DISTRESS DRIVEN IMPULSIVITY AS A RISK FACTOR AND TREATMENT TARGET FOR SUBSTANCE USE DISORDER

by

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Master of Arts
George Mason University, 2010

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DEDICATION

This dissertation is dedicated to Mom, Dad and Mary Fran. I want to thank my amazing advisor June Tangney, for her support and encouragement through this process. June, your mentorship was a true gift. I also want to thank Jeff Stuewig for his cheery enthusiasm day in and day out. Thank you.

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LIST OF ABBREVIATIONS

Balloon Analog Risk Task ..... BART
Brief Self-Control Scale ..... BSCS
Brief Self-Control Scale-Reversed Scored ..... BSCS-R
Distress Driven Impulsivity ..... DDI
Negative Urgency ..... NU
Titrating Mirror Tracing Task ..... TMTT
UPPS Impulsive Behavior Scale ..... UPPS
UPPS Impulsive Behavior Scale-Negative Urgency Subscale ..... UPPS-NU

ABSTRACT

DISTRESS DRIVEN IMPULSIVITY AS A RISK FACTOR AND TREATMENT TARGET FOR SUBSTANCE USE DISORDER

Elizabeth T. Malouf, Ph.D.

George Mason University, 2014

Dissertation Director: Dr. June Price Tangney

This dissertation investigated distress-driven impulsivity as a potential treatment target for substance misuse among jail inmates. This dissertation included two studies that examined: 1) the relationship between distress-driven impulsivity and pre-incarceration substance misuse [Study 1] and 2) changes in distress-driven impulsivity before and after a mindfulness-based intervention [Study 2]. In Study 1, 108 jail inmates completed self-report and behavioral measures of distress-driven impulsivity and provided retrospective reports of pre-incarceration substance misuse. A self-report measure of distress-driven impulsivity was significantly related to alcohol and hard drug misuse and marginally significantly related to marijuana misuse. When controlling for the effects of general impulsivity, the relationship between self-reported distress-driven impulsivity and alcohol misuse remained significant, while the relationship with hard drug misuse dropped to non-significant. Regarding behavioral measures, a behavioral measure of

distress-intolerance was related to hard drug misuse while a behavioral measure of distress-driven risk taking was related to marijuana misuse. Study 2 was a small scale Randomized Clinical Trial of a mindfulness-based re-entry intervention in a sample of 40 jail inmates. There was some evidence that the treatment group improved in general impulsivity compared to the control group. While no evidence of improvements in distress-driven impulsivity was observed, the small sample size of this study limited the ability to detect effects. Attendance and participant feedback suggested that this treatment was feasible and acceptable in a high-risk sample of jail inmates. Implications for future research and treatment are discussed.

CHAPTER ONE: GENERAL INTRODUCTION

Impulsivity and Distress-Driven Impulsivity Relationship with Substance-use Disorder

Substance misuse is a major public health problem, especially among individuals who cycle in and out of the criminal justice system (CDC, 2001). Inmates returning to the community following incarceration are at especially high risk for relapse, which in turn is associated with increased likelihood of criminal recidivism (Chandler, Fletcher, & Volkow, 2009). Improving treatment for inmates may not only ameliorate individuals' lives but also reduce the toll of substance misuse on society.

A better understanding of the causes of substance misuse, might improve our ability to craft more effective and efficient treatments for substance misuse. While research has identified many risk factors for substance use disorder, the majority of these risk factors are static (e.g. family history) and do not have the potential to be treatment targets. In order to identify empirically supported treatment targets, there is a need for research identifying psychological variables that function as variable-causal risk-factors, that is that they: 1) influence substance abuse and 2) can be modified by treatment (Kazdin, Kraemer, Kessler, Kupfer & Offord, 1997).

Impulsivity is a psychological risk factor shown to relate to substance misuse. Recent research suggests that distress-driven impulsivity, one dimension of impulsivity,

may have a stronger relationship with disordered substance use compared to other dimensions of impulsivity. Distress-driven impulsivity refers to the tendency to engage in rash behavior during times of negative emotion.

This dissertation aims to contribute to understanding of distress-driven impulsivity as a potential treatment target for substance use disorder among individuals involved in the criminal justice system. To this end, this dissertation is composed of two studies to examine the extent to which distress-driven impulsivity functions as a variable risk factor for substance-use disorder. The first of these two studies investigates the relationship between jail inmates' substance misuse and distress-driven impulsivity above and beyond general impulsivity. The second study examines if distress-driven impulsivity and general impulsivity are modified by a mindfulness-based intervention for jail inmates.

CHAPTER TWO: ABSTRACT STUDY 1

While impulsivity has long been known to be a risk factor for substance misuse, recent research has highlighted the potential importance of a specific subtype of impulsivity known as distress-driven impulsivity. Distress-driven impulsivity was assessed by self-report as well as with behavioral measures of distress-intolerance and distress-driven risk taking. A sample of 108 adult jail inmates completed measures of distress-driven impulsivity and provided retrospective reports of pre-incarceration substance misuse. This study focused the relationship between substance misuse and1) behavioral measures of distress-driven impulsivity above and beyond self-report measures and 2) self-report measures of distress-driven impulsivity above and beyond self-report measures of general self-control. One behavioral measure of distress intolerance was related to misuse of hard drugs while a behavioral measure of distress-driven risk taking was related to misuse of marijuana. Self-reported distress-driven impulsivity had a strong negative relationship with self-reported general self-control. Self-reported distress-driven impulsivity was related to pre-incarceration misuse of alcohol and hard drugs. However, when controlling for the effect of general self-control, the relationship with hard drugs was reduced to non-significant. Results indicate that self-reported distress-driven impulsivity is an independent risk factor for alcohol misuse.

However, distress-driven impulsivity and general self-control may be largely redundant in the relationship to misuse of hard drugs.

CHAPTER THREE: INTRODUCTION STUDY 1

Better understanding risk factors for substance misuse may improve clinical interventions. Impulsivity (i.e., low self-control) is a psychological factor that has been found to have a robust relationship to substance misuse. One sub-type of impulsivity, known as distress-driven impulsivity, refers to the tendency to engage in rash behavior during times of negative emotion. Research suggests that distress-driven impulsivity may have a stronger relationship with substance misuse compared to other dimensions of impulsivity. However there are important limitations to our understanding of distress-driven impulsivity and how it relates to substance misuse. Aiming to extend knowledge of distress-driven impulsivity, this study investigates both self-report and behavioral measures of distress-driven impulsivity in a sample of adult jail inmates.

Impulsivity and Its Relationship to Substance Misuse

Defining Impulsivity.

Impulsivity refers to deficits in self-control, the conscious and effortful regulation to override impulses in order to conform behavior to some self-standard (Vohs & Baumeister, 2004; Baumeister, Vohs, & Tice, 2007). Impulsivity is multi-dimensional, involving impairments in multiple regulatory processes, such as: reflection before action, inhibition of impulses, delay of gratification, persistence, planning, and sensation seeking

(de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2011; Gerbing, Ahadi & Patton, 1987; Reynolds, Ortengren, Richards, & de Wit, 2006; Whiteside & Lynam 2001). Impulsivity can be summed up as impairment in a variety of abilities related to resisting "the temptations of the moment" (Gottfredson & Hirschi, 1990). Impulsive individuals are susceptible to urges for short-term reinforcement, including both negative reinforcement and positive reinforcement.

Relationship between Impulsivity and Substance Misuse.

Looking at impulsivity through the lens of reinforcement helps to conceptualize its relationship with substance misuse. Early stages of substance use involve positive reinforcement; individuals experience a strong impulse to administer the substance followed by pleasure. During later stages, substance use provides a temporary escape from withdrawal and serves as a powerful negative reinforcement mechanism (Koob & LeMoah, 2006; Parsons, Koob, Weiss, 1995; Koob & LeMoah, 2008). Initially, impulsive individuals may reflect less on the risks and consequences of substance use, increasing their chances of experimentation. After initiation of substance use, impulsive individuals may be more likely to fail to regulate substances use, leading to problematic use. Once psychological and physical dependence on substances arises, impulsive individuals may be less likely to succeed in abstinence attempts.

A wide body of empirical literature supports the relationship between impulsivity and substance misuse (Verdejo Garcia et al. 2008; de Wit, 2008; Moeller, Dougherty, 2002; Wills & Ainette 2010 for review). Within this literature, there are two overarching measurement approaches to impulsivity: self-report methodology and laboratory

behavioral methodology. The relationship between impulsivity and substance misuse is supported when impulsivity is measured using self-report (Patton, Stanford, & Barratt, 1995; Simons & Carey, 2002; Simons, Carey & Gaher, 2004) and with behavioral measures (Kirby, Petry, & Bickel, 1999; Petry, 2001; Bjork, Hommer, Grant & Danube, 2004; Sher, Bartholow, & Wood, 2000). Given the low correlations between self-report and behavioral measures of impulsivity (Lane, Cherek, Rhoades, Pietras & Tcheremissine, 2003; Gerbing et al., 1987; Reynolds et al., 2006, Reynolds, Penfold, Patak, 2008) and the relative strengths and weaknesses of each approach (Verdejo Garcia et al., 2008), many have recommended that research utilize both behavioral and self-report measures (Cyders & Coskunpinar, 2010; McHugh et. al, 2010; Skeel, et al., 2007).

Distress-Driven Impulsivity and Its Relationship to Substance Misuse

Defining Distress-Driven Impulsivity.

The general tendency for emotional distress to exacerbate impulsivity is both intuitive and well supported by research; most individuals act more impulsively when they are distressed (Gailliot & Tice, 2007 for review). Some individuals are more vulnerable than others to rash behavior during times of distress. I will refer to individual differences in the propensity for impulsive behavior when distressed as distress-driven impulsivity. Recently researchers have begun to investigate differences between individuals in this tendency toward distress-driven impulsivity.

Relationship between Distress-Driven Impulsivity and Substance Misuse.

Individuals may turn to substances during times of distress to attempt to escape their feelings or distract themselves. Consider, for example, Khantzian's well-known self-medication hypothesis of substance use, which argues that some individuals turn to drugs and alcohol to manage negative emotion (Khantzian, 1997). Individuals high in distress-driven impulsivity may be less able to take constructive action during times of negative emotion, and thus, more likely to turn to substances misuse. Additionally, symptoms of substance withdrawal involve distress. Individuals high in distress-driven impulsivity may be more likely to give into urges to use substances when experiencing withdrawal symptoms.

The empirical study of distress-driven impulsivity's relationship with substance misuse is a young and growing area of research. All in all, research in this area supports a relationship between distress-driven impulsivity and substance misuse, with some research suggesting that distress-driven impulsivity's relationship with substance misuse is stronger than other dimensions of impulsivity. These results will be reviewed below.

The Negative Urgency subscale and substance misuse: Self-report distress-driven impulsivity.

Distress-driven impulsivity has most often been assessed by a self-report measure: the Negative Urgency subscale of Whiteside and Lynam's UPPS Impulsive behavior measure (2001). The UPPS was the result of a factor analysis of over 10 existing measures of impulsivity, taken from personality assessments and stand-alone questionnaire (Whiteside & Lynam, 2001). The four resulting scales were named

Negative Urgency, (Lack of) Premeditation, (Lack of) Perseverance, and Sensation Seeking.

Whiteside and Lynam described the Negative Urgency scale as referring "to the tendency to experience strong impulses, frequently under conditions of negative affect." This 12-item scale includes four items assessing general poor impulse control (e.g., "I have trouble controlling my impulses" and "sometimes I do things on impulse that I later regret") and eight items assessing distress-driven impulsivity (e.g., "When I am upset, I often act without thinking," "When I feel bad, I will often do things I later regret in order to make myself feel better now.") Thus, items include *both* general and distress-driven impulsivity. The mixture of both types of items has often been ignored in the research literature, and the negative urgency subscale is often summarized as a measure of specifically negative-affect related impulsive behavior, or, distress-driven impulsivity (Anestis, Selby, Fink, & Joiner, 2007; Cyders & Smith, 2008).

Research with the UPPS has found a robust association between the negative urgency subscale and problematic substance use in a variety of studies. This self-report measure of distress-driven impulsivity has been linked to problematic use of alcohol (Whitside & Lynam, 2003; Whitside, Lynam, Miller, & Reynolds, 2005; Adams, Kaiser, Lynam, Charnigo, Milich, 2012; Coskunpinar & Cyders, 2012; Weaver, Martens, & Smith, 2012; Settles, Fischer, Cyders, Combs, Gunn, & Smith, 2012; Burton, Pedersen & McCarthy, 2012) and drugs (Kaiser, Milich, Lynam, & Charningo, 2012; Settles et al., 2012; Verdejo-García, et al., 2008).

Several studies have looked at whether the relationship between negative urgency and substance use holds above and beyond the other facets of impulsivity measured in the UPPS (i.e., lack of premeditation, lack of planning, and sensation seeking). Across these studies, negative urgency has maintained a significant relationship above and beyond the effect of the other subscales (Gonzales, Reynolds, & Skewes, 2011; King, Karyadi, Luk, & Patock-Peckham, 2011, Verdejo, Garcia, Bechara, Recknor, & Perez-Garcia , 2007; Whiteside et al., 2005). Among all subscales of the UPPS, negative urgency has been identified as the domain of impulsivity most consistently related with substance use disorder outcomes (Verdejo Garcia et al., 2007).

Distress intolerance and substance misuse: Behavioral measure of Distress-Driven Impulsivity.

Behavioral measures provide a more focused assessment of a specific type of impulsive behavior (Perry & Caroll, 2008). Distress intolerance is one facet of distress-driven impulsivity that has been assessed through behavioral measures. Distress intolerance is defined as the behavioral act of escaping (vs. enduring) negative experience (Leyro, Zvolensky, & Bernstein, 2010).

One well performing computer-based distress intolerance measure is the mirror-tracing task. This task involves tracing the outline of a shape with a reverse programmed computer mouse (the cursor moves in the opposite direction of the mouse). Often a buzzer is paired with errors in performance on the task. Distress intolerance is operationalized as how long the participant attempts the task before deciding to quit, the shorter the latency to quit the higher the distress intolerance (Leyro et al., 2010).

Empirical research has shown that task persistence on mirror tracing tasks has a significant positive longitudinal relationship to length of abstinent attempt among adults enrolled in residential substance use treatment- the higher the distress intolerance the shorter the abstinence attempt (Daughters et al., 2005). Furthermore this relationship holds above and beyond substance use disorder symptom severity. A second study by Brandon and colleagues a longitudinal relationship between mirror-tracing task persistence and length of abstinence from nicotine (Brandon et al., 2003). Both of these studies employed multiple behavioral measures of distress tolerance and found that the mirror-tracing task was the only measure to demonstrate incremental validity in its relationship with substance use outcomes (Daughters et al., 2005; Brandon et al., 2003).

Extending behavioral measures of distress-driven impulsivity: A behavioral measure of distress-driven impulsive risk taking.

What about regulation of the impulses for rewards during times of distress? A construct that is closely related to the positive reinforcement side of impulsivity is risk taking. Risk taking refers to behavior that involves both the potential for some reward balanced against the potential for harm (Lejuez et al., 2002).[1] Cyders and Smith review theoretical and empirical evidence for the link between distress-driven impulsivity and risk taking (2008). They argue that distress motivates reward seeking to mitigate the negative emotional state, thus, precipitating impulsive risk taking. Additionally, they review evidence that emotional arousal impairs decision making, further increasing the

[1] Risk-taking often involves impulsive action but not always. For example, an individual who succumbs to the urge to have unprotected sex engages in impulsive risk-taking, whereas an individual who plans an exhibition to Mount Everest engages in non-impulsive risk-taking.

propensity to risk taking (Cyders & Smith, 2008). This study aims to test a novel measure of distress-driven impulsivity: change in risk-taking behavior in the face of distress.

Risk taking has been operationalized by the Balloon Analog Risk Task (BART) (Lejuez et al, 2002; Aklin, Lejuez, Zvolensky, Kahler, Gwadz, 2005).. The BART has demonstrated associations with measures of substance use in adolescents (MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2011; Lejuez et al., 2002; Skeel, Neudecker, Pilarski, & Pytlak, 2007; Bornovolova, Gwadz, Kahler, Aklin, & Lejuez, 2008) and adults (Fernie, Cole, Goudie, & Field, 2010; Weafer, Milich, & Fillmore, 2011; Hopko, Lejuez, Daughters, Aklin, Osborne, Simmons, & Strong, 2006; Duva, Silverstein, & Spiga, 2011;Ledgerwood, Alessi, Phoenix, Petry, & Ave, 2010; Lejuez et al., 2003).

To our knowledge, no behavioral measure has operationalized individual differences in the tendency to engage in risk-taking during times of distress. This study addresses this gap by examining changes in risk taking on the BART before and after distress-induction. This assessment provides a measure of a theoretically important type of impulsive behavior during distress, complementing existing measures of distress intolerance, which currently the most widely used behavioral measure of distress driven impulsivity.

The Current Study: Expanding Knowledge About Distress-driven Impulsivity's Relationship with Substance Misuse

Extant research suggests that distress-driven impulsivity is an important risk factor for substance misuse when it is measured by self-report and by behavioral measures. However, little is known about the relative importance of each type of measure

(self-report vs. behavioral) in relation to substance misuse. Additionally, it remains unclear if distress-driven impulsivity is distinct from general impulsivity and whether it explains unique variance in substance misuse. Thus, this study aimed to investigate: 1) the relationship between behavioral measures of distress driven impulsivity and substance misuse above and beyond a self-report measure and 2) the relationship between distress-driven impulsivity and substance misuse above and beyond general impulsivity

Q1. To what degree are measure of general impulsivity and distress-driven impulsivity related to one another?

As more is learned about the importance of distress-driven impulsivity for substance misuse, a question arises as to how distinct this construct is from general impulsivity. Are those individuals who act on impulse during times of distress also those who exhibit elevated impulsivity in general? Little is known about the degree to which one's level of distress-driven impulsivity is explained by general impulsivity. In other words, it is uncertain whether general and distress-driven impulsivity are related but distinct characteristics.

This study aims to test the relationship between a measure of distress-driven impulsivity (the UPPS-Negative Urgency subscale, Whiteside & Lynam, 2001) and general impulsivity (the Brief Self-Control Scale, BSCS, Tangney, Baumeister & Boone, 2004). It is hypothesized that self-report measure of general impulsivity (BSCS, Tangney et al., 2004) and self-report measures of distress-driven impulsivity (UPPS-NU, Whiteside & Lynam, 2001) will be positively correlated with a moderate effect size (Hypothesis 2).

Q2: Is substance misuse uniquely related to both self-reports and behavioral measures of distress-driven impulsivity?

In the case of general impulsivity, self-report and behavioral measures of impulsivity have been found to explain unique variance in substance misuse and other risky behaviors (Skeel, Neudecker, Pilarski, Pytlak, 2007; Lejuez et al., 2002). At present, no research has examined the relationship between behavioral measures of distress-driven impulsivity and substance misuse above and beyond self-report measures. Understanding whether behavioral and self-report measures capture unique or overlapping variance in substance misuse will inform measurement selection for future research. It is hypothesized that measures of pre-incarceration substance misuse will have significant semi partial correlations with all three measures of distress-driven impulsivity (i.e., self-reported distress-driven impulsivity, and computer-based behavioral measures of distress intolerance and distress-driven risk taking) (Hypothesis 1).

Q3. Is substance misuse uniquely related to both self-reported general impulsivity and self-reported distress-driven impulsivity?

There are major limitations to what is known about the ability of measures of distress-driven impulsivity to explain variance in substance misuse above and beyond general impulsivity. Research with the UPPS has allowed for a comparison the Negative Urgency subscale (UPPS-NU) to other specific facets of impulsivity, including inability to plan, impersistence, and thrill seeking. However, as of yet, there has been no test of the relationship between self-reported distress-driven impulsivity and substance misuse above and beyond a measure of general impulse control. This study aims to address this

question by including testing the relationship between substance misuse and the UPPS-NU above and beyond a measure of general impulsivity, the Brief Self-Control Scale (BSCS, Tangney, Baumeister, Boone, 2004). This study hypothesized that self-reported distress-driven impulsivity (UPPS-NU) will demonstrate a relationship with pre-incarceration substance misuse above and beyond a self-report measure of general impulsivity (BSCS) (Hypothesis 3). Table 1 presents a summary of study research questions and hypotheses:

Table 1: Study 1 Research Questions and Hypotheses

Q1. Are measure of general impulsivity and distress-driven impulsivity related to one another?

Hypothesis 1: Self-report measure of general impulsivity (BSCS, Tangney et al., 2004) and self-report measures of distress-driven impulsivity (UPPS-NU, Whiteside & Lynam, 2001) will be positively correlated with a moderate effect size.

Q2. Is substance misuse uniquely related to both self-reports and behavioral measures of distress-driven impulsivity?

Hypothesis 2: Measures of pre-incarceration substance misuse have significant semi partial correlations with all three measures of distress-driven impulsivity (self-reported overall distress-driven impulsivity, and computer-based behavioral measures of distress intolerance and distress-driven risk taking).

Q3. Is substance misuse uniquely related to both general impulsivity and distress-driven impulsivity?

Hypothesis 3: The self-reported distress-driven impulsivity will demonstrate a relationship with pre-incarceration substance misuse above and beyond a self-report measure of general impulsivity.

CHAPTER FOUR: STUDY 1 METHODS

Participants

Eligible study participants were adult male jail inmates at the Fairfax County Adult Detention Center. The limited pool of eligible female inmates at any given time precluded inclusion in the parent study. Additional selection criteria for the parent study included post-sentencing status, assignment to the jail's general population (i.e., not solitary confinement or forensic housing), and language proficiency in English. Eligible inmates underwent a process of informed consent, which stressed the voluntary nature of participation and the confidentiality of data. Participants were informed that data were protected by a Certificate of Confidentiality from Department of Health and Human Services. The Institutional Review Board at George Mason University approved all research procedures.

Measures

Self-report Measures.

The following self-report measures were administered as part of the baseline assessment:

Self-reported general impulsivity was assessed by the Brief Self-Control Scale, a 13-item self-report measure (BSCS; Tangney, Baumeister, Boone, 2004). Participants

rated how well statements described them (e.g., "I am good at resisting temptation") on a 5-point scale. Participants were instructed to consider whether each "statement describes what you are like" and were not given a specific time frame. This measure has been shown to be reliable and valid in a similar offender sample at the same institution (α = .85) (Malouf, Stuewig, Tangney, 2012). In the current study, reliability was good (α = .88). For the purposes of this report, higher scores on this scale reflect higher impulsivity and lower self-control.

Self-reported distress-driven impulsivity was assessed by the 12-item Negative Urgency subscale (UPPS-NU) of the of the multifaceted measure of impulsivity: the Urgency, Premeditation, Perseverance, and Sensation Seeking Scale (UPPS Impulsive Behavior Scale, Whiteside & Lynam, 2001). The UPPS has been shown to be reliable and valid in college student sample (Whiteside & Lynam, 2001) as well as clinical samples (Whiteside & Lynam, 2003). The original version of this scale includes two types of items, eight that assess distress-driven impulsivity, such as "When I feel bad, I will often do things I later regret in order to make myself feel better now." And four that assess general impulsivity, such as "Sometimes I do things on impulse that I later regret." In the current sample, the negative urgency scale was highly reliable (α = .93).[2]

[2] We examined if results of the current study differed based on whether or not the four items of general impulsivity included in the Negative Urgency subscale were included or excluded. An alternative version of the negative urgency scale with just the eight items assessing distress-driven impulsivity was created. This alternative distress-driven impulsivity scale had excellent reliability in the current sample (α = .92). The original negative urgency subscale and the alternative subscale were extremely highly correlated (r=.98). This alternative scale had a large positive relationship with the BSCS (r=.55, p<.01). Analyses performed using either the original or the alternative UPPS-NU scale measure yielded virtually identical results. The original negative urgency subscale was used in the final analyses that were reported in this paper.

Frequency of substance use was assessed by the Timeline Follow-Back Assessment of Substance Use*:* (Timeline Follow-back: TLFB; Sobell, Brown, Leo, & Sobell, 1996). Using a calendar, participants reported their frequency of drug and alcohol use during the three months pre-arrest. Interviewers assessed participants' substance use patterns as well as special events to assist in accurate recall. Previous research has demonstrated that the timeline followback is a highly reliable measure of use of alcohol (Sobell, Brown, Leo, & Sobell, 1996) and illicit drugs (Robinson, Sobell, Sobell, & Leo, 2012). Due to the similarities between cocaine and opiates (illegal, highly addictive) and the relatively low rate of opiate use in our sample, opiates and cocaine were combined into a category of "hard drugs." The outcome variables from the TLFB was percentage of days using each substance (e.g., % of alcohol use days, % of marijuana use days, % of hard drug use days).

Symptoms of Substance Abuse and Dependence were assessed by the Texas Christian University Correctional: Residential Treatment Form, Initial Substance Use Assessment (TCU-CRTF; Simpson & Knight, 1998). Participants rated how often during the three months before arrest they experienced symptoms of substance abuse and dependence in different domains as specified by DSM-IV (American Psychiatric Association, 2000). For abuse, symptom domains included: failure to fulfill major roles, physical hazard, legal problems, and social problems. For dependence, symptom domains included: tolerance, withdrawal, persistent desire to cut down on use, large amount of time spent using, difficulty regulating amount used, and important activities given up due to use. The withdrawal domain included multiple items assessing substance-specific

symptoms of withdrawal (e.g., “when the effects of alcohol were wearing off, how often did you find yourself shaking?”). There were no withdrawal domain items for marijuana. . Item responses ranged from 0 = “never” to 4 = “7 or more times.” Total scores for abuse and dependence on each substance were computed by taking the mean across the symptom domains. Four substance dependence scales were created to assess dependency on alcohol (17 items, $\alpha = .90$), marijuana (8 items, $\alpha = .87$), cocaine (14 items, $\alpha = .94$) and opiates (18 items, $\alpha = .96$). Three substance abuse scales were created to assess abuse of alcohol (5 items, $\alpha = .78$), marijuana (5 items, $\alpha = .71$), cocaine (5 items, $\alpha = .80$) and opiate (5 items, $\alpha = .85$). Abuse and dependence on opiates and cocaine were collapsed into variables of hard drug abuse and hard drug dependence, which was defined as the higher of the two measures of abuse and dependence.

Behavioral Measures.

Impulsive risk taking was assessed by the *Balloon Analog Risk Task (BART:* Lejuez et al., 2002), a computerized task that presents participant with a graphic of a balloon that they can inflate by clicking the mouse. Each mouse click represents one ‘pump’ of the balloon and earns the participant 1 cent. Each time the participant pumps the balloon, there is an increased chance that it will pop. Participants pump up the balloon until either it popped or they decided to move onto the next balloon. If the balloon pops, they lose the money for that balloon, if they move on to the next balloon, the money gets transferred into a permanent bank. Participants were not informed of the chances the balloon will pop. The primary outcome variable for the BART is the average number of pumps on balloons that did not explode (i.e., adjusted average pumps). Individuals who

score high on this are considered to have a higher propensity for risk taking than those who score low. This study administered a series of 20 balloons.

Distress intolerance was assessed by the Titrating Mirror Tracing Persistence Task (TMTT: Lejuez & Calvin, 2009). In this study, the TMTT serves two roles: 1) to induce frustration and 2) to operationalize distress intolerance. Researchers employing the mirror tracing task find that it induces moderate distress (Steptoe & Wardle, 2005; Owen, Poulton, Hay, Mohamed-Ali and Steptoe, 2003).

Participants are asked to trace a shape with the cursor using a reversed program computer-mouse (moving the mouse up and to the left would result in the cursor moving down and to the right). When the cursor is moved off of the lines of the star for more than two seconds, the cursor returns to the start position and a loud buzzing noise sounds. Participants complete three practice levels of the task (easy, medium, hard) before the final level The adjusts the difficulty of the task based on the participant's performance. The difficulty of each level was based on performance on the previous level, titrating the difficulty to participant skill level. During the last level of the task, participants were able to quit whenever they wanted.

Distress-driven risk taking was operationalized as a residual gain score. This study administers the BART twice: before the TMTT (baseline BART) and immediately after the TMTT (post-distress induction BART) (see Figure 1). Distress driven risk taking is conceptualized as change on the BART post-distress induction compared to baseline. To calculate this, the post-distress induction BART was regressed on the baseline BART and a residual value was saved as an additional variable (Δ BART). This variable,

variance in the post-distress induction BART independent of baseline risk taking, is interpreted as a measure of distress-induced risk taking.

Procedures

Participants were recruited from the initial waves of a larger longitudinal study of jail inmates, referred to as the "parent study." The parent study is a Randomized Clinical Trial (RCT) of a restorative justice intervention, which encourages offenders to re-evaluate distorted "criminogenic" beliefs and to reflect on one's place and role in the community. This intervention does not target any constructs of interest to the current study, notably: impulsivity, distress-tolerance, or distress-driven impulsivity. While this intervention provided some information about the community effects of substance abuse, it was not an addictions program. Participants were assessed at four points during: 1) baseline, 2) mid-treatment, 3) post-treatment, 4) pre-release. The current study presents data from the baseline and pre-release time points.

Behavioral measures of impulsivity were administered as part of an independent session of the parent study at the pre-release assessment time point. Eligible participants in the parent study were informed of the possibility of participating in an optional session involving computer-tasks for which they could earn between $5-10 depending on their performance. Finally, participants were informed that some tasks might be frustrating. Participants who consented to the behavioral measures session first completed the baseline administration of the BART. They then received instructions for the TMTT and were informed that once they finished the TMTT they would complete a second trial of the BART. Instructions for the TMTT and second BART trial were given together before

the TMTT to minimize time between the TMTT (which served as a distress induction), and the second BART. Participants provided distress ratings through the computer program throughout the session to ensure participant welfare. For a visual representation of this session, see Figure 1.

Figure 1: Behavioral Measures Session

There was no difference between participants who received the IOC treatment and those who were in the control group for risk taking on the BART ($t(102)=.23$, $p>.10$), persistence on the TMTT ($t(102)=-.40$, $p>.10$) and the residualized gain score of distress-driven risk taking ($t(100)=1.06$, $p>.10$).

Enrollment for the parent study occurred between 2009 and 2012; 212 participants in the parent study completed baseline assessment and were followed longitudinally. The behavioral measures for the current study were added in 2010 (i.e., after enrollment for the parent study began) and 151 of parent study participants were eligible for the current study. Of these, 109 (72.2%) participated, 20 (13.3%) were missed

(e.g., released early), 16 (10.5%) refused, 5 (3.3%) were unavailable (e.g., restricted cells), and 2 (1.3%) were excluded for other reasons (e.g., behavioral concerns). Of those who participated, data from two participants were partially or completely invalid. The final sample presented in this paper included the 108 adult male jail inmates who provided at least partial behavioral measures data. Participants' age ranged from 18 to 65 (M=32.61, SD=11.03). This sample was diverse in terms of race and ethnicity; 53% were African American, 27% Caucasian, 13% Hispanic/Latino, and 7% Other.

Data Analysis

Analyses were performed using MPlus, which provided full information maximum likelihood estimation (FIML) of model parameters. This method estimates parameters based on covariance matrixes incorporating all available data including cases with incomplete data. FIML is thought to be superior to other methods of handling missing data (e.g., listwise deletion) (Enders, 2001; Muthén, Kaplan, Hollis, 1987). Due to violations of normality for variables of substance use, abuse, and dependence, models were fitted using Maximum Likelihood estimation with robust standard errors (MLR). Models were evaluated using the $\chi 2$ test along with other fit indices. A Root Mean Square Error of Approximation (RMSEA) close to .06, a Comparative Fit Index (CFI) over .95, and a Standardized Root Mean Square Residual (SRMR) under .08 indicate close fitting models (Hu & Bentler, 1999).

CHAPTER FIVE: STUDY 1 RESULTS

Descriptive Information

Participants reported high rates of pre-incarceration substance use. During the three months prior to arrest, 84.5% of participants reported alcohol use, 47.1% marijuana use, 25% cocaine use and 16.3% reported opiate use. Taken together, 33.7% of participants reported use of hard drugs. Of the 108 participants who completed the titrated mirror tracing task (TMTT), 62 (57.4%) quit before the maximum time had passed and 46 (42.6%) persisted for the entire five minute testing period. On average, participants persisted 217.32 seconds (*SD*= 97.77). On average, participants pumped 36.69 (*SD* = 12.37) pumps on balloons that did not explode during the pre-distress induction trial of the BART (BART1) and 38.49 (*SD* = 12.64) on the post-distress induction trial of the BART. Thus, on the whole, participants tended to take more risks on the post-distress induction BART compared to the pre-distress induction BART (t=2.19, p<.05). The effect size for this difference was small (Cohen's d=.14).

Correlations between Self-Reported General Impulsivity and Distress-Driven Impulsivity (Hypothesis 1).

As hypothesized, self-reported general self-control assessed by the BSCS had a large negative correlation with the UPPS Negative Urgency scale (r=-.59, p<.01). This relationship between the BSCS and the UPPS Negative Urgency scale was of large effect

size, 34.8% of the variance in Negative Urgency was explained by general impulsivity. This indicates that the variance in self-reported inability to manage impulses in general has a strong correlation with self-reported inability to manage impulses when distressed. While this constitutes a substantial relationship, general and distress-driven impulsivity were not fully redundant and remained empirically distinct.

Relationship between Distress-Driven Impulsivity and Substance Misuse

Bivariate correlations between impulsivity and substance use, abuse, and dependency can be found in Table 2. Relationships varied across types of substance; no measure had consistent relationships across all three substances.

The baseline impulsive risk-taking (BART-baseline) was negatively related to alcohol use and abuse symptoms (such that those who took more risks reported lower rates of alcohol use and abuse), but unrelated to marijuana misuse and marginally positively related to hard drug abuse and dependence (such that those who took more risks reported higher rates of hard drug misuse). The behavioral measure of distress-driven impulsive risk taking (Δ BART) had a small positive relationship with marijuana abuse and a marginally significant positive relationship with marijuana dependence, indicating that individuals who tended to take more risks following distress induction had reported higher symptoms[3]. Distress-driven risk taking (Δ BART) was unrelated to misuse of alcohol and hard drugs. Distress tolerance (TMTT) demonstrated a small to

[3] Review influence statistics found that the positive relationship between ΔBART and marijuana abuse and dependence were largely influenced by one individual and to a lesser degree by three other individuals. These four individuals had *not* raised any other validity concerns (e.g., no abnormal behavior). Removing the most influential case, reduced the relationship to marginally significant, but did not completely negate the effect. All four individuals were kept in the analyses.

medium strength negative relationship with hard drug use, abuse and dependence, but not use or misuse of alcohol and marijuana.

Regarding self-report measures, general impulsivity measured by the BSCS (reversed) was positively related to use of hard drugs, but not of alcohol or marijuana. The BSCS was related to symptoms of abuse and dependence of hard drugs and alcohol but not marijuana. Self-reported distress-driven impulsivity, measured by the UPPS Negative Urgency scale, had a significant positive relationship misuse (i.e., frequency of use, symptoms of abuse and dependence) of alcohol and hard drugs. Self-reported distress-driven impulsivity, however, was unrelated to measures of marijuana misuse.

Table 2: Relation between substance misuse and measures of measures of impulsivity and distress-driven impulsivity

Constructs	Measures	**Alcohol**			**Marijuana**			**Hard Drugs**		
		Freq.	Abuse	Dep.	Freq.	Abuse	Dep.	Freq.	Abuse	Dep.
	Behavioral									
1. Impulsive Risk Taking	BART baseline	-.24*	-.21*	-.10	.03	.05	.07	.07	.17$^{\partial}$	.16$^{\partial}$
2. DDI: Risk Taking	Δ BART	-.02	-.03	-.02	.08	.20*	.16$^{\partial}$	-.04	-.01	.01
3. DDI: Intolerance	TMTT	.09	.00	.08	-.01	.03	.04	.34**	.26**	.27**
	n=101-106									
4. General Impulsivity	Self-Report									
5. DDI	BSCS-R	.09	.29**	.25**	.02	.23*	.17$^{\partial}$	.23*	.33**	.32**
	UPPS-NU	.23**	.46**	.43**	.06	.15	.18$^{\partial}$	.25**	.28**	.27**
	n=97-103									

Key:
DDI = Distress-Driven Impulsivity, BART= Balloon Analog Risk Task, TMTT= Titrating Mirror Tracing Task, BSCS-R= Brief Self-Control Scale-Reversed scored, UPPS-NU= UPPS Impulsive Behavior Scale- Negative Urgency Subscale
* p< .05, ** p <.01

Explaining variance in substance misuse: self-report vs. behavioral measures of distress-driven impulsivity (SEM Model A).

Because alcohol, marijuana and hard drugs evidenced different bivariate relationships with measures of impulsivity, separate latent variables of misuse of alcohol, marijuana and hard drugs were created. Structural equation modeling (SEM) was used to test the relationship between misuse of each of the three types of substances and measures of distress driven impulsivity. For each substance-type, substance misuse was a latent variable with three indicators: percentage of days using that substance, symptoms of abuse, and symptoms of dependence during the three months pre-arrest.

Three separate SEMs were run for each substance-type. In the first model (Model A), substance misuse latent variables were regressed on: 1) the residual of the post-distress induction BART regressed on the pre-distress induction BART (Δ BART: behavioral measure of distress-driven Risk Taking) 2) seconds persisted on the TMTT (TMTT: behavioral measure of distress tolerance) and 3) the distress-driven impulsivity items of the negative urgency subscale of the UPPS Impulsive Behavior Scale (UPPS-NU: self-report measure of distress-driven impulsivity). Thus, Model A tested substance misuse's relationship with behavioral and self-report measures of distress-driven impulsivity (Hypothesis 3).

Alcohol Misuse: SEM Model A

Results from the SEM of alcohol misuse can be found in Figure 2.A. Model fit indices supported good fit for Model A ($\chi^2(6)5.93=$ (p=.43), RMSEA=0.00, SRMR=.02, CFI=1.00, n=108). Results from alcohol Model A indicated a significant positive

relationship between self-reported distress-driven impulsivity (UPPS-NU) but not behavioral measures of distress-driven risk taking or distress intolerance. Overall, 22% of the variance in alcohol misuse was explained by the three measures of distress-driven impulsivity (R^2 =.22, *SE*=.086, *p*=.01).

Marijuana Misuse: SEM Model A

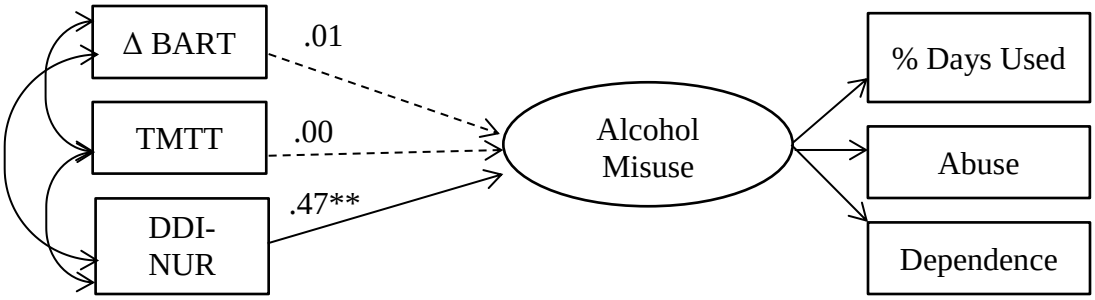
Results from the SEM of marijuana misuse can be found in Figure 2.B. Model fit indices supported good fit for marijuana Model A ($X^2(6)$=4.51 (*p*=.61), RMSEA=0.00, SRMR=.024, CFI=1.00, n=108). Results from marijuana Model A indicated significant positive relationship between the distress-driven risk taking (Δ BART) and marijuana misuse, such that participants who took more risk on the second BART compared to the first BART tended to endorse higher levels of marijuana misuse. There was a marginally significant positive relationship between self-reported distress-driven impulsivity (UPPS-NU) and marijuana misuse. Overall, 6.6% of the variance in marijuana misuse was explained by the three measures of distress-driven impulsivity (R^2 =.66, *SE*=.04, *p*=.12).

Hard drug misuse: SEM Model A

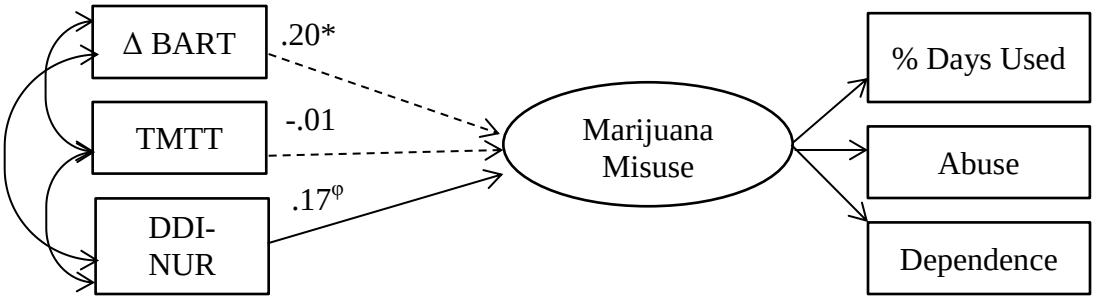
Results from the SEM of hard drug misuse can be found in Figure 2.C. Model fit indices supported good fit for hard drug Model A ($\chi^2(6)$=6.32 (*p*=.38), RMSEA=0.02, SRMR=.025, CFI=.99, n=108). Results from the hard drug model indicated a significant positive relationship between hard drug misuse and distress intolerance indicating that participants who persisted longer on the TMTT reported lower rates of hard drug misuse. There was a significant positive relationship between hard drug misuse and self-reported distress-driven impulsivity (UPPS-NU), such that those who reported higher distress-

driven impulsivity reported higher hard drug misuse. Overall, 14% of the variance in hard drug misuse was explained by the three measures of distress-driven impulsivity (R^2 =.14, *SE*=.07, *p*=.03).

A. Alcohol misuse



B. Marijuana misuse



C. Hard Drug misuse

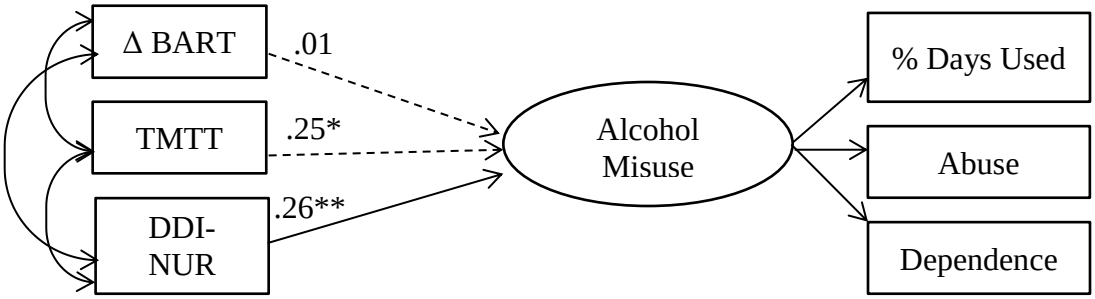


Figure 2: Substance Misuse on Behavioral and Self-Report Measures of DDI (Models A)

Explaining variance in substance misuse: distress-driven vs. general impulsivity (SEM Model B & C).

In the second set of models, (Model B & C), the same substance misuse latent variables were regressed first on the self-report measure of general impulsivity (BSCS) to assess the amount of variance in substance misuse explained by general impulsivity (Model B). Next, distress-driven impulsivity (UPPS-NU) was added to the model (Model C). Model C tested self-reported distress-driven impulsivity's relationship with substance misuse above and beyond general impulsivity (Hypothesis 4).

Alcohol Misuse: SEM Model B&C

When the latent variable of alcohol misuse was regressed on self-reported general impulsivity, (BSCS) the model fit the data adequately well (Model B: $\chi^2(2)=3.47$, (p=.17), RMSEA=0.084, SRMR=.02, CFI=.989, n=103) . In Model B, general impulsivity had a significant positive relationship with alcohol misuse, explaining 7.5% of the variance R^2=.075 *SE* =.049, p=.13). In Model C, adding self-reported distress-driven impulsivity (UPPS-NU) reduced the pathway between general impulsivity and alcohol misuse to non-significant; distress-driven impulsivity was significantly related to misuse of alcohol while general impulsivity was not. Together, general and distress-driven impulsivity explained 25.5% of the variance in alcohol misuse (R^2=.255 *SE*=.087, p<.01), which constitutes a significant increase in R^2 ($F(2, 99)=11.96$, p<.01) compared to Model B. Fit indices were good for Model C ($\chi^2(4)=3.32$ (p=.51), RMSEA=0.00, SRMR=.022, CFI=1.00, n=103).

Marijuana Misuse: SEM Model B&C

When the latent variable of marijuana misuse was regressed on self-reported general impulsivity, (BSCS) the model fit the data marginally well (Model B: $\chi^2(2)=7.61$ (p=.02), RMSEA=0.165, SRMR=.03, CFI=.951, n=103). In Model B, general impulsivity had a significant positive relationship with marijuana misuse, explaining 4.3% of the variance (R^2=.043 *SE*=.041, p=.29). In Model C, both distress-driven impulsivity and general impulsivity had a non-significant relationship with marijuana misuse. Together, general and distress-driven impulsivity explained 4.9% of the variance in marijuana misuse (R^2= .049 *SE*=.043, p=.26), a non-significant increase in R^2 compared to model B ($F(2, 99)=.31$, $p>.10$).Fit indices were good for Model C($\chi^2(4)=8.68$(p=.07), RMSEA=0.11, SRMR=.034, CFI=.96, n=103) .

Hard drug misuse: SEM Model B&C

When the latent variable of hard drug misuse was regressed on self-reported general impulsivity, (BSCS) the model fit the data well ($\chi^2(2)=.375$ (p=.82), RMSEA=0.00, SRMR=.007, CFI=1.00, n=103) . In Model B, general impulsivity had a significant positive relationship with hard drug misuse, explaining 11.2% of the variance (R^2= .112 *SE* =.05, p=.03). In Model C, this pathway between hard drug misuse and self-reported general impulsivity (BSCS) remained significant. Together, BSCS and DDI-NU explained 12.6% of the variance in hard drug misuse (R^2= .126 *SE* =.06, p=.02), a non-significant increase in R^2 compared to model B ($F(2,99)=.79$, $p>.10$). Fit indices were good for Model C (Model C ($X^2(4)=1.22$ (p=.87), RMSEA=0.00, SRMR=.009, CFI=1.00, n= 103).

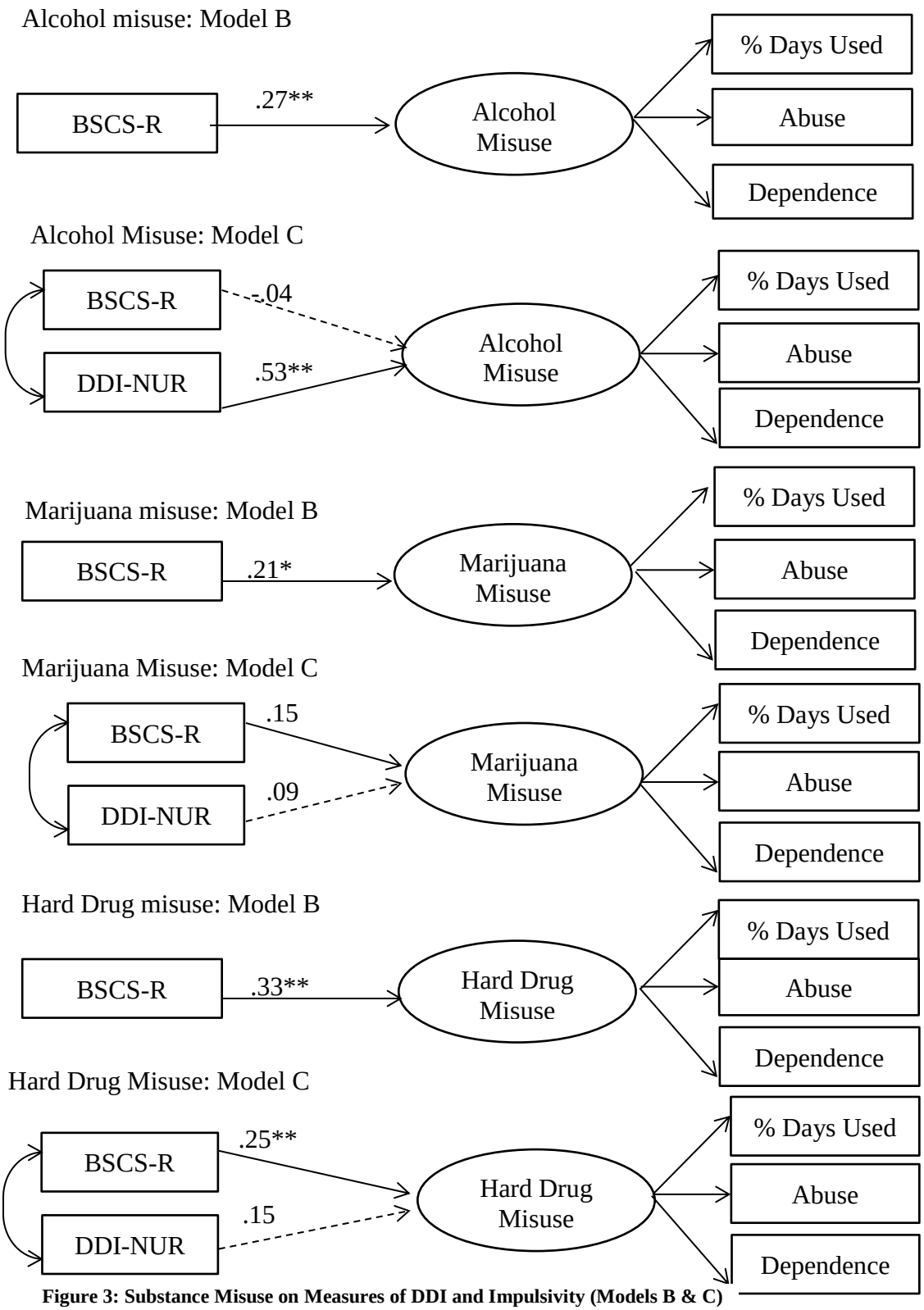


Figure 3: Substance Misuse on Measures of DDI and Impulsivity (Models B & C)

CHAPTER SIX: STUDY 1 DISCUSSION

Recent research has highlighted the potential importance of a specific subtype of impulsivity known as distress-driven impulsivity. This study investigated the relationship between distress-driven impulsivity and jail inmates' pre-incarceration substance misuse. Key results were that: 1) a self-report measure of distress-driven impulsivity (UPPS-NU) tended to have more consistent relationship with substance misuse (e.g., frequency of use, symptoms of abuse and dependence) than did behavioral measures of distress-driven impulsivity (Δ BART, TMTT) and 2) the self-reported measure of distress-driven impulsivity (UPPS-NU) was related to misuse of alcohol (but not hard drugs or marijuana) above and beyond general impulsivity (BSCS-R).

Distress-driven Impulsivity and Substance Misuse: Behavioral Measures vs. Self-Report

This study examined the relationship between several measures of impulsivity and types of substance misuse, latent variables indicated by frequency of use, symptoms of abuse and dependence, and several measures of impulsivity and distress-driven impulsivity. One existing and one novel behavioral measure were employed to assess two subtypes of distress-driven impulsivity. The Titrated Mirror Tracing Task (TMTT) provided a measure of distress intolerance, the inability to resist temptation for relief from distress (negative reinforcement). This measure had a small to medium positive

relationship with misuse of hard drugs but was not significantly related to alcohol or marijuana misuse. Distress-driven risk taking was measured by the difference in risk-taking on the Balloon Analog Risk Task before and after the distress induction (Δ BART: positive reinforcement). This measure was demonstrated a small relationship with misuse of marijuana. Those who misused marijuana before incarceration demonstrated a tendency to take more risks when they were distressed compared to baseline risk taking.

The type of reinforcement involved in each behavioral measure may explain the different relationships with substance misuse. Distress intolerance involves giving into the impulse for relief from distress (i.e., negative reinforcement). The fact that hard drugs involve powerful psychological and physical symptoms of withdrawal may explain the relationship with distress intolerance; individuals who are less able to withstand distress may be more likely to experience problematic use of hard drugs. Misuse of marijuana, which involves less intense symptoms of withdrawal, was related to distress-driven risk taking seeking rather than distress-intolerance. Individuals predisposed to reward seeking during times of distress may be more likely to turn to marijuana. Thus, the impaired ability to resist urges for relief vs. reward may correspond to risk for different substances depending on the degree to which they are physically/psychologically addictive. Of note, this cross sectional data does not allow us to speak to the direction of these observed relationships between distress intolerance and hard drug misuse and distress-driven risk taking and marijuana misuse. This limitation is discussed below.

Self-reported distress-driven impulsivity (UPPS-NU) had a more consistent relationship with substance misuse than did the behavioral measures. It was significantly

related to higher misuse of alcohol (large effect size) and hard drugs (medium effect size) and marginally significantly related to higher misuse of marijuana (small effect size). In sum, both behavioral and self-report measures of distress-driven impulsivity explained unique variance in substance misuse, which is consistent with research on general impulsivity (e.g., Skeel et al., 2007). These results indicate that researchers and clinicians striving for a comprehensive assessment of distress-driven impulsivity might do best to include both types of measures. However, behavioral measures of distress-driven impulsivity were less consistently related to measures of substance misuse than was the self-report measure. Researchers and clinicians who are limited for time and resources may prefer to use a self-report rather than a behavioral measure.

Impulsivity and Substance Misuse: Distress-driven vs. General Impulsivity

As more is learned about the importance of distress-driven impulsivity, a question arises as to how distinct this construct is from general impulsivity. Are both general and distress-driven impulsivity important risk factors for substance misuse? Previous research has examined the utility of the UPPS Negative Urgency scale (UPPS-NU) in explaining behavior above and beyond measures of premeditation, perseverance, and sensation seeking. However, research is lacking that investigates the incremental importance of distress-driven impulsivity above and beyond impulse control in general to explaining variance in substance misuse.

This study allowed for an examination of both self-reported general impulsivity, the brief self-control scale (BSCS, Tangney et al., 2004) and distress-driven impulsivity, the UPPS-NU. These two measures were found to be highly correlated; those individuals

who endorsed the tendency to act on impulse when they were distressed also endorsed higher levels of general impulsivity. The magnitude of the correlation suggests that these two constructs are related but still distinct. Similar to other related but distinct psychological phenomena (e.g., anxiety and depression), the unique variance in these constructs might have potential importance to explaining behavioral outcomes.

The relationship between substance misuse and unique variance in self-reported distress-driven impulsivity (controlling for general impulsivity) was significant for alcohol but not for marijuana or hard drugs. Thus, a self-reported distress-driven impulsivity measure explained substantial unique variance in alcohol, above and beyond what was explained by general impulsivity. In fact, adding distress-driven impulsivity to the model increased the amount of alcohol misuse variance explained by about three fold (from 7.5% to 23.1%).

This suggests that overall distress-driven impulsivity may be important independent of general impulsivity in relation to problematic use of alcohol. In other words, it is impulse control during times of distress that is most important for alcohol misuse, not general impulse control. Alcohol use may be particularly associated with the tendency to give into urges when experiencing emotional distress; individuals who use substances to self-medicate or coping with emotions may turn to alcohol for this purpose. The clinical implications of this finding are discussed below.

Limitations/ Future Directions

This study had several significant limitations. The design of the study did not allow for a test of causal directions of relationships. Theory suggests that distress-driven

impulsivity would lead to future substance misuse (i.e., distress-driven impulsivity is the independent variable and substance misuse is the dependent variable). However, it is also possible that the cognitive and psychological effects of substances use may reduce the ability to regulate impulses during times of distress (i.e., substance misuse is the independent variable and distress-driven impulsivity is the dependent variable). In this study, participants completed measures of distress-driven impulsivity during incarceration and provided retrospective reports of their pre-incarceration substance use. Thus, results are unable to determine the direction of the relationship. There is a need for longitudinal research to help clarify the directionality of this link between distress intolerance and hard drug misuse.

This study relied on self-report measures of substance misuse. Although participant underwent a process of consent, which emphasized confidentiality of data, it is possible that some participants under reported their substance misuse. Future research would benefit from employing biological assessments of substance use (e.g., urine drug screens) in addition to self-report assessment.

Additionally, this study employed self-report assessments of general and distress-driven impulsivity. Self-report measures can be vulnerable to social desirability bias. Previous research on self-report measures of general impulsivity and finds that when controlling for social desirability bias, the relationship with behavioral outcomes is reduced but remains significant (Tangney et al., 2004). It is possible that controlling for social desirability bias may reduce the effect size of relationships between self-reported distress-driven impulsivity and substance misuse as well. In this study, which did not take

social desirability bias into account, self-reported distress-driven impulsivity demonstrated a stronger relationship with substance misuse than behavioral measures. However, it is unclear if self-reported distress-driven impulsivity would maintain this advantage when the effects of social desirability bias were controlled. Understanding the strength of the relationship between substance misuse and distress-driven impulsivity controlling for social desirability bias will help evaluate the relative utility of self-reported vs. behavioral measures of distress-driven impulsivity. Future research should assess and control for social desirability bias in self-report assessments of distress-driven impulsivity.

Conclusions/ Implications for research and clinical practice

This study has implications for further research into distress-driven impulsivity. No measure of distress-driven impulsivity had consistent relationship with misuse across all three substance types. Given that many studies of distress-driven impulsivity have focused only one substance (e.g., alcohol), this finding offers an important caution. We should not assume that findings related to alcohol misuse would apply to marijuana or hard drug use or vice versa. Future research may benefit from assessing different substance types independently.

Regarding clinical implications, this supports the importance of distress-driven impulsivity as a risk factor for alcohol and, to a lesser extent, hard drug misuse. This study found that distress-driven and general impulsivity are highly correlated; generally impulsive individuals are more likely to also exhibit distress-driven impulsivity. General impulsivity, which is often more observable than distress-driven impulsivity, can be a

signal that distress-driven impulsivity may also be an issue. Like assessing for depression in a client presenting with anxiety (or vice versa), clinicians may benefit from assessing for both types of impulsivity, especially when alcohol misuse is a concern.

This study found that that distress-driven impulsivity is a meaningful risk factor for alcohol independent from general impulsivity. Therapeutic interventions that improve the ability to manage distressing emotions may be important to improving impulsive behavior. Skills from cognitive behavioral therapy that address the relationship between distressing automatic thoughts, emotions and behavior, may help to reduce distress and improve impulse control during times of distress. Additionally, mindfulness and acceptance-based interventions may be particularly helpful to improving distress-driven impulsivity because of the intensive focus on emotion regulation. For example, Dialectical Behavior Therapy (DBT) includes an intensive focus on cognitive and behavioral responses to distress (Linehan, 1993). Additionally, Mindfulness-based Stress Reduction (MBSR) focuses on building the ability to observe without reacting to physical and emotional discomfort (Samuelson, Carmody, Kabat-Zinn, & Bratt, 2007). As a third example, Acceptance and Commitment Therapy (ACT) includes skills to reduce the impact of distressing thoughts (i.e., cognitive de-fusion) while focusing on encouraging individuals to act with intention rather than on impulse during difficult times (i.e., values-based action) (Hayes & Smith, 2005). Empirical research finds that mindfulness and acceptance based interventions are associated with improved emotion regulation (Jimenez, Niles & Park, 2010; Modinos, Ormel, & Aleman, 2010; Arch & Craske, 2010). In sum, when a client presents with impulsive behavior, a focus on emotions may not be

immediately obvious. However, these results speak to the connection between impulse control and distress, and the importance of distress-driven impulsivity to misuse of alcohol.

CHAPTER SEVEN: STUDY 2 ABSTRACT

Research suggests that both impulsivity and distress-driven impulsivity are risk factors for substance misuse and other risky behaviors. However, it is less clear whether impulsivity and distress-driven impulsivity can be targeted by psychological interventions. This study investigates changes in impulsivity and distress-driven impulsivity during a small scale randomized clinical trial of a mindfulness-based intervention for jail inmates re-entering the community: the ReEntry Values and Mindfulness Program (REVAMP). At pre- and post- treatment, 40 inmates (20 assigned to REVAMP and 20 to treatment as usual) completed self-report measure of self-control (Brief Self-Control Scale, Tangney et al. 2004), premeditation, perseverance, and distress-driven impulsivity (UPPS Impulsive Behavior Scale, Whiteside & Lynam, 2001) as well as behavioral measures of risk-taking (Balloon Analog Risk Task, Lejuez et al., 2002), distress-driven risk taking, and distress tolerance (Titrating Mirror Tracing Task, Lejuez & Calvin, 2011). At post treatment, inmates who received REVAMP reported marginally significantly higher premeditation compared to the control group. Treatment dosage was related to improvements in self-reported perseverance at post-treatment. No statistically significant differences between the treatment and control groups in behavioral measures of impulsivity or distress-driven impulsivity were observed.

Attendance and participant feedback suggested that this treatment was feasible and acceptable in a high risk sample of jail inmates.

CHAPTER EIGHT: STUDY 2 INTRODUCTION

Substance use disorder is a major public health concern, especially among individuals who cycle in and out of the criminal justice system (CDC, 2001). Inmates returning to the community following incarceration are at especially high risk for relapse, which in turn is associated with increased likelihood of criminal recidivism (Chandler, Fletcher, & Volkow, 2009). Improving treatment for inmates may reduce the toll of substance use disorder on society. In order to improve current treatment, a better understanding of treatment-malleable risk factors for substance use disorder is crucial.

One factor that has a strong intuitive, theoretical and empirical link to substance use disorder is impulsivity. However, there is debate in the literature whether impulsivity is a stable personality trait (Gottfredson & Hirschi, 1991; Vaske, Ward, Boisvert, & Wright, 2012) or a dynamic factor that can be improved through intervention (see Baumeister, Gailliot, DeWall, & Oaten, 2006 for review). This study aimed to better evaluate impulsivity as a malleable treatment target. To this end, this study investigated changes in impulsivity following a mindfulness-based re-entry intervention for jail inmates returning to the community.

Impulsivity and Substance Use Disorder

Broadly, impulsivity refers to deficient self-control, which is the ability to regulate impulses and conform behavior to some standard (Vohs & Baumeister, 2004;

Baumeister, Vohs, & Tice, 2007). Impulsivity is a multi-faceted construct, referring to deficits in multiple regulatory processes, such as premeditation, inhibition of impulses, and perseverance (Whiteside & Lynam 2001).

Theory suggests that impulsivity is a root cause of substance abuse (Baumeister, Heatherton, & Tice, 1994; Gottfredson & Hirschi, 1991). Additionally, the relationship between impulsivity and substance abuse has been supported by a wide body of empirical research using diverse methodologies and clinical and community samples (de Wit, 2008; Lejuez, et al., 2010; Verdejo-Garcia, Lawrence, & Clark, 2008). This relationship between impulsivity and substance use also has been found in samples of criminal offenders (Longshore, Chang, Hsieh, Messina, 2004; Packer, Best, Day and Wood, 2009; Malouf, Stuewig & Tangney, 2012).

Distress-Driven Impulsivity and Substance Use Disorder

Distress-driven impulsivity is the tendency to behave impulsively when experiencing negative affect. Research suggests that distress driven impulsivity is a particularly risky type of impulsivity for disordered substance use. Self-report measures of distress driven impulsivity have been linked to problematic use of alcohol (Whitside & Lynam, 2003; Whitside, Lynam, Miller, & Reynolds, 2005; Adams, Kaiser, Lynam, Charnigo, Milich, 2012; Cosunpinar & Cyders, 2012; Weaver, Martens, & Smith, 2012; Settles, Fischer, Cyders, Combs, Gunn, & Smith, 2012; Burton, Pedersen & McCarthy, 2012) and drugs (Kaiser, Milich, Lynam, & Charningo, 2012; Settles et al., 2012; Verdejo-García, Bechara, Recknor, Pérez-García, 2008). The relationship between distress-driven impulsivity and problematic substance use has held above and beyond

other types of impulsivity (Gonzales, Reynolds, Skewes, 2011; Verdejo, Garcia, et al., 2007; Whiteside et al., 2005). Compared with other dimensions of impulsivity, distress-driven impulsivity is domain of impulsivity most consistently related to substance use disorder in empirical research (Verdejo Garcia et al., 2007).

Impulsivity and distress driven impulsivity: Stable or Malleable?

An association with substance use disorder is not sufficient to indicate that impulsivity and distress-driven impulsivity are appropriate treatment targets for psychosocial substance use treatment. Impulsivity may be a stable personality factor that is resistant to intervention. For example, in their influential theory of self-control, Gottfredson and Hirschi propose that impulsivity develops in early childhood and is stable throughout the lifespan (1991). Some empirical research has supported the relative stability of risk taking and impulsivity (Vaske, Ward, Boisvert, & Wright, 2012). However, other theoretical models of impulsivity offer a more dynamic view. For example, Baumeister and colleagues' strength model of self-control posits that self-control capacity fluctuates similar to physical strength (see Muraven & Baumesiter, 2000 for review). In other words, after individuals exert self-control they experience a temporary period of depleted capacity (i.e., increased impulsivity). Depletion of self-control following a taxing self-control task has been observed in multiple laboratory studies (Leith & Baumesiter, 1996, Muraven, et al., 1998, Baumeister, Vohs, & Tice, 2007). Research finds that regulation of negative emotion absorbs self-control resources, thus depleting capacity to exert self-control in other areas (Schmeichel & Baumesiter, 2004; Fry, 1975; Knapp & Clark, 1991; Tice, Bratslavsky and Baumeister, 2001).

Empirical evidence, however, suggests that repeated exercise of self-control in one domain (e.g., improving posture) can result in increased self-control capacity across other domains (Oaten & Cheng, 2006; Oaten & Cheng, 2007; Baumeister, Gailliot, DeWall, & Oaten, 2006). These studies involve intensive training of self-control in one domain and subsequently found improvements in both related and un-related behavior such as reducing tobacco and caffeine use and improving responsible behavior.

Taking together, theory and empirical evidence suggest two ways that treatment might reduce impulsivity. First, there are findings that the experience of negative affect can deplete self-control in the short term, leading to increases in impulsivity. This suggests that interventions that boost emotion regulation skills or reduce negative affect might serve to reduce impulsive behavior. Second, empirical evidence suggests that self-control capacity can be built over time through repeated exercise involving intensive regulation of behavior. As such, both impulsivity and distress driven impulsivity may be improved by treatments that promote regular self-control exercise or improve emotion regulation.

Mindfulness Meditation as an Approach for Impulsivity and Distress-Driven Impulsivity

These dual aims of exercising self-control and improving emotion regulation closely match mindfulness and acceptance base treatment approaches. Definitions of mindfulness generally include two components: 1) self-regulation of attention and 2) an orientation to experience characterized by openness, acceptance and non-judgment (Bishop et al. 2004).

Over the past several decades, there has been an impressive proliferation in development and implementation of mindfulness-based therapeutic interventions. Empirical evidence supports mindfulness-based interventions in the treatment of a wide variety of disorders (see Brown et al., 2007; Keng, Smoski, Robins, 2011 for review), including substance use disorders. Many of the empirical studies of mindfulness have employed randomized clinical trials (RCT), the gold standard study design for evaluating treatment effect. Mindfulness-based treatment has amassed sufficient research evidence to be labeled as "empirically supported" for the reduction of suicidal behavior (Dialectical Behavior Therapy; SAMHSA, 2006), symptoms of depression and anxiety (Mindfulness Based Stress Reduction; SAMHSA, 2012) and obsessive-compulsive disorder severity (Acceptance and Commitment Therapy; SAMHSA 2010). Additionally, mindfulness-based interventions that have successfully been applied to substance abuse, including Mindfulness-based Relapse Prevention (MBRP: Witkiewitz, Marlatt, & Walker, 2005; Bowen, Chawla, & Marlatt, 2010), Acceptance and Commitment Therapy (ACT: Hayes et al., 2004) and Dialectical Behavior Therapy (DBT, Linehan, Schmidt, Dimeff, Craft, Kanter, Comtois, 1999; Linehan et al., 2002). While no RCTs have been conducted in samples of criminal offenders, there have been promising preliminary results in this population (Bowen, Witkiewitz, Dillworth, Chawla, Simpson, Ostafin, & Larimer, 2006).

Mindfulness interventions and reduction of impulsivity.

As reviewed above, research on the 'strength model of self-control' finds that self-control can be strengthened over time through regular exercise (Muraven &

Baumesiter, 2000 for review). Masicampo and Baumeister (2004) describe the theoretical overlap between self-control exercise and mindfulness meditation. Like the self-control interventions described above, mindfulness meditation also involves intensive monitoring and regulating a specific behavior: attention. Masicampo and Baumeister (2004) suggest that the relationship between mindfulness meditation and psychological health may be partially explained through improvement in general self-control strength.Only a few research studies have specifically tested whether mindfulness-based interventions are associated with improvements in self-control. These studies provide promising findings that mindfulness meditation is associated with improvements in cognitive flexibility (Heeren,Van Broeck, & Philippot, 2009) attention regulation (Jha, Krompinger & Baime, 2007; Hogins & Adair, 2010) and response inhibition (Chan & Woollacott, 2007) While many of these studies have included comparison groups (e.g., Heeren et al., 2009; Jha et al., 2007), no RCTs have been performed, limiting conclusions that can be made about treatment effects. Additionally, research in a sample of incarcerated adolescents found that following completion of an eight-week mindfulness-based drug treatment, inmates reported lower levels of impulsivity compared to baseline (Himelstein, 2011).

Mindfulness interventions and improvement of emotion regulation.

While engaging in mindfulness meditations, individuals are taught to observe their internal emotional experience in a non-judgmental, detached fashion. This accepting, non-elaborative attitude towards emotional experience may reduce secondary-emotional responses and decrease the motivation for avoidance behavior, such as substance use (Gratz & Tull, 2010). Studies of dispositional mindfulness support a

relationship with emotion regulation ability (Jimenez, Niles & Park, 2010; Modinos, Ormel, & Aleman, 2010;Arch & Craske, 2010). Evaluations of mindfulness-based interventions have found evidence for reductions in negative affect (see Chambers, Gullone & Allen, 2009 for review), as well as improvements in emotion regulation (Goldin & Gross, 2010; Arch and Craske, 2006). While this preliminary evidence supports a link between mindfulness-meditation and emotional regulation, this has not been investigated through RCTs.

Mindfulness treatment in jail settings.

While there have been a multitude of studies of mindfulness in non-correctional environments, little research has been conducted on mindfulness interventions during incarceration (see Himelstein, 2010 for review). Early studies conducted in a prison in India yielded promising results, as participation in a mindfulness meditation program correlated with reduced jail-misbehavior and symptoms of psychopathology (Chandiramani, Verma, & Dhar, 1998; Kumar, 1995; Vora, 1995). We are aware of only five published studies of either mindfulness approaches in United States correctional facilities. These include studies Mindfulness Based Stress Reduction (Samuelson, Carmody, Kabat-Zinn, & Bratt, 2007), silent Vipassana retreats (Bowen et al., 2006; Perelman, Miller, Clements, Rodriguez, Allen, & Cavanaugh, 2012; Simpson et al., 2007) and a mindfulness-based substance use intervention (Himelstein, 2011). Across these studies, participation in mindfulness programming during incarceration has been associated with reductions in post-release substance use (Bowen et al., 2006), improved

mood (Samuelson et al., 2007; Perelman et al., 2012), increased emotional intelligence (Perelman et al., 2012), and reduced self-reported impulsivity (Himelstein, 2011).

While these early investigations of mindfulness and incarceration offer some promising findings, they also have notable limitations. Major methodological limitations include lack of comparison groups (Himelstein, 2011), use of un-validated measures of symptoms (Chandiramani, Verma, & Dhar, 1998) and high attrition rates from pre-treatment to post-treatment assessments (Bowen et al., 2006; Samuelson et al., 2007). No studies have employed randomized assignment. Finally, the majority of these studies have been on Vipassana meditation courses, leaving little known about the effects of broader mindfulness-based interventions (e.g., Acceptance and Commitment Therapy) in correctional setting. All in all, it remains unclear how mindfulness treatment, especially mindfulness-based interventions, would be received by general treatment seeking inmates who did not specifically volunteer for a meditation-based treatment. Given the unique approach adopted by mindfulness-based programs, it is unclear if this approach would be feasible and acceptable to reduce inmates' impulsivity and distress-driven impulsivity.

The Current Study

The current study investigates impulsivity and distress driven impulsivity in a sample of jail inmates as treatment targets of a mindfulness-based intervention: the ReEntry Values and Mindfulness Program (REVAMP). The REVAMP aims to reduce psychological symptoms and improve values-based living. Specifically, REVAMP consists of eight 90-minute sessions delivered twice a week within the jail. REVAMP focuses on mindfulness and acceptance-based skills to improve coping and problem

solving abilities. Topics related to impulsivity and distress-driven impulsivity are covered throughout REVAMP (see description below).

Behavioral measures of impulsivity.

The current research aimed to conduct a thorough assessment of participants' impulsivity and distress-driven impulsivity at pre- and post-treatment. In order to best assess changes in impulsivity over time, the current study employs both self-report and behavioral measurement methods. Compared to self-report measures, behavioral measures have certain advantages that make them particularly well suited to assessment of impulsivity and distress-driven impulsivity. Behavioral measures provide specific measures of in the moment behavior. Researchers have argued that behavioral measures are more specific, less sensitive to social desirability bias, and more sensitive to mood induction (Dougherty, Mathias, Marsh, Jagar, 2005). Because they provide relatively non-transparent, fine-tuned, in the moment assessments, behavioral measures may be well suited to measuring specific facets of general impulsivity and distress-driven impulsivity.

Two well performing behavioral measures are the Balloon Analog Risk Task (BART; Lejuez, Read, Kahler, Richards, Ramsey, Stuart, Strong & Brown, 2002) and the Mirror Tracing Task (MTT; Strong, Lejuez, Daughters, Marinello, Kahler, & Brown; 2003; Leyro et al., 2010), which, respectively, measure risk taking and distress intolerance. Risk taking, a construct closely related to impulsivity, refers to behavior that involves both the potential for some reward balanced against the potential for harm (Lejuez, Read, Kahler, Richards, Ramsey, Stuart, Strong & Brown, 2002). The BART

has demonstrated a small to medium positive associations with measures of adolescents' substance use (MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2011; Lejuez et al., 2002; Bornovolova, Gwadz, Kahler, Aklin, & Lejuez, 2008) and adults' problematic alcohol use (Fernie, Cole, Goudie, & Field, 2010; Weafer, Milich, & Fillmore, 2011) Additionally, research in a variety of samples has found that risk taking on the BART is significantly higher among substance users compared to non-substance users (Hopko, Lejuez, Daughters, Aklin, Osborne, Simmons, & Strong, 2006; Duva, Silverstein, & Spiga, 2011; Ledgerwood, Alessi, Phoenix, Petry, & Ave, 2010; Lejuez et al., 2003).

Distress intolerance is defined as impulsively escaping (vs. enduring) negative experience (Leyro, Zvolensky, & Bernstein, 2010). Empirical research has shown that distress tolerance as measured by the mirror-tracing task has a significant positive longitudinal relationship to completion of a residential treatment program (vs. treatment drop out) among adults enrolled in residential substance use treatment (Daughters et al., 2005). Furthermore this relationship holds above and beyond substance use disorder symptom severity. A second study by Brandon and colleague in a sample of 144 smokers in treatment also found a positive longitudinal relationship between mirror-tracing task persistence and length of abstinence from nicotine (Brandon et al., 2003). Both of studies employed multiple behavioral measures of distress tolerance and found that the mirror-tracing task was the only measure to demonstrate incremental validity in its relationship with substance use outcomes (Daughters et al., 2005; Brandon et al., 2003).

Only two prior studies have investigated changes in performance on these behavioral measures over the course of treatment. In a sample of patients in a 30 day

residential drug treatment program, Alkin and colleagues found that participants' risk taking on the BART decreased from pre- to post-treatment (Aklin, Tull, Kahler, & Lejuez, 2009). In a similar sample, improvements in performance on the MTT have been observed in patients in residential treatment who received a six-session adjunctive distress tolerance intervention compared to patients who just received general residential treatment programming (Bornovalova, Gratz, Daughters, Hunt, Lejuez, 2012).

Behavioral measures are not without their limitations. They may be affected by an array of potentially confounding variables. For example, factors like attention and learning can affect performance on behavioral measures and, ultimately, contaminate measurement of impulsivity. Given the relative strengths and weaknesses of each approach, many have recommended that research utilize both behavioral and self-report measures in order to enhance construct and predictive validity (Cyders & Coskunpinar, 2011; McHugh et. al, 2011; Skeel, Neudecker, Pilarski, Pytlak, 2007). In accordance with these recommendations, the current study utilized the Balloon Analog Risk Task (BART: Lejuez et al., 2002) and the Titrating Mirror Tracing Task (TMTT: Lejuez & Calvin, 2011) in addition to self-report measures of self-control, impulsivity, and distress driven impulsivity.

Study Hypotheses.

This study aimed to answer the following research questions and address the following specific hypotheses:

Research Question 1 (general impulsivity): Compared to the control group, does the treatment group improve in self-report and behavioral measures of general (non-distressed driven) impulsivity?

Hypothesis 1: We hypothesize that the treatment group will demonstrate relative improvement in self-report measures of impulsivity. Specifically, we expect significant increases in self-reported self-control, persistence and planning ability in the treatment group relative to the control group.

Hypothesis 2: We hypothesize that the treatment group will demonstrate relative improvement in a computer-based behavioral measure of a construct related to impulsive behavior: risk taking. Specifically, we expect significant decreases in risk taking in the treatment group relative to the control group.

Research Question 2 (*distress-driven impulsivity)*: Compared to the control group, does the treatment group improve in self-report and behavioral measures of distress-driven impulsivity?

Hypothesis 3: We hypothesize that the treatment group will demonstrate relative decreases in self-report measures distress-driven impulsivity.

Hypothesis 4: We hypothesize that the treatment group will demonstrate relative improvement in computer-based behavioral measures of distress-driven impulsivity, including: distress-driven risk taking, and distress tolerance (Titrating Mirror Tracing Persistence Task, Lejuez & Calvin, 2009).

CHAPTER NINE: STUDY 2 METHODS

Participants

The current study presents data from a small-scale randomized controlled trial (RCT) of the Re-Entry Values and Mindfulness Program (REVAMP). Participants included 40 adults males incarcerated at the Fairfax County Adult Detention Center. Selection criteria included post-sentencing status, assignment to the jail's general population (i.e. not solitary confinement or forensic housing), language proficiency in English, and a release date that would allow adequate time for program participation and data collection. Due to the limited number of female inmates, only male inmates were eligible for participation in the RCT.

Measures

Self-Report Measures.

Questionnaires were administered using touch-screen computers not requiring computer literacy (e.g., no keyboard, no mouse) or by an individual interviewer who read all items to the participant. Demographics were assessed by participants' self-reported gender, age, and race as part of the initial Wave 1 (pre-treatment) interview.

Self-control was assessed at Wave 1 (pre-treatment) and Wave 2 (post-treatment) by the 13-item Brief Self-Control Scale (Tangney, Baumeister, Boone, 2004).

Participants rated how well statements described them (i.e. “I am good at resisting temptation”) on a 5-point scale. Participants were instructed to consider whether each “statement describes what you are like” and were not given a specific time frame. This measure was shown to be reliable in the current sample at Wave 1 (α=.84) and at Wave 2 (α=.90).

Impulsivity was assessed at Wave 1 and 2 by the Perseverance and Premeditation subscales from the UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001). The UPPS has been shown to be reliable and valid in college student sample (Whiteside & Lynam, 2001) as well as clinical samples (Whiteside & Lynam, 2003). Both the Perseverance (α=.88) and Premeditation (α=.89) subscales had good reliability in the current sample at Wave 1 (Perseverance, α=.88; Premeditation, α=.89) and Wave 2 (Perseverance, α= .90; Premeditation α=.97) .

Distress driven impulsivity at Wave 1 and 2 was assessed by the Negative Urgency subscale of UPPS Impulsive behavior subscale (Whiteside & Lynam, 2001). This 13-item subscale includes items such as “When I feel bad, I will often do things I later regret in order to make myself feel better now”. This scale demonstrated excellent reliability in this sample at Wave 1 (α=.92) and Wave 2 (α=.93) .

Substance use was assessed at Wave 1 using the Texas Christian University: Correctional Residential Treatment Form, Initial Substance Use Assessment (TCU-CRTF) (Simpson & Knight, 1998). Participants reported frequency of substance use during the three months prior to incarceration. Participants reported how often they used

alcohol, marijuana, cocaine, and opiates on a scale ranging from 0 = "Never" to 8 = "More than once a day."

Participant feedback was assessed by anonymous questionnaires that participants completed at the end of the program just prior to Wave 2. Participants were able to either turn in the feedback or mail the feedback form (through the free jail-based mail system) to program facilitators. Participants used a 1 ('poor') to 4 ('excellent') scale to rate the intervention's quality, usefulness as well as their overall satisfaction with participation.

Behavioral measures.

Behavioral measures were administered by trained research assistants in two sessions: the first (Wave 1) occurred within one week before the start of treatment and the second (Wave 2) within one week after the end of treatment. The behavioral measures session was presented as optional, and participants were informed that some tasks may be frustrating. Participants were informed that they would earn between $5-10 depending on their performance on each task. All participants elected to participate in the behavioral measures session. Throughout the behavioral measures session, participants provided several ratings of subjective units of distress on a scale from one (least distressed possible) to ten (most distressed possible) throughout the session. After completing the first distress rating, participants completed the baseline administration of the BART, followed by a second distress rating. Next participants completed the TMTT followed by a final distress rating. The session concluded with the post-distress administration of the BART. Figure 2.1 presents a visual representation of the sequence of behavioral measures administered at each Wave.

Risk taking was assessed by the Balloon Analog Risk Task (BART; Lejuez et al., 2002). This computerized task presented participants with a graphic of a balloon that they could inflate by clicking the mouse. Each mouse click represented one 'pump' of the balloon that earned the participant one cent in a temporary bank. With each pump, there was an increased chance that the balloon would pop. Specifically, there was a 1/128 probability that the balloon would pop on the first pump, a 1/127 probability that it would explode on the second pump, and continuing on until the 128th pump, which had a 1/1 chance of exploding. If the balloon popped, participants lost all of the money they had earned on that balloon in their temporary bank. Participants continued pumping up the balloon until either it popped or they decided to move onto the next balloon. Consistent with prior research using the BART, participants were given limited information about the task. They were not informed of the chances the balloon would pop (Lejuez et al., 2002). Participants were informed that they would receive 20 balloons on which they could earn money.

The primary outcome variable for the BART is the adjusted number of pumps, which equals the average number of pumps on balloons that did not explode. Individuals who scored high on this were considered to have a higher propensity for risk taking than those who score low. This study administered a series of 20 balloons to participants at two time points within the behavioral measures session (pre-distress induction and post-distress induction). Lejuez and colleagues (2002) administered a series of 30 balloons in a sample of 86 adults and found that average correlation between sets of 10 balloons was high ($r > .8$; Lejuez, 2002). Additionally, studies that have administered the 30-balloon

BART report that their results would have been identical if only 10 balloons were used (Lejuez et al., 2002; Lejuez et al., 2003).

Distress intolerance was assessed by the Titrating Mirror Tracing Persistence Task (TMTT: Lejuez & Calvin, 2011). In this study, the TMTT served two roles: 1) to induce frustration and 2) to operationalize distress intolerance. Participants were asked to trace a star with the cursor using a reversed program computer-mouse (moving the mouse up and to the left would result in the cursor moving down and to the right). When the cursor is moved off of the lines of the star for more than two seconds, the cursor returns to the start position and a loud buzzing noise sounds. Participants complete three practice levels of the task (easy, medium, hard) before the final level during which they are able to quit the task. The difficulty of each level is based on performance on the previous level, titrating the difficulty to participant skill level. During the fourth level of the task, participants are informed that they can quit whenever they want by pressing the spacebar. The outcome variable of the mirror tracing tasks is latency to quitting the task measured in seconds. The TMTT keeps the same basic structure of other mirror tracing tasks but includes a longer practice period and adjusts the difficulty of the task based on the participant's performance. This modification was made to address the evidence found in previous studies that participant persistence was confounded with participant ability. That is, participants who made fewer errors on the task tended to persist longer than participants who made more errors (Daughters et al., 2005).

Distress-driven Risk taking was assessed by comparing scores on the BART obtained before and after the distressing TMTT. This study administered the BART

twice: before the TMTT (baseline BART) and immediately after the TMTT (post-distress induction BART) (see Figure 4). Distress driven risk taking is conceptualized as change on the BART post-distress induction compared to baseline. To calculate this, the post-distress induction BART was regressed on the baseline BART and a standardized residual value was saved as an additional variable (Δ BART). This variable, variance in the post-distress induction BART independent of base-line risk taking, is interpreted as a measure of distress-induced risk taking.

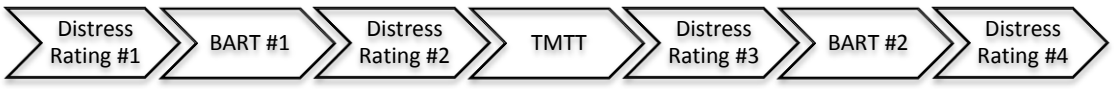


Figure 4: Behavioral Measures Session

Procedures

Participant Enrollment.

Enrollment for the study occurred in 2011. All participants underwent a process of informed consent, which stressed the voluntary nature of participation and the confidentiality of data. Eligible inmates were informed that the study involved potentially participating in a program designed to "identify goals for the future and learn new ways to deal with strong emotions." Random assignment was explained to inmates before they decided whether or not they wanted to participate. Participants were informed that data

are protected by a Certificate of Confidentiality from Department of Health and Human Services. All research procedures were approved by the Institutional Review Board at the researchers' university.

Schedule of assessments.

Data collection occurred at three time points: pre-treatment (Wave 1), post-treatment (Wave 2) and post-release follow up (Wave 3). The current study presents data from Waves 1 and 2. Pre- and Post-treatment interviews were conducted in secure areas of the jail that ensured privacy and confidentiality. All data were collected by trained research assistants who were blind to treatment condition.

Randomization and Study Conditions.

After Wave 1, all participants were randomly assigned to either have access to normal jail programming (treatment as usual: TAU) or to receive REVAMP in addition to having access to normal jail programming (REVAMP + TAU). Programs available in the jail included mental health groups (e.g., depression support group), anger management, financial planning, health education, GED services, religious services, substance abuse treatment, parenting skills, mentoring, employability skills, and computer skills. Across both groups, 21 participants were assigned to REVAMP+TAU and 19 participants were assigned to TAU.

REVAMP

The REVAMP aims to reduce psychological symptoms and improve values-based living. An outline of REVAMP is provided in Table 3. Topics related to impulsivity and

distress-driven impulsivity are covered throughout REVAMP. For example, Sessions 5 and 6 cover skills for managing distress, both in the short term and long term. Additionally, Session 6 covers the upsetting emotions model in depth, which describes the relationship between emotions and impulsive behavior. Other relevant session topics include acceptance of emotional pain in Session 3, mindfulness of thoughts, emotions, and physical sensations (Session 4). Except for the first and the last session, the session structure was consistent. Sessions began with an opening mindfulness exercise, review of homework, curriculum, discussion, homework assignment, and closing mindfulness exercise. See Table 3 for outline of session content. For a more detailed description of REVAMP, see Malouf, Youman, Harty, Schaefer and Tangney (2013). The REVAMP program was delivered in groups that met twice a week for 90-minute sessions over the course of four weeks. There were two rounds of treatment, the first of which began in May 2011 and the second in July 2011.

Therapist training and treatment fidelity.

Co-facilitators were an advanced graduate student and a recent graduate of a George Mason University's clinical psychology PhD program. Both facilitators had previous training in mindfulness-based treatments. A licensed clinical psychologist provided supervision. Co-facilitators rotated between two roles; one would deliver the treatment while the second ensured fidelity to the manual.

All sessions were videotaped for fidelity coding. A checklist of each session was created based on the treatment manual. Two research assistants watched session tapes

and independently rated whether each treatment component was fully covered, partially covered, or absent.

Table 3: REVAMP Treatment Outline

- Session 1- *Introduction*
  - Topics: Program goals and rationale
  - In class exercise: Introduction to mindfulness meditation
  - Homework: brief values reflection
- Session 2-*Values Identification*
  - Topics: Identifying and clarifying values, setting values-based goals
  - In class exercise: Values identification
  - Homework: Detailed values identification and goal setting inventory (i.e. "Life compass exercise")
- Session 3-*Acceptance and Willingness*
  - Topics: Pain vs. suffering, experiential avoidance, acceptance and willingness
  - In class exercise: Willingness metaphor (i.e. "Fingertrap exercise")
  - Homework: Avoidance Inventory
- Session 4- *Automatic Pilot/ Present Awareness*
  - Topics: Automatic pilot vs. present awareness
  - In class exercise: Awareness of thoughts (i.e. "mental chatter exercise")
  - Homework: Two formal mindfulness practices of body (i.e. "body scan") and thoughts (i.e. "leaves on stream").
- Session 5-*Short-term Distress Tolerance*
  - Topics: Adaptive and maladaptive coping techniques
  - In class exercise: brainstorm and discuss coping techniques (i.e. "five senses adaptive self-soothing")
  - Homework: Personal adaptive self-soothing
- Session 6- *Long-term Distress Tolerance*
  - Topics: Upsetting emotions model, observer perspective
  - In class exercise: Observer perspective metaphor (i.e. "chessboard exercise")
  - Homework: Future monitoring of distress
- Session 7- *Values in Action and Perceived Barriers*
  - Topics: Short-term achievable goals, Overcoming barriers to goals
  - In class exercise: Goal setting exercise
  - Homework: Identifying barriers to valued living/ strategies
- Session 8-*Conclusion*
  - Topics: Review
  - In class exercise- discussion

CHAPTER TEN: STUDY 2 RESULTS

Preliminary analyses

Of the 40 participants who completed baseline assessment and were randomized to receive either REVAMP or TAU, two were transferred or released early and were unable to participate in post-treatment follow-up assessment (Wave 2). Thirty-eight participants completed some portion of the Wave 2 assessment with 35 completing the post-treatment behavioral measures assessment. Reasons for missing the behavioral measures session included inadequate time betw een end of treatment and release date (two participants) and refusal to attend the session (one participant). Due to computer malfunctions, three participants scores were excluded from Mirror Tracing Analyses (one at baseline and two at follow-up). Additionally, one participant's mirror tracing score was deemed to be invalid due to abnormal behavior during the Wave 2 assessment.

Characteristics of Sample and Success of Randomization.

This sample was diverse in terms of race/ethnicity (48% African American, 27% Caucasian, 15% Hispanic/Latino,10% Other). The average age was 37.2 (*SD*=15.7*)* with participants ranging from 18 to 81 years old. On average, participants had completed 12.0 years of education (*SD*=2.5). Participant's education ranged from eight to 18 years. Participants reported high rates of pre-incarceration substance use. During the three

months prior to arrest, 82.5% of participants reported alcohol use, 45.5% marijuana use, 10% reported opiate use, and 22.5% reported cocaine use.

Differences between the treatment and control group at baseline were assessed by a series of *t* tests. Results found no significant differences in age (t=-.28, p=.78), education (t=-1.21, p=.23), or frequency of pre-incarceration use of alcohol (t=-.90, p=.37), marijuana (t=.59, p=.56), cocaine (t=.41, p>.68), or opiates (t=-.11, p>.91). Additionally, the treatment and control groups were not significantly different in racial composition according to Chi Square analysis ($\chi^2(2)=2.04$, p=.36). As can be seen in Table 4, there were no significant differences between the treatment and control group in any of the behavioral or self-report measures involved in the study at time 1 indicating success of randomization.

Effect of Treatment on Impulsivity and Distress Driven Impulsivity

Hypothesis 1: Self-reports of self-control, perseverance, and premeditation.

At post-treatment, results of independent samples *t*-tests found no significant differences between the treatment and the control group in measures of self-control or perseverance. The treatment group reported marginally significantly higher levels of premeditation compared to the control group (T=-1.90, p=.07). Results of analysis of covariance (ANCOVA), in which baseline levels of each variable were taken into account, are found in Table 5. When pre-treatment levels of premeditation were taken into account, there was a relative increase in premeditation observed in the treatment

group that was of small to medium effect size (Cohen's d=.43). However, this increase was statistically non-significant in this small sample (p=.15).

To examine if dosage of REVAMP (number of REVAMP sessions attended) was related to change in self reports of impulsivity, each variable measured at time two was regressed on number of sessions attended controlling for the baseline level of that variable (Table 6). Results found no significant relationship between treatment dosage and changes in self-reported self-control or premeditation among those participants assigned to the REVAMP condition. There was a marginally significant positive relationship between treatment dosage and increases in self-reported perseverance. While this relationship was only marginally significant in this small sample, the effect size was of medium strength (β= .42, p=.09).

Hypothesis 2: Behavioral Measure of risk taking.

The treatment group did not differ from the control group in risk taking measured by the pre-distress induction BART. Neither was change in risk taking significantly different between the treatment and control group. Although not significant, the treatment group evidenced higher post-treatment risk taking and a small to medium effect size increase in risk taking from pre to post treatment relative to the control group. Treatment dosage had a positive relationship with increase in risk taking on the BART, that, while not statistically significant, was of medium effect size (β= .39, p=.10).

Hypothesis 3: Self-reported distress-driven impulsivity.

At post-treatment, results of independent samples *t*-tests found no significant differences between the treatment and the control group in self-reported distress-driven impulsivity. When controlling for pre-treatment distress-driven impulsivity, this effect remained non-significant.

Hypothesis 4: Behavioral measures of distress-driven risk taking and distress intolerance.

Regarding changes in distress-driven risk taking, we considered performance both on the post-distress induction trial of the BART as well the difference score between the pre- and post- distress trials of the BART. Following treatment, participant's performance on the post-distress induction BART was marginally significantly higher in the treatment group compared to the control group (p= .09). When pretreatment (Wave 1) performance on the post-distress induction BART was controlled, this difference dropped to non-significant (p=.18) but remained of a small to medium effect size (Cohen's D = .34). Results from T-test and ANCOVA found no significant effect of treatment on the distress-driven risk taking difference score. Treatment dosage was unrelated to either measure of distress driven risk taking.

Distress tolerance as measured by persistence on the TMTT was not significantly different between the treatment and control groups at post treatment (Wave 2), although the treatment group persisted slightly longer. When the effect of pre-treatment (Wave 1) distress tolerance was controlled, this effect remained non-significant with a small effect

size (Cohen's d= .26). Treatment dosage was unrelated to distress tolerance assessed by the TMTT.[4]

REVAMP: Feasibility and Acceptability.

Feasibility and acceptability of REVAMP were assessed via an examination of records of participant attendance and feedback. Of the 21 participants randomized to REVAMP, 10 people (25.0%) attended all sessions, five people (12.5%) attended seven sessions, one person (2.5%) attended six sessions, and five people (23.8%) attended five or fewer sessions. In sum, 71.4% of the sample missed no more than one class, receiving 87.5% of the treatment curriculum. Over the course of treatment, two inmates were transferred, causing one to miss four sessions and the other to miss five sessions. Additional reasons that participants missed treatment included medical procedures, partial lock down of the facility, and schedule conflict with other programs and jail-based employment.

Eleven of the participants who had been assigned to REVAMP, and who were not transferred, completed the feedback form (61%). On a one to four scale, participants rated the quality (*M*=3.3, *SD*=.78) and usefulness (*M*=3.5, *SD*=.69) of the program as well as their overall satisfaction with the program (*M*=3.6, *SD*= .51), indicating highly positive evaluations.

[4] To take into account clustering of data into two treatment cohorts, interclass correlations (ICC) were computed for all study variables at Time 2 for which there was some evidence of an effect of treatment (either at the *p*=.10 or *p*=.05 level). The ICC allowed us to determine if variance in the construct at time 2 was attributable to cohort membership. Results of ICCs found that 0.00% of the variance was attributable to cohort membership in BART score, Δ BART, premeditation, or perseverance.

Table 4: Group Differences in Impulsivity and DDI at Wave 1 and Wave 2 (t test)

	Pre-Treatment			Post-Treatment		
	TX	**Control**	**Diff.**	**TX**	**Control**	**Diff.**
Scale	*M (SD)*	*M (SD)*	*t*	*M (SD)*	*M (SD)*	*t (p)*
Self-Report Measures						
Impulsivity						
Self-Control	3.07 (.70)	2.93 (.77)	-.61	3.25 (.71)	3.00 (.99)	-.93
Premeditation	2.92 (.59)	2.80 (.51)	-.64	3.05 (.54)	2.73 (.49)	-1.90$^{\delta}$
Perseverance	3.21 (.48)	3.20 (.55)	-.03	3.09 (.51)	2.99 (.67)	-.50
Distress-Driven Impulsivity						
Negative urgency	2.17 (.56)	2.37 (.86)	.80	2.24 (.60)	2.31 (.90)	.28
Behavioral Measures						
Risk Taking						
BART pre	39.54 (13.40)	35.99 (12.91)	-.85	45.71 (12.03)	39.53 (10.87)	-1.58
Distress-Driven Risk Taking						
BART post	40.09 (13.95)	34.71 (11.66)	-1.28	45.72 (10.61)	38.90 (12.23)	-1.77$^{\delta}$
BART residual	.13 (1.14)	-.14 (.78)	-.88	.13 (1.07)	-.13 (.91)	-.77
Distress Tolerance						
TMTT	179.90 (119.81)	190.51 (101.64)	.30	157.62 (113.50)	143.70 (108.73)	-.35

δ = .05< *p* <.10

Table 5: Group Differences at Wave 2 Controlling for Wave 1 (ANCOVA)

Scale	Sum of Squares (df)	*F*	*p*	Cohen's d
Self-Report Measures				
Impulsivity				
Self-Control	.018 (1)	.071	.80	0.05
Premeditation	.409 (1)	2.24	.15	0.43
Perseverance	.06 (1)	.28	.60	0.16
Distress-Driven Impulsivity				
Negative urgency	.01 (1)	.04	.85	0.04
Behavioral Measures				
Risk Taking				
BART pre distress	149.93 (1)	1.40	.25	0.36
Distress-Driven Risk Taking				
BART post distress	114.08 (1)	1.87	.18	0.34
BART residual	.67 (1)	.67	.42	0.28
Distress Tolerance				
TMTT	6151.76 (1)	.921	.35	0.26

Table 6: Relationship of Treatment Dosage to Impulsivity and Distress Driven Impulsivity at Wave 2

	Dosage *r*	Dosage controlling for Time 1 Beta
Self-Report Measures		
Impulsivity		
Self-Control	.40	.23
Premeditation	.08	.09
Perseverance	**.52***	**.41** $^{\delta}$
Distress-Driven Impulsivity		
Negative urgency	-.21	-.09
Behavioral Measures		
Risk Taking		
BART pre distress	.39	.39
Distress-Driven Risk Taking		
BART post distress	**.46**$^{\delta}$	.25
BART residual	.13	.40
Distress Tolerance		
TMTT	-.25	-.11

* $p < .05$, $^{\delta} = .05 < p < .10$

CHAPTER ELEVEN: STUDY 2 DISCUSSION

This study aimed to answer questions about whether mindfulness treatment was associated with improvements in measures of general impulsivity and distress-driven impulsivity. We employed both self-report measures and computer-based behavioral measures to assess these constructs in a sample of 40 adult male jail inmates, 20 of whom participated in the ReEntry Values and Mindfulness Program (REVAMP) and 20 of whom received treatment as usual.

REVAMP and changes in participants' general impulsivity

We expected that jail inmates who were assigned to participate in REVAMP would improve in self-reported assessments of impulsivity relative to those who received only treatment as usual (Hypothesis #1). We found partial support for our hypothesis, as there was some evidence of modest improvements in self-report measures of general impulsivity in the treatment group compared to the control group. We administered three self-report questionnaires of general impulsivity, measuring self-control, premeditation and perseverance. No results were statistically significant at the conventional cutoff of $p<.05$, however there were two marginally significant trends (i.e. more than five percent likelihood but less than 10% likelihood that the observed effects would have occurred due to chance if there was truly no effect). There was evidence that the treatment group increased in premeditation compared to the control group (medium effect size) and that

treatment dosage was related to increases in perseverance (medium effect size). While these effects were modest, they offer some promising initial evidence that participation in REVAMP is associated with improvements in self-reported impulsivity.

We hypothesized that REVAMP would be associated with decreased risk taking as measured by performance on the Balloon Analog Risk Task (Hypothesis #2). However, no statistically significant differences between the treatment and control groups in risk taking on the BART were observed. It is notable that the data suggest, if anything, a trend in the opposite of the hypothesized direction, such that the treatment group took slightly (non-significantly) more risks compared to the control group.

REVAMP and changes in distress driven impulsivity

We expected that the REVAMP program would improve participants' distress-driven impulsivity, the tendency to behave impulsively when distressed, as measured by self-report (Hypothesis #3) and behavioral measures (Hypothesis #4). However, there were no observed statistically significant improvements in either self-report or behavioral measures of distress-driven impulsivity. Of note, the trend for distress tolerance was in the expected direction with the treatment group persisting slightly longer than the control group on a distressing task. On the other hand, the trend for distress-driven risk taking was in an unexpected direction; the treatment group, when distressed, took slightly more risks than the control group on the BART.

Despite the strong theoretical support for an effect of mindfulness-based treatment on distress-driven impulsivity, we did not find evidence in this small pilot trial. Because of small sample size, we cannot assume that failure to find statistically significant result

means that the treatment had no effect on distress-driven impulsivity. Instead, we can take these results as indicating that any effect of REVAMP is unlikely to have been of large effect size.

REVAMP feasibility and acceptability

Prior studies of mindfulness-based interventions in correctional settings have employed samples of inmates who selected to participate in mindfulness treatment. Given that mindfulness-based treatments involve methods that are unconventional (e.g., meditation) compared to other jail based programs, we were uncertain how the treatment would be received in the general population of treatment-seeking inmates. Results indicate that REVAMP is a feasible and acceptable treatment for a sample of general population treatment-seeking jail inmates. Rates of attendance were similar to rates of attendance reported in samples of where inmates volunteered for mindfulness-programming. For example, Samuelson and colleagues found that 70% of prison inmates who chose to participate in a mindfulness-based stress reduction program completed at least 80% of the course (Samuelson, Carmody, Kabat-Zinn & Bratt, 2007). The current study found that 72% of participants completed at least seven of the eight courses (88% of coursework). Additionally, participant feedback indicated high level of satisfaction and appreciation for the course.

Limitations and Future Directions

The most substantial limitation of this study was the small sample size. We enrolled a sample of 40 participants into the RCT, with only 35 individuals who

completed behavioral measures at both time points. This sample size provided very limited statistical power to detect significant effects. It is important to recognize that null findings reported in this study may either be due either to lack of actual effect of treatment on distress driven impulsivity or limited power.

This study employed both self-report and behavioral measures of impulsivity and distress-driven impulsivity. Both types of measures are subject to limitations. Social desirability bias and lack of insight can contaminate self-report measures. These limitations should be kept in mind when interpreting findings from the current study. For example, the observed increase in self-reported premeditation for participants who received REVAMP should considered with some caution as we are unable to rule out the possibility that these differences are due to biased responding.

The behavioral measures employed in this study had their own limitations. Due to technical difficulties on the mirror tracing task, data from three participants were lost. This further limited this study's power. Additionally, the behavioral measure of risk taking employed in this study, the Balloon Analog Risk Task, has notable limitations related to construct validity. Because participants are not informed of the likelihood that balloons will explode, learning is confounded with risk taking. Other studies have employed an alternative administration of the BART in which participants were informed of the average explosion point, and thus, minimized this confound. One such study using this alternative BART found that risk taking on the BART reduced across the course of substance abuse treatment (approximately 30 days) for individuals who received substance abuse treatment compared to waitlist controls (Aklin, Tull, Kahler, Lejuez,

2009). Future research may benefit from employing this alternative administration of the BART in order to enhance the BART's construct validity.

Finally, the specific nature of this study's sample must be considered. The current study employed a high-risk sample of male jail inmates who were diverse in terms of race/ethnicity and age. While we believe that this is a highly important sample, findings may not generalize to other populations, for example female inmates or adolescent offenders or those not involved in the criminal justice system. All in all, results indicate a promising area for future research: impulsivity as a treatment target of mindfulness intervention in a jail setting. Future research using larger and more diverse samples could profitably examine factors that moderate the impact of mindfulness interventions on both general impulsivity and distress-driven impulsivity.

APPENDIX A : MEASUREMENT INFORMATION FOR BEHAVIORAL MEASURES

Mirror Tracing Descriptive

Of the 108 participants who completed the titrated mirror tracing task (TMTT), 62 (57.4%) quit before the maximum time had passed and 46 (42.6%) persisted for the entire five minute testing period. On average, participants persisted 217.32 seconds (*SD*= 97.77). There was no difference in persistence on the TMTT between participants who received the IOC treatment and those who were in the control group ($t(102)=-.40$, $p>.10$). Because distress tolerance is conceptually distinct from tracing skill and the TMTT calibrates task difficulty to skill level, TMTT persistence should be uncorrelated with measurements of participant skill-level. Time persisted on the TMTT was not correlated with distance traced at the easy level ($r=-.12$, $p>.10$), medium level ($r=-.11$, $p<.10$), or hard level($r=-.08$, $p<.10$), nor with errors made on the easy level ($r=-.06$, $p>.10$), or medium level($r=-.16$, $p>.10$). However, there was a small negative relationship between number of errors made on the hard level of the task and persistence on the final level ($r= -.21$, $p< .05$).

Distress-driven risk taking descriptives

On average, participants pumped 36.69 (*SD* = 12.37) pumps on balloons that did not explode during the pre-distress induction trial of the BART (BART1) and 38.49 (*SD* = 12.64) on the post-distress induction trial of the BART. Thus, on the whole,

participants tended to take more risks on the post-distress induction BART compared to the pre-distress induction BART (t=2.19, p<.05). The effect size for this difference was small (Cohen's d=.14). There was no difference in the residualized gain score between participants who received the IOC treatment and those who were in the control group (t(100)=1.06, p>.10).

APPENDIX B: SUPPLEMENTARY RESEARCH QUESTION

The following research question and two hypotheses were included in the dissertation proposal but excluded from the final dissertation paper: *To what degree are different measures of distress-driven impulsivity related to one another?*

Rationale

In the domain of general impulsivity, correlations between self-report and behavioral measurement methods tend to be very modest, suggesting that they each capture unique components of the overarching construct of impulsivity (Cyders & Coskunpinar, 2011; Lane, Cherek, Rhoades, Pietras, & Tcheremissine, 2003; Gerbing et al., 1987; McHugh, Daughters, Lejuez, Murray, Hearon, Gorka, & Otto, 2011; Reynolds, Penfold, & Patak, 2008; Reynolds et al., 2006). Very few studies have investigated correlations between self-report and behavioral measures of specifically *distress-driven* impulsivity. One study by McHugh and colleagues found small to non-significant correlations between behavioral and self-report measures of distress intolerance (McHugh, Daughters, Lejuez, Murray, Hearon, Gorka, & Otto, 2011). In order to determine the relative importance of each measure in the relationship with substance misuse, this study considered both self-report and behavioral measures of distress-driven impulsivity.

In addition to a widely used self-report measure, this study looks at two different behavioral measures of distress-driven impulsivity. A measure of distress intolerance operationalizes the tendency to escape from negative emotions while a measure of distress-driven impulsive risk taking operationalizes risky behavior under conditions of distress. This study hypothesizes that behavioral measures of distress-driven impulsivity (i.e., distress intolerance and distress-driven impulsive risk taking) will have a small positive relationship with one another (Hypothesis 1A) and that these behavioral measures will demonstrate a modest correlation with a self-report measure of distress-driven impulsivity (Hypothesis 1B).

Hypotheses

Hypothesis A: Behavioral measures of distress-driven impulsivity (i.e., distress intolerance and distress-driven impulsive risk taking) will be positively correlated.

Hypothesis B: Behavioral measures will demonstrate a modest correlation with a self-report measure of distress-driven impulsivity.

Results

Correlations between Behavioral Measures (Hypotheses A).

Correlations among all behavioral and self-report measures of impulsivity can be found in Table 1. Contrary to my hypothesis, distress intolerance measured by persistence on the titrating mirror tracing task (TMTT) was uncorrelated with changes in risk taking between the two trials of the BART (Δ BART). Additionally, participants who quit the TMTT and those who persisted did not differ significantly in any behavioral measure of risk taking. We found no significant mean difference between those who persisted and

those who quit on the baseline BART ($t(105)=.87$, $p>.10$), or on the post-distress induction BART ($t(104)=.71$, $p>.10$), nor changes in risk taking ($t(104) =.02$, $p>.10$).

Correlations between Behavioral and Self-Report Measures (Hypotheses B).

Behavioral measures (e.g., risk taking, distress-driven risk taking, and distress intolerance) had no significant relationships with self-report measures of impulsivity and distress-driven impulsivity. As can be seen in Table 1, bivariate correlations between all measures were small and non-significant, contrary to the hypothesis. Results of *t* tests found that participants who persisted on the TMTT did not have different means from those who quit the task in self-reported distress-driven impulsivity $t(99)=.69$, $p>.10$) or self-control $t(99)=.28$, $p>.10$).

Discussion

Contrary to hypotheses, no significant correlation was observed between behavioral measures of distress intolerance (TMTT) and distress-driven risk taking (Δ BART). Individuals with low persistence on the TMTT task were not more likely to engage in distress-driven risk taking. These results indicate that, sensitivity to short-term rewards may be independent of sensitivity to short-term relief. Also contrary to hypotheses, all relationships between self-report and behavioral measures were non-significant. All in all, this work contributes to the growing evidence that behavioral measures of impulsivity are less consistently related to other measures of impulsivity, including other behavioral measures and self-report measures.

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