approach to better understand the possible causal nature of these relationships.

There are several possible explanations for the lack of statistical significance with attentional bias measures and with gender moderating effects. First is being underpowered due to many participants' data being excluded from analysis. In order to have the highest quality data, I used stringent guidelines for retaining data (Komogortsev et al., 2010) that are largely not reported in the existing literature (Holmqvist, Nyström, & Mulvey, 2012). This reduced my sample of attentional bias data by over 50%. Along with this are issues in recording high-quality data. These are discussed in more detail in the limitations section, but include difficulties with measurement, movement, brightness changes, and how participants completed the task. I made decisions in data retention that resulted in less power to detect statistical significance, but ensured high-quality data. However, the pattern of results remained unchanged across the different cut-points examined. In order to improve the quality of eye-tracking data, future studies utilizing

eye-tracking technology should adhere to Komogortzev and colleagues' (2010) guidelines for data retention, report any additional eye-tracking specific exclusion criteria, and be aware of technological issues that arise using this methodology when designing studies.

Second, it is possible that there are no significant associations between attentional bias measures and negative urgency or marijuana use behaviors in the present sample because of methodological differences from previous studies. I recruited a community-based sample rather than undergraduate university students (e.g., Field et al., 2004; Field et al., 2006) - samples that often do not generalize to community-based samples (see Peterson & Merunka, 2014 for review) as used in the present study. I also recruited participants based on past-year marijuana use rather than other behaviors- a decision that could have led to a range restriction in marijuana-related attentional bias, making it more difficult to detect effect sizes (Sullivan & Feinn, 2012). Finally, I added the sentence "This is NOT a reaction time task, so feel free to look around the screen rather than anticipate where the arrow will be." While this likely increased the quality of data, it is likely that this also biased the eye-tracking data in ways that previous studies did not. This instruction increased the likelihood that participants focused their attention within the areas of interest, so it does not reflect what their natural behavior may have been (e.g., demand characteristics; Orne, 1962). Because of this instruction, participants also may have tried to guess the hypotheses and adapt their behavior accordingly (e.g., social desirability; Nederhof, 1985)

There are several explanations as to why negative urgency does not impart direct effects on marijuana use frequency. This can be explained within the framework of

urgency theory. First is that negative urgency is a more distal risk factor that influences the development of more proximal risk factors, such as coping motives and attentional bias (as described above). Other common reasons for a significant indirect effect but not a significant direct effect in mediational models include differential power to detect effects based on measurement precision and a stronger effect of the independent variable on the mediator variable than on the dependent variable (Rucker et al., 2011). The present study used a single item measure to assess marijuana use frequency; compared to the coping motives scale of the marijuana motives measure, it is likely that there was a difference in the precision of these measurements. Additionally, previous studies have found only weak associations between negative urgency and marijuana use frequency (e.g., VanderVeen et al., 2016a), but have found moderate associations between negative urgency and coping motives for other substance use behaviors (Adams et al., 2012; Jones et al., 2014; Keough et al., 2016). Second, being high in negative urgency does not equate to experiencing more negative emotions (Cyders & Coskunpinar, 2010). Thus, a person high in negative urgency may only use marijuana as a rash action when experiencing strong negative emotions, may not frequently experience such emotions, and so they would not use marijuana often. In this way, negative urgency would not have a direct effect on marijuana use frequency, but would exert indirect effects by the development of coping motives.

Future Research Directions

As the first step in a broader program of research, there are several directions for future examination. First, future studies should use a longitudinal design to confirm the

time-ordered, causal direction proposed in the current study. This will allow for a better understanding of the role negative urgency has in influencing the development of marijuana coping motives and marijuana use behaviors. For instance, it has been proposed that impulsivity likely biases individuals towards the rewarding effects of drug use (Corbin et al., 2011; Settles et al., 2010), making people higher in impulsive personality traits (such as negative urgency) more likely to develop coping motives and problematic substance use patterns. It will be important to see if and how negative urgency impacts the development of other, more adaptive, coping skills. Because intense emotions act as motivation for action (Frijda, 1986; Lang, 1993), it is possible that negative urgency could be used as a driving force to develop adaptive coping skills, rather than a trait that needs to be reduced in treatment. It will also be important for research to examine the process through which marijuana use moves from recreational to problematic. The serial mediation found in the current study suggests associations between negative urgency and mechanisms of marijuana use may play a role. Future studies should seek to better understand the processes through which this occurs.

Next, future research should utilize eye-tracking in a larger sample to examine the pathways of urgency theory with sufficient power. Because of the vast body of research demonstrating a relationship between attentional bias in visual probe tasks and both negative urgency (see Coskunpinar & Cyders, 2013 for review) and substance use behaviors (Coskunpinar, 2015; Field et al., 2006; Robbins & Ehrman, 2004), it is likely that this is a viable research area despite null findings in the present study. It is important to replicate and expand on existing marijuana-related attentional bias findings in broader, more generalizable samples. By doing this, we will gain an understanding of the role

initial orientation and delayed disengagement play in marijuana use onset, maintenance, and negative marijuana consequences; as well as how negative urgency may relate to the development of such biases. However, future studies should also be held to the same standards used in the present study whereby they use guidelines proposed by Komogortsev and colleagues (2010) (3 consecutive saccades for a fixation, fixations within 2 degrees visual angle, at least 100ms fixation, and fixation tracking for at least 75% of time in which stimuli is presented) and report any other inclusion and exclusion criteria for this data, such as the degree to which participants were engaged in the task. Such reporting will improve and standardize the quality of eye-tracking data within the field, allowing for more generalizable findings.

Future studies should continue to seek to understand gender differences in marijuana use behaviors. Despite the widening gender gap in marijuana use prevalence (Carliner et al., 2017), the present study did not find gender differences in marijuana use behaviors. This was likely because the present study recruited specifically based on past year marijuana use and there were equal numbers of men and women. However, the present study did find several meaningful effect sizes in marijuana use mechanisms related to gender differences that, although not statistically significant, the size of the effects suggest further examination in future work. Other factors not included in the present study that could impact gender differences might include social norms (Mahalik et al., 2015), beliefs about the harmful effects of marijuana (Ames et al., 1999), and mood disorders (van Laar et al., 2007; McQueeny et al., 2011), as evidence suggests these factors are all related to marijuana use and differentially impact men and women.

Finally, future studies should continue to expand upon urgency theory. A recent review provides several ways in which this theory can be improved (Smith & Cyders, 2016). The present study suggests that this theory can be applied to marijuana use behaviors. Therefore, it will be important to understand how structural and functional brain networks and neurotransmitter levels not assessed by the present study impact, and are affected by, marijuana use- both short term and over time. Some work has begun to explore these relationships, with findings that marijuana use is positively associated with fractional anisotropy (a measure of impaired white matter connectivity), that these changes are associated with increased impulsive responding (Gruber et al., 2011), and that these effects are minimized if first use is after age 21 (Gruber et al., 2014). Future work should assess the viability of prevention efforts to delay the onset of marijuana use, as well as exploring whether these structural and functional brain processes can be restored with treatment. Additionally, there is converging evidence that marijuana use early in life is associated with reduced neurotransmitter levels (including glutamate, N-acetyl aspartate, creatine, and *myo*-inositol) within the anterior cingulate cortex (Chang et al., 2006; Hermann et al., 2007; Prescot et al., 2011), and such deficits are associated with impaired affective responding (Gruber et al., 2009) and inhibitory processing (Gruber & Yurgelun-Todd, 2005). Therefore, future work should consider if these neurotransmitter levels can be restored through medical interventions, developing coping skills, or prevented by delaying marijuana use onset.

Limitations

As with all studies, the present study has several limitations. First, the current study is cross-sectional in nature and is thus unable to determine causality of these effects. However, as the first study examining the mediating role of coping motives in the relationship between negative urgency and marijuana use behaviors, findings can be used to inform larger, longitudinal studies about the viability of targeting negative urgency, attentional bias, and coping motives for marijuana-related research. Additionally, the causal order (from personality to mechanisms to use and consequences) has been supported by a wealth of literature (e.g., Adams et al., 2012; Corbin et al., 2011; Field & Cox, 2008; Jones et al., 2014; Settles et al., 2010; Steinberg, 2008), making the order of the theoretical model plausible.

Second, the current study did not include other factors relating to marijuana use behaviors (e.g., peer influence, parental supervision, education level, etc.) (Maxwell, 2002; Galea et al., 2007; Lac & Crano, 2009) and therefore likely missed external influences on marijuana use behaviors. Third, the current study was unable to compare marijuana users and non-users, which could limit the generalizability of findings. However, it would not make theoretical sense to include non-users when examining a construct like marijuana coping motives. Fourth, the current study used a sample of individuals living in the Indianapolis area, so it may not be generalizable to individuals living outside of an urban Midwestern city. Along with this, the present study examined an illegal behavior in Indianapolis, so it is possible that participants were reluctant to honestly report their marijuana use behaviors. However, by advertising specifically for

marijuana use in the past year, the self-selecting participants were likely more open about their behaviors, evidenced by the variability within the marijuana use behavior variables.

There were also several limitations due to the complexity of the eye-tracking data, leading to a small sample size to assess hypotheses associated with attentional bias. At the event level, two common sources of data loss were identified: (1) poor measurement of the pupil or corneal reflections, and (2) extreme values of gaze coordinates. Pupil and corneal reflection measurement are both established during the calibration process, but it was not uncommon for these to be lost either completely or partially during the eye-tracking task. Several reasons for this emerged based on my observation. First was participant head movement. While participants were instructed to keep their chin in the chin rest and their head placed against the head rest, several participants simply did not do this. Similarly, the head and chin rest used in this study was not bolted to the table, and so participants prone to moving and readjusting their position often moved the head rest to the point that pupil recognition or corneal reflection measurement were lost. Another reason for poor pupil recognition or corneal reflection measurement is changes in the brightness of the monitor. While the entire experimental task presentation had a black background with white font or image, pupil dilation changed between presentation of the fixation cross and the image pairs. For some participants, this change in dilation was extreme and thus led to poor measurement. Data loss from extreme values of gaze coordinates occurs when the eye gaze is recorded as outside of the region of the computer monitor. ASL Results does not report this data. However, from my experience and observations, this was largely due to participants looking away from the monitor. This

happened when participants would either blink for an extended period of time or look down at the keyboard.

At the participant level, limitations occurred because of the aforementioned head movements, eye-movements, and blinking, but also due to how the participant completed the visual probe task. The most common issue with how participants completed the visual probe task was to not look at either AOI. Several participants would gaze only at the fixation cross. I spoke with most participants after the visual probe task to see if they had a strategy. Some of the participants reported trying to anticipate where the arrow was going to be and so they did not look at any of the images. To address this limitation, I included in the visual probe task instructions "This is NOT a reaction time task, so feel free to look around the screen rather than anticipate where the arrow will be" after the first 44 participants. While this decision may have biased the data by increasing the likelihood of participant demand characteristics and social desirability, this decision improved participant engagement in the task, as there was a significantly larger proportion of participants included in the study after adding this instruction (n= 44 (58%)) than before this instruction (n=13 (30%); χ^2= 8.98, df=1, p< 0.01).

Conclusions

The current study examined several pathways of urgency theory in relation to marijuana use behaviors. There was a clear pattern of a serial mediation of marijuana coping motives and marijuana use frequency in the relationship between negative urgency and negative marijuana consequences. These results, while cross-sectional in nature, suggest that negative urgency likely influences the development of marijuana

coping motives, which increases the frequency of marijuana use, subsequently increasing the likelihood of experiencing negative marijuana consequences. Several competing and alternative models were examined that did not have meaningful effect sizes and were not statistically significant. Pathways examined among negative urgency, attentional bias measures, and negative marijuana consequences were not statistically significant, although there was a pattern of small effect sizes suggesting that such pathways may be more applicable in men than in women. Put together, these findings expand urgency theory by suggesting that negative urgency is a distal risk factor that is associated with more proximal predictors of marijuana use behaviors. Future studies should seek to clarify the causal direction of relationships proposed in the present study, should seek to better understand gender differences in marijuana use behaviors and the role of attentional bias, and should use larger, more generalizable sample sizes and more stringent reporting of inclusion and exclusion criteria of attentional bias measures.

REFERENCES

REFERENCES

Adams, Z. W., Kaiser, A. J., Lynam, D. R., Charnigo, R. J., & Milich, R. (2012). Drinking motives as mediators of the impulsivity-substance use relation: Pathways for negative urgency, lack of premeditation, and sensation seeking. *Addictive Behaviors*, *37*, 848-855.

Ames, S. L., Grenard, J. L., Thush, C., Sussman, S., Wiers, R. W., & Stacy, A. W. (2007). Comparison of indirect assessments of association as predictors of marijuana use among at-risk adolescents. *Experimental and Clinical Psychopharmacology*, *15*(2), 204.

Ames, S. L., Sussman, S., & Dent, C. W. (1999). Pre-drug-use myths and competing constructs in the prediction of substance use among youth at continuation high schools: A one-year prospective study. *Personality and Individual Differences*, *26*(6), 987-1003.

Ames, S. L., Sussman, S., Dent, C. W., & Stacy, A. W. (2005). Implicit cognition and dissocative experiences as predictors of adolescent substance use. *The American Journal of Drug and Alcohol Abuse*, 31(1), 129-162.

Applied Science Laboratories, Eye Tracking System Instructions. (2006). ASL Eye-Trac 6000. Bedford, MA: Applied Science Group.

Arendt, M., & Munk-Jørgensen, P. (2004). Heavy cannabis users seeking treatment. *Social Psychiatry and Psychiatric Epidemiology*, *39*(2), 97-105.

Argyriou, E., Um, M., Carron, C., & Cyders, M. (*under review*). Age and impulsive decision making in drug addiction: A review of past research and future directions. *Manuscript under review.*

Armeli, S., Todd, M., Conner, T. S., & Tennen, H. (2008). Drinking to cope with negative moods and the immediacy of drinking within the weekly cycle among college students. *Journal of Studies on Alcohol and Drugs*, *69*(2), 313-322.

Asmaro, D., Carolan, P. L., & Liotti, M. (2014). Electrophysiological evidence of early attentional bias to drug-related pictures in chronic cannabis users. *Addictive Behaviors*, *39*(1), 114-121.

Baskir, L. R. (2006). Cognitive impulsivity and behavioral problems in adolescents. (Doctoral dissertation). Retrieved from DigitalResearch@Fordham. (AA13216904)

Berg, J. M., Latzman, R. D., Bliwise, N. G., & Lilienfeld, S. O. (2015). Parsing the heterogeneity of impulsivity: A meta-analytic review of the behavioral implications of the UPPS for psychopathology. *Psychological Assessment*, *27*(4), 1129-1146.

Bilsky, S. A., Feldner, M. T., Knapp, A. A., Rojas, S. M., & Leen-Feldner, E. W. (2016). The roles of sex, anxious reactivity to bodily arousal, and anxiety sensitivity in coping motives for cigarette smoking among adolescents. *Experimental And Clinical Psychopharmacology*, *24*(3), 147-155.

Bonn-Miller, M. O., Vujanovic, A. A., & Zvolensky, M. J. (2008). Emotional dysregulation: Association with coping-oriented marijuana use motives among current marijuana users. *Substance Use & Misuse*, *43*(11), 1653-1665.

Bonn-Miller, M. O., Zvolensky, M. J., & Bernstein, A. (2007). Marijuana use motives: Concurrent relations to frequency of past 30-day use and anxiety sensitivity among young adult marijuana smokers. *Addictive Behaviors, 32,* 49-62.

Bonn-Miller, M. O., Zvolensky, M. J., & Johnson, K. A. (2010). Uni-Morbid and Co-Occurring Marijuana and Tobacco Use: Examination of Concurrent Associations with Negative Mood States. *Journal of Addictive Diseases*,*29*(1), 68–77.

Bovasso, G. B. (2001). Cannabis abuse as a risk factor for depressive symptoms. *American Journal of Psychiatry*, *158*(12), 2033-2037.

Buckner, J. D., Zvolensky, M. J., & Schmidt, N. B. (2012). Cannabis-related impairment and social anxiety: The role of gender and cannabis use motives. *Addictive Behaviors, 37,* 1294-1297.

Bujarski, S. J., Norberg, M. M., & Copeland, J. (2012). The association between distress tolerance and cannabis use-related problems: The mediating and moderating roles of coping motives and gender. *Addictive Behaviors, 37,* 1181-1184.

Carliner, H., Mauro, P., Brown, Q., Shmulewitz, D., Rahim-Juwel, R., … & Hasin, D. S. (2017). The widening gender gap in marijuana use prevalence in the U.S. during a period of economic change, 2002-2014. *Drug and Alcohol Dependence*, *170*, 51-58.

Castellanos-Ryan, N., Parent, S., Vitaro, F., Tremblay, R. E., & Séguin, J. R. (2013). Pubertal development, personality, and substance use: a 10-year longitudinal study from childhood to adolescence. *Journal of Abnormal Psychology, 122*(3), 782.

Caspi, A., Begg, D., Dickson, N., Harrington, H., Langley, J., Moffitt, T. E., & Silva, P. A. (1997). Personality differences predict health-risk behaviors in young adulthood: evidence from a longitudinal study. *Journal of Personality and Social Psychology, 73*(5), 1052-1063.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: stability and change. *Annual Review of Psychology, 56*, 1-659.

Chabrol, H., Chauchard, E., Goutaudier, N., & van Leeuwen, N. (2012). Exploratory study of the psychopathological profiles of adolescent cannabis users. *Addictive behaviors, 37*(10), 1109-1113.

Chang, L., Cloak, C., Yakupov, R., & Ernst, T. (2006). Combined and independent effects of chronic marijuana use and HIV on brain metabolites. *Journal of Neuroimmune Pharmacology, 1*(1), 65-76.

Chanon, V. W., Sours, C. R., & Boettiger, C. A. (2010). Attentional bias toward cigarette cues in active smokers. *Psychopharmacologia*, *212*(3), 309-320.

Churchwell, J. C., Lopez-Larson, M., & Yurgelun-Todd, D. A. (2010). Altered frontal cortical volume and decision making in adolescent cannabis users. *Frontiers in Psychology*, 1, article 225.

Cisler, J. M., Bacon, A. K., & Williams, N. L. (2009). Phenomenological characteristics of attentional biases towards threat: A critical review. *Cognitive therapy and research, 33*(2), 221-234.

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in the anxiety disorders: An integrative review. *Clinical Psychology Review, 30*(2), 203-231.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

Conrod, P. J., Castellanos-Ryan, N., & Strang, J. (2010). Brief, personality-targeted coping skills interventions and survival as a non-drug user over a 2-year period during adolescence. *Archives of General Psychiatry, 67*(1), 85-93.

Comeau, N., Stewart, S. H., & Loba, P. (2001). The relations of trait anxiety, anxiety sensitivity, and sensation seeking to adolescents' motivations for alcohol, cigarette, aand marijuana use. *Addictive Behaviors, 26,* 803-825.

Cook, J. R. (1985). Repression-sensitization and approach-avoidance as predictors of response to laboratory stressor. *Journal of Personality and Social Psychology, 49, 759-773.*

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6,* 117-128.

Corbin, W. R., Iwamoto, D. K., & Fromme, K. (2011). A comprehensive longitudinal test of the acquired preparedness model for alcohol use and related problems. *Journal of Studies on Alcohol and Drugs, 72,* 602-610.

Coskunpinar, A. (2015). The relationship between trait impulsivity and alcohol-related attentional biases. (Doctoral dissertation, Purdue University).

Coskunpinar, A., & Cyders, M. A. (2013). Impulsivity and substance-related attentional bias: a meta-analytic review. *Drug and Alcohol Dependence,133,* 1-14.

Cox, W. M., Hogan, L. M., Kristian, M. R., & Race, J. H. (2002). Alcohol attentional bias as a predictor of alcohol abusers' treatment outcome. *Drug and Alcohol Dependence, 68*(3), 237-243.

Cross, C. P., Copping, L. T., & Campbell, A. (2011). Sex differences in impulsivity: A meta-analysis.*Psychological Bulletin, 137*(1), 97-130.

Cyders, M. A. (2013). Impulsivity and the sexes: Measurement and structural invariance of the UPPS-P impulsive behavior scale. *Assessment, 20*(1), 86-97.

Cyders, M. A., & Coskunpinar, A. (2010). Is urgency emotionality? Separating urgent behaviors from effects of emotional experiences. *Personality and individual differences, 48*(7), 839-844.

Cyders, M. A., Coskunpinar, A., & VanderVeen, J. D. (2017). Urgency–a common transdiagnostic endophenotype for maladaptive risk-taking. Invited chapter. *The Dark Side of Personality. American Psychological Association*.

Cyders, M. A., & Smith, G. T. (2008). Emotion-based Dispositions to Rash Action: Positive and Negative Urgency. *Psychological Bulletin*, *134*(6), 807–828.

Cyders, M. A., VanderVeen, J. D., Plawecki, M., Milward, J. B., Hays, J., Kareken, D. A., & O'Connor, S. (2016). Gender specific effects of mood on alcohol seeking behaviros: Preliminary findings using intravenous alcohol self-administration. *Alcoholism, Clinical and Experimental Research, 40*(2), 393-400.

Davis, K. C., Hendershot, C. S., George, W. H., Norris, J., & Heiman, J. R. (2007). Alcohol's effects on sexual decision making: An integration of alcohol myopia and individual differences. *Journal of Studies on Alcohol and Drugs*, *68*(6), 843-851.

Dick, D. M., Aliev, F., Viken, R., Kaprio, J., & Rose, R. J. (2011). Rutgers Alcohol Problem Index Scores at Age 18 Predict Alcohol Dependence Diagnoses Seven Years Later. *Alcoholism, Clinical and Experimental Research*, *35*(5), 1011–1014.

Doran, N., Khoddam, R., Sanders, P. E., Schweizer, C. A., Trim, R. S., & Myers, M. G. (2013). A prospective study of the acquired preparedness model: The effects of impulsivity and expectancies on smoking initiation in college students. *Psychology of Addictive Behaviors, 27,* 714-722.

Dvorak, R. D., & Day, A. M. (2014). Marijuana and self-regulation: Examining likelihood and intensity of use and problems. *Addictive Behaviors, 39*(3), 709-712.

Eastwood, B., Bradley, B., Mogg, K., Tyler, E., & Field, M. (2010). Investigating the effects of a craving induction procedure on cognitive bias in cannabis users. *Addiction Research and Theory, 18,* 97-109.

Emery, N. N., & Simons, J. S. (2015). Mood & alcohol-related attentional biases: New considerations for gender differences and reliability of the visual-probe task. *Addictive Behaviors, 50,* 1-5.

Evans-Polce, R. J., Vasilenko, S. A., & Lanza, S. T. (2015). Changes in gender and racial/ethnic disparities in rates of cigarette use, regular heavy episodic drinking, and marijuana use: Ages 14 to 32. *Addictive Behaviors,* 41, 218-222.

Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology, 146*(4), 348-361.

Ewing, S. W. F., Filbey, F. M., Loughran, T. A., Chassin, L., & Piquero, A. R. (2015). Which matters most? Demographic, neuropsychological, personality, and situational factors in long-term marijuana and alcohol trajectories for justice-involved male youth. *Psychology of Addictive Behaviors, 29*(3), 603-612.

Field, M., & Cox, W. M. (2008). Attentional bias in addictive behaviors: A review of its development, causes, and consequences. *Drug and Alcohol Dependence*, *97*(1-2), 1-20.

Field, M., Eastwood, B., Bradley, B. P., & Mogg, K. (2006). Selective processing of cannabis cues in regular cannabis users. *Drug and Alcohol Dependence*, *85*, 75-82.

Field, M., Mogg, K., & Bradley, B. P. (2004). Eye movements to smoking-related cues: Effects of nicotine deprivation. *Psychopharmacology*, *173*, 116-123.

Field, M., Mogg, K., & Bradley, B. P. (2005). Craving and cognitive biases for alcohol cues in social drinkers. *Alcohol and Alcoholism*, *40*(6), 504-510.

Field, M., Munafò, M. R., & Franken, I. H. A. (2009). A meta-analytic investigation of the relationship between attentional bias and subjective craving in substance abuse. *Psychological Bulletin*, *135*(4), 589-607.

Fillmore, K. M. (1988). Alcohol use across the life course. Toronto, Ontario, Canada: Alcoholism and Drug Addiction Research Foundation.

Flory, K., Lynam, D., Milich, R., Leukefeld, C., & Clayton, R. (2002). The relations among personality, symptoms of alcohol and marijuana abuse, and symptoms of comorbid psychopathology: Results from a community sample. *Experimental and Clinical Psychopharmacology*, *10*(4), 425-434.

Foster, D. W., Young, C. M., Steers, M. N., Quist, M. C., Bryan, J. L., & Neighbors, C. (2014). Tears in your beer: Gender differences in coping drinking motives, depressive symptoms and drinking. *International Journal of Mental Health and Addiction*, *12*, 730-746.

Fox, C. L., Towe, S. L., Stephens, R. S., Walker, D. D., & Roffman, R. A. (2011). Motives for cannabis use in high-risk adolescent users. *Psychology of Addictive Behaviors, 25*(3), 492-500.

Frayn, M., Sears, C. R., & von Ranson, K. M. (2016). A sad mood increases attention to unhealthy food images in women with food addiction. *Appetite, 100,* 55-63.

Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *Journal of Counseling Psychology, 51*(1), 115-134.

Frijda, N. H. (1986). *The emotions.* New York: Cambridge University Press.

Frost, R.O., & Green, M.L. (1982). Velten mood induction procedure effects: Duration and postexperimental removal. *Personality and Social Psychology Bulletin, 8,* 341–347.

Fucito, L. M. (2009). Smoking behavior in response to a negative mood induction: The moderating role of depression. *Dissertation Abstracts International, 69,* 5776.

Gable, P., & Harmon-Jones, E. (2010). The blues broaden, but the nasty narrows: Attentional consequences of negative affects low and high in motivational intensity. *Psychological Science, 21*(2), 211-215.

Galea, S., Ahern, J., Tracy, M., Rudenstine, S., & Vlahov, D. (2007). Education inequality and use of cigarettes, alcohol, and marijuana. *Drug and Alcohol Dependence, 90*(Suppl), S4-S15.

Gerra, G., Angioni, L., Zaimovic, A., Moi, G., Bussandri, M., Bertacca, S., ... & Nicoli, M. A. (2004). Substance use among high-school students: relationships with temperament, personality traits, and parental care perception. *Substance Use & Misuse*, *39*(2), 345-367.

Gruber, S. A., Dahlgren, M. K., Sagar, K. A., Gonenc, A., & Lukas, S. E. (2014). Worth the wait: effects of age of onset of marijuana use on white matter and impulsivity. *Psychopharmacology (Berl), 231*(8), 1455-1465.

Gruber, S. A., Rogowska, J., & Yurgelun-Todd, D. A. (2009). Altered affective response in marijuana smokers: an FMRI study. *Drug and Alcohol Dependence*, *105*(1), 139-153.

Gruber, S. A., Silveri, M. M., Dahlgren, M. K., & Yurgelin-Todd, D. (2011). Why so impulsive? White matter alterations are associated with impulsivity in chronic marijuana smokers. *Experimental and Clinical Psychopharmacology, 19*(3), 231-242.

Gruber, S. A., & Yurgelun-Todd, D. A. (2005). Neuroimaging of marijuana smokers during inhibitory processing: a pilot investigation. *Cognitive Brain Research*, *23*(1), 107-118.

Hall, W. (2009). The adverse health effects of cannabis use: What are they, and what are their implications for policy? *International Journal of Drug Policy*, 20, 458-466.

Hall, W., & Degenhardt, L. (2009). Adverse health effects of non-medical cannabis use. *Lancet, 374*(9698), 1383-1391.

Hasin, D. S., Saha, T. D., Kerridge, B. T., Goldstein, R. B., Chou, S. P., Zhang, H., & ... Grant, B. F. (2015). Prevalence of marijuana use disorders in the United States between 2001-2002 and 2012-2013.*JAMA Psychiatry, 72*(12), 1235-1242.

Hayes, S. C., Wilson, K. G., Gifford, E. V., Follette, V. M., & Strosahl, K. (1996). Experiential avoidance and behavioral disorders: A functional dimensional approach to diagnosis and treatment. *Journal of Consulting and Clinical Psychology, 64,* 1152-1168.

Hays, A. F. (2007). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* New York: The Guilford Press.

Hendershot, C. S., Bryan, A. D., Ewing, S. W. F., Claus, E. D., & Hutchison, K. E. (2011). Preliminary evidence for associations of CHRM2 with substance use and disinhibition in adolescence. *Journal of Abnormal Child Psychology, 39*(5), 671-681.

Hepworth, R., Mogg, K., Brignell, C., & Bradley, B. P. (2010). Negative mood increases selective attention to food cues and subjective appetite. *Appetite*, *54*(1), 134-142.

Hermann, D., Sartorius, A., Welzel, H., Walter, S., Skopp, G., Ende, G., & Mann, K. (2007). Dorsolateral prefrontal cortex N-acetylaspartate/total creatine (NAA/tCr) loss in male recreational cannabis users. *Biological psychiatry*, *61*(11), 1281-1289.

Heyman, G. M. (2013). Quitting drugs: quantitative and qualitative features. *Annual Review of Clinical Psychology, 9*, 29-59.

Holmqvist, K., Nyström, M., & Mulvey, F. (2012, March). Eye tracker data quality: what it is and how to measure it. In *Proceedings of the symposium on eye tracking research and applications* (pp. 45-52). ACM.

Hussong, A. M., Galloway, C. A., & Feagans, L. A. (2005). Coping Motives as a Moderator of Daily Mood-Drinking Covariation. *Journal of Studies on Alcohol*, *66*(3), 344-353.

Jacobs, D. G. (2011). Suicide assessment five-step evaluation and triage. *Best Practices Registry (BPR) for Suicide Prevention*, 83-88.

Johnson, V., & White, H. R. (1989). An investigation of factors related to intoxicated driving behaviors among youth. *Journal of Studies on Alcohol,50,* 320-330.

Johnson, R. M., Fairman, B., Gilreath, T., Xuan, Z., Rothman, E. F., Parnham, T., & Furr-Holden, C. D. (2015). Past 15-year trends in adolescent marijuana use: Differences by race/ethnicity and sex. *Drug and Alcohol Dependence*, 155, 8-15.

Johnson, K. J., Mullin, J. L., Marshall, E. C., Bonn-Miller, M. O., & Zvolensky, M. (2010). Exploring the mediational role of coping motives for marijuana use in terms of the relation between anxiety sensitivity and marijuana dependence. *American Journal of Addiction*, *19*(3), 277-282.

Johnston, L. D., O'Malley, P. M., Miech, R. A., Bachman, J. G., & Schulenberg, J. E. (2014). Monitoring the Future National Results on Drug Use: 1975-2014: Overview, Key Findings on Adolescent Drug Use. Ann Arbor, MI: Institute for Social Research, The University of Michigan.

Jones, K. A., Chryssanthakis, A., & Groom, M. J. (2014). Impulsivity and drinking motives predict problem behaviours relation to alcohol use in university students. *Addictive Behaviors, 39,* 289-296.

Juon, H. S., Fothergill, K. E., Green, K. M., Doherty, E. E., & Ensminger, M. E. (2011). Antecendents and consequences of marijuana use trajectories ove the life course in an African American population. *Drug and Alcohol Dependence, 118*(2), 216-223.

Kenealy, P. M. (1986). The Velten mood induction procedure: A methodological review. *Motivation and Emotion, 10,* 315-335.

Keough, M. T., Badawi, G., Nitka, D., O'Connor, R. M., & Stewart, S. H. (2016). Impulsivity increases risk for coping-motivated drinking in undergraduates with elevated social anxiety. *Personality and Individual Differences, 88,* 45-50.

Keyes, K. M., Vo, T., Wall, M. M., … Hasin, D. (2015). Racial/ethnic differences in use of alcohol, tobacco, and marijuana: Is there a cross-over from adolescence to adulthood?. *Social Science & Medicine, 124,* 132-141.

Kline, R. B. (1998). *Principles and practice of structured equation modeling.* New York: Guilford Press.

Komogortsev, O., Gobert, D. V., Jayarathna, S., Koh, D. H., & Gowda, S. M. (2010). Standardization of automated analyses of oculomotor fixation and saccadic behaviors. *IEEE Transactions on Biomedical Engineering, 57*(11), 2635-2645

Kosterman, R., Hawkins, J. D., Guo, J., Catalano, R. F., & Abbott, R. D. (2000). The dynamics of alcohol and marijuana initiation: patterns and predictors of first use in adolescence. *American Journal of Public Health, 90*(3), 360.

Kowler, E. (1995). Eye movements. In S. M. Kosslyn & D. M. Osheron (Eds.), *Visual cognition* (pp. 215–265). Cambridge, MA: Harvard University Press.

Lac, A., & Crano, W. D. (2009). Monitoring matters meta-analytic review reveals the reliable linkage of parental monitoring with adolescent marijuana use. *Perspectives on Psychological Science*, *4*(6), 578-586.

Lang, P. J. (1993). The motivational organization of emotion: Affect reflex connections. In S. van Goozen, N. E., van der Poll, & J. A. Sergeant (Eds.), *The emotions: Essays on emotion theory* (pp. 61-96). Hillsdale, NJ: Erlbaum.

Lewis, M. A., Hove, M. C., Whiteside, U., Lee, C. M. Krikeby, B. S., … & Larimer, M. E. (2008). Fitting in and feeling fine. Conformity and coping motives as mediators of the relationship between social anxiety and problematic drinking. *Psychology of Addictive Behaviors*, *22*(1), 58-67.

Lex, B. W., Griffin, M. L., Mello, N. K., & Mendelson, J. H. (1989). Alcohol, marijuana, and mood states in young women. *International Journal of the Addictions*, *24*(5), 405-424.

Littlefield, A. K., & Sher, K. J. (2016). 10 Personality and Substance Use Disorders. *The Oxford Handbook of Substance Use and Substance Use Disorders: Two-Volume Set*, 351.

Littlefield, A. K., Sher, K. J., & Wood, P. K. (2009). Is "maturing out" of problematic alcohol involvement related to personality change? *Journal of Abnormal Psychology*, *118*, 360-374.

Littlefield, A. K., Stevens, A. K., Ellingson, J. M., King, K. M., & Jackson, K. M. (2016). Changes in negative urgency, positive urgency, and sensation seeking across adolescence. *Personality and Individual Differences, 90,* 332-337.

Lynam, D. R., Smith, G. T., Whiteside, S. A., & Cyders, M. A. (2006). The UPPS-P: Assessing five personality pathways to impulsive behavior. West Lafayette, IN: Purdue University.

Lynne-Landsman, S. D., Graber, J. A., Nichols, T. R., & Botvin, G. J. (2011). Is sensation seeking a stable trait or does it change over time?. *Journal of Youth and Adolescence*, *40*(1), 48-58.

Mahalik, J. R., Lombardi, C. M., Sims, J., Coley, R., L., & Lynch, A. D. (2015). Gender, male-typicality, and social norms predicting adolescent alcohol intoxication and marijuana use. *Social Science & Medicine, 143,* 71-80.

Martens, M. P., Neighbors, C., Dams-O'Connor, K., Lee, C. M., & Larimer, M. E. (2007). The factor structure of a dichotomously scored Rutgers Alcohol Problem Index. *Journal of Studies on Alcohol and Drugs*, *68*(4), 597-606.

Martin, C. A., Kelly, T. H., Rayens, M. K., Brogli, B. R., Brenzel, A., Smith, W. J., & Omar, H. A. (2002). Sensation seeking, puberty, and nicotine, alcohol, and marijuana use in adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry*, *41*(12), 1495-1502.

Maxwell, K. A. (2002). Friends: The role of peer influence across adolescent risk behaviors. *Journal of Youth and adolescence*, *31*(4), 267-277.

McCarthy, D. M., Kroll, L. S., & Smith, G. T. (2001). Integrating disinhibition and learning risk for alcohol use. *Experimental and clinical psychopharmacology*, *9*(4), 389-398.

McQueeny, T., Padula, C. B., Price, J., Medina, K. L., Logan, P., & Tapert, S. (2011). Gender effects on amygdala morphometry in adolescent marijuana users. *Behavioural Brain Research, 224*(1), 128-134.

Meier, M. H., Caspi, A., Ambler, A., Harrington, H., Houts, R., Keefe, R. S., . . . Moffitt, T. E. (2012). Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proceedings of the National Academy of Sciences*, *109*(40), E2657-E2664.

Metrik, J., Aston, E. R., Kahler, C. W., Rohsenow, D. J., McGeary, J. E., & Knopik, V. S. (2015). Marijuana's acute effects on cognitive bias for affective and marijuana cues. *Experimental and Clinical Psychopharmacology*, *23*, 339-350.

Miller, J., & Ulrich, R. (2013). Mental chronometry and individual differences: Modeling reliabilities and correlations of reaction time means and effect sizes. *Psychonomic Bulletin & Review*, *20*(5), 819-858.

Mitchell, H., Svolensky, M. J., Marshall, E. C., Bonn-Miller, M. O., & Vujanovic, A. A. (2007). Incremental validity of coping-oriented marijuana use motives in the prediction of affect-based psychological vulnerability. *Journal of Psychopathology and Behavioral Assessment*, *29*(4), 277-288.

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*(6), 825-836.

Moitra, E., Christopher, P. P., Anderson, B. J., & Stein, M. D. (2015). Coping-motivated marijuana use correlates with DSM-5 cannabis use disorder and psychological distress among emerging adults. *Psychology of Addictive Behaviors, 29*(3), 627-632.

Moriya, H., & Nittono, H. (2011). Effect of mood states on the breadth of spatial attentional focus: an event-related potential study. *Neuropsychologia, 49*(5), 1162-1170.

National Conference of State Legislatures (NCSL). (2016). State medical marijuana laws. Retrieved January 27, 2016 from http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx

Nederhof, A. J. (1985). Methods of coping with social desirability bias: A review. *European Journal of Social Psychology, 15* (3), 263–280.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist, 17* (11), 776–783.

Pacek, L. R., Malcolm, R. J., & Martins, S. S. (2012). Race/ethnicity differences between alcohol, marijuana, and co-occurring alcohol and marijuana use disorders and their association with public health and social problems using a national sample. *The American Journal on Addictions, 21*(5), 435-444.

Palmgreen, P., Lorch, E. P., Stephenson, M. T., Hoyle, R. H., & Donohew, L. (2007). Effects of the Office of National Drug Control Policy's marijuana initiative campaign on high-sensation-seeking adolescents. *American Journal of Public Health, 97*(9), 1644-1649.

Parker, J. S., & Morton, T. L. (2009). Distinguishing between early and late onset delinquents: Race, income, verbal intelligence and impulsivity. *North American Journal of Psychology, 11*(2), 273-284.

Pedersen, S. L., Molina, B. S., Belendiuk, K. A., & Donovan, J. E. (2012). Racial differences in the development of impulsivity and sensation seeking from childhood into adolescence and their relation to alcohol use. *Alcoholism: Clinical and Experimental Research, 36*(10), 1794-1802.

Peters, E. N., LaPaglia, D. M., Petry, N. M., Reynolds, B., & Carroll, M. C. (2013). Delay discounting in adults receiving treatment for marijuana dependence. *Experimental and Clinical Psychopharmacology, 21*(1), 46-54.

Peterson, R. A., & Merunka, D. R. (2014). Convenience samples of college students and research reproducibility. *Journal of Business Research, 67*, 1035-1041.

Porath-Waller, A. J., & Beirness, D. J. (2014). An examination of the validity of the standardized field sobriety test in detecting drug impairment using data from the Drug Evaluation and Classification program. *Traffic Injury Prevention, 15*(2), 125-131.

Prescot, A. P., Locatelli, A. E., Renshaw, P. F., & Yurgelun-Todd, D. A. (2011). Neurochemical Alterations in Adolescent Chronic Marijuana Smokers: A Proton MRS Study. *NeuroImage*, *57*(1), 69–75.

Purvis, D. M., Gallagher, K. E., & Parrott, D. J. (2016). Reducing alcohol-related aggression: Effects of a self-awareness manipulation and locus of control in heavy drinking males. *Addictive Behaviors, 58*, 31-34.

Robbins, S. J., & Ehrman, R. N. (2004). The role of attentional bias in substance abuse. *Behavioral and Cognitive Neuroscience Reviews, 3*(4), 243-260.

Robinson, J. M., Ladd, B. O., & Anderson, K. G. (2014). When you see it, let it be: Urgency, mindfulness and adolescent substance use. *Addictive Behaviors, 39*(6), 1038-1041.

Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: An incentive-sensitization theory of addiction. *Brain research reviews, 18*(3), 247-291.

Robinson, T. E., & Berridge, K. C. (2000). The psychology and neurobiology of addiction: An incentive-sensitization view. *Addiction, 95*(8s2), 91-117.

Romer, D., & Hennessy, M. (2007). A biosocial-affect model of adolescent sensation seeking: The role of affect evaluation and peer-group influence in adolescent drug use. *Prevention Science, 8*, 89–101.

Rucker, D. D., Preacher, K. J., Tormala, Z. L., & Petty, R. E. (2011). Mediation analysis in social psychology: Current practices and new recommendations. *Social and Personality Psychology Compass, 5*(6), 359-371.

Scherrer, M. C., & Dobson, K. S. (2009). Predicting responsiveness to a depressive mood induction procedure. *Journal of Clinical Psychology, 65*, 20-35.

Scherrer, M. C., & Dobson, K. S. (2015). Cognitive reactivity to a depressive mood induction procedure across diagnostic categories. *Journal of Depression and Anxiety, 4*, 203.

Scherrer, M. C., Dobson, K. S., & Quigley, L. (2014). Predictors of self-reported negative mood following a depressive mood induction procedure across previously depressed, currently anxious, and control individuals. *British Journal of Clinical Psychology*, *53*, 348-368.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime: User's guide*. Psychology Software Incorporated.

Schoenmakers, T., Wiers, R. W., & Field, M. (2008). Effects of a low dose of alcohol on

cognitive biases and craving in heavy drinkers. *Psychopharmacology*, *197*, 169-178.

Settles, R. F., Cyders, M., & Smith, G. T. (2010). Longitudinal validation of the acquired preparedness model of drinking risk. *Psychology of Addictive Behaviors*, *24*(2), 198.

Shulman, E. P., Smith, A. R., Silva, K., Icenogle, G., Duell, N., Chein, J., & Steinberg, L. (2016). The dual systems model: Review, reappraisal, and reaffirmation. *Developmental Cognitive Neuroscience*, 17, 103-117.

Simons, J. S., & Carey, K. B. (2002). Risk and vulnerability for marijuana use problems: The role of affect dysregulation. *Psychology of Addictive Behaviors, 16*(1), 72-75.

Simons, J. S., & Carey, K. B. (2006). An affective and cognitive model of marijuana and alcohol problems. *Addictive Behaviors*, *31*(9), 1578-1592.

Simons, J., Correia, C. J., Carey, K. B., & Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, *45*, 265-273.

Simons, J. S., Gaher, R. M., Correia, C. J., Hansen, C. L., & Christopher, M. S. (2005). An affective-motivational model of marijuana and alcohol problems among college students. *Psychology Of Addictive Behaviors*, *19*(3), 326-334.

Smith, G. T., & Anderson, K. G. (2001). *Personality and learning factors combine to create risk for adolescent problem drinking: A model and suggestions for intervention*. In: Monti, P. M., Colby, S. M., O'Leary, T. A. (Eds.). Adolescents, alcohol, and substance abuse: Reaching teens through brief interventions. New York, New York: Guilford Press.

Smith, G. T., & Cyders, M. A. (2016). Integrating affect and impulsivity: The role of positive and negative urgency in substance use risk. *Drug and Alcohol Dependence*, *163*(Suppl 1), S3-S12.

Smith, G. T., Fischer, S., & Fister, S. M. (2003). Incremental Validity Principles in Test Construction. *Psychological Assessment*, *15*(4), 467-477.

Smith, G. T., Guller, L., & Zapolski, T. B. (2013). A comparison of two models of urgency: Urgency predicts both rash action and depression in youth. *Clinical Psychological Science*, *1*(3), 266-275.

Stautz, K., & Cooper, A. (2013). Impulsivity-related personality traits and adolescent alcohol use: a meta-analytic review. *Clinical Psychology Review, 33*(4), 574-592.

Steele, C. M., & Josephs, R. A. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist*, *45*(8), 921-933.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review, 28*(1), 78-106.

Stephenson, M. T., & Helme, D. W. (2006). Authoritative parenting and sensation seeking as predictors of adolescent cigarette and marijuana use. *Journal of Drug Education, 36*(3), 247-270.

Stephenson, M. T., & Palmgreen, P. (2001). Sensation seeking, perceived message sensation value, personal involvement and processing of anti-marijuana PSAs. *Communication Monographs, 68*(1), 49-71.

Stephenson, M. T., Palmgreen, P., Hoyle, R. H., Donohew, L., Lorch, E. P., & Colon, S. E. (1999). Short-term effects of an anti-marijuana media campaign targeting high sensation seeking adolescents. *Journal of Applied Communication Research, 27*(3), 175-195.

Stuster, J., & Burns, M. (1998). Validation of the standardized field sobriety test battery at BACs below 0.10 percent. *US Department of Transportation, National Highway Traffic Safety Administration, Report DOT HS, 809*, 839.

Substance abuse and mental health services administration (SAMHSA). (2009). Suicide assessment five-step evaluation and triage (SAFE-T). Retrieved August 8, 2016 from http://www.integration.samhsa.gov/images/res/SAFE_T.pdf

Substance abuse and mental health services administration (SAMHSA). (2014). Results from the 2013 national survey on drug use and health: Summary of national findings. (HHS Publication No. (SMA) 14-4887). Rockville, MD.

Sullivan, G. M., & Feinn, R. (2012). Using effect size- or why the P value is not enough. *Journal of Graduate Medical Education, 4*(3), 279-282.

Terry-McElrath, Y. N., O'Malley, P. M., Johnston, L. D., Bray, B. C., Patrick, M. E., & Schulenberg, J. E. (2017). Longitudinal patterns of marijuana use across ages 18-50 in a US national sample: A descriptive examination of predictors and health correlates of repeated measures latent class membership. *Drug and Alcohol Dependence, 171,* 70-83.

Testa, M. (2002). The impact of men's alcohol consumption on perpetration of sexual aggression. *Clinical Psychology Review, 22*(8), 1239-1263.

VanderVeen, J. D., Hershberger, A. R., & Cyders, M. A. (2016a). UPPS-P model impulsivity and marijuana use behaviors in adolescents: A meta-analysis. *Drug and alcohol dependence, 168,* 181-190.

VanderVeen, J. D., Plawecki, M. H., Milward, J. B., Hays, J., Kareken, D. A., O'Connor, S., & Cyders, M. A. (2016b). Negative urgency, mood induction, and alcohol seeking behaviors. *Drug and Alcohol Dependence, 165*, 151-158.

van Laar, M., van Dorsselaer, S., Monshouwer, K., & de Graaf, R. (2007). Does cannabis use predict the first incidence of mood and anxiety disorders in the adult population? *Addiction, 102*(8), 1251-2160.

Vangsness, L., Bry, B. H., & LaBouvie, E. W. (2005). Impulsivity, negative expectancies, and marijuana use: A test of the acquired preparedness model. *Addictive Behaviors, 30*(5), 1071-1076.

Velten, E. (1968). A laboratory task for induction of mood states. *Behaviour Research and Therapy, 6,* 473-482.

Vergés, A., Jackson, K. M., Bucholz, K. K., Grant, J. D., Trull, T. J., Wood, P. K., & Sher, K. J. (2012). Deconstructing the age-prevalence curve of alcohol dependence: Why "maturing out" is only a small piece of the puzzle. *Journal of Abnormal Psychology, 121*(2), 511-523.

Waechter, S., & Stolz, J. A. (2015). Trait anxiety, state anxiety, and attentional bias to threat: Assessing the psychometric properties of response time measures. Cognitive Therapy and Research, 39(4), 441-458.

White, H. R., Beardslee, J., & Pardini, D. (2017). Early predictors of maturing out of marijuana use among young men. *Addictive Behaviors, 65,* 56-62.

White, H. R., & Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol, 50,* 30-37.

Whiteside, S. A., & Lynam, D. R. (2001). The five factor model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30*(4), 669-689.

Willem, L., Vasey, M. W., Beckers, T., Claes, L., & Bijttebier, P. (2013). Cognitive biases and alcohol use in adolescence and young adulthood: The moderating role of gender, attentional control and inhibitory control. *Personality And Individual Differences, 54*(8), 925-930.

Wray, T. B., Simons, J. S., & Maisto, S. A. (2015). Effects of alcohol intoxication and autonomic arousal on delay discounting and risky sex in young adult heterosexual men. *Addictive Behaviors, 42,* 9-13.

Zvolensky, M. J., Marshall, E. C., Johnson, K., Hogan, J., Bernstein, A., & Bonn-Miller, M. O. (2009). Relations between anxiety sensitivity, distress tolerance, and fear reactivity to bodily sensations to coping and conformity marijuana use motives among young adult marijuana users. *Experimental and Clinical Psychopharmacology*, *17*(1), 31-42.

APPENDICES

Appendix A: Background Information

Table A1

Measures of marijuana use and negative marijuana consequences

Marijuana Behavior	**Duration**	**Measurement**
Lifetime use	Lifetime	Yes or No
		"Have you ever used marijuana"
		"Have you used marijuana in the past year"
		"Have you used marijuana in the past 6 months"
		"Have you used marijuana in the past 30 days"
		Continuum used to dichotomize
		3-item scale (1=never, 3=more than once)
		5-item scale (0= never, 4= 21+ times)
		5-item scale (0=never, 4= daily)
		7-item scale (0=never, 6= 40+ times)
		Open Answer
		"How many times have you used marijuana?"
Frequency of use	1-year	4-item scale (1= never, 4=very often)
		6-item scale (1= never, 6= nearly every day)
		7- item scale (1=none, 7= 40+ times)
	6-month	3-item scale (never, only on weekends, everyday)
		7-item scale (0= Never, 6= More than once a day)
		9-item scale (0=never, 8= everyday)
		9-item scale (0=never, 8=90+ times used)
		9-item scale (0=never, 8= more than once a day)

		Open answer
	3-months	5-item scale (1= never tried, 5= daily use)
		6-item scale (1= never, 6= nearly every day)
		9-item scale (0=never, 8= more than once a day)
		Timeline Followback Calendar (TLFB)
	1-month	5-item scale (0=never to 4= 4+ per week)
		6-item scale (1= never, 6= nearly every day)
		6-item scale (1=never, 6= several times each day)
		11-item scale (1= never, 11= more than once per day)
		Open answer
		TLFB
Marijuana Problems	6-months	Rutgers Marijuana Problem Index
		Personal Experience Inventory
	1-month	Cannabis Problems Questionnaire for Adolescents
Marijuana Dependence	1- year lifetime	Structured Clinical Interview for DSM Disorders (SCID) for DSM-III-R OR DSM-IV-TR

Table A2

Mean effect sizes between impulsivity and marijuana use behaviors in adolescents and young adults.

	k	ES	SE	*z*	*p*
Sensation Seeking	42	0.22	0.02	12.77	<0.01
Lack of Perseverance	3	0.12	0.72	0.17	0.87
Lack of Planning	10	0.18	0.07	2.38	0.02
Positive Urgency	4	0.20	0.06	3.64	<0.01
Negative Urgency	6	0.23	0.06	4.09	<0.01

Figure A1
Conceptual Model

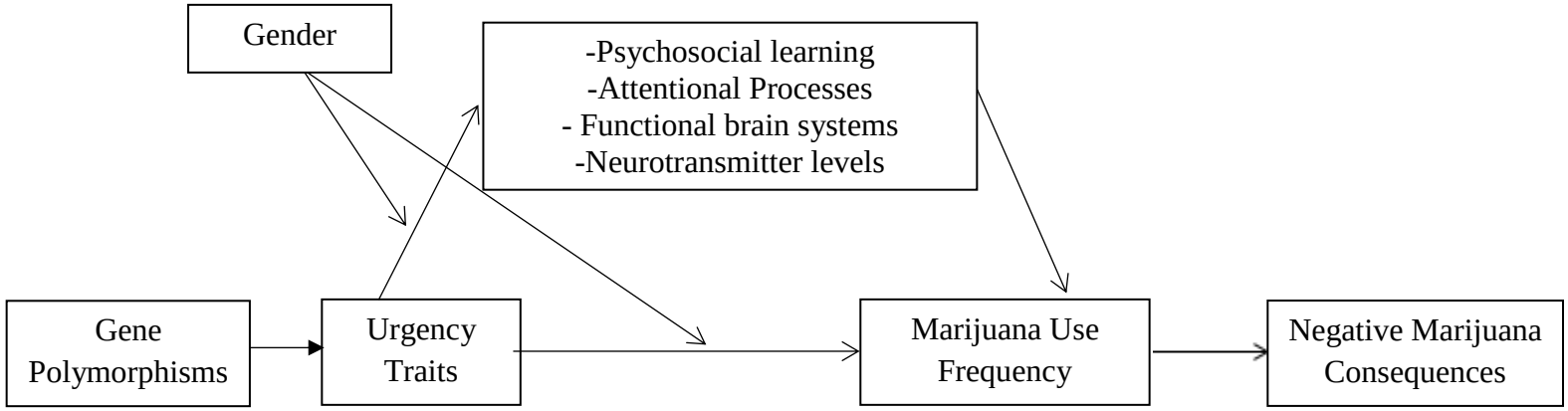
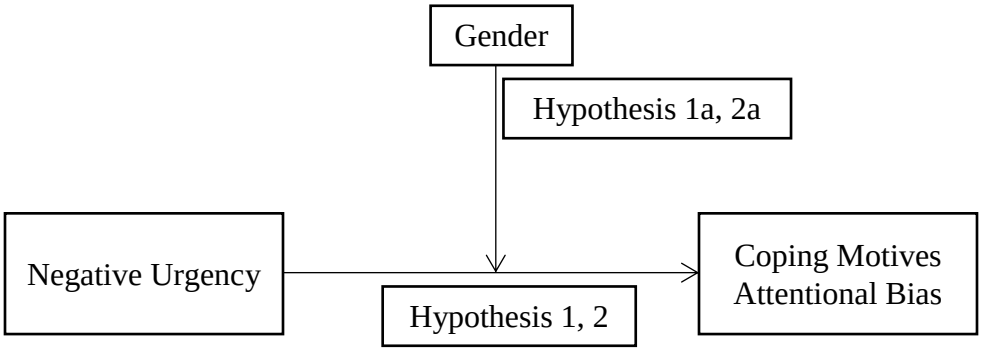


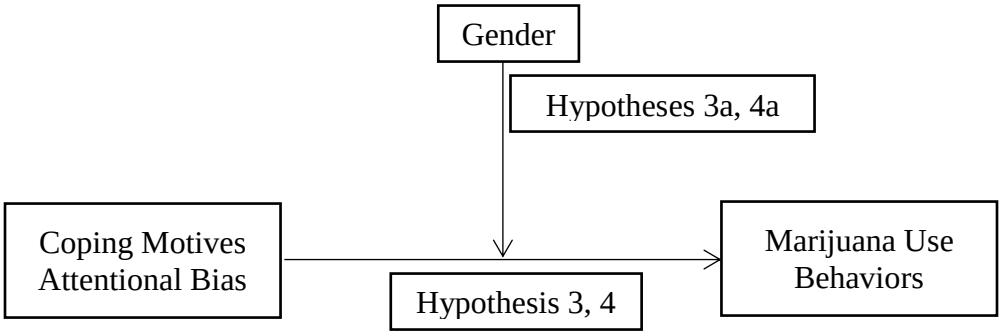
Figure A2

Study-specific model

Aim 1



Aim 2



Appendix B: Methods

Table B1

Standardized Field Sobriety Test

Horizontal Gaze Nystagmus

"I am going to check your eyes. Keep your head still and follow my finger with your eyes only. Keep following my finger with your eyes until I tell you to stop"

Observe each eye individually while slowly moving pen across face 12-15" away. It should take roughly 2s to move from nose to wide angle, 2s to move back to nose, for each eye. Check appropriate line for presence of each sign:

Lack of smooth pursuit- the person has difficulty smoothly tracking the object.

Left: __ YES __NO Right: __ YES __NO

Distinct nystagmus at maximum deviation- the person has jerking eye movements when holding gaze at maximum angle for more than 4 seconds

Left: __ YES __NO Right: __ YES __NO

Onset of nystagmus prior to 45 degrees- the first jerk is noticed prior to eye moving 45 degrees

Left: __ YES __NO Right: __ YES __NO

NOTE: Participants with 4+ YES are likely (88%) under the influence of a substance

Walk and Turn Test

"Place your left foot on the line. Place your right foot on the line ahead of the left foot, with hell of right foot against toe of left foot. Place your arms down at your sides. Maintain this position until I have completed the instructions. Do not start to walk until told to do so. When I tell you to start, take nine heel-to-toe steps, turn, and take nine heel-to-toe steps back. When you turn, keep the front foot on the line, and turn be taking a series of small steps with the other foot, like this. While you are walking, keep your arms at your sides watch your feet at all times, and count your steps out loud. Once you start walking, don't stop until you have completed the test. Do you understand the instructions? Begin, and count your first step from heel-to-toe position as One."

Demonstrate heel to toe walk

Demonstrate multi-step turn

Check below if any of the following were demonstrated

__ YES __NO **Could not keep balance while listening to the test instructions**

__ YES __NO **Started the test before the instructions were completed**

__ YES __NO **Stopped walking during the test**

__ YES __NO **Did not touch heel-to-toe while walking**

__ YES __NO **Stepped off the line**

__ YES __NO **Used arms to maintain balance**

__ YES __NO **Took the incorrect number of steps (Not 9)**

__ YES __NO **Turned improperly (Not 2 steps to turn)**

NOTE: Participants with 2+ YES are likely (68%) under the influence of a substance

One-Leg Stand Test

"Please stand with your feet together and your arms down at the sides, like this. Do not start to perform the test until I tell you to do so. Do you understand the instructions so far? When I tell you to start, raise one leg, either leg, with the foot approximately six inches off the ground, keeping your raid foot parallel to the ground. You must keep moth legs straight, arms at your side. While holding that position, count out loud in the following manner: one thousand and one, one thousand and two, one thousand and three, until told to stop. Keep your arms at your sides at all times and keep watching the raised foot. Do you understand? Go ahead and perform the test."

Terminate test after 30 seconds.

Check below if any of the following were demonstrated

__ YES __NO **Swaying while balancing on one leg**

__ YES __NO **Using arms to maintain balance**

__ YES __NO **Hopping during test**

__ YES __NO **Putting the raised foot down**

NOTE: Participants with 2+ YES are likely (83%) under the influence of a substance

Table B2

Suicide Assessment Five-step Evaluation and Triage (SAFE-T)

1. Have you ever gotten to the point you thought life was not worth living? ___ Yes ___ No

IF NO, SKIP TO 3. IF YES, CONTINUE

When was the last time?

Please describe:

2. Have you ever had a plan to end your life? ___ Yes ___ No

When was the last time?

Please describe:

3. Have you ever attempted to end your own life? ___ Yes ___ No

IF NO, SKIP REST OF SUICIDE ASSESSMENT. IF YES, CONTINUE

When was the last time?

Please describe:

IF 1-3 WAS IN THE LAST YEAR, CONTINUE BELOW.

Risk Factors

4. Has anyone in your family ever attempted suicide?

5. Are there any circumstances that lead you to feeling this way?

6. Have you had any significant life changes in the last year? Please describe.

7. Do you have access to [plan from #2]

Protective Factors

8. In what ways do you manage stress in your life?

9. Do you have family nearby?

10. Do you have friends nearby?

11. Do you have any pets?

Suicide Inquiry

12. How often do you think about killing yourself?

13. How intense are these thoughts?

14. How long do these thoughts typically last?

15. When you would kill yourself?

16. Where you would kill yourself?

17. What steps have you gone through to prepare for it?

18. Do you think you will carry out your plan?

19. Do you think your plan will kill you?

RISK LEVEL	RISK / PROTECTIVE FACTOR	SUICIDALITY	POSSIBLE INTERVENTIONS
High	Psychiatric disorders with severe symptoms, or acute precipitating event; protective factors not relevant	Potentially lethal suicide attempt or persistent ideation with strong intent or suicide rehearsal	Admission generally indicated unless a significant change reduces risk. Suicide precautions
Moderate	Multiple risk factors, few protective factors	Suicidal ideation with plan, but no intent or behavior	Admission may be necessary depending on risk factors. Develop crisis plan. Give emergency/crisis numbers
Low	Modifiable risk factors, strong protective factors	Thoughts of death, no plan, intent or behavior	Outpatient referral, symptom reduction. Give emergency/crisis numbers

(This chart is intended to represent a range of risk levels and interventions, not actual determinations.)

DOCUMENT

Risk Level:
Rationale for risk level:
Plan (emergency/crisis numbers; Outpatient referral; Inpatient referral)
Crisis line number (Indianapolis): (317) 251-7575

Table B3

Phone Screen/Demographic Questionnaire

Phone Screen

1. When were you born?

2. Have you ever used marijuana in your lifetime?

    2a. When was the last time?

3. Do you have normal or corrected-to-normal vision?

    3a. If you have corrected vision, do you own contact lenses?

Demographics Questionnaire

1. How old are you

2. What gender do you identify with?

3. What racial group do you identify with?

Table B4

UPPS-P Impulsive Behavior Scale- Negative Urgency Subscale

No.	Statement	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
1	I have trouble controlling my impulses	1	2	3	4
2	I have trouble resisting my craving (for food, cigarettes, etc.)	1	2	3	4
3	I often get involved in things I later wish I could get out of	1	2	3	4
4	When I feel bad, I will often do things I later regret in order to make myself feel better now	1	2	3	4
5	Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse	1	2	3	4
6	When I am upset I often act without thinking	1	2	3	4
7	When I feel rejected, I will often say things that I later regret	1	2	3	4
8	It is hard for me to resist acting on my feelings	1	2	3	4
9	I often make matters worse because I act without thinking when I am upset	1	2	3	4
10	In the heat of an argument, I will often say things that I later regret	1	2	3	4
11	I always keep my feelings under control	1	2	3	4
12	Sometimes I do impulsive things that I later regret	1	2	3	4

Note. Items 1-10, 12 reverse scored so that higher numbers indicate higher levels of negative urgency.

Table B5

Marijuana use frequency measure

How many times did you use marijuana in the last 6 months?	1 No use	2 Less than once per month but at least once in the last 6 months	3 Once a month	4 2-3 times per month	5 Once or twice per week	6 3-4 times per week	7 Nearly every day	8 Once a day	9 More than once a day

Table B6

Rutgers Marijuana Problems Index

	No	Yes
Not able to do your homework or study for a test	0	1
Got into fights, acted bad, or did mean things	0	1
Missed out on other things because you spent too much money on marijuana	0	1
Went to work or school high	0	1
Cause shame or embarrassment to someone	0	1
Neglected your responsibilities	0	1
Relatives avoided you	0	1
Felt that you need *more* marijuana than you used to use in order to get the same effect	0	1
Tried to control your marijuana sue by trying to use only at certain times of the day or certain places	0	1
Had withdrawal symptoms, that is, felt sick because you stopped or cut down on marijuana	0	1
Noticed a change in your personality	0	1
Felt that you had a problem with marijuana	0	1
Missed a day (or part of a day) of school or work	0	1
Tried to cut down or quit marijuana use	0	1
Suddenly found yourself in a place that you could not remember getting to	0	1
Passed out or fainted suddenly	0	1
Had a fight, argument, or bad feelings with a friend	0	1

Had a fight, argument, or bad feelings with a family member	0	1
Kept smoking when you promised yourself not to	0	1
Felt that you were going crazy	0	1
Had a bad time	0	1
Felt physically or psychologically dependent on marijuana	0	1
Was told by a friend or neighbor to stop or cut down on marijuana	0	1

Have any of the following events happened in the last 6-months while you were using marijuana or because of your marijuana use:

Table B7

Marijuana Motives Measure- Coping Motives Subscale

	Almost never/never	Rarely	Sometimes	Often	Almost always/always
To forget my worries	1	2	3	4	5
Because it helps me when I feel depressed or nervous	1	2	3	4	5
To cheer me up when I am in a bad mood	1	2	3	4	5
Because I feel more self-confident and sure of myself	1	2	3	4	5
To forget about my problems	1	2	3	4	5

Figure B1

Exclusion Criteria Flowchart

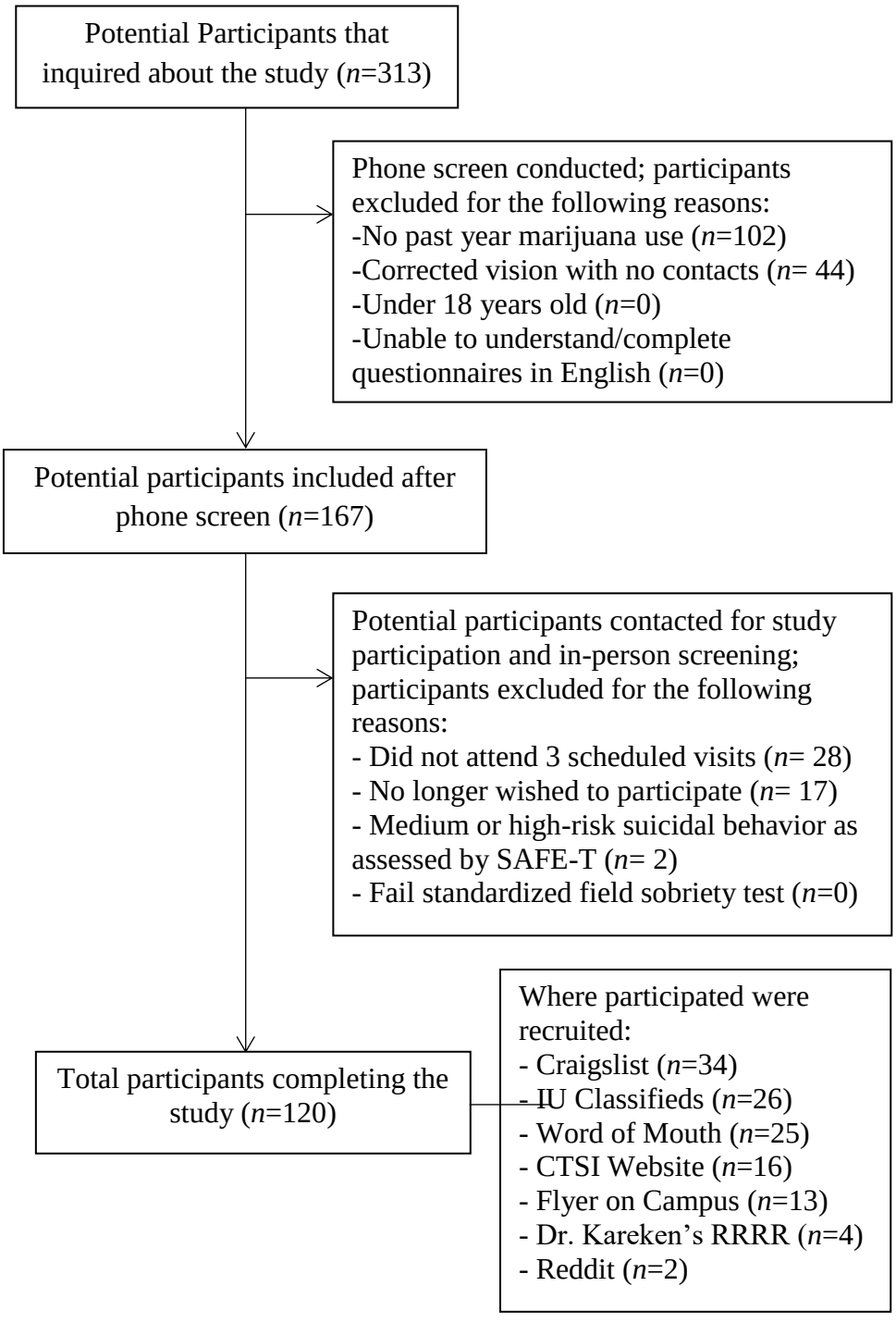


Figure B2

Velten Mood Induction Procedures

Negative Mood Induction Procedure

1. Today is neither better nor worse than any other day.
2. I feel rather sluggish now.
3. Every now and then I feel so tired and gloomy that I'd rather just sit than do anything.
4. Sometimes I wonder whether school/work is all that worthwhile.
5. I can remember times when everybody but me seemed full of energy.
6. Too often I have found myself staring listlessly into the distance, my mind a blank, when I definitely should have been studying/working.
7. It has occurred to me more than once that study is basically useless, because you forget almost everything you learn anyway.
8. People annoy me; I wish I could be by myself.
9. I've had important decisions to make in the past, and I've sometimes made the wrong ones.
10. I do feel somewhat discouraged and drowsy - maybe I'll need a nap when I get home.
11. Perhaps college takes more time, effort, and money than it's worth.
12. I just don't seem to be able to get going as fast as I used to.
13. I couldn't remember things well right now if I had to.
14. Just a little bit of effort tires me out.
15. I've had daydreams in which my mistakes kept occurring to me - sometimes I wish I could start over again.
16. I'm ashamed that I've caused my parents needless worry.
17. I feel too tired and indifferent to do things today.
18. Just to stand up would take a big effort.
19. I'm getting tired out. I can feel my body getting exhausted and heavy.
20. I'm beginning to feel sleepy. My thoughts are drifting.
21. At times I've been so tired and discouraged that I went to sleep rather than face important problems.
22. My life is so tiresome - the same old thing day after day depresses me.
23. There have been days when I felt weak and confused and everything went miserably wrong.
24. I can't make up my mind; it's so hard to make simple decisions.
25. I want to go to sleep - I feel like just closing my eyes and going to sleep right here.
26. I'm not very alert; I feel listless and vaguely sad.
27. I've doubted that I'm a worthwhile person.
28. I feel worn out. My health may not be as good as it's supposed to be.
29. It often seems that no matter how hard I try, things still go wrong.
30. I've noticed that no one seems to really understand or care when I complain or feel unhappy.
31. I'm uncertain about my future.

32. I'm discouraged and unhappy about myself.
33. I've lain awake at night worrying so long that I hated myself.
34. Things are worse now than when I was younger.
35. The way I feel now, the future looks boring and hopeless.
36. My parents never really tried to understand me.
37. Some very important decisions are almost impossible for me to make.
38. I feel tired and depressed; I don't feel like working on the things I know I must get done.
39. I feel horribly guilty about how I've treated my parents at times.
40. I have the feeling that I just can't reach people.
41. Things are easier and better for other people than for me. I feel like there's no use in trying again.
42. Often people make me very upset. I don't like to be around them.
43. It takes too much effort to convince people of anything. There's no point in trying.
44. I fail in communicating with people about my problems.
45. It's so discouraging the way people don't really listen to me.
46. I've felt so lonesome before, that I could have cried.
47. Sometimes I've wished I could die.
48. My thoughts are so slow and downcast. I don't want to think or talk.
49. I just don't care about anything. Life just isn't any fun
50. Life seems too much for me - my efforts are wasted.
51. I'm so tired.
52. I don't concentrate or move. I just want to forget about everything.
53. I have too many bad things in my life.
54. Everything seems utterly futile and empty.
55. I feel dizzy and faint. I need to put my head down and not move.
56. I don't want to do anything.
57. All of my unhappiness of my past life is taking possession of me.
58. I want to go to sleep and never wake up.

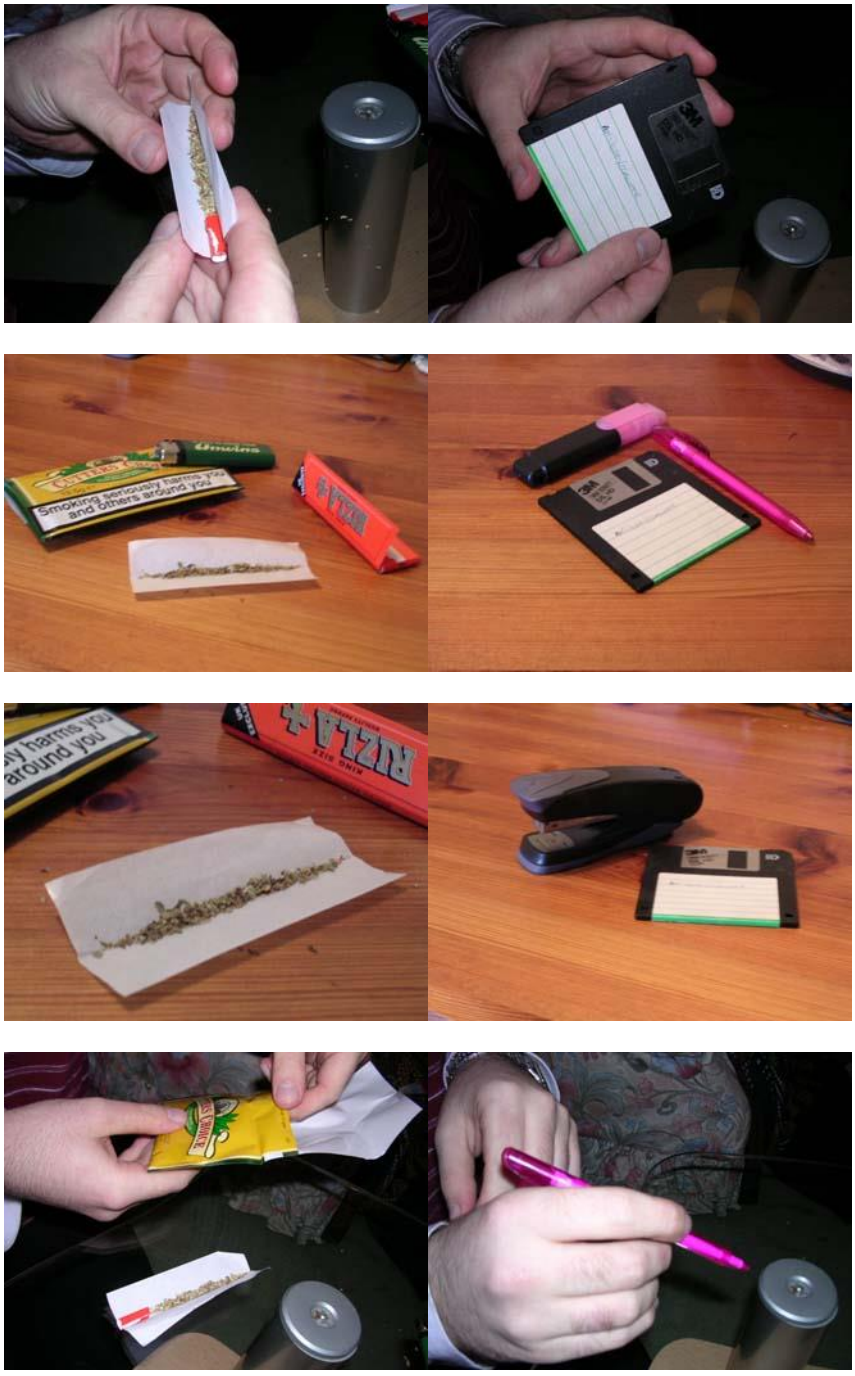
Positive Mood Induction Procedure

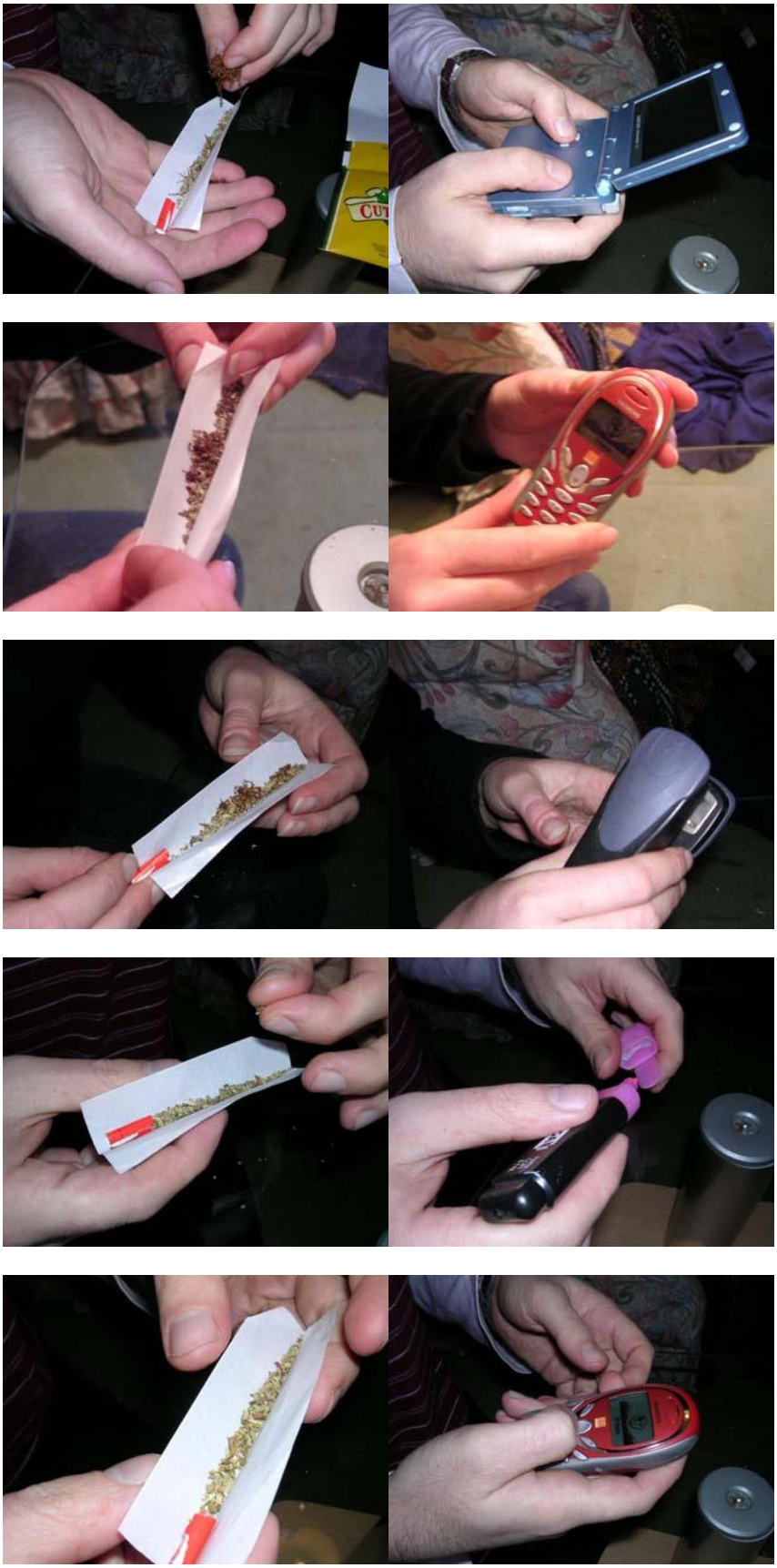
1. Today is neither better nor worse than any other day
2. I do feel pretty good today, though
3. I feel light-hearted
4. This might turn out to have been one of my good days
5. If your attitude is good, then things are good and my attitude is good
6. I feel cheerful and lively
7. I've certainly got energy and self-confidence to share
8. On the whole, I have very little difficulty in thinking clearly
9. My friends & family are pretty proud of me most of the time
10. I'm in a good position to make a success of things
11. For the rest of the day, I bet things will go really well
12. I'm pleased that most people are so friendly to me
13. My judgments about most things are sound
14. The more I get into things the easier they become for me
15. I'm full of energy and ambition - I feel like I could go a long time without sleep
16. This is one of those days when I can get things done with practically no effort at all
17. My judgment is keen and precise today. Just let someone try to put something over me
18. When I want to, I can make friends extremely easily
19. If I set my mind to it, I can make things turn out fine
20. I feel enthusiastic and confident now
21. There should be opportunity for a lot of good times coming along
22. My favourite songs keep going through my mind
23. Some of my friends are so lively and optimistic
24. I feel talkative - I feel like talking to almost anybody
25. I'm full of energy, and am really getting to like the things I'm doing
26. I feel like bursting with laughter - I wish somebody would tell a joke and give me an excuse
27. I feel an exhilarating animation in all I do
28. My memory is in rare form today
29. I'm able to do things accurately and efficiently
30. I know good and well that I can achieve the goals I set
31. Now that it occurs to me, most of the things that have depressed me wouldn't have if I'd just had the right attitude
32. I have a sense of power and vigour
33. I feel so vivacious and efficient today - sitting on top of the world
34. It would really take something to stop me now

35. In the long run, it's obvious that things have gotten better and better during my life
36. I know in the future I won't over-emphasize so-called "problems"
37. I'm optimistic that I can get along very well with most of the people I meet
38. I'm too absorbed in things to have time for worry
39. I'm feeling amazingly good today
40. I am particularly inventive and resourceful in this mood
41. I feel superb! I think I can work to the best of my ability
42. Things look good Things look great!
43. I feel that many of my friendships will stick with me in the future
44. I feel highly perceptive and refreshed
45. I can find the good in almost everything
46. In a buoyant mood like this one, I can work fast and do it right the first time
47. I can concentrate hard on anything I do
48. My thinking is clear and rapid
49. Life is so much fun; it seems to offer so many sources of fulfilment
50. Things will be better and better today
51. I can make decisions rapidly and correctly; and I can defend them against criticisms easily
52. I feel industrious as heck - I want something to do!
53. Life is firmly in my control
54. I wish somebody would play some good loud music!
55. This is great -- I really do feel good. I am elated about things!
56. I'm really feeling sharp now
57. This is just one of those days when I'm ready to go!
58. Wow, I feel great!

Figure B3

Stimuli for visual-probe task





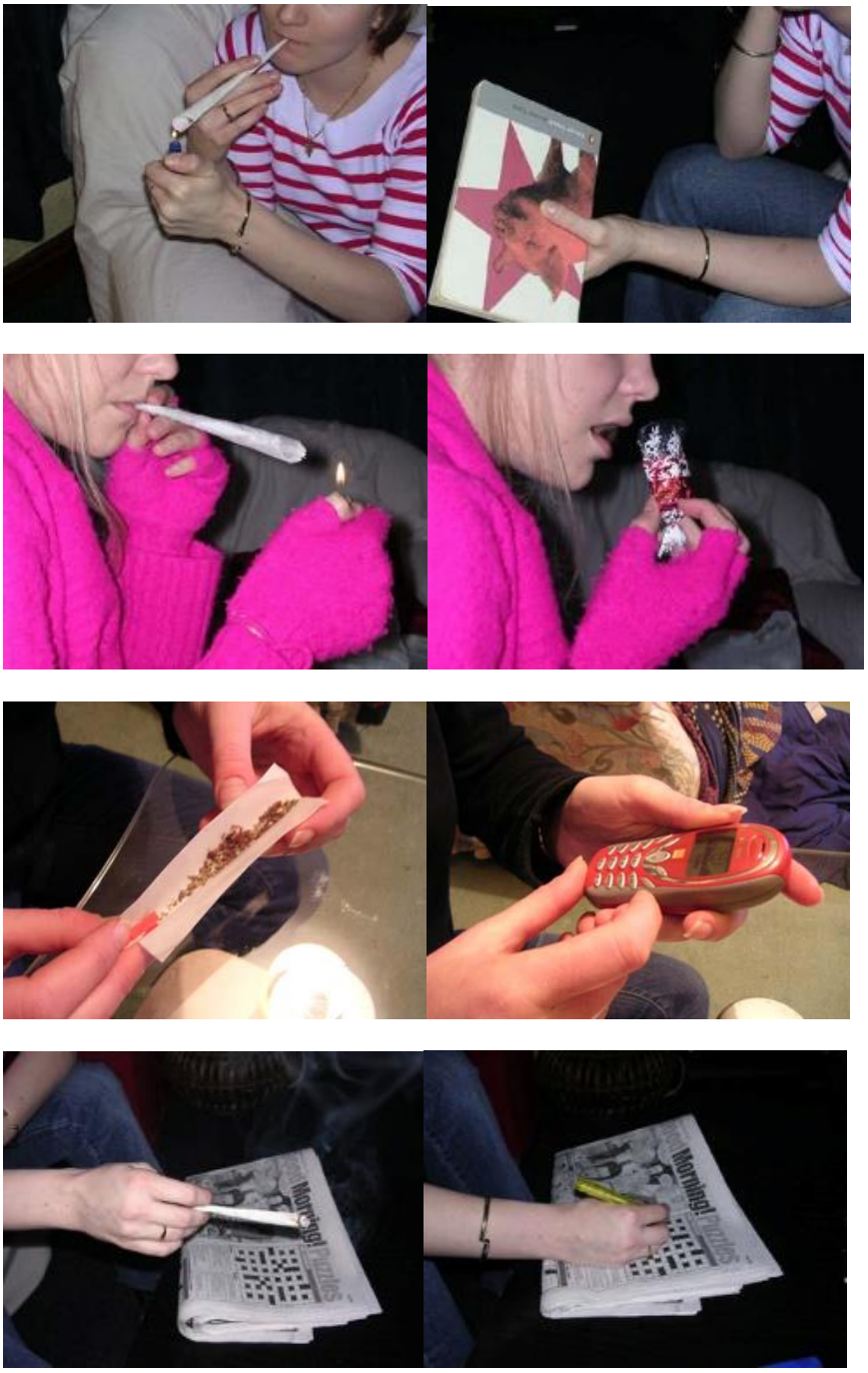


Figure B4

Experimental room setup

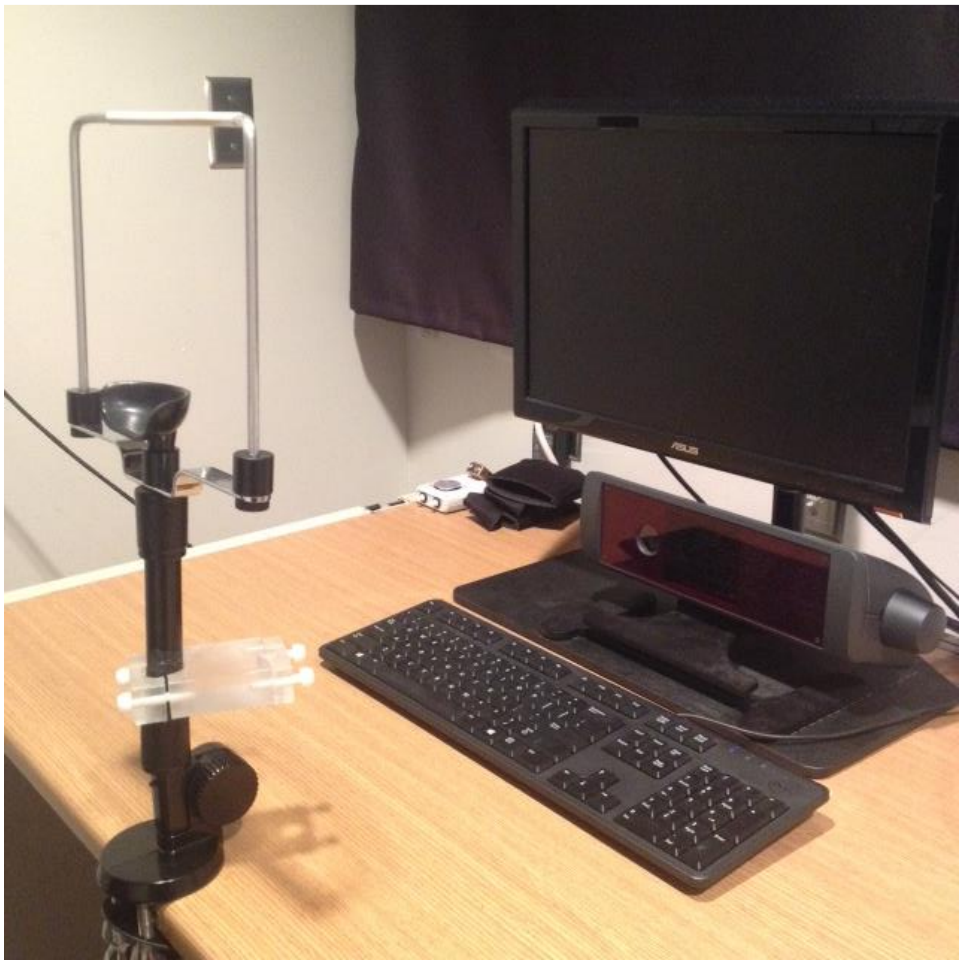


Figure B5

Eye-tracking target map

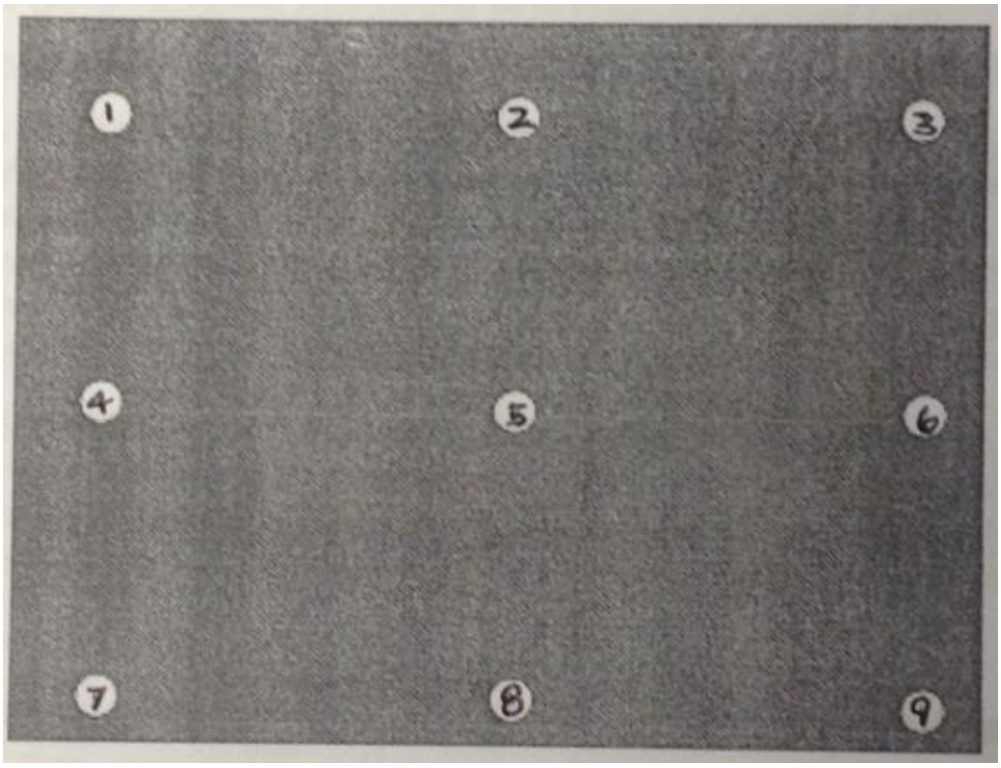
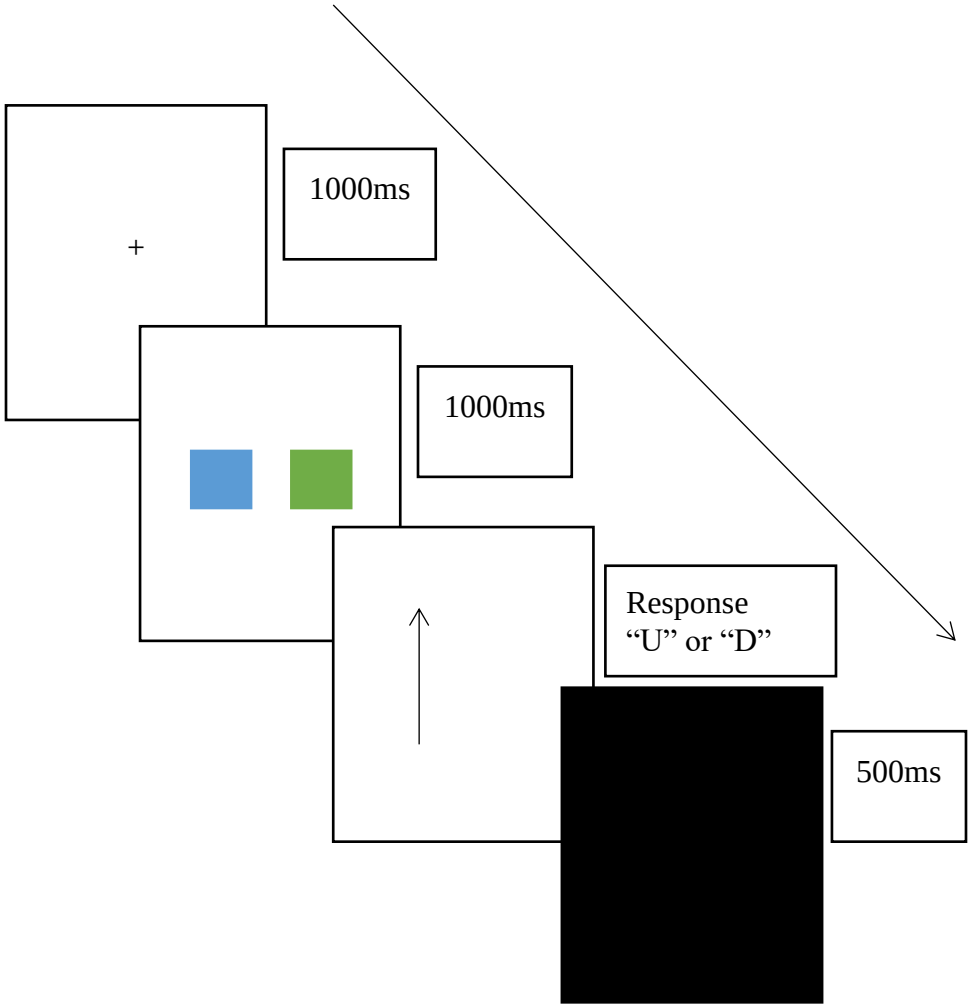


Figure B6

Visual probe experimental task



Appendix C: Sensitivity Analyses

Table C1

Differences in data quality measures across minimum fixation within area of interest percentage cut-points

	AOI 25% *M (SD)*	AOI 50% *M(SD)*	AOI 75% *M(SD)*		Sum of Squares	df	Mean Squares	F	*p*
N	60	57	52						
Total Dwell Time	63.54 (4.55)	63.29 (4.52)	62.98 (4.43)	Between groups	8.74	2	4.37	0.22	0.81
				Within groups	3366.42	166	20.28		
				Total	3375.16	168			
Trials with at least one Fixation	71.32 (1.69)	71.30 (1.73)	71.27 (1.81)	Between groups	0.07	2	0.04	0.01	0.98
				Within groups	503.19	166	3.03		
				Total	503.26	168			

Note. AOI= area of interest

Table C2

Differences in demographic and study variables across minimum fixation within area of interest percentage cut-points

	AOI 25%	AOI 50%	AOI 75%	Statistic	df	*p*
N	60	57	52			
Gender (% male)	28	27	24	χ^2= 0.01	2	0.99
Race (% white)	42	40	37	χ^2= 0.01	2	0.98
Age (*M(SD)*)	24.37 (6.39)	24.29 (6.13)	24.08 (5.88)	F= 0.03	2, 166	0.97
NUR *(M(SD))*	2.23 (0.63)	2.20 (0.62)	2.24 (0.62)	F= 0.06	2, 166	0.94
COP *(M(SD))*	2.78 (1.04)	2.77 (1.04)	2.79 (1.05)	F= 0.01	2, 166	0.99
MjF *M(SD))*	5.50 (2.19)	5.44 (2.18)	5.40 (2.26)	F=0.03	2, 166	0.97
RMPI (*M(SD)*	4.48 (4.24)	4.37 (4.03)	4.38 (4.10)	F= 0.01	2, 166	0.99
InOr *(M(SD))*	51.92 (5.92)	51.71 (5.94)	51.35 (4.96)	F= 0.14	2, 166	0.87
DelDis *(M(SD))*	51.66 (6.69)	51.65 (6.58)	51.59 (6.66)	F= 0.01	2, 166	0.99

Note. AOI= area of interest; NUR= negative urgency; COP= marijuana coping motives; MjF= marijuana use frequency; RMPI= Rutgers marijuana problems index; InOr= initial orientation; DelDis= delayed disengagement. Gender and Race differences assessed using a chi-square test. All other analyses conducted using repeated measures ANOVA.

Table C3

Effect sizes for study analyses across minimum fixation within area of interest percentage cut-points

Relationship	AOI 25%	AOI 50%	AOI 75%
NUR-AB	$\Delta R^2 < 0.01$	$\Delta R^2 < 0.01$	$\Delta R^2 < 0.01$
NUR-GEN-InOr	β= -0.29	β= -0.33	β= -0.35
NUR-GEN-DelDis	β= -0.20	β= -0.18	β= -0.13
AB-MJ	$\Delta R^2 < 0.01$	$\Delta R^2 = 0.01$	$\Delta R^2 = 0.01$
InOr-Gen-MjF	β= -0.18	β= -0.14	β= -0.17
InOr-Gen-RMPI	β= -0.22	β= -0.20	β= -0.21
DelDis-Gen-MjF	β= -0.29	β= -0.33	β= -0.24
DelDis-Gen-RMPI	β= -0.19	β= -0.21	β= -0.25

Note. NUR= negative urgency; AB= attentional bias measures; GEN= gender; InOr= initial orientation; DelDis= delayed disengagement; MJ= marijuana use behaviors; MjF= marijuana use frequency RMPI= Rutgers marijuana problems index

Appendix D: Study Results

Table D1

Demographic Variables

		Total Sample (*n*=120)	Eye-tracking Included (*n*=57)	Eye-tracking Excluded (*n*=63)	Statistic	*df*	*p*
Gender	Female	60 (50%)	30 (52.6%)	30 (47.6%)	χ^2= 0.31	1	0.72
	Male	60 (50%)	27 (47.4%)	33 (52.4%)			
Race	White/Caucasian	76 (63.3%)	40 (70.2%)	36 (57.2%)	χ^2= 7.71	*5*	0.17
	Black/African American	24 (20.0%)	10 (17.5%)	14 (22.2%)			
	Hispanic/Latino	9 (7.5%)	5 (8.8%)	4 (6.3%)			
	Asian	4 (3.3%)	0 (0.0%)	4 (6.3%)			
	Multiracial	4 (3.3%)	2 (3.5%)	2 (3.2%)			
	Other	3 (2.5%)	0 (0.0%)	3 (4.8%)			
Age (*M*(SD))		26.61 (9.28)	24.3 (6.08)	28.7 (11.06)	*t*= 2.70	118	0.01

Note. Gender and Race differences were examined using a chi-square test. Age differences were examined using an independent samples t-test.

Table D2

Mean values of all study variables

	Total Sample (*n*=120) *M*(SD)	Eye-tracking Included (*n*=57) *M*(SD)	Eye-tracking Excluded (*n*=63) *M*(SD)	*t*	*df*	*p*
Negative Urgency	2.23 (0.61)	2.20 (0.62)	2.26 (0.59)	0.57	118	0.57
Coping Motives	2.78 (1.02)	2.77 (1.04)	2.78 (1.01)	0.05	118	0.96
Marijuana Use Frequency	5.70 (2.34)	5.44 (2.18)	5.94 (2.46)	1.17	118	0.25
Negative Marijuana Consequences	4.83 (4.06)	4.37 (4.03)	5.25 (4.08)	1.19	118	0.24
Initial Orientation	51.40 (8.09)	51.71 (5.94)	51.10 (9.85)	-0.40	111	0.69
Delayed Disengagement	51.28 (8.43)	51.65 (6.58)	50.91 (10.02)	-0.47	111	0.64

Note. All differences were examined using independent samples t-tests.

Table D3

Study variables across gender

		Men (*n*=60)	Women (*n*=60)			
		M(SD)	*M*(SD)	*Statistic*	*df*	*p*
Race	White/Caucasian	43 (71.7%)	33 (55.0%)	χ^2= 6.43	5	0.27
n(%)	Black/African American	8 (13.3%)	16(26.7%)			
	Hispanic/Latino	5 (8.3%)	4(6.6%)			
	Asian	1 (1.7%)	3(5.0%)			
	Multiracial	1(1.7%)	3(5.0%)			
	Other	2 (3.3%)	1(1.7%)			
Age		26.93 (9.10)	26.28 (9.53)	*t*= 0.38	118	0.70
Negative Urgency		2.28 (0.57)	2.18 (0.64)	*t*= 0.88	118	0.38
Coping Motives		2.66 (1.06)	2.89 (0.97)	*t*= -1.25	118	0.21

Marijuana Use Frequency	5.82 (2.49)	5.58 (2.18)	*t*= 0.55		0.59
Marijuana Use Problems	4.92 (4.09)	4.75 (4.07)	*t*= 0.22	118	0.82
Initial Orientation	51.42 (7.36)	51.96 (4.42)	*t*= -0.34	55	0.74
Delayed Disengagement	50.93 (8.50)	52.30 (4.25)	*t*= -0.78	55	0.44

Note. Race differences were examined using a chi-square test. All other differences were examined using an independent samples t-test.

Table D4

Regression table of negative urgency's relation to coping motives

	Step 1				Step 2			
	B	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Constant	2.46	0.42			1.58	0.53		
Gender	0.21	0.19	0.10	0.27	0.25	0.18	0.12	0.18
Age	-0.01	0.01	-0.05	0.61	-0.01	0.01	-0.07	0.44
Race	0.08	0.08	0.09	0.29	0.07	0.08	0.08	0.35
Negative Urgency					0.40	0.15	0.24	0.01

Table D5

Regression table of negative urgency's relation to initial orientation and delayed disengagement

	Step 1				Step 2			
	B	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Constant	45.67	4.08		<0.01	44.60	4.63		<0.01
Gender	0.36	1.60	0.03	0.82	0.42	1.62	0.04	0.80
Age	0.22	0.13	0.23	0.10	0.21	0.14	0.21	0.13
Race	0.05	0.87	0.01	0.95	0.01	0.88	0.01	0.99
Initial Orientation					0.67	1.33	0.07	0.62
Constant	45.67	4.08		<0.01	44.85	5.20		<0.01
Gender	0.36	1.60	0.03	0.82	1.26	1.82	0.10	0.49
Age	0.22	0.13	0.23	0.10	0.13	0.15	0.11	0.42
Race	0.05	0.87	0.01	0.95	0.17	0.99	0.02	0.87
Delayed Disengagement					0.73	1.49	0.07	0.63

Table D6.

Regression table of coping motives' relation to marijuana use frequency and negative marijuana consequences

Marijuana Use Frequency	Step 1				Step 2			
	B	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Constant	5.21	0.95		<0.01	2.77	0.98		<0.01
Gender	-0.29	0.43	-0.06	0.50	-0.49	0.39	-0.11	0.21
Age	0.02	0.02	0.07	0.44	0.02	0.02	0.09	0.27
Race	0.26	0.18	0.14	0.14	0.18	0.16	0.09	0.26
COP					0.99	0.19	0.43	<0.01

Negative Marijuana Consequences	Step 1				Step 2			
	B	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Constant	4.82	1.63		<0.01	0.37	1.65		0.82
Gender	-0.38	0.73	-0.05	0.60	-0.76	0.66	-0.09	0.25
Age	-0.03	0.04	-0.07	0.47	-0.02	0.04	-0.04	0.58
Race	0.79	0.30	0.23	0.01	-0.76	0.66	-0.09	0.25
COP					1.81	0.32	0.45	<0.01

Table D7

Regression table of individual attentional bias measures' association with marijuana use behaviors

		Step 1				Step 2			
		B	*SE B*	β	*p*	*B*	*SE B*	β	*p*
Marijuana Use Frequency	Constant	5.78	1.48		<0.01	6.29	2.74		0.03
	Gender	-0.88	0.68	-0.15	0.21	-0.87	0.69	-0.13	0.33
	Age	0.04	0.05	0.12	0.36	0.05	0.05	0.13	0.35
	Race	0.16	0.32	0.07	0.61	0.16	0.32	0.07	0.62
	Initial Orientation					-0.01	0.05	-0.03	0.82
	Constant	5.78	1.48		<0.01	4.40	2.54		0.09
	Gender	-0.88	0.68	-0.15	0.21	-0.91	0.65	-0.14	0.26
	Age	0.04	0.05	0.12	0.36	0.04	0.05	0.11	0.42
	Race	0.16	0.32	0.07	0.61	0.15	0.32	0.07	0.63
	Delayed Disengagement					0.03	0.05	0.09	0.51

Negative Marijuana Consequences	Constant	6.18	2.79		0.03	2.18	5.12		0.67
	Gender	-0.57	1.09	-0.07	0.60	-0.60	1.10	-0.08	0.58
	Age	-0.08	0.09	-0.12	0.38	-0.10	0.09	-0.15	0.28
	Race	0.67	0.59	0.15	0.26	0.67	0.59	0.15	0.27
	Initial Orientation					0.11	0.09	0.19	0.20
	Constant	6.18	2.79		0.03	0.69	4.70		0.88
	Gender	-0.57	1.09	-0.07	0.60	-0.71	1.09	-0.09	0.52
	Age	-0.08	0.09	-0.12	0.38	-0.10	0.09	-0.15	0.28
	Race	0.67	0.59	0.15	0.26	0.64	0.59	0.15	0.28
	Delayed Disengagement					0.12	0.08	0.20	0.16

Table D8

Gender moderating effects of each analysis

Association	β	SE	95% CI	ΔR^2	*p*
NUR- COP	0.08	0.19	-0.29 to 0.46	<0.01	0.66
NUR- InOr	-0.33	0.19	-0.72 to 0.06	0.05	0.10
NUR - DelDis	-0.18	0.21	-0.61 to 0.25	0.01	0.40
COP- MjF	-0.18	0.17	-0.51 to 0.15	<0.01	0.29
COP- RMPI	0.14	0.16	-0.18 to 0.46	<0.01	0.37
InOr- MjF	-0.14	0.39	-0.92 to 0.64	<0.01	0.72
InOr- RMPI	-0.20	0.42	-1.04 to 0.63	<0.01	0.63
DelDis- MjF	-0.33	0.39	01.11 to 0.45	0.01	0.40
DelDis-RMPI	-0.21	0.42	-1.04 to 0.62	<0.01	0.61

Note. NUR= negative urgency; COP= marijuana coping motives; InOr= initial orientation; DelDis= delayed disengagement; MjF= marijuana use frequency; RMPI= Rutgers marijuana problems index

Table D9

Mediating effects of coping motives in the relationship between negative urgency and marijuana use frequency

		B	*SE*	95%CI
	Constant	0.14	0.34	-0.53 to 0.81
	Age	-0.01	0.01	-0.02 to 0.01
	Gender	-0.12	0.15	-0.42 to 0.18
	Race	0.15	0.06	0.03 to 0.28
Direct effects	NUR- MjF	0.29	0.08	0.14 to 0.46
	NUR-COP	0.24	0.09	0.06 to 0.42
	COP-MjF	0.38	0.08	0.23 to 0.54
Indirect effect	NUR-COP-MjF	0.11	0.04	0.04 to 0.22

Note. NUR= negative urgency; MjF= marijuana use frequency; COP= marijuana coping motives

Table D10

Mediating effects of coping motives in the relationship between negative urgency and negative marijuana consequences

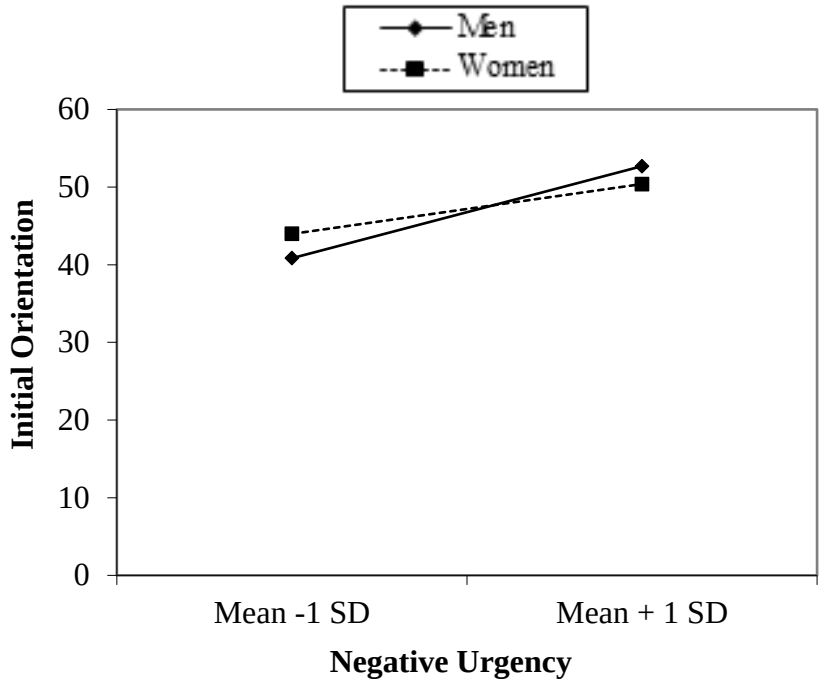
		B	*SE*	95%CI
	Constant	0.14	0.34	-0.53 to 0.81
	Age	-0.01	0.01	-0.02 to 0.01
	Gender	-0.12	0.15	-0.43 to 0.18
	Race	0.15	0.06	0.03 to 0.28
Direct effects	NUR- RMPI	0.30	0.08	0.14 to 0.46
	NUR-COP	0.24	0.09	0.06 to 0.42
	COP-RMPI	0.38	0.08	0.23 to 0.54
Indirect effect	NUR-COP-RMPI	0.09	0.03	0.03 to 0.17

Note. NUR= negative urgency; RMPI= Rutgers marijuana problems index; COP= marijuana coping motives

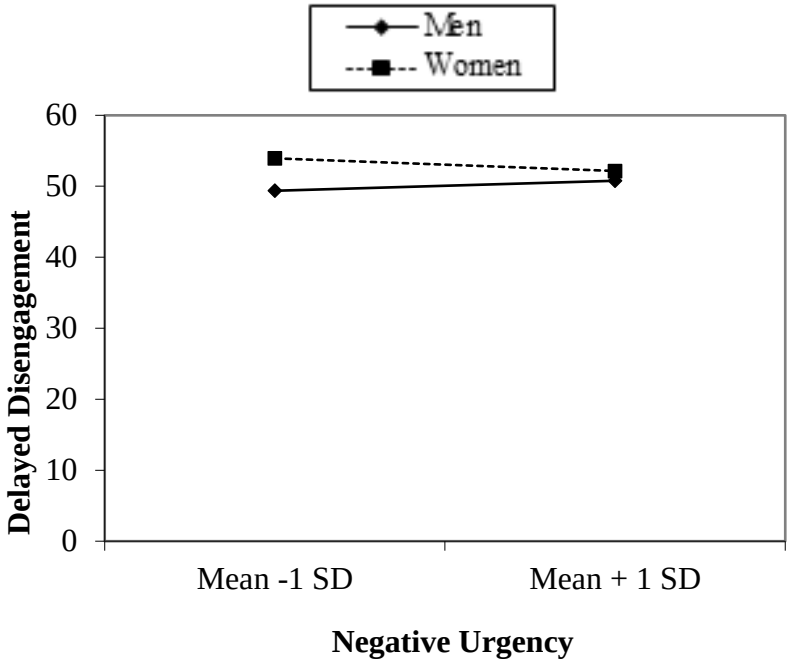
Figure D1

Gender Moderation Graphs

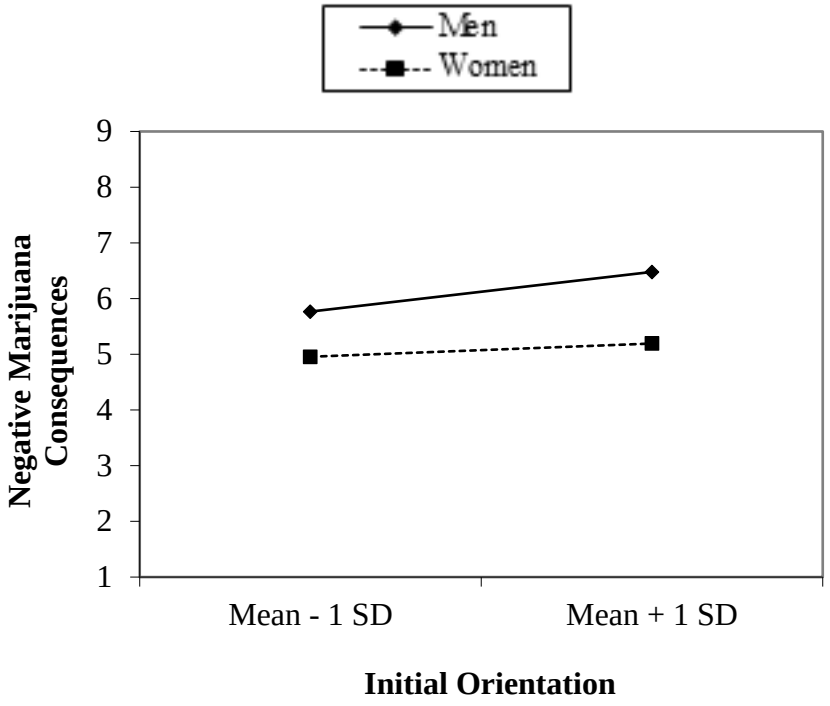
a. Gender moderating effects in the relationship between negative urgency and initial orientation



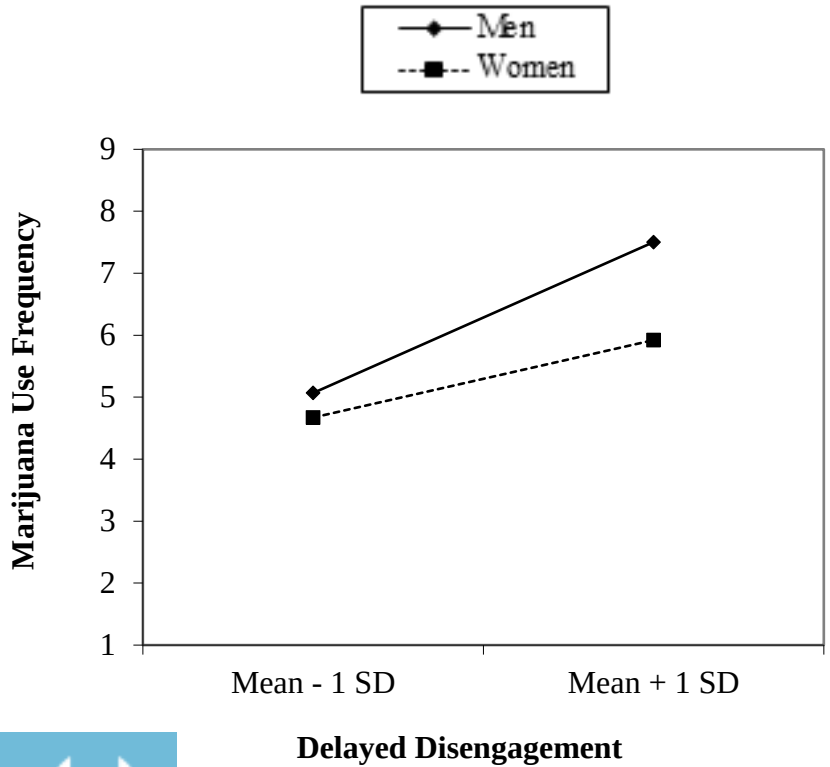
b. Gender moderating effects in the relationship between negative urgency and delayed disengagement.



c. Gender moderating effects in the relationship between initial orientation and negative marijuana consequences.



d. Gender moderating effects in the relationship between delayed disengagement and marijuana use frequency



e. Gender moderating effects in the relationship between delayed disengagement and negative marijuana consequences

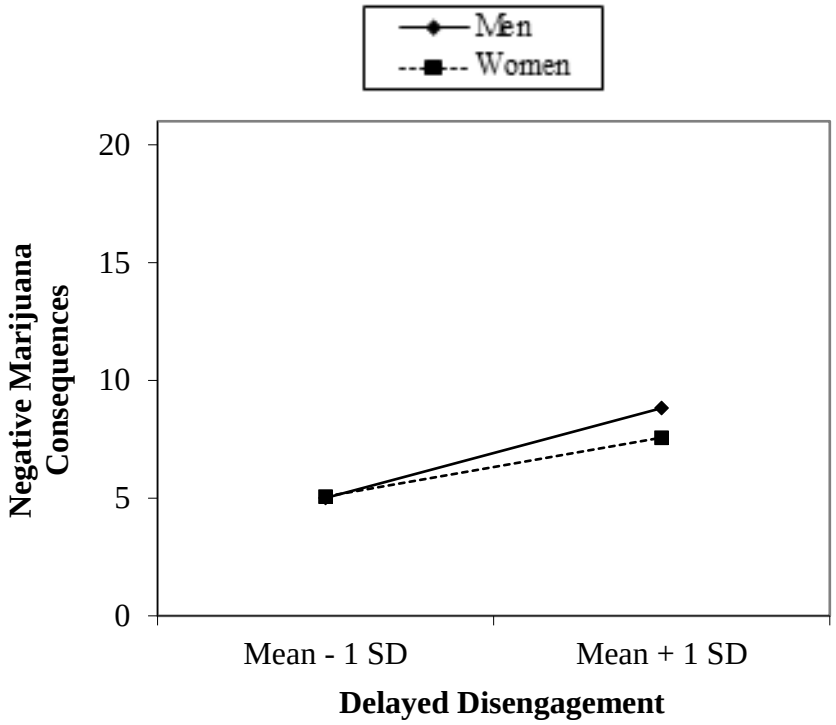
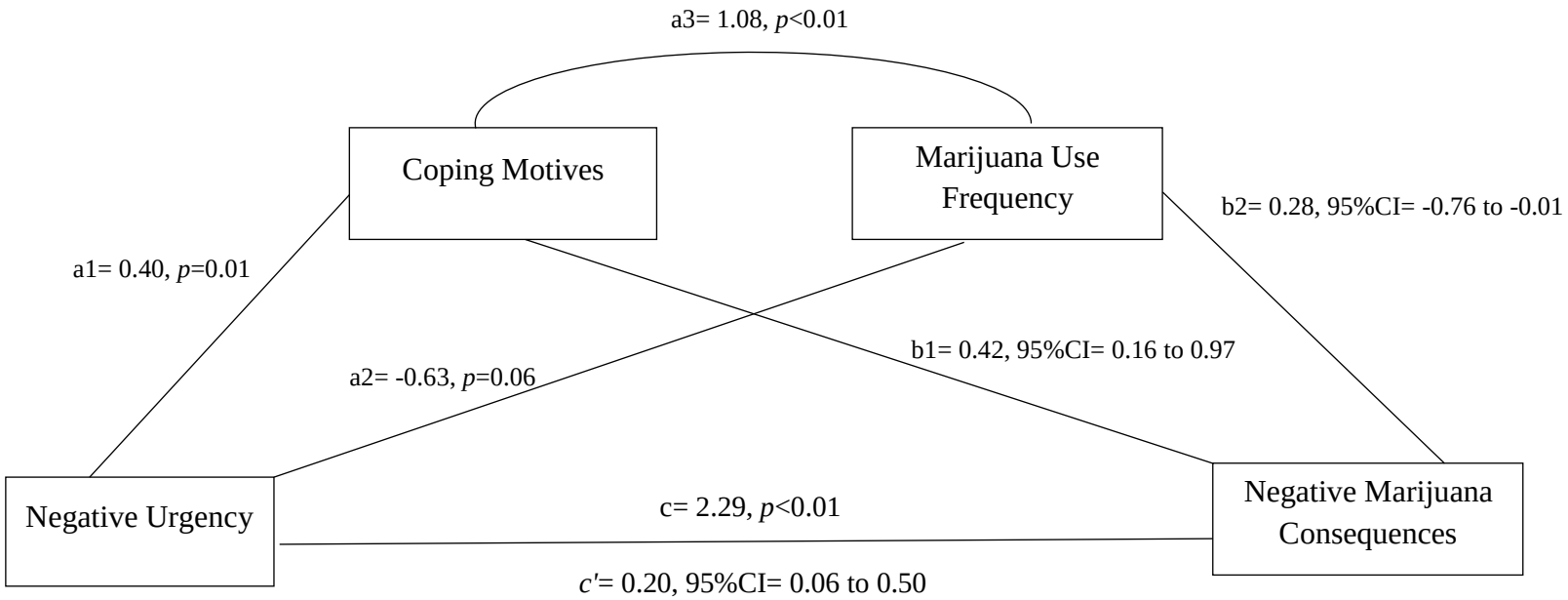


Figure D2

Double mediation of the relationship between negative urgency and negative marijuana consequences by coping motives and marijuana use frequency.



Appendix E: Alternative Models

Table E1

Mediating effects of negative urgency in the relationship between coping motives and marijuana use frequency

		B	*SE*	95%CI
	Constant	-0.01	0.40	-0.81 to 0.78
	Age	0.01	0.01	-0.01 to 0.03
	Gender	-0.21	0.18	-0.57 to 0.14
	Race	0.03	0.08	-0.12 to 0.17
Direct effects	COP- NUR	0.24	0.09	0.06 to 0.42
	COP-MjF	0.37	0.09	0.20 to 0.54
	NUR-MjF	-0.16	0.09	-0.25 to 0.09
Indirect effect	COP-NUR-MjF	-0.03	0.03	-0.09 to 0.04

Note. COP= marijuana coping motives; NUR= negative urgency; MjF= marijuana use frequency.

Table E2

Mediating effects of coping motives in the relationship between negative urgency and negative marijuana consequences

		B	*SE*	95%CI
	Constant	0.14	0.34	-0.53 to 0.81
	Age	-0.01	0.01	-0.02 to 0.01
	Gender	-0.12	0.15	-0.43 to 0.18
	Race	0.13	0.06	-0.03 to 0.24
Direct effects	COP- NUR	0.24	0.09	0.06 to 0.42
	COP-RMPI	0.38	0.07	0.22 to 0.53
	NUR-RMPI	0.30	0.08	0.14 to 0.47
Indirect effect	COP-NUR-RMPI	0.05	0.04	-0.04 to 0.12

Note. COP= marijuana coping motives; NUR= negative urgency; RMPI= Rutgers marijuana problems index

Figure E1

Double mediation of the relationship between negative urgency and negative marijuana consequences by marijuana use frequency and coping motives.

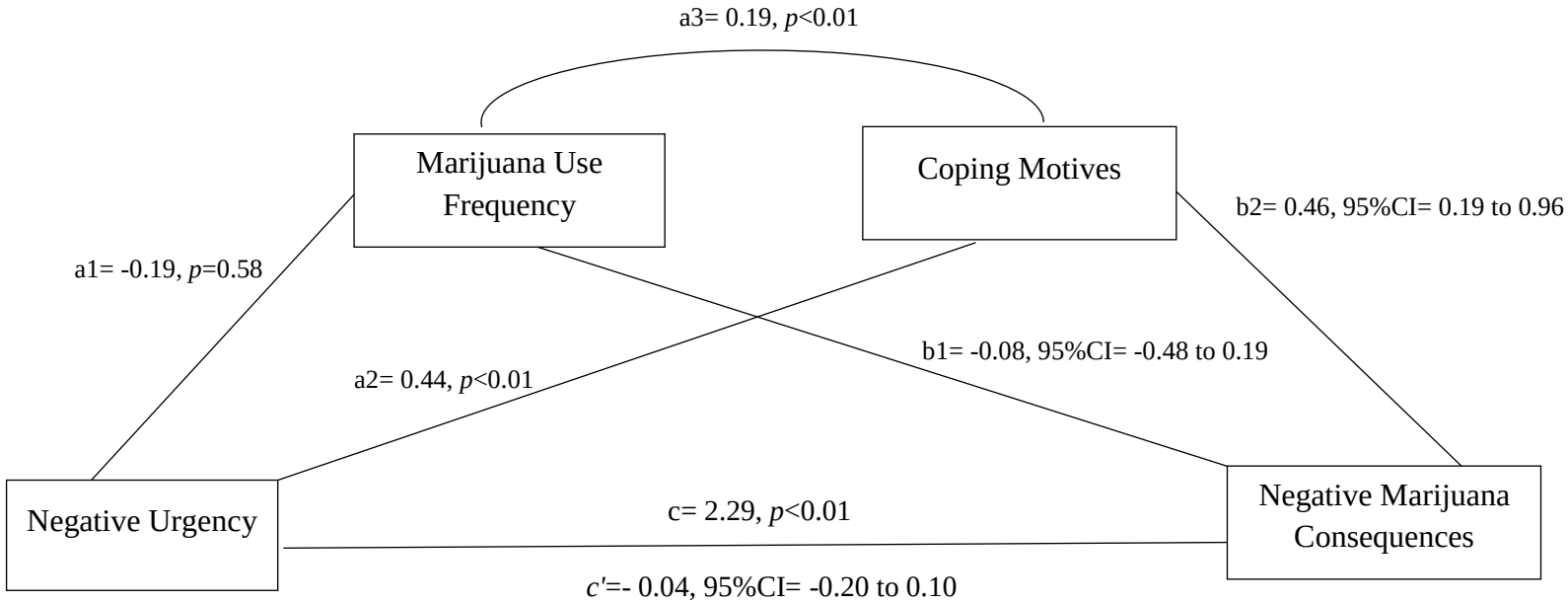


Figure E2

Double mediation of the relationship between negative urgency and marijuana use frequency by coping motives and negative marijuana consequences.