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Understanding How Change Occurs for Women of Childbearing Age: The Role of Depression and Marijuana Use on Reducing Alcohol Consumption

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Understanding How Change Occurs for Women of Childbearing Age: The Role of Depression and Marijuana Use on Reducing Alcohol Consumption

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Dedication

I dedicate this dissertation to my parents, Drs. Yong Gyo and Jungsook Park Lee.

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Understanding How Change Occurs for Women of Childbearing Age: The Role of Depression and Marijuana Use on Reducing Alcohol Consumption

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Alcohol and marijuana are reportedly two of the most pervasively used substances in the United States among women of childbearing age (18-44 years). About 10–50% of childbearing-aged women report drinking alcohol and are at risk of an Alcohol-Exposed Pregnancy (AEP). As for marijuana use, about 9.5% of women of childbearing age report marijuana use in the past month, and use has been steadily increasing since 2007. Further compounding concerns for women include mental health disorders like depression. Among women of childbearing age, studies have estimated that about 8-16% suffer from depression.

Furthermore, it is all too common for both substance use and mental health disorders to co-occur. Comorbid substance use and mental health disorders among women of childbearing age have emerged as a particularly significant area of concern. However, a key obstacle in further understanding the relationship between these disorders among women, in general, is that women either do not report, or under-report substance

abuse and mental health symptoms, and may not be aware of the concerns associated with substance use while at risk for pregnancy. Therefore, it is critical to find a setting where women can receive information about alcohol- and substance-exposed pregnancies, while also identifying and treating these co-occurring disorders.

This dissertation explores the feasibility of meeting these needs through primary care settings. Primary care, identified as an "opportunistic setting," is often the first setting substance use and mental disorders are detected and addressed. However, comorbidity in primary care has not been explored in detail, more so for women of childbearing age, and requires further examination. Alcohol use, marijuana use, and depression are all critical issues for childbearing-aged women, and often occur concurrently, yet research is limited and needs further attention. Therefore, this dissertation aims to better understand comorbid alcohol use and depression, and comorbid alcohol use and marijuana use among women of childbearing age presenting in primary care. To do so, this dissertation draws upon the Transtheoretical Model of Change to study a sample of women from the CDC-funded CHOICES Plus study who were at risk of an AEP.

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I. INTRODUCTION

Introduction

Alcohol and marijuana are reportedly two of the most pervasively used substances in the United States among women of childbearing age (18-44 years). About 10–50% of childbearing-aged women report drinking alcohol and are at risk of an alcohol-exposed pregnancy (AEP) (Center for Disease Control and Prevention [CDC], 2017). In addition, approximately 9.5% of women of childbearing age report marijuana use in the past month (Substance Abuse and Mental Health Services Administration [SAMSHA], 2015), and use has steadily increased since 2007 (National Survey on Drug Use and Health [NSDUH], 2014). Further compounding concerns for women are mental disorders such as depression. Among women of childbearing age, studies have estimated that about 8-16% have depression (Barth et al., 2015; Letourneau et al., 2015; Geier et al., 2015; Ko et al., 2012).

Moreover, substance use and mental disorders commonly occur together. Comorbid substance use and mental disorders among women of childbearing age have emerged as a particularly significant area of concern (Ko et al., 2015; Bertrand et al., 2004; Riley, Infante, & Warren, 2011; Velasquez et al., 2010). Though exact estimates are unavailable, up to 50% of women of childbearing age are estimated to have co-occurring substance use and mental disorders (Khan et al., 2013a; Khan et al., 2013b; D'Angelo et al., 2007).

Women of childbearing age are especially important for researchers to consider, because prevention efforts can significantly reduce the harmful effects of substance use (i.e., alcohol, marijuana) and mental disorders (i.e., depression) before pregnancy for this group (van Gelder et al., 2010; Passey, Sanson-Fisher, D'Este, & Stirling, 2014). While alcohol use, marijuana use, and depression and their co-occurrence are critical issues for childbearing-aged women, research on the subject is limited.

A key obstacle to understanding the relationship between these co-occurring substance use and mental disorders is that, in many cases, women either do not report or they under-report substance abuse and mental health symptoms (Bessa et al., 2010; Ernhart et al., 1988; Myers et al., 2014). Furthermore, many women may be unaware of the risks associated with substance use during pregnancy, which could result in a substance-exposed pregnancy (SEP). Health care providers must give women with more information about SEP in the clinical settings where women seek diagnosis and treatment for these co-occurring substance use and mental disorders.

This dissertation explores the feasibility of meeting these needs through primary care settings. Primary care, identified as an "opportunistic setting," is often the first setting substance use and mental disorders are detected and addressed (SAMSHA, 2015; National Institute on Drug Abuse [NIDA], 2010; Cummings & Cummings, 2000; Jeffrey et al., 2014; O'Donohue et al., 2005). Since up to 20% of patients in primary care settings present with substance use and mental disorders (NSDUH, 2010; Jeffrey et al., 2014; Wittchen et al., 2002; Nordstrom & Bodlund, 2008; Unutzer & Park, 2012), primary care settings provide prime opportunities for facilitating prevention, screening, and treatment

for co-occurring substance use and mental disorders, compared to other treatment settings like specialty substance use and mental health facilities which carry more stigma (Connors, DiClemente, Velasquez, & Donovan, 2013). However, comorbid substance use and mental disorders among women of childbearing age have not been explored in detail in primary care centers and require further examination.

PROBLEM STATEMENT

Risks for SEPs have been addressed in a series of studies. For example, in a randomized controlled trial to test an intervention to reduce alcohol- and tobacco-exposed pregnancies (Velasquez et al., 2017), participants with depression were twice as likely to continue risk drinking as non-depressed participants (Johnson, von Sternberg, & Velasquez, 2016). The current study aims to investigate comorbid alcohol use and depression, and comorbid alcohol use and marijuana use, among women of childbearing age in primary care settings. To do so, this dissertation draws upon the Transtheoretical Model of Change (Prochaska & DiClemente, 1984), that conceptualizes the means of behavior change, to study a sample of women from the CDC-funded CHOICES Plus study (Velasquez et al., 2017; U84 DD000438) who were at risk of an AEP. CHOICES Plus tested the efficacy of a briefer two-session "bundled" (alcohol, contraception, and tobacco) behavior intervention aimed at reducing the risk of alcohol- and tobacco-exposed pregnancies (Velasquez et al., 2017).

II. LITERATURE REVIEW

The literature review outlines the importance of addressing both comorbid alcohol use and depression and comorbid alcohol and marijuana use among women of child-bearing age. This section also provides an overview of theories/theoretical frameworks of comorbidity, theories/theoretical frameworks of change, and reviews relevant literature on the application of theories/theoretical frameworks on the above mentioned comorbid relationships. Description and definitions of key concepts and issues are presented in Appendix A.

Importance of the Problem

This section provides an overview of comorbid alcohol use and depression and comorbid alcohol and marijuana use, with a targeted review of prevalence and negative effects of these comorbid relationships among women of childbearing age followed by a review of alcohol use, marijuana use, and depression among patients in primary care settings.

COMORBID ALCOHOL USE AND DEPRESSION

Prevalence of comorbid alcohol use and depression. In 2002, the National Institute of Alcohol Abuse and Alcoholism (NIAAA) sponsored the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) to examine comorbidity among alcohol use disorders and nine independent mood/anxiety disorders among 43,000 adults in the United States (Grant, Moore, & Kaplan, 2003). The study found that those with alcohol dependence were almost four times more likely to have

depressive disorder than those without alcohol dependence (Grant et al., 2003). Others have also found that major depressive disorder was the mental health disorder most frequently associated with alcohol use disorder (NIAAA, 2002; Gold & Aronson, 2010; Kessler, 2004; Kushner, Abrams, & Borchardt, 2000).

Negative effects of comorbid alcohol use and depression. Studies indicate that individuals with co-occurring alcohol use and depression are at risk of developing adverse health problems related to motor activity, endocrine regulation, memory, learning, and cognition (D'Souza et al., 2008; Gardner, 2005; Laviolette & Grace, 2006; Johns, 2001). Other adverse effects include interpersonal conflict with family and friends (Rosenberg et al., 2001), financial problems (Mueser et al., 1998), homelessness (Goldfinger et al., 1999), and legal consequences (Mueser et al., 2001).

Comorbid alcohol use and depression among women of childbearing age.

Prevalence of comorbid alcohol use and depression among women of childbearing age. In the United States, approximately 50% of women of childbearing age report drinking alcohol (CDC, 2018; D'Angelo et al., 2007), and depression impacts about 8–16% of women in this same age group (Barth et al., 2015; Letourneau et al., 2015; Geier et al., 2015; Ko et al., 2012).

Negative effects of comorbid alcohol use and depression among women of childbearing age. About 50% of all pregnancies in the U.S. each year are unplanned (Finer & Zolna, 2016; CDC, 2016), and are likely higher for women who drink alcohol (Naimi et al., 2003). Many women are unaware of their pregnancy and may continue drinking during the first three months or more of the pregnancy (CDC, 2016; Floyd et al.,

2007; Kanny et al., 2013). The risks of alcohol use during pregnancy have been well-researched. It is estimated that about 1 out of 20 children born to women who drank while pregnant have Fetal Alcohol Spectrum Disorder (FASD) (May, Chambes, & Kalberg, 2018). AEPs cause FASD, which can include a variety of birth defects and developmental disabilities (Jacobson & Jacobson, 1999; Sood et al., 2001; Chudley, 2017). Examination of risks of depression among childbearing-aged women indicates that depressed women may be more likely to have unhealthy pregnancy practices (Marcus & Heringhausen, 2009; Hall et al., 2014), higher rates of smoking and substance use during pregnancy (Marcus & Heringhausen, 2009), poor pregnancy outcomes (Chung et al., 2001; Zukerman et al., 1990), and higher rates of preterm birth (Orr, James, & Prince, 2002) than non-depressed women.

COMORBID ALCOHOL USE AND MARIJUANA USE

Prevalence of comorbid alcohol use and marijuana use. Longitudinal examinations of the prevalence of alcohol use and marijuana use report that about 7-24% of U.S. adults use alcohol in combination with marijuana (Norton & Colliver, 1998; Midanik, Tam, & Weisåner, 2007; Martin, 2008). Studies report that marijuana use is more prevalent among younger drinkers (18-29 years) than older drinkers (Subbaraman & Kerr, 2016).

Negative effects of comorbid alcohol use and marijuana use. Comorbid alcohol and marijuana use significantly increases the risk of drunk driving, social consequences, and harm to self (Subbaraman & Kerr, 2016; Midanik et al., 2007).

Comorbid use of these substances has also been found to adversely affect cognitive functioning and has been linked to poor academic performance (Meda et al., 2017) and poor job-related outcomes (Normand, Lempert, & O'Brien, 1994). It is widely recognized that excessive alcohol and marijuana use may lead to substance use disorders (APA, 2013).

Comorbid alcohol use and marijuana use among women of childbearing age.

Prevalence of comorbid alcohol use and marijuana use among women of childbearing age. Examination of national prevalence rates of marijuana and alcohol use among childbearing-aged women from the 2007–2012 NSDUH indicated significant: 1 out of 10 childbearing-aged women reported using marijuana in the past year (Ko et al., 2015; Oh et al., 2017a), and about 9.5% reported using marijuana in the past month (also Oh et al., 2017b; SAMSHA, 2016). Additionally, women of childbearing-age who drink alcohol are often concurrent marijuana users (Ko et al., 2015; van Gelder et al., 2010; Passey et al., 2014): alcohol users were 2–3 times more likely to have used marijuana in the past year (Ko et al., 2015).

Negative effects of comorbid alcohol use and marijuana use among women of childbearing age. In addition to the aforementioned risks of AEP among women of childbearing age, a growing body of research has explored the implications of marijuana use for this population (Mark et al., 2017). Marijuana use before pregnancy increases the risk of preterm birth and stillbirths (Varner et al., 2014; Hurd et al., 2005), marijuana-(cannabis)-exposed pregnancy is also found to increase the risk of stillbirths (Hurd et al.,

2005) and is often associated with impairments in cognitive functioning (Goldschmidt, Richardson, Cornelius, & Day, 2004; Wu, Jew, & Lu, 2011).

Alcohol Use, Marijuana Use, and Depression in Primary Care Settings

Primary care is not only a gateway for treatment, but it is often where mental and substance use disorders are first recognized and addressed. Even subclinical substance use and mental health problems can be identified in primary care settings (SAMSHA, 2016; NIDA, 2010; Cummings & Cummings, 2000; Jeffrey et al., 2014; O'Donohue et al., 2005).

Exact estimates of comorbid alcohol use and depression, and alcohol use and marijuana use in primary care settings are unavailable. However, of primary care patients, 7–20% are estimated to have a substance use disorder (NSDUH, 2010; Jeffrey et al., 2014), and 5–20% present with depressive symptoms (Wittchen et al., 2002; Jeffrey et al., 2014; Nordstrom & Bodlund, 2008). In addition, about 10% of all primary care visits are related to depression, and depression among the most commonly treated conditions in primary care settings (Stafford, Ausiello, Misra, & Saglam, 2000; Unutzer & Park, 2012).

Theories/Theoretical Frameworks of Comorbidity

Copious information is available regarding comorbid substance use and mental disorders, as researchers across disciplines have attempted to understand the causes, consequences, and mechanisms of these relationships (Mueser et al., 2003; Swendsen & Merikangas, 2000; Sterling, Chi, & Hinman, 2011; NIDA, 2010). This dissertation

considers the The Common Risk Factor Model, which examines how and why comorbidity occurs. An overview of other theories/frameworks examining comorbidity is listed in Appendix B.

COMMON RISK FACTOR MODEL

The Common Risk Factor Model, also known as the Shared Risk Factor Model, may explain the relationship between substance use and mental disorders (Mueser et al., 1998; Degenhardt et al., 2003). According to this model, if a set of risk factors potentially results in comorbidity, and if that set of risk factors is the same or similar for two disorders, this may indicate that the disorders develop in similar ways (Degenhardt et al., 2003). In essence, the model suggests that one or more of the same factors may independently increase the risk for both substance use (i.e., alcohol use, marijuana use) and mental disorders (i.e., depression) (Mueser et al., 2003; NIDA, 2010; Fergusson et al., 1996; Kendler et al., 1993). In the following sections, factors that may impact comorbidity, 1) biological, 2) psychological, and 3) social/environmental common risk factors are discussed in detail.

Biological. Some argue that biological factors contribute to the rate at which comorbid relationships between substance use and mental disorders occur (Mueser et al., 2003; Mueser et al., 1998; Kessler, 1995; Caron & Rutter, 1991). Biological factors may include inherent traits such as genes or other features of a person's biological makeup that may contribute to developing comorbidity (i.e., genetic vulnerability). More specifically, while some researchers posit that some individuals may be genetically

susceptible to developing co-occurring substance use and mental disorders, others suggest that abnormal activities in the brain may contribute to the risk of developing this comorbidity (i.e., similar brain region/shared neurobiological dysfunction).

Psychological. In addition to biological factors, some psychological factors are thought to contribute to the development of co-occurring disorders. Although traits like neuroticism have been linked to substance use and mental disorders in the past (Eysenck & Eysenck, 1991; Andrews, 1996; Zunhammer, Eberle, Eichhammer, & Busch 2013), the most commonly referenced psychological factor linked to comorbidity is Antisocial Personality Disorder (ASPD) (Mueser et al., 2003; Krueger et al., 2002). A line of studies consistently demonstrates that ASPD (as well as Conduct Disorder, an early indicator of possible ASPD) is linked with both substance use and depression (Krueger et al., 2002; Mueser et al., 2003). Kessler et al. (1997) found evidence that individuals with ASPD have higher rates of substance use disorders. Others have found that other mental disorders are more prevalent among those with ASPD (Mueser et al., 2003). Studies of this kind support the notion that ASPD might be a common psychological risk factor that accounts for the comorbid relationship between substance use and mental disorders (Mueser et al., 2003).

Social. Research has also identified many social and environmental factors that may explain the comorbid relationship between substance use and mental disorders (Bachrach & Read, 2012). Overlapping social triggers caused by trauma, abuse, stress, drug exposure, and low SES may lead to substance use and other mental disorders (NIDA, 2010). Twin studies report that such environmental factors can increase the

likelihood of both alcohol dependence and depression (Tsuang et al., 1982; True et al., 1999).

Exposure to trauma/abuse. A common social risk factor for substance use and mental disorders is exposure to trauma (Mueser et al., 2003). Traumatic events, such as physical or sexual abuse experienced as a child or as an adult, have been identified as triggers for substance use disorders (Mueser et al., 2003). Consequently, individuals with a history of abuse have been found to experience mental disorders at higher rates (Wasserman, Havassy, & Boles, 1997). Similarly, a strong association between a history of abuse and/or trauma and substance use disorders has been found among those with mental disorders (Rosenberg et al., 2001).

Exposure to drugs. Exposure to drugs, including prenatal exposure to alcohol and drugs, puts an individual at greater risk of developing a substance use disorder and/or a mental health disorder (NIDA, 2014). Early exposure to substance use may cause significant changes to the brain, which may increase one's risk of developing a substance use disorder or mental health disorder (NIDA, 2014). Furthermore, the effects of drugs on the brain, especially during adolescence, are thought to significantly impact learning, memory, pleasure/reward, decision making, and behavioral control (NIDA, 2010). Several studies have assessed marijuana's negative impact on the brains of adolescents, as well on this population's risk of developing a mental disorder (NIDA, 2014).

Low SES/or poverty. Individuals with low socioeconomic status (SES) have higher rates of substance use and meet criteria for mood and psychotic disorders more often than the general population (Degenhardt et al., 2003; Kessler et al., 1995). Studies

report that financial problems often accompany mental disorders as well as substance use disorders (Drake et al., 1989; Mueser et al., 2003).

Other social factors impacting comorbidity include age (Tsai et al., 2007; Caetano et al., 2006; Pettigrew et al., 2016; Meschke, Holl, & Messelt, 2013), marital status (Kessler et al., 1995), race/ethnicity (Saraceno, Munafo, Heron, & van den Bree, 2009), peer relationships (Saraceno et al., 2009), and family dysfunction (Fergusson, Horwood, & Lynseky, 1994).

Theories/Theoretical Frameworks of Change

This dissertation also considered theories/theoretical frameworks of change as a mechanism of addressing each target behavior (i.e., alcohol use, marijuana use) or of overlapping effects of alcohol and marijuana use. This dissertation reviews an integrative psychosocial model of behavior change: the Transtheoretical Model of Change.

THE TRANSTHEORETICAL MODEL OF CHANGE

The Transtheoretical Model of Change (TTM) (Prochaska & DiClemente, 1984) is a model that conceptualizes the means of behavior change. The applicability of TTM extends beyond solely addressing individual behavior changes; this versatility has led to the model's widespread use in complex settings, such as treatment for alcoholism (Prochaska et al., 2004), smoking/tobacco cessation (Wagner, Burg, & Sirois, 2004), cocaine addiction groups (Velasquez et al., 2001), STI screening (Chacko et al., 2003), and safer sexual behaviors (White et al. 2001; Redding et al., 1996).

While the TTM has guided studies such as Velasquez, Carbonari, and DiClemente (1999), which examined behavior change among alcohol-dependent patients with psychiatric distress, it has not been widely used in the study of co-occurring mental health and substance use disorders. TTM's application to individuals with comorbid disorders can provide insight into the implementation of comorbidity interventions. TTM's focus on mechanisms of behavior change may provide insight into the "process of recovery" for individuals with co-occurring disorders, particularly for persons with substance use and mental disorders (Velasquez et al., 1999). Key variables of the model include 1) Stages of Change, 2) Decisional Balance, 3) Self-Efficacy, and 4) Processes of Change.

Stages of Change. TTM focuses on one's progression through a series of stages. According, to TTM, before a full behavior transformation occurs, individuals move through a sequence of specific stages of change. These stages include precontemplation, contemplation, preparation, action, and maintenance (Prochaska & DiClemente, 1984; DiClemente, 2003).

Precontemplation. In precontemplation—the earliest stage of change—individuals are unaware of a problem, unconcerned about it, and/or unwilling to change it. It is common for individuals at this stage to feel unconvinced that the negative aspects of the problem behavior outweigh the positive (Velasquez, Crouch, Stephens, & DiClemente, 2016). For example, individuals with substance use disorders may not consider that the negative aspects of substance use are outweighing the positives. Rather than viewing such persons as resistant, the precontemplation stage of the TTM allows

inclusion of these individuals into the change process and guides the development of interventions targeted for those engaged in risky behavior who have not yet initiated change (Prochaska & DiClemente, 1984; DiClemente, 2003; DiClemente, Schlundt, & Gemmell, 2004).

Contemplation. In this stage, individuals become more aware and concerned about the problem behavior. They may begin to think about solving the problem, but do not yet take action towards making a change. Exploring ambivalence is common at this stage; individuals in this stage typically weigh the pros and cons for potential change (Velasquez et al., 2016). Consequently, individuals often stay in this stage for a long time until their ambivalence is resolved (Prochaska & DiClemente, 1984; DiClemente, 2003; DiClemente et al., 2004).

Preparation. In this stage, the pros for making change outweigh the cons, and individuals with substance use or other problems are ready to make a change (in the next 30 days) (Velasquez et al., 2016). People in this stage begin to take concrete steps, such as seeking help for their substance use (Prochaska & DiClemente, 1984; DiClemente, 2003; DiClemente et al., 2004).

Action. Individuals in this stage "implement the plan they prepared" (Velasquez et al. 2016, p.15). They take concrete steps to change their problematic behaviors (Velasquez et al., 2016). For example, individuals with substance use problems seek treatment and support to change their substance use (DiClemente et al., 1991; Prochaska & Velicer, 1997; Velicer, Prochaska, Fava, Norman, & Redding, 1998). Without

adequate preparation, relapse and regression towards earlier stages typically occur at this stage (DiClemente, 2003).

Maintenance. In this final stage, individuals make efforts to consolidate the gains from their changed problematic behavior and create new positive behaviors to sustain behavioral change. Individuals at this stage are generally less tempted to return to the problematic behavior and more confident in maintaining their behavior change than they were at previous stages (Velasquez et al., 2016; Prochaska & DiClemente, 1984; DiClemente, 2003; DiClemente et al., 2004).

Decisional Balance (Pros for change and Cons for change). Decisional balance, first conceptualized by Janis and Mann (1977), refers to the act of sitting with ambivalence—comparing potential pros for change and cons for change. As individuals progress or regress through the different stages of change, decisional balance often shifts according to one's stage (DiClemente, 2003; Prochaska, 1994). For example, individuals in precontemplation might identify more cons for change of the targeted behavior, while those in the later stages might identify more pros and move towards behavior change (Velasquez et al., 2016).

Self-Efficacy (Confidence to change and Temptation not to change). Guided by Bandura's Self-Efficacy Theory (Bandura, 1977), the TTM's self-efficacy variable is another important concept of the TTM. Self-efficacy identifies the degree of confidence one has in maintaining their targeted behavior change, especially in difficult situations that may trigger returning to problem behavior. Also, self-efficacy measures one's temptation in situations that may prompt the individual to relapse (Prochaska &

DiClemente, 1984; DiClemente, 2003). Stages of change are reflective of one's level of self-efficacy, as individuals in the earlier stages (precontemplation and contemplation) may be more tempted than persons in the later stages (preparation and action) with higher confidence levels (Prochaska & DiClemente, 1984; DiClemente, 2003).

Processes of Change (Experiential Processes of Change and Behavioral Processes of Change). The Processes of Change (POC) explain how behavior change occurs (Prochaska & DiClemente, 1984; DiClemente, 2003). The ten POC include experiences that enable individuals to move through the stages (Velasquez et al., 2016). The two different parts of the POC are experiential POC and behavioral POC.

Experiential POC refers to an individual's internal thoughts and perceptions about behavior change, including consciousness-raising (building knowledge and awareness), dramatic relief/emotional arousal (emotionally moving experiences), self-reevaluation (seeing myself differently), environmental reevaluation (seeing my surroundings differently), and social liberation (recognizing changing societal norms and options). Behavioral POC are more action oriented and include reinforcement management (finding and using rewards), helping relationships (social support for change), counterconditioning (changing my automatic reactions), stimulus control (managing cues and triggers) and self-liberation (taking responsibility/making commitments) (Velasquez et al., 2016).

Overview of Literature on TTM

This dissertation presents insight from a literature review on the TTM's application to addressing comorbid alcohol use and depression and comorbid alcohol use and marijuana use among women of childbearing age. Next, the application of the TTM and Profile Analysis, and the TTM and Latent Growth Curve Modeling, to the study of comorbid substance use and mental disorders is reviewed.

TTM and Comorbid Alcohol use and Depression among Women of Childbearing Age

Research on the TTM, comorbid alcohol use, and depression among childbearing-aged women is scarce, but related studies offer insight into behavior change. Studies have indicated that some features of depression, such as lack of motivation, anhedonia, feelings of hopelessness, pessimism, decreased energy, difficulty concentrating, and difficulty making decisions (NIMH, 2017), hinder a person's ability to make behavior changes, including reducing risky health behaviors (O'Cleirigh et al., 2013). The tendency for depressed individuals to ruminate on their thoughts may make them more likely to get stuck in the beginning stages of the TTM's stages of change, such as precontemplation and contemplation (O'Cleirigh et al., 2013). This tendency may thereby prevent them from changing problematic behaviors such as risky drinking; depressed individuals may not be as ready to change their drinking behaviors as non-depressed individuals (O'Cleirigh et al., 2013). Additionally, research shows that depressed individuals have difficulty identifying good reasons to change their risky drinking

behaviors, have lower confidence, and experience greater temptation to drink than non-depressed individuals (Lovejoy & Heckman, 2014; Kanfer & Zeiss, 1983; Johnson, von Sternberg, & Velasquez, 2017). Overall, depressed individuals appear to be limited in their capacity to change their drinking behavior (O'Cleirigh et al., 2013). However, since studies on the topic are few, further exploration is needed to better understand the relationship between depression and risky drinking.

TTM and Comorbid Alcohol use and Marijuana Use among Women of Childbearing Age

Research on the TTM, comorbid alcohol use and marijuana use among women of childbearing-age is limited, but related studies provide valuable insight into what motivates people to change risky health behaviors, such as marijuana use. Research has identified a relationship between marijuana use and lack of motivation (Simons, Clarke, Simons, & Spelman, 2016). Thus, marijuana users often need to "work harder" than non-marijuana users to initiate changes in their lives (Simons et al., 2016). Marijuana studies examining the TTM's stages of change indicated that individuals in the earlier stages of change, such as precontemplation and contemplation, had poorer marijuana intervention outcomes, including minimal changes or greater marijuana use (Callaghan et al., 2008; Dupont et al., 2017), continued positive views of marijuana use despite their awareness of marijuana's negative effects (Harrell et al., 2013), and higher dropout rates from marijuana treatment programs (Callaghan et al., 2005). Marijuana users reported lower levels of confidence (self-efficacy) in their ability to quit, except for those who had a

history of prior quit attempts (Caviness et al., 2013). Studies of the TTM's decisional balance and POC reported greater pros than cons of using marijuana, which in turn predicted marijuana problems and dependence (Elliot et al., 2013).

On the other hand, the TTM's readiness to change measure was a better indicator of changes in marijuana use. Individuals with greater levels of readiness to change reported greater reduction in marijuana use (Sherman, Baker, & McRae-Clark, 2016; Maisto et al., 2011; Duvall et al., 2008; Naar-King et al., 2010). Similarly, higher levels of the TTM's self-efficacy measure (i.e., greater confidence to change marijuana use) were associated with better alcohol and marijuana outcomes, such as lower alcohol and marijuana use (Naar-King et al., 2010; Berman et al., 2010). Although marijuana users appear to be limited in their ability to make meaningful changes to risky health behaviors (Caviness et al., 2013; Simons et al., 2016), research is insufficient, and further examination is needed to better understand the relationships between marijuana use and alcohol use.

TTM AND PROFILE ANALYSIS

Profile Analysis is a type of statistical analysis used when determining group profiles by assessing the interaction of the mean scores of the study variables (Nidecker, DiClemente, Bennett, & Bellack, 2008; Finnell, 2003). Most research investigating TTM profiles using Profile Analysis, determined by the interaction of the mean scores on the TTM variables, has focused on alcohol use. For example, from NIAAA's Project MATCH study, Carbonari and DiClemente (2000) found significantly different TTM

profiles at the end-of-treatment between individuals who were abstinent at 12 months post-treatment compared to individuals who were heavy drinkers at 12 months. Individuals abstinent at 12 months had greater confidence in their ability to change, lower levels of temptation to drink, and greater use of both experiential and behavioral POC those drinking heavily. Similarly, from the CHOICES study (Velasquez et al., 2010), the TTM profiles of women at the end-of-treatment who were drinking below risky levels at 9 months indicated that these women had more pros than cons for behavior change, had greater confidence, experienced lower levels of temptation, and made greater use of both experiential and behavioral POC than women who were drinking at or above risky levels (von Sternberg, Velasquez, & DiClemente, 2012). A study that examined the profiles of smokers using Profile Analysis reported that smokers moving from precontemplation to contemplation made greater use of experiential POC (Callaghan and Herzog, 2006).

Collectively, findings from Carbonari and DiClemente (2000) and von Sternberg et al. (2012), assessed by the interaction of the mean scores on the TTM variables, appear to establish an end-of-treatment success profile for changing alcohol use. Individuals in these studies had higher pros for change than cons for change, higher confidence than temptation, and greater use of experiential and behavioral POC. However, in a Profile Analysis of depressed women from the CHOICES study (Floyd et al., 2007), Johnson et al. (2017) found that depressed women scored higher on the cons for change and temptation to drink while making greater use of POC than non-depressed women. Further understanding of the potential impact of additional factors on the interaction of the TTM variables, such as depression or marijuana use, may better predict drinking outcomes and

provide insight into areas where individuals may need additional support to change their behavior.

TTM AND LATENT GROWTH CURVE MODELING

While the TTM has guided a multitude of studies examining behavior change, longitudinal examination of the TTM variables over time using latent growth curve modeling (LGC) is limited and needs further assessment. Most research in this area has focused on motivation toward physical activity. For example, studies have found greater levels of self-efficacy (Dishman et al., 2010; Kosma et al., 2012; Roesch et al., 2009; Parker et al., 2010), later stages of change (Kosma et al., 2012; Parker et al., 2010), and greater use of POC (Dishman et al., 2010; Kosma et al., 2012) as significant predictors of increases in physical activity. Additional studies guided by the TTM have examined other target behaviors using LGC including self-management (Chan et al., 2015), chronic disease self-management (Chan et al. 2011), and drinking among college students (Carey et al., 2010). In general, later stages of change (Chan et al., 2011), readiness to change (Chan et al., 2015), and self-efficacy (Chan et al., 2011; Chan et al., 2015) were identified as significant predictors of behavior change. Further, using LGC, Carey et al. (2010) reported gender differences in the utilization of TTM variables when examining drinking behaviors among college students with readiness to change a significant predictor of change for only female college students.

This dissertation examines three interconnected questions to explore the role of depression and marijuana use among risky drinking women of childbearing age in

primary care settings. First, this study explores social and motivational factors associated with 1) alcohol use; 2) comorbid alcohol use and depression; and 3) comorbid alcohol and marijuana use. Second, this study explores the interaction of the TTM variables (i.e., stages of change, decisional balance, self-efficacy, and POC) for two comorbid groups: women with comorbid alcohol use and depression and women with comorbid alcohol use and marijuana use. Lastly, this study examines differences in the rate of change in TTM variables (i.e., readiness to change, decisional balance, self-efficacy, and POC) for risky drinkers over time, and the impact of time-invariant predictors, i.e., depression and marijuana use, on the rate of change.

III. METHODS

Data previously collected for a CDC funded study (CHOICES Plus; U84 DD000438) were used for this study. Adapted from the CDC funded parent project called CHOICES (U84 CCU614576) (Velasquez et al., 2004), CHOICES Plus tested the efficacy of a briefer two-session "bundled" (alcohol, contraception, and tobacco) behavior intervention aimed at reducing the risk of alcohol- and tobacco-exposed pregnancies (Velasquez et al., 2017).

Participants

The CHOICES Plus study included 261 participants who were randomly assigned to the Intervention (n=131) or Brief Advice (n=130) condition. Of these 261 participants, 95% (n=248) completed the 9-month follow-up. To be included in the CHOICES Plus study, participants had to be 1) female; 2) 18-44 years old; 3) fertile; 4) not pregnant or planning to become pregnant in the next 9 months; 5) have had sexual intercourse during the previous 3 months with a fertile man without using effective contraception, 6) drinking at risky levels (4 or more drinks per day or 8 or more per week), and 7) available for follow-ups.

Measures

DEMOGRAPHIC VARIABLES

Basic demographic information comes from the CHOICES Plus questionnaire, which included age, race, marital status, education, income, employment status, history of abuse (physical, sexual), and history of mental health/substance use service utilization.

THE TIMELINE FOLLOW BACK

The Timeline Follow Back (TLFB; Sobell & Sobell, 1996) was used to measure alcohol and contraception outcomes. The TLFB provided a record of frequency/quantity of daily alcohol consumption and contraception use from 90 days prior to enrollment to 9-month follow-up. Individuals consuming four or more drinks on a single day or those drinking eight or more drinks per week were considered risky drinkers (CDC, 2016). At baseline, all women in this study reported risky drinking. Previous studies have demonstrated the TLFB's reliability and validity (Sobell et al., 1992; Robinson et al., 2014). The TLFB was used for Research Question 2 and 3.

THE ALCOHOL USE DISORDERS IDENTIFICATION TEST

This study used the 10-item Alcohol Use Disorders Identification Test (AUDIT) (WHO, 1989). The self-report AUDIT is a screening tool used to identify the severity of alcohol consumption by asking about ones' quantity and frequency of drinking, symptoms of dependence, and problems related to alcohol use (Babor, Higgins-Biddle, Saunders & Monteiro, 2001). The AUDIT scores were coded as a continuous variable. Research demonstrates AUDIT's reliability (Cronbach's alpha of .80-.85) (Moussas et al., 2009; Daeppen et al., 2000) and validity in outpatient settings (Bradley et al., 2003; Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009; Barry & Fleming, 1993; Allen, Litten, Fertig, & Babor, 1997). The AUDIT was used for Research Question 1.

BRIEF SYMPTOM INVENTORY 18

The Brief Symptom Inventory-18 (BSI-18; Derogatis, 2001) was used to assess psychological distress. The self-report BSI-18 is an abridged version of the 53-item BSI, derived from the Symptom Checklist-90-Revised (SCL-90-R), and measures three psychological symptom dimensions (somatization, depression, and anxiety) and a composite score called the Global Severity Index (GSI). The BSI-18 is especially useful for measuring progress during and after treatment to monitor change (Derogatis, 2001). Only items from the depression subscale were used for this study. Raw scores were converted into standardized t-scores. Participants with a t-score greater than or equal to 63 at baseline were considered depressed based on Derogatis's (1993) guidelines. The Depressed variable was coded yes, depressed=1 and no, not depresses=0. Research has demonstrated the BSI-18's reliability, validity, and utility (Wieland, Wardenaar, Fontein, & Zitman, 2012; Boulet & Boss, 1991; Andreu et al., 2008).

MARIJUANA USE

A single item question was used to assess baseline marijuana use. Individuals were asked to indicate frequency of marijuana use in the last 12 months ("Daily," "4-6 times/week," "2-3 times/week," "once a week," "2-3 times/month," "less than once a month," "not at all," "don't know," and "refuse to answer"). Responses were re-coded into yes=1 and no=0 (yes=at least once in the last 12 months).

TRANSTHEORETICAL MODEL (TTM) VARIABLES

Stages of Change.

University of Rhode Island Change Assessment Scale-Alcohol Version. The 28-item University of Rhode Island Change Assessment Scale (URICA; McConnaughy, Prochaska, & Velicer, 1983) was used to assess motivation to change with the readiness score. Specifying the target behavior is critical for the URICA—In this case, the URICA-alcohol version was utilized (DiClemente et al., 2004). The study used a readiness score derived from the URICA (readiness score = [Contemplation + Action + Maintenance]-Precontemplation) (DiClemente & Hughes, 1990). The URICA measures individuals' opinions related to drinking on a 5-point scale with 1 = "strongly disagree" to 5 = "strongly agree." Previous studies have identified good internal validity (Dozois et al., 2004; Field et al., 2009) and reliability (Cronbach's Alpha of .68-.85) (Carbonari & DiClemente, 2000; Carney et al., 1995; Pantalon et al., 2002).

Decisional Balance.

Decisional Balance Scale for Alcohol. The 16-item Decisional Balance Scale for Alcohol (DB-A) (Velicer, DiClemente, Rossi & Prochaska, 1990) was used to measure a major construct of the TTM- pros for changing and cons for changing one's alcohol use. The balance between pros and cons for change is thought to be dependent on an individual's stage of change (Prochaska & DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992). The 5-point scale ("not at all," "a little bit," "some," "quite a bit," and "a lot") is used to ask individuals, at present, how much eight pros for change and eight cons for change statements matter in deciding their drinking behavior. Studies report

good validity (Ward, Velicer, & Rossi, 2004; Baker & Cannon, 1988) and reliability (Cronbach's Alpha of .76-.84 for pros and .76-.96 for cons) (Carey et al., 2001) for the DB-A.

Self-Efficacy.

The Brief Situational Confidence Questionnaire for Alcohol. Adapted from the Situational Confidence Questionnaire (Annis & Davis, 1988), the 8-item Brief Situational Confidence Questionnaire for Alcohol (BSCQ-A) measures confidence in one's ability to abstain from alcohol or to drink below risky levels in various life situations. The eight domains that make up the measure are unpleasant emotions, physical discomfort, pleasant emotions, testing control over the use of alcohol, urges and temptations, conflict with others, social pressure to drink, and pleasant times with others. Using a 5-point Likert scale, individuals were asked to identify their confidence level at present for each of those domains. Responses range from 1 (not confident at all) to 5 (extremely confident). The BSCQ-A has been used to assess self-efficacy at the start of and during treatment, which allows for an evaluation of increases or decreases in self-efficacy as a function of an intervention (Breslin, Sobell, Sobell, Agrawal, 2000). BSCQ-A has been found to be valid and reliable (Cronbach's Alpha of .61-.88) (DiClemente et al., 1994).

The Brief Situational Temptation Questionnaire for Alcohol. The 8-item Brief Situational Temptation Questionnaire (BSTQ-A) was adapted from the BSCQ-A used in project CHOICES (Velasquez et al., 2013) to measure the level of temptation women face in various life situations regarding abstaining from drinking or drinking less than risky levels. The BSTQ-A covers eight domains: unpleasant emotions, physical

discomfort, pleasant emotions, testing control over the use of alcohol, urges and temptations, conflict with others, social pressure to drink, and pleasant times with others. A 5-point Likert scale identified temptation levels at present for each domain with responses ranging from 1 (not tempted at all) to 5 (extremely tempted). Similar to the BSCQ-A, the BSTQ-A is designed to measure increases and decreases of self-efficacy as a function of an intervention (Velasquez et al., 2013).

Processes of Change Questionnaire.

Processes of Change Questionnaire-A. The 20-item Processes of Change Questionnaire-A (POC-A; Prochaska, Velicer, DiClemente, & Fava, 1988) measured the use of processes of change for alcohol. Individuals were asked how often they use each thought or situation to help avoid risky drinking. The POC-A asked participants to identify how often they make use of the particular situation or thought to refrain from drinking. On a 5- point Likert scale from 1 (never) to 5 (repeatedly), ten experiential POC based situations and ten behavioral POC based situations were measured. Studies have reported good validity (Prochaska et al., 1988) and reliability (Cronbach's Alpha of .75-.91) of the POC-A (von Sternberg, 2005).

Procedures

Recruitment and Sample

Participants in the CHOICES Plus study were recruited from 11 community health clinics in the Harris County Hospital District (HCHD) in Houston, Texas. Over a 36-month period, 11,470 women were screened, 485 were eligible, and 261 were

enrolled. Participants were randomized to either the Intervention (n=131) or Brief Advice (n=130). The study sample included both the Intervention and the Brief Advice group.

INTERVENTION AND DATA COLLECTION

The intervention in the CHOICES Plus study is a briefer adaptation of the original parent project CHOICES protocol and consists of two in-person sessions provided by a trained Behavioral Health Specialist. The CHOICES Plus study utilized a Motivational Interviewing-based approach to encourage change in one or both of the target behaviors, alcohol use and contraception use (i.e., Women were given the choice to change their drinking or contraception use effectively to avoid an AEP). The intervention consisted of: 1) two counseling sessions to address risky alcohol use, ineffective contraception, and smoking, 2) referral to a contraceptive consultation session, and 3) referral to a smoking cessation program. Participants were assessed at baseline and at three post-intake points (3-, 6-, and 9-month follow-ups).

IV. RESEARCH QUESTION 1: FACTORS ASSOCIATED WITH ALCOHOL USE, MARIJUANA USE, DEPRESSION, AND THEIR COMORBIDITY AMONG WOMEN OF CHILDBEARING AGE

Research Questions

1. What social and motivational factors are associated with alcohol use among women of childbearing age in primary care settings?

Hypothesis: Younger age, ethnic minority, not married, lower income levels, lower educational levels, history of trauma (physical and sexual abuse), mental health disorder (history of mental health treatment, depression) and other drug use (history of treatment, marijuana use), low readiness to change, low pros for change, high cons for change, low confidence to change, and lower experiential POC and behavioral POC will be related to greater alcohol use among women of childbearing age in primary care settings.

2. What social and motivational factors are associated with comorbid alcohol use and depression among women of childbearing age in primary care settings?

Hypothesis Younger age, ethnic minority, not married, lower income levels, lower educational levels, history of trauma (physical and sexual abuse), mental health disorder (history of mental health treatment, depression) and other drug use (history of treatment, marijuana use), low readiness to change, low pros for change, high cons for change, low confidence to change, and lower experiential POC and behavioral POC will be related to greater alcohol use among depressed women of childbearing age.

3. What social and motivational factors are associated with comorbid alcohol and marijuana use among women of childbearing age in primary care settings?

Hypothesis: Younger age, ethnic minority, not married, lower income levels, lower educational levels, history of trauma (physical and sexual abuse), and mental health disorder (depression,) low readiness to change, low pros for change, high cons for change, low confidence to change, and lower experiential POC and behavioral POC will be related to greater comorbid alcohol and marijuana use among women of childbearing age.

Analysis for Question 1

To better understand the characteristics of the overall sample, descriptive statistics (means, standard deviations, and distributions) were performed. After assessing bivariate correlations among study variables, the predictive models of 1) alcohol use, 2) alcohol use among depressed participants, and 3) alcohol use among marijuana users were estimated using hierarchical linear regression. Guided by the Common Risk Factor model (Mueser et al., 1998) and TTM (Prochaska & DiClemente, 1984), sets of social (age, race, marital status, education, employment, income, history of mental health treatment, history of substance use treatment, history of trauma (physical and sexual abuse), mental health disorder (depression), other drug use (marijuana) and motivational factors (Readiness to change, Pros for change, Cons for change, Confidence, Temptation, Processes of Change (POC)(Experiential POC and Behavioral POC) were sequentially entered using SPSS version 24 for all analyses.

MISSING VALUE ANALYSIS

Among 261 cases at baseline, 13 missing cases at 9-month follow up were removed. After removing 19 more cases with missing data and multivariate outliers, the final sample size was 229. For marijuana use among alcohol users, among 229 cases, a subsample of the data (N=176) set containing only those who had lifetime marijuana use was used (i.e., 53 cases with no lifetime marijuana use were excluded).

Results for Question 1

SAMPLE CHARACTERISTICS AND STUDY VARIABLES

Social factors. Table 1-1 shows descriptive information of the study variables for the final sample (N=229). The sample consisted of women ranging in ages from 18 to 44 with a mean age of 31.180 (SD=7.127). Approximately 40% of the women were cohabitating (married and living together), 62.4% had at least a high school education, and 70% had an income less than $20,000. About 21% of the women reported a history of mental health treatment and 27.1% had a history of physical abuse. About 46.3% met the clinical cutoff score for depressive symptoms (≥ 63 BSI-18), and the mean depression score was 59.3493 (SD= 9.927) ranging from 42 to 78. About 60.2% of the women reported marijuana use in the last 12 months, and approximately 11% reported daily marijuana use. The mean AUDIT score was 10.926 (SD=7.272) ranging from 0 to 40.

Motivational factors. The mean readiness to change score was 5.747 (SD= 2.942) and mean pros and cons for change scores were 2.679 (SD= 1.124) and 2.366 (SD=.958), respectively. The mean confidence score was 2.892 (SD=.892) and

temptation mean was 2.854 (SD=.929). Processes of change (POC) means were 2.090 (SD=.780) for experiential POC and 2.260 (SD=.734) for behavioral POC.

Table 1-1. Study Variables for the Full Sample (N=229)

	Variable	Value (M ± SD or %)
Social Factors	Age	31.180 ± 7.127
	Race	
	White, Non-Hispanic	12.0%
	Black, Non-Hispanic	44.5%
	Hispanic	41.5%
	Other	2.0%
	Marital Status	
	Single	44.5%
	Living together	20.1%
	Married	20.1%
	Other	15.4%
	Education (≥ high school)	62.4%
	Employed	42.4%
	Income (<$20,000)	70.1%
	History of mental health treatment	21.4%
	History of substance use treatment	3.5%
	History of physical abuse	27.1%
	History of sexual abuse	5.7%
	Depression (BSI 18)	59.3493 ± 9.927
	Depression (≥63 BSI-18)	46.3%
	Marijuana use (yes/no)	60.2%
	Marijuana use (frequency)	
	Daily	11.8%
	4-6 times/week	4.8%
	2-3 times/week	7.4%
	2-3times/month	0.9%
	Less than once a month	4.8%
	Not at all	16.6%
	Don't know/Refuse to answer	30.6%
	Alcohol use (≥8 AUDIT)	10.926 ± 7.272
Motivational Factors	TTM Variables	
	Readiness to change	5.747 ± 2.942
	Pros for change	2.679 ± 1.124
	Cons for change	2.366 ± 0.958
	Confidence	2.892 ± 0.892
	Temptation	2.854 ± 0.929
	Experiential POC	2.090 ± 0.780
	Behavioral POC	2.260 ± 0.734

FACTORS ASSOCIATED WITH ALCOHOL USE

Correlational analyses revealed that greater levels of alcohol use were associated with older age ($r=.234$, $p<.001$), less than a high school education ($r= -.163$, $p<.05$), lower income ($r=-.177$, $p<.01$), history of alcohol/substance use treatment ($r=.225$, $p<.01$), history of mental health treatment ($r=.187$, $p<.01$), history of physical abuse ($r=.241$, $p<.001$), higher readiness to change ($r=.484$, $p<.001$), higher pros for change ($r=.347$, $p<. 001$), higher cons for change ($r=.626$, $p<.001$), lower confidence ($r=-.420$, $p<.001$), higher temptation ($r=.476$, $p<.001$), greater use of experiential POC ($r=.415$, $p<.01$), higher levels of depression ($r=.396$, $p<.001$), and marijuana use ($r=.246$, $p<.001$).

Results of the hierarchical linear regression model testing the associations between social and motivational factors with alcohol use are summarized in Table 1-2. Social factors explained 35% ($p<.001$) of the variance. Older age ($p<.01$), history of substance use treatment ($p<.05$), higher levels of depression ($p<.001$) and marijuana use ($p<.01$) were found to significantly related to alcohol use.

Motivational factors accounted for an additional 23% ($p<.001$) of the variance. The significant variables were readiness to change ($p<.001$), cons for change ($p<.001$), experiential POC ($p<.05$), and behavioral POC ($p<.01$). Higher readiness to change, higher cons for change, and experiential POC were significantly associated with greater alcohol use. Lower behavioral POC was found to be a significant predictor of greater alcohol use. The full model explained 58.5% of the total variance ($p<.001$).

Table 1-2. Factors Associated with Alcohol Use (N=229)

Block	Predictor	B (SE)	β	t
1 Social Factors	**R^2= .351*** **			
	Age	**.221 (.070)**	**.215**	**3.179****
	Race	.904 (2.497)	.024	.362
	Education	-1.589 (1.082)	-.101	-1.469
	Employment	-.065 (.643)	-.007	-.101
	Income	-1.605 (1.126)	-.098	-1.425
	Marital status	.199 (.444)	.031	.448
	History of substance use treatment	**5.353(2.486)**	**.150**	**2.153***
	History of mental health treatment	-.649 (1.161)	-.038	-.559
	History of physical abuse	-.698 (1.228)	-.043	-.568
	History of sexual abuse	-.708 (2.114)	-.022	-.335
	Depression	**5.943 (1.044)**	**.393**	**5.690*****
	Marijuana use	**.680 (.220)**	**.205**	**3.085****
2 Motivational Factors	**$R^2\Delta$= .234*** **			
	Readiness to change	**.713 (.186)**	**.283**	**.3.840*****
	Pros for change	-.011 (.445)	-.002	-.024
	Cons for change	**2.178 (.574)**	**.284**	**3.794*****
	Confidence	-1.006 (.638)	-.021	-2.62
	Temptation	-.174 .663)	-.118	-1.576
	Experiential POC	**2.166 (1.107)**	**.228**	**19.957***
	Behavioral POC	**-2.626 (,906)**	**-.257**	**-2.900****

Note: The total variance explained by the full model was 58.5% (p<.001).
B= unstandardized coefficient, β = standardized coefficient, SE= standard error;
*p<.05, **p<.01, ***p<.001

FACTORS ASSOCIATED WITH ALCOHOL USE AMONG DEPRESSED PARTICIPANTS

Table 1-3 shows the results of the hierarchical linear regression model testing associations between social and motivational factors for alcohol use among depressed participants. For individuals with comorbid depression and alcohol use, social factors explained 24% ($p<.05$) of the variance. Older age ($p<.01$) and marijuana use ($p<.01$) were found to be significant predictors of greater alcohol use among depressed women. Motivational factors accounted for an additional 37% ($p<.001$) of the variance. The significant variables were cons for change ($p<.05$), confidence ($p<.05$), and experiential POC ($p>.05$). Higher cons for change, lower confidence, and greater experiential POC were significantly associated with greater alcohol use among depressed individuals. The full model explained 62% of the total variance ($p<.001$).

Table 1-3. Factors Associated with Alcohol Use among Depressed Participants (n=97)

Block	Predictor	B (SE)	β	t
1 Social Factors		**R^2=.244***		
	Age	**.362 (.130)**	**.311**	**2.784****
	Race	-.325 (3.811)	-.009	-.085
	Education	-.021 (1.930)	-.001	-.011
	Employment	1.193 (1.205)	.108	.991
	Income	-2.261 (2.291)	-.115	-.987
	Marital status	.491 (.757)	.073	.648
	History of substance use treatment	4.776 (4.135)	.124	1.155
	History of mental health treatment	-.441 (1.957)	-.025	-.225
	History of physical abuse	-2.655 (1.933)	-.160	-1.374
	History of sexual abuse	2.621 (2.795)	.103	.938
	Marijuana use	**1.143 (.373)**	**.328**	**3.067****
2 Motivational Factors		**$R^2\Delta$=.377*****		
	Readiness to change	.288 (.297)	.107	.969
	Pros for change	-.222 (.817)	-.029	-.272
	Cons for change	**1.725 (.841)**	**.221**	**2.051***
	Confidence	**-2.889 (1.251)**	**-.271**	**-2.309***
	Temptation	1.007 (1.202)	.108	.838
	Experiential POC	**4.743 (2.009)**	**.463**	**2.361***
	Behavioral POC	-1.966 (1.947)	-.168	-1.010

Note: The total variance explained by the full model was 62% (p<.001).
B= unstandardized coefficient, β = standardized coefficient, SE= standard error;
*p<.05, **p<.01, ***p<.001

FACTORS ASSOCIATED WITH ALCOHOL USE AMONG MARIJUANA USERS

Results of the hierarchical linear regression model testing the associations between social and motivational factors with alcohol use among marijuana users are shown in Table 1-4. Social factors explained 30% ($p<.001$) of the variance. Older age ($p<.01$), history of substance use treatment ($p<.05$), history of sexual abuse ($p<.05$), and depression ($p<.001$ were significant predictors of greater alcohol use among women who use marijuana. Motivational factors accounted for an additional 31% ($p<.001$) of variance. Significance was found in readiness to change ($p<.001$), cons for change ($p<.05$), and behavioral POC ($p<.001$). Higher readiness to change, higher cons for change, and lower use of behavioral POC were found to significantly predict greater alcohol use among marijuana-using individuals. The full model explained 61.4% of the total variance ($p<.001$).

Table 1-4. Factors Associated with Alcohol Use among Marijuana Users (n=106)

Block	Predictor	B (SE)	β	t
1 Social Factors		**R^2= .302*** **		
	Age	**.200 (.098)**	**.197**	**2.043***
	Race	-.885 (2.912)	-.027	-.304
	Education	-2.584 (1.503)	-.162	-.1.720
	Employment	-.101 (.905)	-.010	-.111
	Income	-2.230 (1.607)	-.135	.169
	Marital status	.008 (.618) (.444)	.001	.014
	History of substance use treatment	**6.675(2.988)**	**.223**	**2.234***
	History of mental health treatment	-.338 (1.563)	-.020	-.216
	History of physical abuse	-1.976(1.655)	-.124	-1.194
	History of sexual abuse	2.319 (2.702)	.077	.858
	Depression	**5.586 (1.457)**	**.368**	**3.832*****
2 Motivational Factors		**$R^2\Delta$= .312*****		
	Readiness to change	**1.019 (.259)**	**.393**	**3.930*****
	Pros for change	-.065 (.583)	-.010	-.112
	Cons for change	**1.931 (.748)**	**.246**	**2.582***
	Confidence	-1.477 (.904)	-.160	-1.633
	Temptation	-1.284 (.901)	-.135	-1.424
	Experiential POC	3.097 (1.609)	.328	1.924
	Behavioral POC	**-4.294 (1.379)**	**-.394**	**-3.113****

Note: The total variance explained by the full model was 61.4% (p<.001).
B= unstandardized coefficient, β = standardized coefficient, SE= standard error;
*p<.05, **p<.01, ***p<.001

V. RESEARCH QUESTION 2: PROFILES OF TTM VARIABLES OF CHANGE

Research Questions

1. How do women who are depressed differ on TTM variable profiles of change (i.e. pros and cons for change; confidence and temptation; behavioral POC and experiential POC) compared to non-depressed women at baseline and follow up?

* Hypothesized relations were based on prior studies of profiles of TTM variables (Carbonari & DiClemente, 2000; Johnson, von Sternberg, & Velasquez, 2016; von Sternberg, Velasquez, & DiClemente, 2012).

> *Hypothesis: The TTM profile at baseline and at 9-month follow up for women who are depressed will show lower pros for change, greater cons for change, lower confidence, greater temptation, greater use of experiential POC, and greater use of behavioral POC than non-depressed women.*

2. How do women who use marijuana differ on the TTM variables of change (i.e., pros and cons for change; confidence and temptation; behavioral POC and experiential POC) compared to women who do not use marijuana?

* Hypothesized relations were based on prior studies of TTM variables (Carbonari & DiClemente, 2000; von Sternberg, Velasquez, & DiClemente, 2012).

> *Hypothesis: The TTM profile at baseline and at 9-month follow up for women marijuana users will show lower pros for change, greater cons for change, lower confidence, greater temptation, and greater use of experiential POC, and lower use of behavioral POC than non-marijuana using women.*

Analysis for Question 2

To better understand the characteristics of the overall sample, the depressed vs. non-depressed group, and the marijuana users vs. non-marijuana users, descriptive statistics (means, standard deviations, and distributions) were examined for group differences.

To understand the relationship of the TTM variables to the study outcome (i.e., AEP risk at 9-month follow up), logistic regression was used for depressed and marijuana users. Then, Profile Analysis (PA) was conducted to compare patterns of mean scores on the ten TTM variables (Stages of Change- Precontemplation, Contemplation, Action, Maintenance; Decisional balance- Pros for change (Pros), Cons for change (Cons); Self-Efficacy- Confidence to change (Confidence), Temptation not to change (Temptation); Processes of Change (POC)- Experiential Processes of change (Experiential POC), Behavioral processes of change (Behavioral POC) for all study participants divided into groups based on 1) baseline depression status and 2) baseline marijuana use. Baseline and 9-month follow up profiles were examined for all women, regardless of treatment conditions, who completed the TTM measures at 9-month follow up (N=229).

PA is a type of a multivariate analysis of variance (MANOVA) that is used to determine group profiles on a set of measures at one time point (Tabachnick & Fidell, 2012). PA includes tests of 1) parallelism, 2) overall difference, and 3) flatness. The PA test of interest of this study was the test of parallelism, which is equivalent to the interaction effect that assesses the patterns of the mean values of the dependent variables. Rejection of the null hypothesis of parallelism suggests a parallelism effect, indicating an

interaction between the profiles (Tabachnick & Fidell, 2012). The means and standard deviations across depressed and non-depressed women and marijuana users and non-marijuana users for the TTM variables are reported in Table 2-5a, 2-5b and Table 2-6a, 2-6b (Appendix B). SPSS version 24 was used for all analyses.

Missing Value Analysis

Among 261 cases at baseline, 13 missing cases at 9-month follow up were removed. After removing 19 more cases with missing data and multivariate outliers, the final sample size was 229. For marijuana use among alcohol users, among 229 cases, a subsample of the data (N=176) set containing only those who had lifetime marijuana use data were used for the study (i.e., 53 cases with no lifetime marijuana use were excluded.

Results for Question 2

Sample Characteristics and Study Variables

Depression. The women in the depressed group had an average age of 30 years, were racially diverse, less likely to have at least a high school education, more likely to have a history of mental health treatment and to have a history of physical and sexual abuse, and had a higher average AUDIT score than the non-depressed women (Table 2-1).

Table 2-1. Baseline Comparison Groups for Depressed Participants (N=229)

	Depressed (n=97)	Non-depressed (n= 132)	Differences
Age	31.77 ± 7.114	30.75 ± 7.132	t (227) =1.074 p=.284
Race	40.2% Hispanic 50.0% African American 8.8% Caucasian 1.0% Other	45.7% Hispanic 34.3% African American 15.7% Caucasian 4.3% Other	$\chi^2(3) = 2.499$, p=.114
Education (≥High school)	**53.6%**	**68.9%**	**$\chi^2(1) = 5.604$, p<.05***
Employment	28.8% Unemployed 46.4% Employed 23.7% Not in the workforce	31.1% Unemployed 39.4% Employed 29.5% Not in the workforce	$\chi^2(2) = 1.374$, p=.503
Income (<$20,000)	72.2%	65.9%	$\chi^2(1) = .641$, p=.423
Marital status	40.2% Single 15.5% Living together 23.7% Married 20.6% Other	47.7% Single 23.5% Living together 17.4% Married 11.4% Other	$\chi^2 (3) = 6.735$, p=.081
History of alcohol or drug treatment	4.1%	3.0%	$\chi^2 (1) = .198$, p=.656
History of mental health treatment	**30.9%**	**14.4%**	**$\chi^2 (1) = 9.008$, p<.01****
History of physical abuse	**41.2%**	**16.7%**	**$\chi^2 (1) = 17.086$, p<.001*****
History of sexual abuse	**9.3%**	**3.0%**	**$\chi^2 (1) = .407$, p<.05***
Marijuana use	64.9%	42.4%	$\chi^2 (1) = 1.267$, p=.260
Alcohol use (AUDIT)	**14.278 ± 7.934**	**8.462 ± 7.000**	**t (227) =6.499, p<.001*****

*p<.05, **p<.01, ***p<.001

Marijuana use. The women had an average age of 30 years and were racially diverse. Women who use marijuana were more likely to be single and score higher on the AUDIT than the non-marijuana users (Table 2-2).

Table 2-2. Baseline Comparison Groups for Marijuana Users (N=176)

	Marijuana use (n=106)	Non-marijuana use (n= 70)	Differences
Age	30.15 ± 7.473	31.83 ± 6.958	t (174) =.586, p=.114
Race	40.2% Hispanic 50.0% African American 8.8% Caucasian 1.0% Other	45.7% Hispanic 34.3% African American 15.7% Caucasian 4.3% Other	$\chi^2(3) = 1.977$, p=.160
Education (≥High school)	66.0%	65.7%	$\chi^2(1) = .002$, p=.965
Employment	39.6% Unemployed 37.7% Employed 22.6% Not in the workforce	28.6% Unemployed 44.3% Employed 27.1% Not in the workforce	$\chi^2(2) = 2.260$, p=.323
Income (<$20,000)	67.0%	70.0%	$\chi^2(1) = .003$, p=.956
Marital status	**57.5% Single 16.0% Living together 9.4% Married 17.0% Other**	**38.6% Single 22.9% Living together 21.4% Married 17.1% Other**	**χ^2 (3) = 8.352, p=<.05***
History of alcohol or drug treatment	6.6%	1.4%	χ^2 (1) = 2.602, p=.107
History of mental health treatment	29.2%	21.4%	χ^2 (1) = 1.334, p=.248
History of physical abuse	34.0%	24.3%	χ^2 (1) = 1.876, p=.171
History of sexual abuse	6.6%	4.3%	χ^2 (1) =.423, p=.516
Depression	47.2%	38.6%	χ^2 (1) =1.267, p=.260
Alcohol use (AUDIT)	**13.057 ± 7.659**	**10.971 ± 7.267**	**t (174) =-.203, p<.05***

*p<.05, **p<.01, ***p<.001

OUTCOME ANALYSIS

Table 2-3 shows results of the logistic regression model for AEP risk (at 9-month follow-up) for depressed women at baseline. No significant effect was observed. Table 2-4 shows results of the logistic regression model for AEP risk (at 9-month follow-up) for baseline marijuana use. The odds of AEP risk at 9-month follow-up was 2.48 times greater for baseline marijuana users compared to non-marijuana users. The overall model fit was significant (-2 Log likelihood = 216.382, Chi-square/df = 7.845/1).

Table 2-3. AEP Risk at 9-month Follow Up by Depressed Status at Baseline

Step	Variable	B (SE)	Wald x2 (df=1)	p	OR	95% CI
1	AEP risk (at 9mfu)	.127 (.320)	.158	.691	1.136	.606 to 2.128
Overall Model Summary		- 2 Log likelihood= 224.069; Chi square= .158/1				

*p<.05, **p<.01, ***p<.001

Table 2-4. AEP Risk at 9-month Follow Up by Marijuana Use Status at Baseline

Step	Variable	B (SE)	Wald x2 (df=1)	p	OR	95% CI
1	AEP risk (at 9mfu)	.906 (.326)	7.710	.005**	2.475	1.305 to 4.691
Overall Model Summary		- 2 Log likelihood= 216.382; Chi square= 7.845**/1				

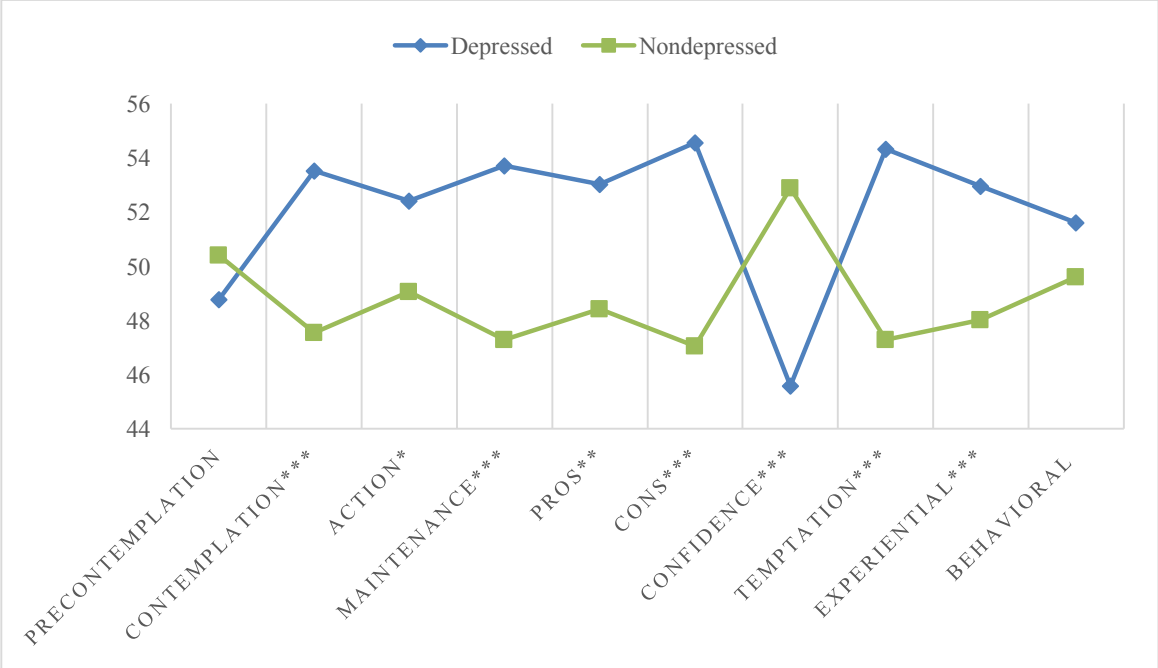
*p<.05, **p<.01, ***p<.001

PROFILE ANALYSIS

Depression.

Baseline. PA test of parallelism at baseline revealed a parallelism effect, indicating significant differences between the depressed and non-depressed women in the overall shape of profiles of the TTM variables ($F(9, 162) = 5.548$, $p < .001$; Wilks' Lambda=.764, partial $\eta 2 = .236$). In addition to the overall difference in profiles, parameter testing revealed that eight estimated marginal means of the ten variables making up the TTM profiles significantly different between the depressed and not depressed women. At baseline, depressed women reported higher Contemplation ($p < .001$), Action ($p < .051$), and Maintenance, greater pros for change ($p < .01$), greater cons for change ($p < .001$), lower confidence ($p < .001$), greater temptation ($p < .001$), and greater use of the experiential POC ($p < .01$) (Figure 2-1) (Appendix C. Table 2-5a, Table 2-5b).

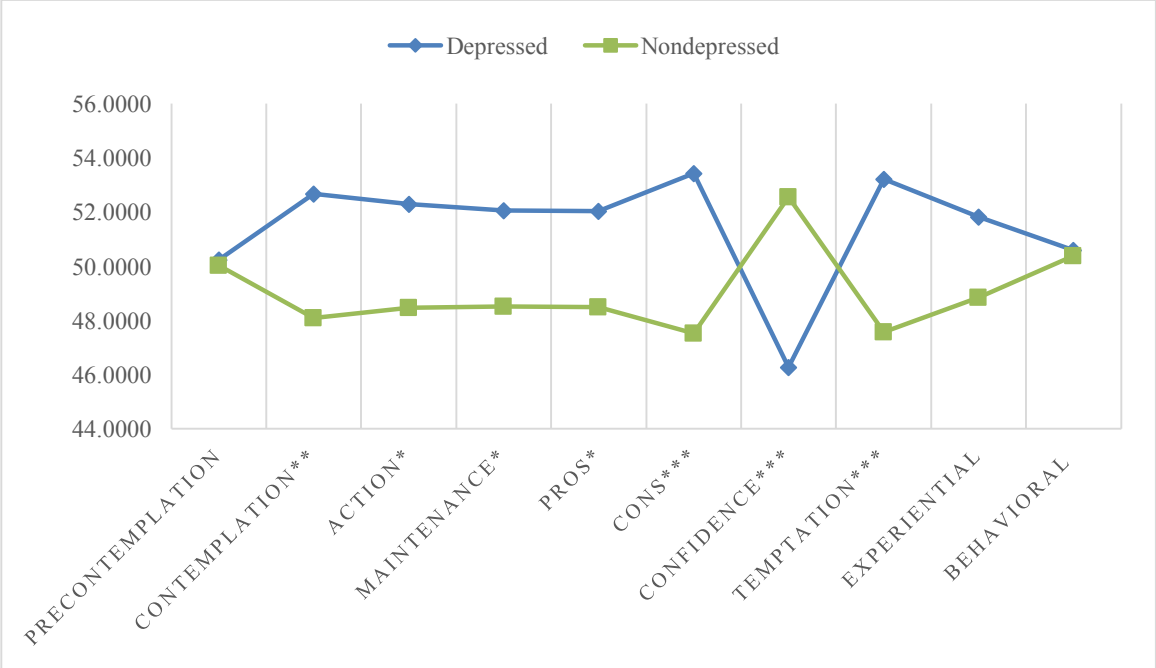
Figure 2-1. TTM Variables Mean Scores of Baseline Depressed (n=97) vs. Non-depressed (n=132) at Baseline (N=229)



*p<.05, **p<.01, ***p<.001

Nine-month follow up. PA test of parallelism also revealed differences between the depressed and non-depressed groups in the overall shape of TTM variable profiles at 9-month follow-up ($F(9, 162) = 3.550$, $p<.001$; Wilks' Lambda= .835, partial $\eta 2=.165$). Parameter testing revealed that seven estimated marginal means of the ten variables making up the TTM profiles at 9-month follow up were significantly different between the depressed and non-depressed women at baseline. Depressed women reported higher Contemplation ($p=<.01$), Action ($p=<.05$), and Maintenance ($p<.05$), greater pros for change ($p<.05$), greater cons for change ($p<.001$), lower confidence ($p<.001$), and greater temptation ($p<.001$) (Figure 2-2) (Appendix C. Table 2-5a, Table 2-5b).

Figure 2-2. TTM Variables Mean Scores of Baseline Depressed (n=97) vs. Non-depressed (n=132) at 9-month Follow-up (N=229)



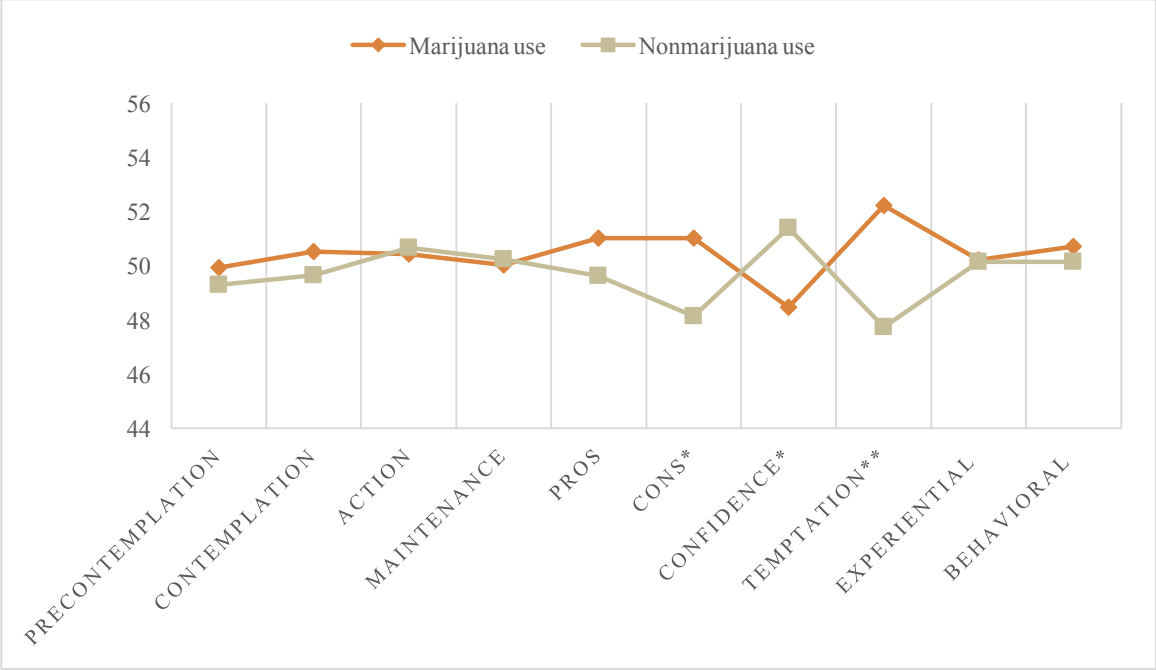
*p<.05, **p<.01, ***p<.001

Marijuana Use.

Baseline. PA test of parallelism revealed no parallelism effect, thus indicating no differences in the overall shape of the TTM variable profiles (F (9, 162) = 1.311, p=.235; Wilks' Lambda= .932, partial η2=.068) between the women who used and did not use marijuana at baseline. Parameter testing revealed that three estimated marginal means of the ten variables making up the TTM profiles differed significantly between the women who used and did not use marijuana at baseline. At baseline, women who used marijuana reported greater cons for change (p<.05), lower confidence (p<.05), and greater temptation not to change (p<.01). Box's M (p=.272) confirmed the null hypothesis that assumes homogeneity of covariance structures; thus, suggesting no difference in

covariance structures between the marijuana users and non-marijuana users at baseline (Figure 2-3) (Appendix B. Table 2-6a, Table 2-6b).

Figure 2-3. TTM Variables Mean Scores of Marijuana Use (n=107) vs. Non-marijuana use (n=70) at Baseline (N=176)

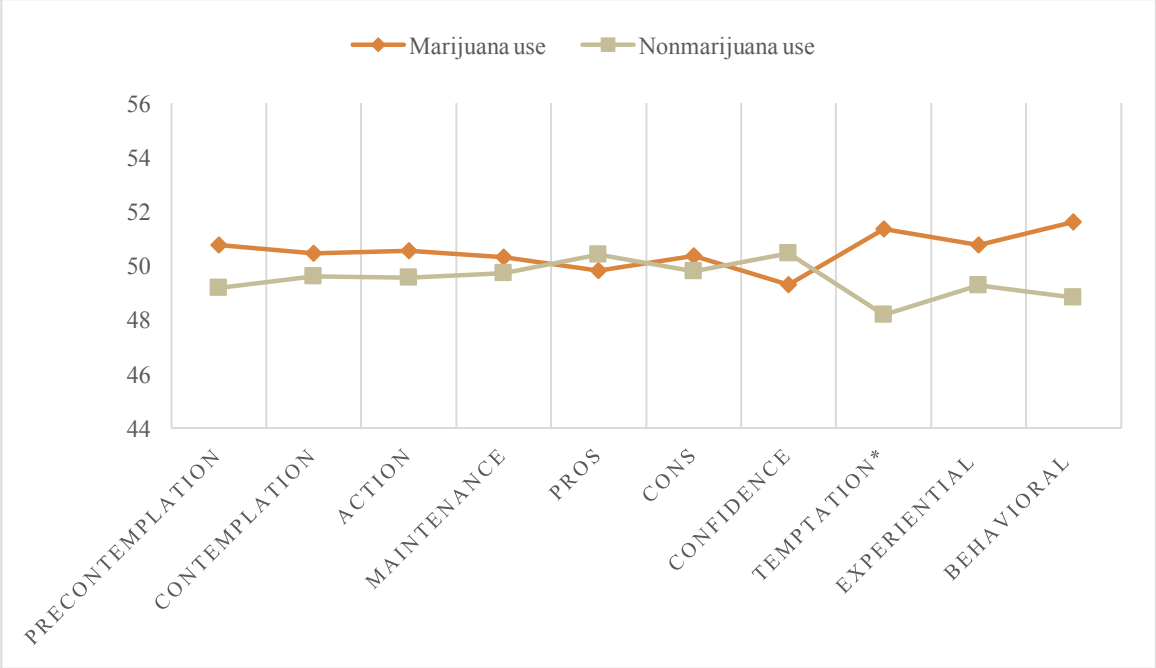


*p<.05, **p<.01, ***p<.001

Nine-month follow up. PA test of parallelism at 9-month follow up revealed no parallelism effect, and thus no differences between the marijuana using and non-marijuana using women in the overall shape of profiles of the TTM variables (F (9, 162) =183, p=.309; Wilks' Lambda= .938, partial η2=.062). Parameter testing revealed that one estimated marginal mean of the ten variables making up the TTM profiles at 9-month follow differed significantly between women used and did not use marijuana at baseline. Women who use marijuana at baseline reported greater temptation not to change (p<.05)

(See Figure 2-4). Box's M (p=.503) confirms the null hypothesis that assumes homogeneity of covariance structures; thus, suggesting no difference in covariance structures between the marijuana users and non-marijuana users at 9-month follow-up (Figure 2-4) (Appendix B. Table 2-6a, Table 2-6b).

Figure 2-4. TTM Variables Mean Scores of Marijuana Use (n=107) vs. Non-marijuana Use (n=70) at 9-month Follow up (N=176)



*p<.05, **p<.01, ***p<.001

VI. RESEARCH QUESTION 3: TTM VARIABLES ACROSS TIME: LATENT GROWTH CURVE MODELING

Research Questions

1. To what extent do TTM variables differ over time for risky drinkers?

Hypothesis: A statistically significant rate of change in TTM variables (i.e., increase in readiness to change, increase in pros for change, decrease in cons for change, increase in confidence, decrease in temptation, decrease in experiential POC, and increase in behavioral POC) will be observed over time among risky drinkers.

2. Does the rate of change in TTM variables differ for risky drinkers who are depressed verses those who are not depressed?

Hypothesis: Among risky drinkers, depressed individuals will have a significantly different rate of change (i.e., slower rate of change in readiness to change, pros for change, cons for change, confidence, temptation, experiential POC, and behavioral POC) than non-depressed individuals.

3. Does the rate of change in the TTM variables differ for risky drinkers who use marijuana verses those who do not use marijuana?

Hypothesis: Among risky drinkers, marijuana users will have a significantly slower rate of change in readiness to change, pros for change, cons for change, confidence, temptation, experiential POC, and behavioral POC than non-marijuana users.

Analysis for Question 3

To better understand the characteristics of the overall sample, descriptive statistics were performed on the outcome variables—average number of drinks per week and average number of days using effective contraception. Then analyses using Latent Growth Curve Modeling (LGC) via SEM were conducted, which is particularly useful for explaining change over time (Byrne, 2013). After assumptions were checked (i.e., continuous outcome variables; same number and spacing of the assumptions for all individuals; data obtained for each on three or more occasions), estimates of growth were observed. By convention, circles represent unobserved factors (i.e., intercept, slope), rectangles represent observed factors (e.g., baseline readiness to change scores, 3-month follow up readiness to change scores, 9-month follow up readiness to change scores), single-headed arrows indicate influence of one variable to another, and double-headed arrows represent covariances (i.e., correlations between pairs of variables) (Byrne, 2006).

In a first level LGC analysis, influences on growth were assessed. The specified model included two growth parameters, 1) an intercept, measuring an individual's score on the outcome variable at baseline, and 2) the slope, measuring the rate of change over the period of interest (baseline, 3-month follow up, and 9-month follow-up) (Byrne, 2013). Then, parameter estimates and goodness of fit indices (CFI, TLI, RMSEA) were used to determine the most appropriate model. In a second level LGC, time-invariant predictors, depression and marijuana use were added to the respecified model.
LGC analysis was conducted to compare patterns of mean scores on the seven TTM variables for alcohol (Stages of Change- Readiness to change; Decisional balance- Pros

for change (Pros), Cons for change (Cons); Self-Efficacy- Confidence to change (Confidence), Temptation not to change (Temptation); Processes of Change (POC)- Experiential POC, Behavioral POC for all study participants. AMOS version 24 was used for all analyses.

Missing Value Analysis

Among 261 cases at baseline, 13 missing cases at 9-month follow up were removed. After removing 19 more cases with missing data and multivariate outliers, the final sample size was 229.

Results for Question 3

Sample Characteristics and Study Variables

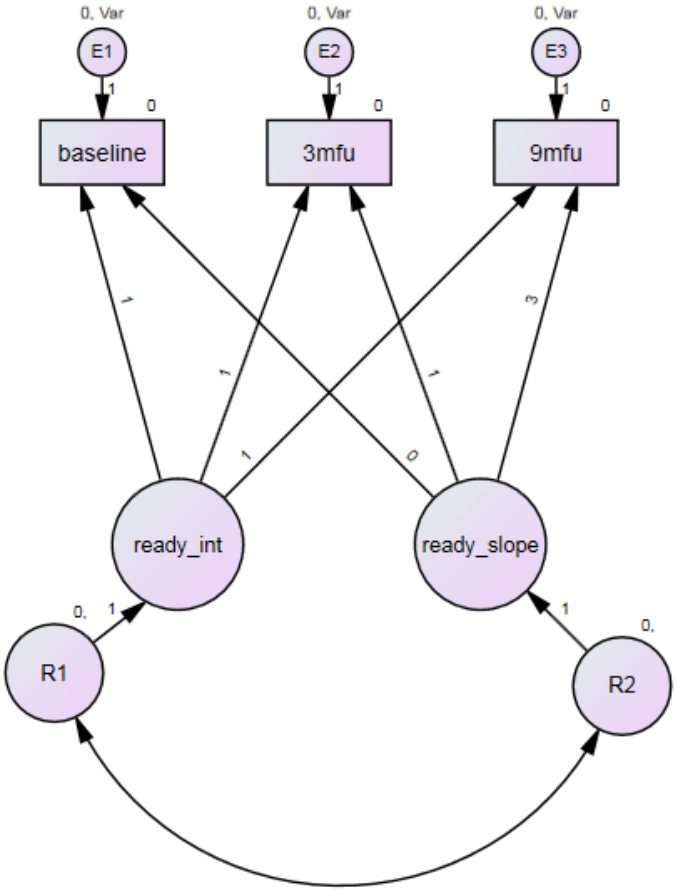
Descriptive statistics indicated that the average number of drinks per week were 28.220 (SD= 78.462) at baseline, 16.730 (SD=34.195) at 3-month follow up, and 12.350 (SD=22.090) at 9-month follow up. The average number of days using effective contraception 1.602 (SD=3.587) at baseline, 8.408 (SD=19.918) at 3-month follow up, and 13.487 (SD=34.167) at 9-month follow up.

Latent Growth Curve Modeling Analysis

Readiness to change alcohol use (Readiness).

Level 1. To assess the mean level of readiness to change alcohol use at time 1 (baseline), the mean rate of change in scores of readiness across time, the interaction between initial score and rate of change, and inter-individual differences in initial scores and rate of change, the Level 1 LGC model was fit without any predictors.

Figure 3-1. Readiness to Change Alcohol Use Respecified Model-Model 2



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another

Table 3-1. Fit Indices for Models for TTM Variable Readiness to Change Alcohol Use

Model	χ2	df	RMSEA	CFI	AIC	TLI
Level 1						
Model 1 Base Model	.923	3	.000	1.000	12.923	1.009
Model 2 Respecified Model	.565	3	.000	1.000	12.565	1.020
Level 2						
Model 3 Predictor Depression	2.090	4	.000	1.000	22.090	1.019
Model 4 Predictor Marijuana use	.588	4	.000	1.000	20.588	1.036

Examination of the covariates indicated that the group intercept did not have a meaningful effect on the slope. According to conventional criteria, the respecified model (model 2) fit indices indicate adequate fit to the data ($\chi 2 = 1.595$, df = 4, p= .810; RMSEA = .000; CFI = 1.000; TLI = 1.004).

No significant variation in the initial level of readiness to change scores was found across time (p=.055). The variance of 6.639 for readiness slope (p<.001) is statistically significant, indicating significant individual variability in the rate of change of readiness scores. The significant intercept mean indicates that the mean readiness to change alcohol score at the initial level is different from 0 (i.e., at baseline) (p<.001). There was no significant change over time for readiness to change alcohol use.

Table 3-2. Variance Estimates of Level 1 for TTM Variable Readiness to Change

	Mean (SE)	C.R.
Readiness Intercept	.168 (.087)	1.920
Readiness Slope	**6.639 (.884) *****	**7.500**

*p<.05, **p<.01, ***p<.001

Table 3-3. Mean Estimates of Level 1 for TTM Variable Readiness to Change

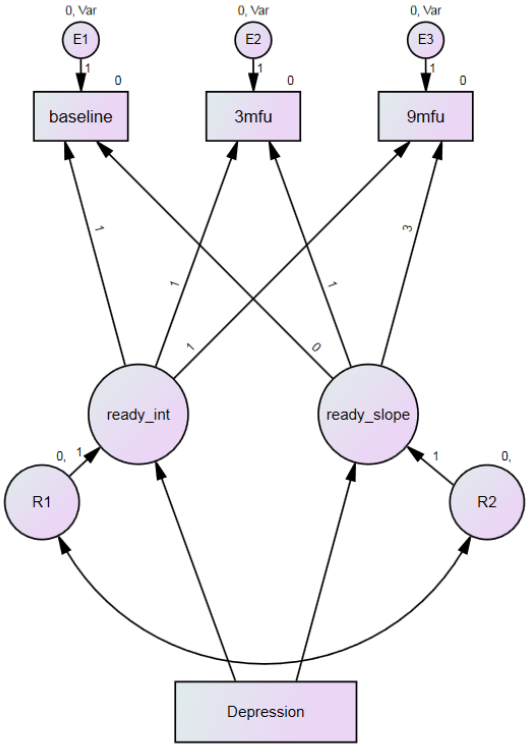
	Intercept		Slope	
	Mean (SE)	CR	Mean (SE)	CR
Readiness	**5.816 (.212) *****	**27.421**	-.097 (.061)	-1.609

*p<.05, **p<.01, ***p<.001

Level 2 (Time-invariant predictors). In Level 2, hypothesized time-invariant predictors—depression and marijuana use—were added one at a time to the model to assess if they affect the initial mean level of readiness scores and the mean rate of change in readiness scores over time (see Table 3-1).

Depression. According to conventional criteria, the predictor model with depression (model 3) fit shows an adequate fit of the model to the data ($\chi 2 = 2.656$, df = 5, p=.753; RMSEA = .000; CFI = 1.000; TLI = 1.019). At baseline, depressed women had significantly higher readiness to change alcohol use scores than non-depressed women (Table 3-4), but the rate of change in readiness to change alcohol use scores did not differ by depression status.

Figure 3-2. Readiness Depression Predictor Model- Model 3



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another

Table 3-4. Regression Estimates for the Depression Predictor Model (Model 3)

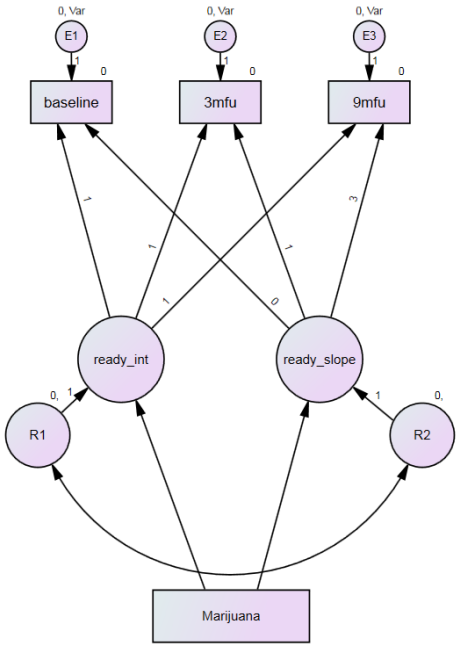
			B (SE)	C.R.
Readiness Intercept	**<---**	**Depression**	**1.418 (.407)**	**3.483*****
Readiness Slope	<---	Depression	-.144 (.119)	-1.207

*p<.05, **p<.01, ***p<.001

Marijuana use. The predictor model with marijuana use (model 4) has an adequate fit to the data according to conventional criteria ($\chi 2 = 1.631$, df = 5, p=.898; RMSEA = .000; CFI = 1.000; TLI = 1.028). No impact of marijuana use was found in

readiness to change alcohol use scores at baseline (p=.748) or in the rate of change (p=.794) (Table 3-5).

Figure 3-3. Readiness Marijuana Predictor Model- Model 4



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another

Table 3-5. Regression Estimates for the Depression Predictor Model (Model 4)

			B (SE)	C.R.
Readiness Intercept	<---	Marijuana	.136 (.424)	.321
Readiness Slope	<---	Marijuana	.032 (.121)	.261

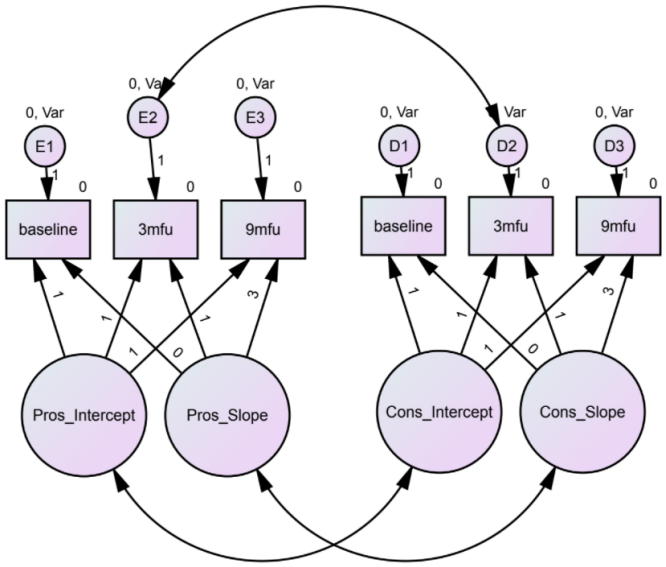
*p<.05, **p<.01, ***p<.001

Pros for change (Pros) and cons for change (Cons).

Level 1. LGC model was fit without any predictors to assess the mean level of pros and cons for change scores at time 1 (baseline), the mean rate of change in scores

across time, the interaction between initial score and rate of change, and inter-individual differences in initial scores and rate of change.

Figure 3-4. Pros and Cons Respecified Model-Model 2



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-6. Fit Indices for Models for TTM Variables Pros and Cons

Model	χ2	df	RMSEA	CFI	AIC	TLI
Level 1						
Model 1 Base Model	72.242	16	.154	.854	94.242	.863
Model 2 Respecified Model	19.698	15	.046	.988	43.698	.988
Level 2						
Model 3 Predictor Depression	19.273	17	.023	.995	55.273	.991
Model 4 Predictor Marijuana use	18.361	17	.018	.997	54.361	.995

The respecified base model (model 1) included the covariate paths: pros for change intercept to cons for change intercept and pros for change slope to cons for change slope. In addition, an error covariance between the pros for change at 3-month follow up (E2) and the Cons at 3-month follow-up (D2) was added. The nonsignificant covariates, pros for change intercept to cons for change slope (p=.570) and pros for change intercept to cons for change slope (p=.703), were deleted. According to conventional criteria, the respecified model (model 2) fit indices indicate adequate fit to the data ($\chi 2 = 19.698$, df = 15, p= .184; RMSEA = .0461; CFI = .988; TLI = .988).

Table 3-7. Covariance Estimates of Level 1 for TTM Variables Pros and Cons

			Mean (SE)	C.R.
Pros Intercept	**<-->**	**Cons Intercept**	**.263 (.069) *****	**3.779**
Pros Slope	**<-->**	**Cons Slope**	**.034 (.007) *****	**4.639**

*p<.05, **p<.01, ***p<.001

Examination of covariances revealed statistically significant differences between participants. The significant positive relationships between the intercepts (i.e., baseline pros for change and baseline cons for change scores) (.263, p<.001), on average, indicated that women with higher baseline pros for change scores were more likely to indicate higher cons for change scores. The positive estimate of .034 (p<.001) suggests that participants who had a greater rate of change in pros for change scores, demonstrated a greater rate of change in cons for change scores over the three time points.

Table 3-8. Variance Estimates of Level 1 for TTM Variables Pros and Cons

	Mean (SE)	C.R.
Pros Intercept	**.812 (.103) *** **	**7.866**
Pros Slope	**.027 (.012) ***	**2.304**
Cons Intercept	**.630 (.082) *** **	**7.721**
Cons Slope	.007 (.009)	.711

*p<.05, **p<.01, ***p<.001

The corresponding variances, .812 for pros for change intercept (p<.001), .630 for pros for change slope (p<.05) are statistically significant, indicating significant individual variability in the initial level and rate of change (growth) in pros for change scores across the three waves of measurement. The corresponding variances, .630 for cons for change intercept (p<.001) is statistically significant, indicating significant individual variability in the initial level of cons for change scores. No significant variation in the rate of change in cons for change scores was found across time (p=.477).

Table 3-9. Mean Estimates of Level 1 for TTM Variables Pros and Cons

	Intercept		Slope	
	Mean (SE)	CR	Mean (SE)	CR
Pros	**2.784 (.080) *** **	**34.985**	.021 (.026)	.790
Cons	**2.478 (.070) *** **	**35.239**	**-.083 (.023) *** **	**-3.557**

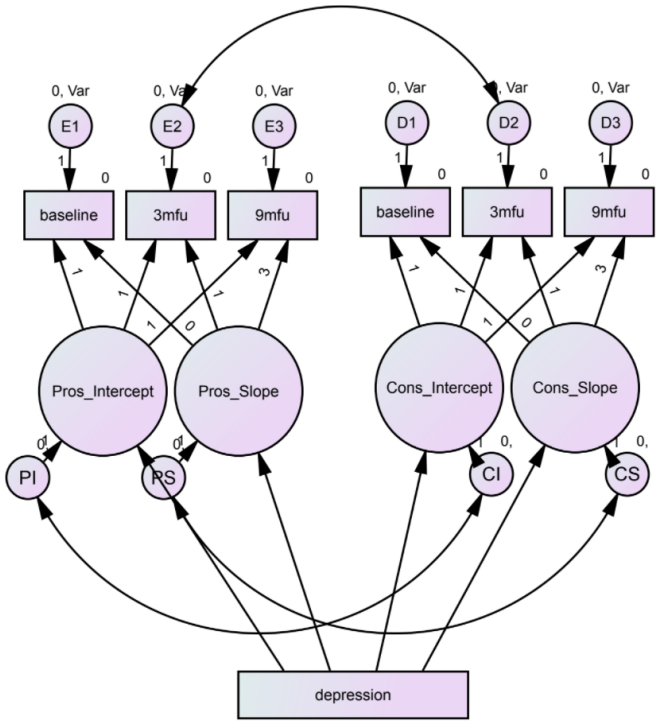
*p<.05, **p<.01, ***p<.001

As shown in Table 3-7, in model 2, the significant intercept mean indicates that the mean pros for change score at the initial level is different from 0 (i.e., at baseline) (p<.001). There is significant change over time for cons for change. Cons score is expected to decrease by .083 units (CR=. -3.557; p<.001) at each time point, beginning with an average score of -.083 (CR= 35.289, p<.001).

Level 2 (Time-invariant predictors). In Level 2, hypothesized time-invariant predictors—depression and marijuana use—were added to the model one at a time to assess if they affect the initial mean level of pros and cons for change scores and the mean rate of change in pros and cons for change scores over time (see Table 3-6).

Depression. The depression predictor model (model 3) provides a good fit to the data with a chi-square (17, N=261) = 19.273, p=.313 and all goodness of fit measures at acceptable ranges (RMSEA=.023, CFI=.995, TLI=.991). At baseline, depressed individuals had significantly higher pros for change scores and higher cons for change scores (see Table 3-10). There was no rate of change differences in the pros and cons for change by depression.

Figure 3-5. Pros and Cons Depression Predictor Model- Model 3



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-10. Regression Estimates for the Depression Predictor Model (Model 3)

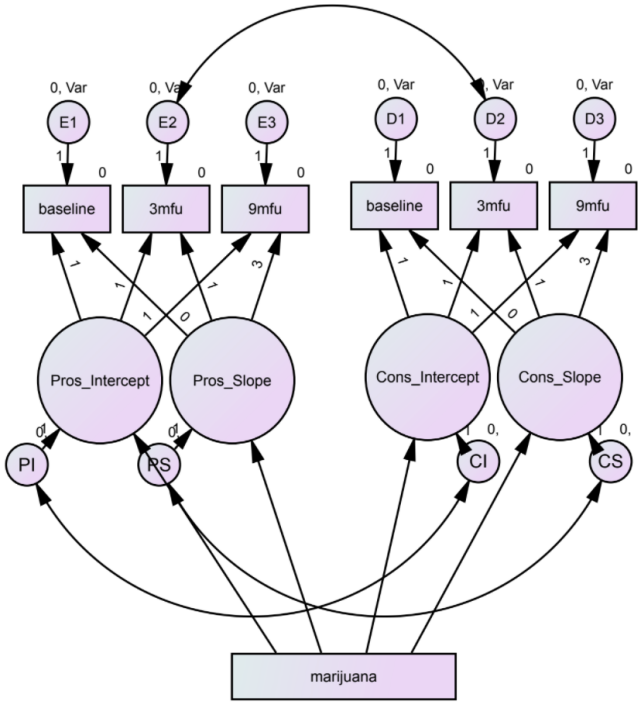
			B (SE)	C.R.
Pros Intercept	**<---**	**Depression**	**.463 (.152) ****	**3.034**
Pros Slope	<---	Depression	-.032 (.051)	-.634
Cons Intercept	**<---**	**Depression**	**.687 (.135) *****	**5.100**
Cons Slope	<---	Depression	-.057 (.047)	-1.228

*p<.05, **p<.01, ***p<.001

Marijuana use. According to conventional criteria, the predictor model with marijuana use (model 4) also has an adequate fit of the model to the data ($\chi 2 = 18.361$, df = 17, p= .366; RMSEA = .018; CFI = .997; TLI = .995). Marijuana users

had greater cons for change scores at baseline, and their cons for change scores decreased (Baseline mean: 2.693, 3-month follow up mean: 2.446, and 9-month follow up mean: 2.314) at a slower rate of change (Table 3-11) than the non-marijuana users.

Figure 3-6. Pros and Cons Marijuana Predictor Model- Model 4



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-11. Regression Estimates for the Marijuana Predictor Model (Model 4)

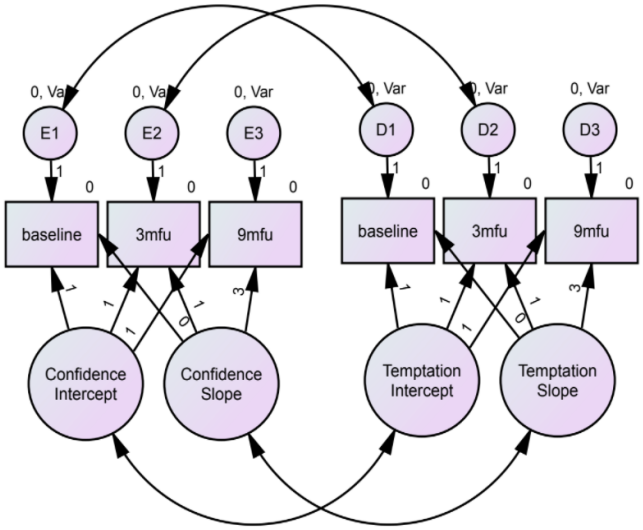
			B (SE)	C.R.
Pros Intercept	<---	Marijuana	.163 (.158)	1.031
Pros Slope	<---	Marijuana	-.079 (.052)	-1.529
Cons Intercept	**<---**	**Marijuana**	**.435 (.142) ****	**3.059**
Cons Slope	**<---**	**Marijuana**	**-.093 (.047) ***	**-1.989**

*p<.05, **p<.01, ***p<.001

Confidence to change (Confidence) and temptation not to change (Temptation).

Level 1. Level 1 LGC model was fit without any predictors to assess the mean level of confidence and temptation scores at time 1 (baseline), the mean rate of change in scores across time, the interaction between initial score and rate of change, and inter-individual differences in initial scores and rate of change.

Figure 3-7. Confidence and Temptation Respecified Model-Model 2



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-12. Fit Indices for Models for TTM Variables Confidence and Temptation

Model	χ2	df	RMSEA	CFI	AIC	TLI
Level 1						
Model 1 Base Model	252.446	16	.313	.532	274.446	.561
Model 2 Respecified Model	19.553	14	.051	.989	45.553	.998
Level 2						
Model 3 Predictor Depression	21.297	16	.036	.990	59.297	.983
Model 4 Predictor Marijuana use	24.789	16	.046	.983	62.789	.971

The base model (model 1) was respecified by covariate paths: confidence intercept to temptation intercept and confidence slope to temptation slope. Also, error covariance's between confidence at 3-month follow up (E2) and temptation at 3-month follow-up (D2), and confidence at baseline (E1) and temptation at baseline (D1) were added. Nonsignificant covariates, temptation intercept to temptation slope (p=.680), and confidence intercept to confidence slope (p=.708) were deleted. According to conventional criteria, the respecified model (model 2) fit indices indicate adequate fit to the data ($\chi 2 = 19.553$, df = 14, p=.145; RMSEA = .051; CFI = .989; TLI = .998).

Table 3-13. Covariance Estimates of Level 1 for TTM Variables Confidence and Temptation

			Mean (SE)	C.R.
Confidence Intercept	**<-->**	**Temptation Intercept**	**-.413 (.062) *** **	**-6.632**
Confidence Slope	**<-->**	**Temptation Slope**	**-.029 (.008) *** **	**-3.701**

*p<.05, **p<.01, ***p<.001

Examination of covariances revealed statistically significant differences between participants. The significant negative relationships between baseline confidence and baseline temptation scores (-.413, p<.001) indicates that women with higher baseline

confidence scores were more likely to have lower temptation scores. The negative estimate of -.029 (p<.001) suggests that participants who had a greater rate of change in confidence, demonstrated a greater decrease in the rate of change in temptation scores over the 3 time points.

Table 3-14. Variance Estimates of Level 1 for TTM Variables Confidence and Temptation

	Mean (SE)	CR
Confidence Intercept	**.466 (.068) *** **	**6.894**
Confidence Slope	**.032 (.011) ** **	**3.047**
Temptation Intercept	**.512 (.072) *** **	**7.147**
Temptation Slope	**.026 (.011) ** **	**2.528**

*p<.05, **p<.01, ***p<.001

The corresponding variances, .466 for confidence intercept (p<.001), .032 for confidence slope (p<.01) are statistically significant, indicating significant individual variability in the initial level and rate of change (growth) in confidence scores across the three waves of measurement. The corresponding variances, .512 for temptation intercept (p<.001), .026 for temptation slope (p<.01) are statistically significant, indicating significant individual variability in the initial level in temptation scores and across the three waves of measurement.

Table 3-15. Mean Estimated of Level 1 for TTM Variables Confidence and Temptation

	Intercept		Slope	
	Mean (SE)	CR	Mean (SE)	CR
Confidence	**2.894 (.063) *** **	**45.725**	**.080 (.025) ** **	**3.196**
Temptation	**2.923 (.065) *** **	**44.814**	**-.114 (.024) *** **	**-4.707**

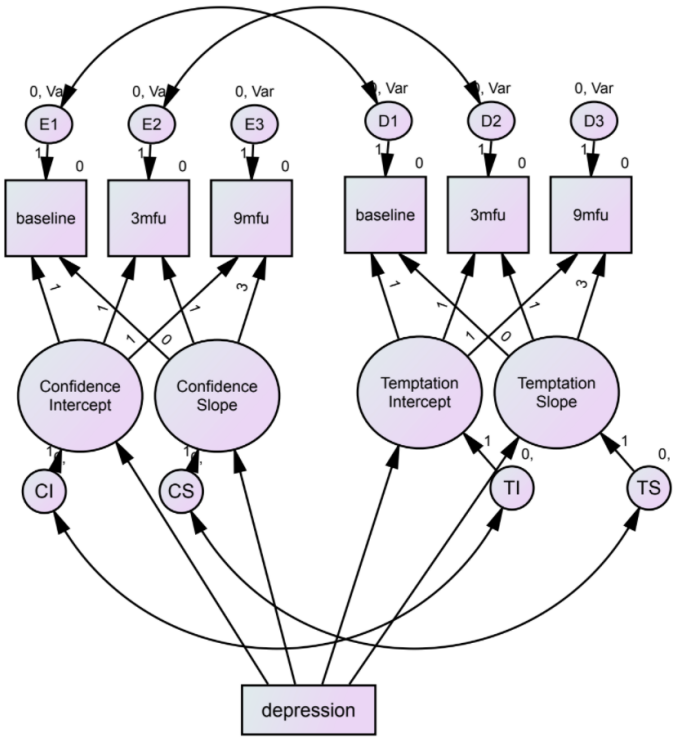
*p<.05, **p<.01, ***p<.001

As shown in Table 3-15, the intercept indicates a statistically significant mean confidence score at the initial level (i.e., at baseline) and the slope mean indicates a significant average increase, via a linear form, in confidence scores during the 3 time points. Confidence scores are expected to increase by .080 units (CR= 3.196, p<.01) each time point, beginning with an average score of 2.894 (CR=45.725, p<.001). There is significant change over time for temptation. Temptation score is expected to decrease by .114 units (CR=. -4.707; p<.001) each time point, beginning with an average score of 2.923 (CR= 44.814, p<.001).

Level 2 (Time-invariant predictors). In Level 2, hypothesized time-invariant predictors—depression and marijuana use—were added to the model one at a time to assess if they affect the initial mean level of confidence and temptation scores and the mean rate of change in confidence and temptation scores over time (see Table 3-12).

Depression. The depression predictor model (model 3) provided a good fit to the data with a chi-square (12, N=261) = 21.297, p=.167 and all goodness of fit measures at acceptable ranges (RMSEA=.036, CFI=.990, TLI=.983). At baseline, depressed women had significantly lower confidence scores and higher temptation scores than non-depressed women (see Table 3-16), but the two groups did not differ in rate of change over time.

Figure 3-8. Confidence and Temptation Depression Predictor Model- Model 3



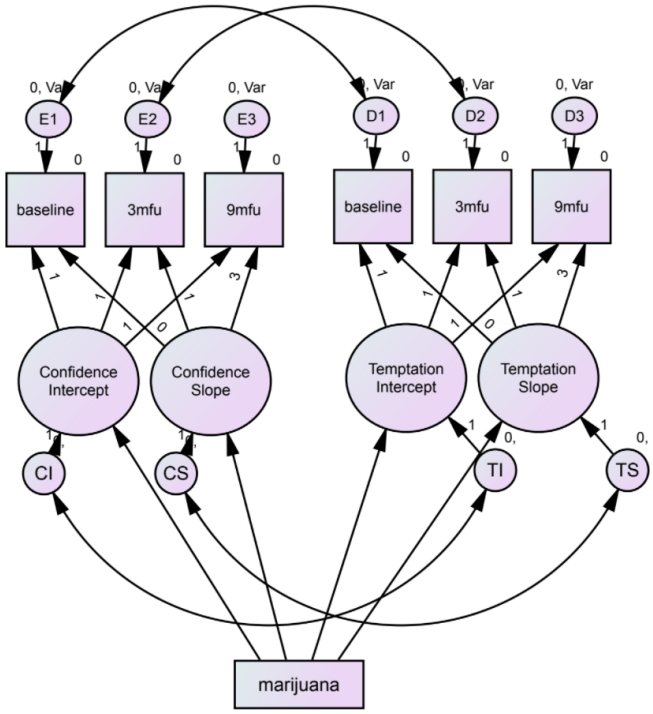
Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-16. Regression Estimates for the Depression Predictor Model (Model 3)

			B (SE)	C.R.
Confidence Intercept	**<---**	**Depression**	**-.668 (.118) *****	**-5.684**
Confidence Slope	<---	Depression	.017 (.050)	.328
Temptation Intercept	**<---**	**Depression**	**.681 (.122) *****	**5.587**
Temptation Slope	<---	Depression	-.032 (.049)	-.661

Marijuana Use. According to conventional criteria, the predictor model with marijuana use (model 4) fit also has an adequate fit of the model to the data ($\chi 2 = 24.789$, df = 16, p=.074; RMSEA = .046; CFI = .983; TLI = .971). At baseline, marijuana users had significantly lower confidence scores and higher temptation scores than non-marijuana users (see Table 3-17), but the two groups did not differ in the rate of change over time.

Figure 3-9. Confidence and Temptation Marijuana Predictor Model- Model 4



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

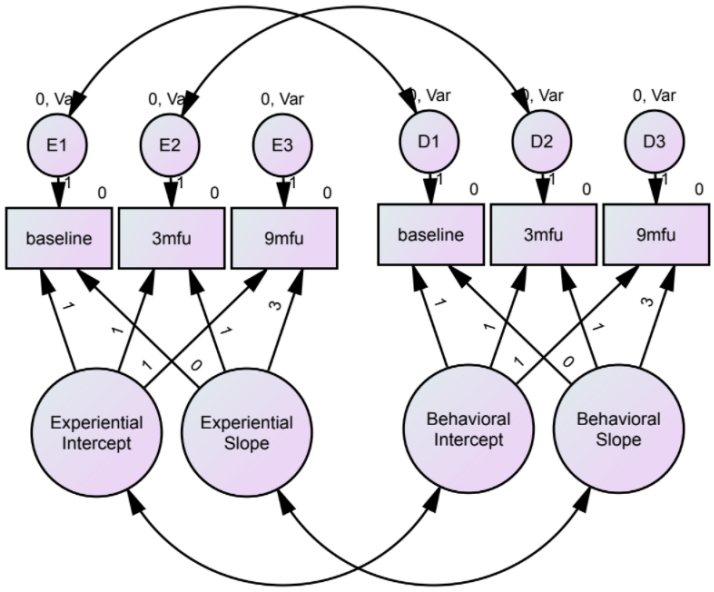
Table 3-17. Regression Estimates for the Marijuana Predictor Model (Model 4)

			B (SE)	C.R.
Confidence Intercept	**<---**	**Marijuana**	**-.255 (.128) ***	**-1.996**
Confidence Slope	<---	Marijuana	.033 (.051)	.657
Temptation Intercept	**<---**	**Marijuana**	**.365 (.130) ****	**2.797**
Temptation Slope	<---	Marijuana	-.030 (.050)	-.597

Processes of change (POC).

Level 1. Level 1 LGC model was fit without any predictors to assess the mean level POC scores at time 1 (baseline), the mean rate of change in scores across time, the interaction between initial score and rate of change, and inter-individual differences in initial scores and rate of change.

Figure 3-10. Processes of Change Respecified Model-Model 2



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-18. Fit Indicess for Models for TTM Variables Processes of Change

Model	χ2	df	RMSEA	CFI	AIC	TLI
Level 1						
Model 1_Base Model	413.351	16	.412	.408	435.351	.445
Model 2 Respecified	39.976	14	.113	.961	65.976	959
Level 2						
Model 3_Predictor_Depression	58.920	16	.102	.943	96.920	.901
Model 4_Predictor_Marijauana use	51.200	16	.092	.953	89.200	.953

The base model (model 1) was respecified by covariate paths: experiential POC intercept to behavioral POC intercept and experiential POC slope to behavioral POC slope. Error covariances between experiential POC at baseline (E1) and behavioral POC at baseline (D1), and experiential POC at 3-month follow up (E2) to behavioral POC at 3-month follow-up (D2) were added. Nonsignificant covariates, experiential POC intercept to experiential POC slope (p=.685), and behavioral POC intercept to behavioral POC slope (p=.282) were deleted. According to conventional criteria, the respecified model (model 2) fit indices indicate a somewhat poor fit to the data ($\chi 2 = 50.221$, df = 14, p= .000; RMSEA = .100; CFI = .951; TLI = .927).

Table 3-19. Covariance Estimates of Level 1 for TTM Variables Processes of Change

			Estimate
Experiential POC Intercept	**<-->**	**Behavioral POC Intercept**	**.309 (.048) *** **
Experiential POC Slope	**<-->**	**Behavioral POC Slope**	**.043 (.007) *** **

*p<.05, **p<.01, ***p<.001

Examination of covariances revealed statistically significant differences. At baseline, women with higher experiential POC scores were also more likely to have

higher behavioral POC scores (.309, p<.001). Participants who had a greater rate of change in experiential POC scores also demonstrated a greater rate of increase in behavioral POC scores over the three time points (.043, p<.001).

Table 3-20. Variance Estimates of Level 1 for TTM Variables Processes of Change

	Mean (SE)	C.R.
Experiential POC Intercept	**.435 (.058) *** **	**7.474**
Experiential POC Slope	**.028 (.008) *** **	**3.517**
Behavioral POC Intercept	**.329 (.048) *** **	**6.861**
Behavioral POC Slope	**.036 (.008) *** **	**4.219**

*p<.05, **p<.01, ***p<.001

The corresponding variances, experiential POC intercept (p<.001) and experiential POC slope (p<.001) are statistically significant, indicating significant individual variability in the initial level and rate of change (growth) in experiential POC scores across the three waves of measurement. Also, behavioral POC intercept (p<.001) and behavioral POC slope (p<.001) were statistically significant, indicating significant individual variability in the initial level and rate of change (growth) in behavioral POC scores across the three waves of measurement.

Table 3-21. Mean Estimates of Level 1 for TTM Variables Processes of Change

	Intercept		Slope	
	Mean (SE)	CR	Mean (SE)	CR
Experiential POC	**2.203 (.059) *** **	**37.204**	.037 (.021)	1.727
Behavioral POC	**2.337 (.053) *** **	**44.244**	**.050 (.023) ***	**2.199**

*p<.05, **p<.01, ***p<.001

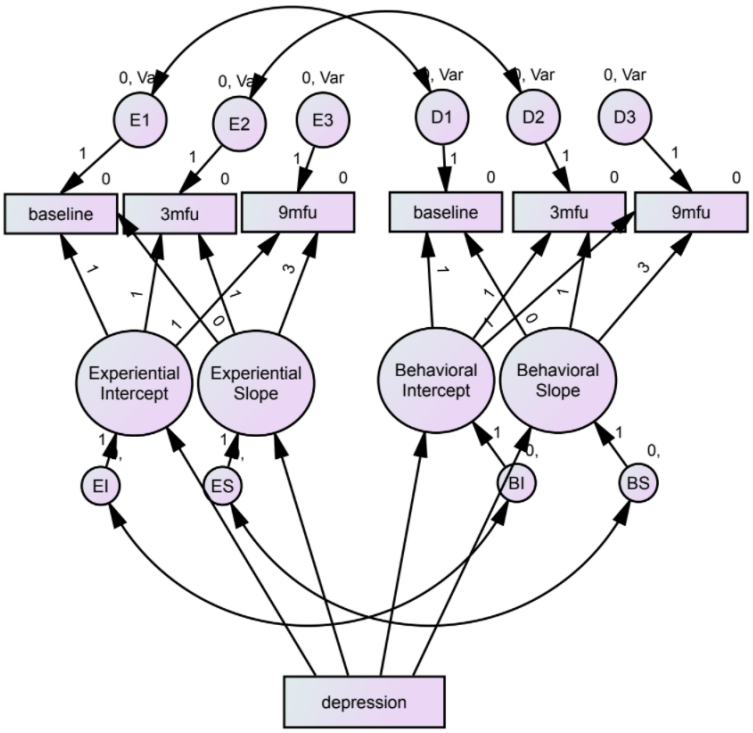
As Table 3-21 shows, the significant intercept mean indicates that the mean experiential POC score at the initial level is different from 0 (i.e., at baseline) (p<.001). There was significant change over time for behavioral POC. Behavioral POC score is expected to increase by .050 units (CR=. -3.557; p<.001) each time point, beginning with an average score of 2.337 (CR= 2.199, p<.05).

Level 2 (Time-invariant predictors).

In Level 2, hypothesized time-invariant predictors—depression and marijuana use—were added to the model to assess if they affect the initial mean level of experiential POC and behavioral POC scores and the mean rate of change in experiential POC and behavioral POC scores over time (see Table 3-18).

Depression. The depression predictor model (model 3) provided a somewhat poor fit to the data ($\chi 2 = 58.920$, df = 16, p= .000; RMSEA=.102, CFI=.943, TLI=.901). At baseline, depressed individuals had significantly higher experiential POC scores (see Table 3-22), but there was no difference in the behavioral POC intercept or the rate of change of the experiential and behavioral POC by depression.

Figure 3-11. Processes of Change Depression Predictor Model- Model 3



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

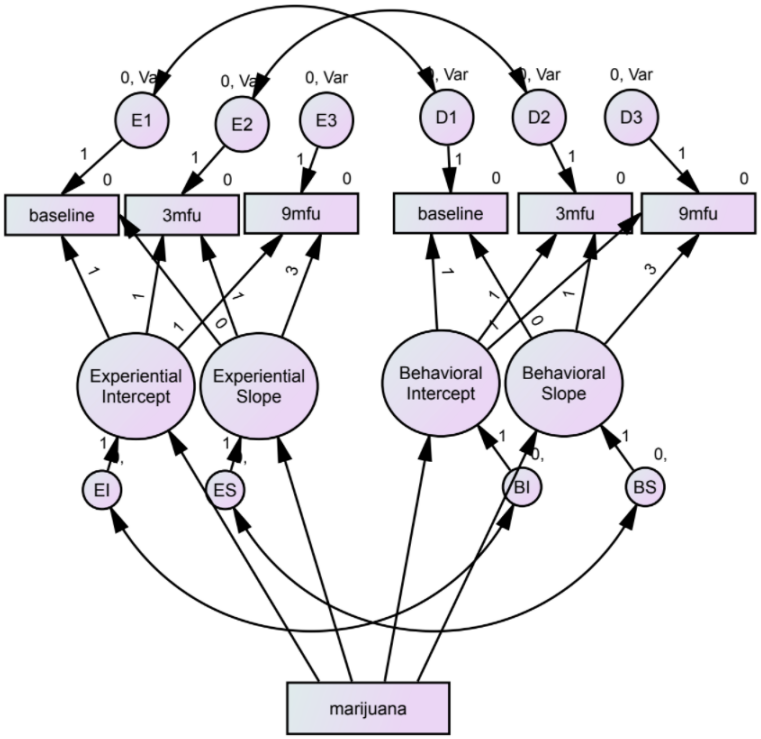
Table 3-22. Regression Estimates for the Depression Predictor Model (Model 3)

			B (SE)	C.R.
Experiential POC Intercept	**<---**	**Depression**	**.327 (.114) ****	**2.871**
Experiential POC Slope	<---	Depression	-.037 (.043)	-.867
Behavioral POC Intercept	<---	Depression	.099 (.105)	.939
Behavioral POC Slope	<---	Depression	-.019 (.044)	-.428

*p<.05, **p<.01, ***p<.001

*Marijuana use***.** According to conventional criteria, the predictor model with marijuana use (model 4) also had an adequate fit of the model to the data ($\chi 2 = 51.200$, df = 16, p= .000; RMSEA = .092; CFI = .953; TLI = .917). The marijuana use and nonuse groups did not differ in baseline experiential POC scores (p=.799), rate of change in Experiential scores (p=.120), baseline behavioral POC scores (p=.879), or rate of change in behavioral POC scores (p=.07) (Table 3-23).

Figure 3-12. Processes of Change Marijuana Predictor Model- Model 3



Circles=unobserved factors; Rectangles=observed factors; Single-headed arrows= influence of one variable on another; Double-headed arrows=covariances

Table 3-23. Regression Estimates for the Marijuana Predictor Model (Model 4)

			B (SE)	C.R.
Experiential POC Intercept	<---	Marijuana	-.030 (.118)	-.255
Experiential POC Slope	<---	Marijuana	.067 (.043)	1.553
Behavioral POC Intercept	<---	Marijuana	.016 (.107)	.153
Behavioral POC Slope	<---	Marijuana	.081 (.045)	1.807

**p<.05, **p<.01, ***p<.001

A summary of level 1 and level 2 LGC analysis for all TTM variables is listed in Table 3-24.

Table 3-24. LGC Analysis Summary for all TTM variables

LEVEL 1	**Readiness**	**Pros**	**Cons**	**Confidence**	**Temptation**	**Experiential POC**	**Behavioral POC**
Means							
Intercept	**5.816 *****	**2.784*****	**2.478*****	**2.894*****	**.080****	**2.203*****	**2.337*****
Slope	-.097	.021	**-.083*****	**2.923*****	**-.114*****	.037	**.050***
Covariance							
Intercept	Readiness	Pros ←→ Cons		Confidence←→ Temptation		Exp POC←→ Beh POC	
Estimates	Intercept	**.263*****		**-.413*****		**.309*****	
Slope	←→						
	Readiness						
	Slope	Pros ←→ Cons		Confidence←→ Temptation		Exp POC←→ Beh POC	
Estimates	.05	**.034*****		**-.029*****		**.043*****	
Variance							
Intercept	.168	**.812*****	**.630*****	**.466*****	**.512*****	**.435*****	**.329*****
Slope	**6.639 *****	**.027***	.007	**.032****	**.026****	**.028*****	**.036*****
LEVEL 2	**Readiness**	**Pros**	**Cons**	**Confidence**	**Temptation**	**Experiential POC**	**Behavioral POC**
DEPRESSION Regression Weights							
Intercept path	**1.418 *****	**.463****	**.687*****	**-.668*****	**.681*****	**.327****	.099
Slope path	.144	-.032	-.057	.017	-.032	-.037	-.019
MARIJUANA Regression Weights							
Intercept path	.136	.163	**.435****	**-.255***	**.365****	-.030	.016
Slope path	.032	-.079	**-.093***	.033	-.030	067	.081

VII. DISCUSSION

TTM guided alcohol intervention studies among women of childbearing age have been well described (Velasquez et al., 2017; Velasquez et al., 2010; Fabbri et al., 2009; Floyd et al., 2007). However, most of this research has not accounted for comorbid marijuana (or other) substance use and mental disorders, particularly as they present in primary care settings. Thus, this study of TTM variables incorporated the examination of comorbid depression and marijuana use among risky-drinking women of childbearing age in primary care settings to explore three interrelated questions.

Research Question 1: Factors Associated with Comorbidity

Research Question 1 was posed to explore social and motivational factors associated with alcohol use, alcohol use among depressed women, and lastly, alcohol use among women who use marijuana.

ALCOHOL USE

Among hypothesized social factors guided by the Common Risk Factor model (Muser et al., 2003), older age, history of substance use treatment, depression, and other drug use (marijuana) were significantly associated with alcohol use. Though literature is mixed (Tsai et al., 2007; Caetano et al., 2006), findings from this study were consistent with the body of alcohol literature that states that older women of childbearing age are more likely than younger women to use alcohol (Pettigrew et al., 2016; Meschke, Holl, & Messelt, 2013). Congruent with literature that reports a high prevalence of comorbid mental health (Gold & Aronson, 2010; Kessler, 2004; Grant et al., 2004) or other drug

use among alcohol users (Stein, Caviness, & Anderson, 2014), findings support similar results for women of childbearing age. For women in this study, depression and marijuana use were significantly associated with more alcohol use.

Motivational factors, readiness to change, cons for change, experiential POC, and behavioral POC were significantly associated with alcohol use. Women with greater readiness to change scores were more likely to consume more alcohol. Even though the importance of readiness as an indicator for motivation toward behavior change has been established (Osterman, 2011; Brown et al., 2005), some studies link high readiness to change to worse substance use outcomes (Fabbi et al., 2009; Li et al., 2011). Similarly, despite having increased levels of readiness to change, depressed women or women who use marijuana in this study appear to show inability or unwillingness to change alcohol use. Further exploration is warranted to better understand the role of readiness to change and potential mediating variables impacting the relationship between readiness to change and alcohol use. The associations between greater cons for change and greater use of experiential POC with greater levels of alcohol use were also congruent with previous research (Velasquez et al., 2016; Prochaska & DiClemente, 1984; DiClemente, 2003; Velasquez et al., 2010; von Sternberg et al., 2012).

ALCOHOL USE AMONG DEPRESSED PARTICIPANTS

Similar to the alcohol use model, social factors associated with alcohol use among women with comorbid depression were age and marijuana use. These findings are congruent with other studies that suggest older age is related to comorbid mental health

and substance use disorder among women (Morse et al., 2015). Significant marijuana use in this group adds to reports of high prevalence of concurrent alcohol use and marijuana use among women of childbearing age (Centers for Disease Control and Prevention, 2004; D'Angelo et al., 2007).

Among motivational factors, more cons for change, lower confidence, and more use of experiential POC were significant factors associated with more alcohol use among depressed women. Consistent with previous research (Prochaska & DiClemente, 1984; DiClemente, 2003), depressed individuals with higher cons for change and lower confidence levels were more likely to endorse drinking.

Alcohol Use among Marijuana Users

Similar to the two models above, older age was a factor related to more increased alcohol use for women with comorbid alcohol and marijuana use. Though older individuals endorsed more alcohol use in this study sample, some studies have reported greater substance use among younger adults (Morse et al., 2015). Additional assessment of age concerning women with comorbidity is needed.

As the Common Risk Factor Model (Muser et al., 2003) suggests, hypothesized social factors, history of substance use treatment (other drug use), and mental disorder (depression) were significantly related to increased levels of drinking among women with comorbid marijuana use. Furthermore, the significance of substance abuse treatment and depression confirms previous studies that report a high prevalence of comorbid substance

use and mental disorders (Langas, Malt, & Opjordsmoen, 2011; Kingston, Marel, & Mills, 2017; Lai et al., 2015).

Motivational factors, higher readiness to change, higher cons for change, and less use of behavioral POC were significantly associated with more alcohol use among women with comorbid alcohol use and marijuana use. Similar to the alcohol only model, women with higher alcohol consumption were more ready to change their drinking. Further assessment of readiness to change is warranted to identify determinants of readiness to change, particularly among women who also use marijuana. Higher cons for change and limited use of behavioral POC may imply that risk-drinking women of childbearing age who are concurrent marijuana users are in the earlier stages of change (Prochaska & DiClemente, 1984; DiClemente, 2003), report greater levels of alcohol use, and are not thinking about changing their drinking behavior.

Overall, study findings suggest that those who should be prioritized in interventions efforts are older women of childbearing age with comorbid depression or marijuana use, and those with high readiness to change, high cons for change, and lower behavioral POC use. In all three groups, high cons for change was a significant factor associated with more alcohol use. Because lower cons for change can serve as a marker for making changes in alcohol use, findings suggest the importance of interventions to reduce cons and explore more pros for change, particularly among women with co-occurring marijuana use and depression.

Research Question 2: Profile Analysis

Research Question 2 aimed to identify patterns of mean scores on the TTM variables for women with comorbid depression and marijuana use at baseline and 9-month follow up.

DEPRESSION

PA results support the hypothesis that TTM profiles differed for depressed and non-depressed women at both time points with depressed women showing lower pros for change than cons for change, lower confidence than temptation, and more experiential POC and behavioral POC than non-depressed women at both time points. These findings are consistent with TTM profiles of depressed women of childbearing age in the CHOICES study (Johnson et al., 2017).

On the decisional balance variables, women with depression scored significantly higher than non-depressed women on pros and cons for change at both time points, indicating an increased awareness of the good and not so good things about changing alcohol use, as well as a heightened exploration of importance and ongoing ambivalence toward change. Depressed women scored significantly lower on confidence and higher on temptation at baseline and at 9-month follow up. Lower confidence scores add to study results that show higher scores on Contemplation at both times; i.e., it is likely that depressed women are "stuck," and remain stuck in the earlier stages of change, often marked by more significant levels of temptation (Prochaska & DiClemente, 1984; DiClemente, 2003; Velasquez et al., 1999).

Women with depression had higher levels of experiential POC and behavioral POC than non-depressed women at baseline and at 9-month follow up. As experiential POC are comprised of internal thoughts and perceptions about change (i.e., building knowledge and awareness, emotionally moving experiences, and seeing oneself differently) (Prochaska & Velicer, 1997; Velasquez et al., 2016), amplified use of experiential POC among depressed women may be indicative of rumination. Depressed women appear stuck in the earlier Contemplation stages; despite consciously thinking more about changing their alcohol use, depressed women in part had high temptation and lacked confidence, and were unable to move forward in the stages of change (Velasquez et al., 1999).

Consistent findings at baseline and the 9-month follow indicate that women may remain depressed, which may suggest addressing co-occurring depression in alcohol interventions to reduce alcohol use. Women with comorbid depression appear to be an at-risk group with higher levels of alcohol use, and higher frequency of alcohol and mental health treatment (Table 1-3). Interventions specifically targeted toward women with comorbid depression may assist them in making meaningful reductions to their drinking, i.e., addressing depression may allow them to break away from being stuck, move forward in the stages of change, and prompt them to change successfully.

MARIJUANA USE

Study findings did not support the hypothesis for marijuana use. TTM profiles for marijuana users and non-users did not differ at baseline or at the 9-month follow up.

Although there was no significant interaction in TTM profiles, significant mean differences in a few TTM variables at both time points provide some insight into changes in alcohol consumption among marijuana users.

On the decisional balance construct, marijuana users scored slightly higher on the cons for change scores than pros for change at baseline. Thus, higher awareness of cons for change among comorbid marijuana users may signify the importance of alcohol use in this group, as well as their ambivalence toward making changes in drinking. On the self-efficacy variables, women marijuana users scored significantly higher than non-marijuana users on temptation at both baseline and at the 9-month follow up, and significantly lower confidence at baseline only. Persistent temptation among women marijuana users may be more important than differences in confidence. Study findings suggest that comorbid marijuana users are an at-risk group. As a group, marijuana users had higher rates of alcohol use, more frequent substance use and mental health treatment, higher rates of depression, and reported more incidents of trauma (Table 1-4). Further assessment of marijuana as it relates to the TTM variables is suggested to better understand marijuana as well as mechanisms of behavior change in this group.

While supporting previous research, findings regarding Research Question 2 also emphasize the need to address comorbid depression to increase motivation to change alcohol use. Further, assessment of comorbid marijuana use discovered a critical at-risk group and confirms the need to address concurrent marijuana use in alcohol interventions. Depression and marijuana use may inhibit changes in alcohol use. Tailored

attention to depression and marijuana may be needed to enable women to successfully change their drinking.

Research Question 3: TTM Variables Across Time: Latent Growth Curve Modeling

Research Question 3 examined the trajectory of TTM variables across three time points and the relationship of time-invariant predictors of depression and marijuana use to TTM trajectories.

Results of the LGC modeling analyses generally support the hypothesis with regards to change in TTM variables over time. A statistically significant rate of change in most TTM variables was observed, but not for readiness to change, pros for change, and experiential POC. The current study found that women with higher pros for change scores at baseline were likely to report higher baseline cons for change scores and vice versa. Further, women with higher pros for change scores demonstrated a greater rate of change in cons for change scores over time. It is possible that those who participated in the alcohol-related study were already thinking about their drinking (regardless of whether those thoughts were pros or cons). By exploring their ambivalence toward change (i.e., weighing the pros and cons for changing alcohol use) in the CHOICES Plus study, they may have been situated closer to the beginning stages of change.

Though changes in pros for change were insignificant over time, a decrease in cons for change scores over time suggest possible progression towards the action stage, which may be identified by a decrease in both pros and cons for change, indicating reduced overall importance of the pros and cons to a decision to change drinking

(Prochaska & DiClemente, 1984; Prochaska, 1994). The non-significant rate of change in pros for change may be explained by the make-up of the study sample. The sample was not differentiated by changes in alcohol use (i.e., successful changers vs. non-changers) nor by the type of intervention received (i.e., Choices Plus vs. Brief Advice). It is possible that the expected changes (i.e., decrease in both pros and cons for change) (Prochaska & DiClemente, 1984; von Sternberg et al., 2017) will be more apparent among women who successfully reduced their drinking or among women who received the more efficacious intervention (Velasquez et al., 2017) compared to women who received Brief Advice. Further exploration based on study outcomes and intervention type is needed to better assess the rate of change in decisional balance.

LGC results showed that initial level of confidence is negatively related to the initial level of temptation, and the rate of change in confidence also negatively influences the rate of change in temptation. Women with higher confidence scores at baseline would tended to have lower scores on temptation at baseline and vice versa; likewise, women who scored higher on confidence showed an associated decrease in temptation. This association over time supports the argument that stages of change reflect one's level of self-efficacy (Prochaska & DiClemente, 1984; DiClemente, 2003). Thus, increases in levels of self-efficacy (high confidence, low temptation) is an indication that, over time, women have progressed to the later stages of change, such as preparation and action. Perhaps efforts to address confidence early on in the intervention may be a key to successful progression through the stages.

Regarding experiential and behavioral POC, findings show that initial experiential POC scores are related to initial behavioral POC scores and the rate of change of experiential POC influences the rate of change of behavioral POC. More specifically, positive values of covariances suggest that women with higher baseline experiential POC scores were more likely to report higher behavioral POC scores, and vice versa. Women with greater rate of change in experiential POC scores demonstrated a greater rate of increase in behavioral POC scores over the three time points. Considering that both experiential and behavioral POC enable individuals to move through the stages (Velasquez et al., 2016), study results support progression to the later stages over time.

It is important to mention the lack of significance in the rate of changes in readiness to change. Researchers have extensively addressed and supported the importance of motivation to change in the behavior change mechanism (Carpenter, Miele, & Hasin, 2002; Saarnio & Vesa, 2007). Moreover, motivation to change has often been measured by the readiness score generated by the URICA (Cadigan et al., 2013; Gomez-Pena et al., 2012; Helfrich et al., 2012; Saarnio & Vesa, 2007). However, the use of URICA's readiness score is not without criticism. The literature urges caution in using URICA readiness scores as the sole marker of change (Ondersma et al., 2009), especially among individuals without a clinical diagnosis of alcohol use (Harris, Walters, & Leahy, 2008). It is possible that the overall severity level of drinking of the women in this study impacted the significance of the readiness scores in this sample. Women in the CHOICES Plus study did not have a clinical diagnosis of alcohol use; instead their average AUDIT

score of 12.292 (SD=7.789) (Table 1-1) reflects hazardous or harmful use (>8) (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001).

This study reveals possible underlying mechanisms of change influencing risky drinking among women of childbearing age. Overall, a significant rate of change in cons for change, confidence, temptation, experiential POC, and behavioral POC suggest that women in this study successfully used TTM variables and progressed through the stages of change, thus making meaningful changes in their drinking. However, findings propose that focus on pros for change early in the intervention may be critical in TTM-based alcohol interventions in assisting women to progress quickly and successfully toward change.

Additionally, significant variances in the intercepts and slopes for most TTM variables indicate the presence of critical interindividual differences in both initial status in the TTM variables and in their change over time. This evidence provided justification for incorporating predictor variables in subsequent analyses to explain this variation. Thus, subsequent models included time-invariant predictors, depression, and marijuana.

DEPRESSION

Differences on initial TTM variables based on depression status were evident, but no differences were found in the rate of change in TTM variables. Depressed women at baseline scored higher on readiness to change, higher on pros for change, higher on cons for change, lower on confidence, higher on temptation, and higher on experiential POC scores compared to non-depressed women.

Results of lower confidence and higher temptation reflect expected features of depression, such as lack of motivation, feelings of hopelessness, pessimism, and difficulty making decisions (NIH, 2016; O'Cleirigh et al., 2013). Such findings indicate that depressed women are more likely to be in the earlier stages of the change process, compared to non-depressed individuals. Individuals in the earlier stages, such as precontemplation and contemplation, are likely to have low self-efficacy and are therefore less confident and more tempted than those in the later stages (Velasquez et al., 2016; Prochaska & DiClemente, 1984; DiClemente, 2003).

Depressed women may be dealing with ambivalence towards change, as evidenced by higher readiness to change, higher pros for change, higher cons for change, and higher experiential POC scores compared to non-depressed women. Greater levels of ambivalence may be attributed to rumination, a significant marker for depression (Velasquez et al., 1999; Johnson et al., 2017; O'Cleirigh et al., 2013). Due to heightened rumination, depressed women may find themselves stuck, unable to make meaningful changes in their drinking, despite thinking about changing more than their non-depressed counterparts. Findings from this study support previous studies that claim that depressed individuals have a limited capacity to make changes (NIH, 2016; O'Cleirigh et al., 2013).

MARIJUANA USE

Marijuana users scored differently on three TTM variables—cons for change, confidence, and temptation, but significant differences in the rate of change were observed only in cons. Marijuana users had significantly higher initial cons for change

scores and changed at a slower rate than non-marijuana users. Specifically, at baseline, marijuana users identified more cons for changing their drinking than non-marijuana users and had a more difficult time reducing cons for change over time compared to their non-marijuana using counterparts.

Findings support previous research that identifies marijuana use as a predictor that potentially inhibits motivation (Simons et al., 2016). Greater levels of cons for change among marijuana users may indicate that women marijuana users are more likely to be in the earlier stages of change (precontemplation, contemplation), and therefore may not be ready to reduce their drinking. Without a shift in decisional balance—identifying more pros to change—women in these earlier stages are often unable to progress to the next stage of change (DiClemente, 2003; Prochaska, 1994).

Similarly, findings of lower confidence and higher temptation among marijuana users are in line with earlier studies that suggest that individuals in the beginning stages may have less confidence about changing and are more tempted not to change their drinking (Prochaska & DiClemente, 1984; DiClemente, 2003).

Marijuana users were less likely to reduce their risk of AEP (See Table 2-4). One possible explanation is that marijuana users did not have enough motivation to make any change compared to non-marijuana users (Simons et al., 2016). Thus, marijuana users were more likely not to make changes in reducing their drinking or in increasing their use of contraception to reduce the risk of AEP.

Limitations

This study has several limitations. First, sample limitations must be noted. Although significant differences in outcomes were found between the two conditions in the parent study, for this dissertation, the sample included both the Intervention and the Brief Advice group in the CHOICES Plus study to ensure sufficient sample size. While the Intervention was significantly more effective in reducing the risk of AEP, the Brief Advice group also had reductions in AEP (Velasquez et al., 2017). Thus, findings at the 9-month follow up should be interpreted with caution. Also, while the CHOICES Plus study focused on reducing the risk of AEP, women had a choice to identify a single target behavior, i.e., either risk drinking or contraception use. Therefore, some women may not have prioritized alcohol behavior change. Furthermore, though the uniqueness of the data (non-treatment-seeking, childbearing-aged, risky-drinking women in primary care settings) provided the impetus for the study, generalizability is limited.

Second, measurement limitations should be noted. A possible limitation is the use of self-report measures. Though measures of alcohol use using the TLFB and the AUDIT have been consistently shown to have sound reliability and validity (Sobell et al., 1992; Robinson et al., 2014; Moussas et al., 2009; Daeppen et al., 2000; Bradley et al., 2003), lack of use of biomarkers of daily alcohol use calls for caution in drawing inferences. Also, the limitations of grouping depressed and non-depressed women based on the BSI's standard depression cut-off score of 63 should be noted (i.e., dichotomous classification of the women groups women with similar scores will be divided into different groups; a score of 63 classified women into the depressed group and a score of 62 classified

women into the non-depressed group). Similarly, the impact of marijuana use may be looked upon with caution given the dichotomous classification of marijuana use. A more comprehensive assessment of marijuana use should be conducted to better address marijuana use among women of childbearing age. Future qualitative studies may also provide meaningful information regarding an individual's change process and also one's experiences receiving a substance use intervention.

Third, a few limitations based on statistical analysis should be noted. For Research Question 1, as a cross-sectional study, caution should be exercised in drawing inferences, as temporal sequence among variables cannot be determined. However, findings of Research Question 1 shed light on social and motivational factors impacting alcohol use, comorbid alcohol use and depression, and comorbid alcohol use and marijuana use among women of childbearing age. For Research Question 2, PA of TTM variables is not a longitudinal assessment of the TTM variables, rather a snapshot of profiles of TTM variables at two separate time points (i.e., baseline and at 9-month follow up). Thus, it is important to note that the profiles created are specific to the use of TTM variables and are not a comprehensive evaluation that includes all variables and markers of measuring behavior change. PA offers one way to help inform clinicians in assessing client progress toward change in treatment.

Lastly, the LGC modeling within the framework of SEM used in Research Question 3 can describe an individual's developmental trajectory and capture individual differences in such trajectories over time. LGC is also able to include predictors (time-invariant or time-variant) that influence the rate of change (Byrne, Lam, & Fielding,

2008; Curran, Obeidat, & Losardo, 2010). A growing body of social science literature supports the use of time-invariant predictors in LGC models (Wimmers & Lee, 2014; Wickrama, Beiser, & Kaspar, 2002; Curran et al., 2010). However, caution may be needed when interpreting the impact of the predictors. This study included two time-invariant predictors measured by baseline depression and baseline marijuana use status; however, the possibility of changes in both depression status and marijuana use over time should be noted. Thus, results need to be interpreted with caution. Despite limitations, the inclusion of time-invariant predictors shed light on the possible impact of depression and marijuana use among risky-drinking, childbearing-aged women presenting in primary care settings. Using longitudinal data with larger sample sizes and incorporating time-variant predictors (e.g., age) into models can provide more insights into the links and interactions among changes in the use of TTM variables.

Implications for Practice and Conclusion

Prevention interventions should assess for comorbid depression and marijuana use and provide approaches targeted to the specific needs of women. Effectively targeting women before they become pregnant could enable clinicians and policymakers to shift the focus toward prevention efforts rather than on treatment of alcohol-related disorders, including AEP, after the fact. Specifically, interventions should aim to address comorbid depression or marijuana use, either simultaneously, or before the interventions. Decreases in depressive symptoms or reductions in marijuana use may enable decreases in both cons for change and temptation and increase motivation to change alcohol use.

Furthermore, study findings suggest that those who should be prioritized in intervention efforts are women in the earlier stages of change with comorbid depression or marijuana use. Intervention components that focus on decisional balance items early in the intervention may prompt women to move along the stages of change more quickly and reduce their chance of being stuck, thus enhancing the effectiveness of alcohol interventions, particularly for women with depression or women who use marijuana.

This study highlights the complexity of addressing comorbid alcohol use and depression and comorbid alcohol use and marijuana use among women of childbearing age and suggests the need for ongoing examination of comorbidity, especially as it presents in primary care settings. Consistent with prior research on alcohol use and TTM (von Sternberg et al., 2017; Cabornari & DiClemente, 2000), findings support markers of successful change, such as higher pros than cons for change, higher confidence than temptation, and greater use of experiential POC and behavioral POC among risky-drinking women. By thoroughly examining three interrelated questions about TTM variables, confidence, a component of self-efficacy, emerged as an essential TTM variable related to change in alcohol use across all three groups. Efforts to increase confidence toward change may be crucial.

Notable differences were found for women with comorbid depressed or marijuana use concerning TTM variables. Depressed women had lower starting points on the use of TTM variables. Concurrent depression and alcohol interventions may yield best results when targeting reduction of alcohol use. Women with comorbid marijuana use especially struggled to reduce cons for change in alcohol use. Thus, aspects of depression and

marijuana use may inhibit change, preventing women from successfully reducing alcohol consumption. Prevention interventions should assess for comorbid depression and marijuana use, and provide targeted approaches to the specific needs of women, particularly in improving self-efficacy and decisional balance.

Given comprehensive assessment of TTM variables, particularly regarding comorbid depression and marijuana use, this study offers a more complete picture of the mechanism of changes in alcohol consumption. Effectively targeting women before they become pregnant could shift the focus from treatment of alcohol-related disorders, including AEP, to preventing them in the first place.

APPENDIX A.

Description & Definitions of Key Concepts and Issues

COMORBIDITY (VS. CO-OCCURRING DISORDERS VS. DUAL-DIAGNOSIS)

Comorbidity refers to the existence of more than one condition or disorder in the same person at the same time (Centers for Disease Control and Prevention [CDC], 2014). The simultaneous or sequential occurrence of two disorders in the same person and the interactions between the disorders that impact the course and prognosis of both disorders are also described as comorbidity (NIDA, 2010).

In the literature, the term comorbidity is often used interchangeably with the terms co-occurring disorders, dual-diagnosis, and dual-disorders. The definitions of each of these terms vary slightly, but all three, in essence, refers to two simultaneously occurring disorders. Co-occurring disorders often refer to co-existence between a substance use disorder and a mental health disorder (SAMSHA, 2014). The limits of dual-diagnoses/dual-disorders are often less stringent and include the presence of any two disorders (McNeece & DiNitto, 2012).

SUBSTANCE USE

Substance use-related terminology has evolved since the 1980s and continues to change. Despite various disciplines' efforts to define substance use terminology, no one convention is used. While cognizant of differences and ongoing changes, for this paper, commonly used older terms were included in the review to ensure a thorough evaluation of the literature.

Most recent substance use terminology. In the most recent edition of the DSM-V (American Psychiatric Association, 2015), the term Substance Use Disorders (SUDs) replaced terms substance abuse and dependence. Terms that refer to specific substance disorders such as Alcohol Use Disorder or Cannabis Use Disorder have been added with markers to identify the severity of use on a spectrum indicated by mild, moderate, and severe.

Substances vs. Drugs. The terms substances and drugs have slightly different definitions, yet the terms are sometimes used interchangeably in the literature. It appears that while drugs often refer to illicit substances and non-medically used prescription medication (NSDUH, 2015), the term "substance" is more inclusive, including not only illicit drugs but other potentially harmful substances such as alcohol, inhalants, solvents, and naturally occurring plants (McNeece & DiNitto, 2012). For instance, though alcohol may also be classified as a drug, its legal status has historically separated it from being categorized as such (Mueser et al., 2003). More changes in substance use nomenclature may occur in the future as several states have legalized marijuana to various degrees since 2013. This paper focuses on two substances: alcohol and marijuana.

Alcohol. Along with barbiturates and benzodiazepines, alcohol belongs to a class of chemicals called central nervous system (CNS) depressants (McNeece & Johnson, 2012). Alcoholic beverages contain a particular type of alcohol compound called ethanol (C2 H5 OH, ethyl alcohol), which creates sedative and hypnotic effects (World Health Organization [WHO], 2011; McNeece & Johnson, 2012).

Alcohol is typically used for relaxation and to improve socialization (Drug and Alcohol Services, 2008). The risk of alcohol overdose by itself appears to be moderate, but alcohol becomes even more dangerous and problematic if used in conjunction with another drug. Depending on the level of use, varying levels of harmful effects can occur, including slurring of speech, reduced motor coordination, reduced vision and consciousness, central nervous system disturbances, and liver, gastrointestinal, and heart disease (Drug and Alcohol Services, 2008).

Marijuana. Marijuana, also known as "weed, herb, pot, grass, bud, ganja, Mary Jane, and many other slang terms, is a greenish-gray mixture of the dried, shredded leaves and flowers of Cannabis sativa—the hemp plant" (NIDA, 2014, p. 1). Marijuana can be smoked as hand-rolled cigarettes (also called joints), as cigars (also called blunts; made by replacing the tobacco in cigars with marijuana), via pipes/water pipes (also called bongs), brewed as tea, or mixed with food (brownies, cookies, or candies). The delta-9-tetrahydro-cannabinol (THC) chemical in marijuana causes intoxicating, psychoactive effects (NIDA, 2014).

Effects often seen from marijuana include relaxation; feelings of happiness, sleepiness; sharpened senses; and increased appetite (Drug and Alcohol Services, 2008). Commonly associated harm such as hallucinations, anxiety, panic attacks, paranoia, nausea, impaired judgment and motor coordination, reduced motivation, and acute/chronic lung problems are found with marijuana use (Drug and Alcohol Services, 2008).

One of the dangers of marijuana use is its potential to be "laced" with other substances such as PCP, cocaine, or formaldehyde. The effects of laced marijuana can be extremely dangerous, especially for a person with no tolerance to the additionally added substances (Center for Substance Abuse Research, 2013).

Marijuana legalization. While widespread use of marijuana is already a serious public health concern, recent changes in policies legalizing marijuana use further highlight the urgent need to understand marijuana better. As of November 2016, recreational marijuana use is legal in California, Oregon, Washington, Alaska, Colorado, Washington DC, Nevada, Massachusetts, and Maine (Steinmetz, 2016). Twenty-eight states have legalized medical marijuana (Steinmetz, 2016), and more than half of US states have decriminalized marijuana possession (Boyette & Wilson, 2015). Studies show more than 60% of Americans live in a state where marijuana is legal or soon to be legal (Berliner, 2016). Legalization of marijuana is expected to draw more new users (Hall & Weier, 2015).

Unsurprisingly, newer studies have started assessing the impact of marijuana legalization. Preliminary findings from Monte, Zane, and Heard (2015) report that since the legalization of marijuana in Colorado in 2013, higher rates of car accidents and emergency room visits occurred as a result of marijuana intoxication. Previously a rare occurrence, currently at the University of Colorado emergency room, about 1 to 2 patients are seen each week for marijuana intoxication, while about 10 to 15 patients are seen due to marijuana-associated illnesses such as anxiety, panic attacks, and vomiting

(Monte et al., 2015). Also, another study reported increased use of marijuana upon legalization, even after a substance use intervention (Grant et al., 2018).

Medical marijuana. On the other hand, there is evidence that medical marijuana use can potentially help reduce pain and nausea caused by illnesses such as cancer and HIV/AIDS (NIDA, 2014). The field continues to debate whether the benefits of medical marijuana use outweigh potential health risks (NIDA, 2014; Monte et al., 2015).

DEPRESSION

Depression is broadly defined as the interference of persistent depressive symptoms that affect one's ability to work, sleep, study, eat, and enjoy life (National Institute of Mental Health [NIMH], 2015). Symptoms of depression are persistent feelings of sadness, loss of interest in pleasurable activities once enjoyed, change in weight, changes in sleep patterns, fatigue, feelings of worthlessness, and suicidal thoughts (DSM-5, 2015; NIMH, 2015). Depending on symptom severity and duration, there are several different types of depressive disorders such as Major Depressive Disorder (MDD), Depression NOS, Dysthymic Disorder, Postpartum Depression, and Seasonal Affective Disorder (SAD).

PRIMARY CARE SETTINGS

Primary care settings, often identified as the first source patients look to for treatment, is a medical setting in which patients receive most of their medical care (O'Donohue, Bryd, Cummings, & Henderson, 2005). Since inception of the term in 1961,

Primary care has had many definitions, but has been most commonly defined as treatment provided by a "generalist physician who provides definitive care to the patient at the first point of contact for the patient's medical and health care needs –not limited by problem origin, organ system, or diagnosis" (Donaldson et al., 1996). Primary care physicians are advocates for the patient in coordinating the use of the entire health care system to benefit the patient (American Academy of Family Physicians, 2015; Donaldson et al., 1996). Physicians in primary care settings may focus on specific patient care needs related to prevention, health maintenance, acute care, chronic care or rehabilitation (American Academy of Family Physicians, 2015; Donaldson et al., 1996).

Alcohol Use, Marijuana Use, and Depression

ALCOHOL USE

Prevalence of alcohol use. According to the 2012 NSDUH, about 90% of adults in the United States reported drinking alcohol at some point in their lives, 56% reported drinking in the past month, 25% reported binge drinking in the past month (NSDUH, 2013a; NSDUH, 2013b), and approximately 16.6 million adults had an alcohol use disorder (NSDUH, 2013c). In another study, the lifetime prevalence of alcohol use disorder was estimated to be more than 30% (Hasin et al., 2007).

Negative effects of alcohol use. Alcohol is considered the third leading cause of preventable deaths in the United States, following tobacco use and a combination of poor diet and limited physical activity (CDC, 2012; Mokdad, Marks, Stroup, & Gerberding, 2004; Freedy & Ryan, 2011). Some alcohol use (one drink per day for women and two

drinks per day for men) (NIAAA, 2015; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010) may result in health benefits, such as decreased risk of heart disease, ischemic stroke, and diabetes (U.S. Department of Agriculture; 2010; Danaei, Ding, & Mozaffarian, 2009). However, as NIAAA (2015) and others report, risky alcohol use can lead to a variety of adverse health issues including hypertension, cirrhosis, gastritis, gastric ulcers, breast cancer, anemia, osteoporosis, cognitive impairment, insomnia, and injuries (Cherpitel & Ye, 2012; Corrao et al., 2004; Schuckit, 2009). Approximately 88,000 individuals die from alcohol-related causes each year (CDC, 2015). In 2013, fatalities related to alcohol-impaired driving resulted in 10,076 deaths (National Highway Traffic Safety Administration, 2013).

MARIJUANA USE

Prevalence of marijuana use. According to the 2013 NSDUH, marijuana is the most commonly used illicit drug in the United States; an estimated 31.5 million individuals reported having used marijuana in the past year. About 52% of individuals aged 18 to 25 and 46% of individuals age 26 and older reported lifetime marijuana use. Among 18 to 25-year-olds, 19% reported marijuana use in the past month (NIDA, 2014). Recent trend studies report a steady increase in marijuana use in the U.S. (Hasin et al., 2015; Salas-Wright et al., 2017).

Negative effects of marijuana use. The negative consequences of marijuana use have been well-documented as well. Various consequences and serious health concerns have been linked to marijuana use (NIDA, 2014). Often identified as a "gateway" drug,

marijuana is thought to lead individuals to "harder" drug use such as cocaine and heroin (NIDA, 2014). Also, researchers have challenged the popular assumption that marijuana use is benign, as some studies have refuted the popular belief that marijuana is not addictive; these studies have reported the possibility of developing marijuana dependence (NIDA, 2014). In the Diagnostic Statistical Manual-5 (DSM-5), Cannabis Use Disorder is listed as a Substance-Related Disorder (American Psychiatric Association, 2013).

The physical and mental health consequences of marijuana use include respiratory problems (daily cough, phlegm production, frequent acute chest illness, and lung infections) and mental disorders such as anxiety, panic reactions, and depression (NIDA, 2014; Monte et al., 2015; Hall & Pacula, 2003; Kalant, 2004). Heavy marijuana use appears to increase the risk of developing depressive disorders (Lev-Ran, Roerecke, Le Foll, & George, 2013). Further, marijuana use has been linked to adverse psychosocial outcomes: marijuana use impacts attention, memory, and learning, consequently increasing the risk of poorer education outcomes and potentially reducing educational attainment (NIDA, 2014; Macleod et al., 2004).

DEPRESSION.

Prevalence of depression. Depression impacts 16 million U.S. adults (NIMH, 2017). About 16% meet criteria for major depressive disorder in a given year (Martin, Neighbors, & Griffith, 2013; Kessler et al., 2003). The prevalence of depression is reportedly highest among women and younger adults (18-25 years) (NIMH, 2017).

Negative effects of depression. Symptoms of depression include persistent feelings of sadness, loss of interest in pleasurable activities the patient once enjoyed, change in weight, changes in sleep patterns, fatigue, feelings of worthlessness, and suicidal thoughts (DSM-5, 2015; NIMH, 2015). Untreated depression can also have detrimental effects on physical health. Depressed individuals may be at a higher risk for other medical conditions, such as coronary heart disease, diabetes, and cancer (NIMH, 2016). Studies have indicated that depression may complicate childbearing as well (Muzik, Marcus, Heringhausen, & Flynn, 2009).

APPENDIX B.

OVERVIEW OF COMORBIDITY TRAJECTORY THEORIES/FRAMEWORK

Trajectories of comorbidity may be broadly explained in one of three ways: 1) mental disorders precede substance use disorders, 2) substance use disorders bring about symptoms of mental disorders, and 3) comorbidity results from a bidirectional interaction between substance use and mental disorders.

Mental disorders can lead to substance use disorders. A body of literature suggests a direct causal relationship between mental health and substance use disorders; the Self-Medication Model, Dysphoria Reduction Theory, and the Super-Sensitivity Theory explain this phenomenon (Mueser et al., 1998; NIDA, 2014; Quello et al., 2005). According to the Self-Medication Model, individuals with mental disorders have an increased risk of substance abuse, as individuals seek substances to alleviate psychiatric symptoms or painful affect (Khantzian, 1985; Quello et al., 2005; Mueser et al., 1998; Sterling, Chi, & Hinman, 2011). For example, some people might drink because they are depressed, using alcohol to medicate depressive symptoms (Mueser et al., 1998). Some have found that "specific substances are selected for their specific effects on mood" (Degenhardt et al., 2003, p. 15); depressed individuals might use more alcohol or cocaine (Khantzian, 1985; McLellan, Childress, & Woody, 1985), and individuals experiencing positive symptoms of schizophrenia might use more tobacco (Gilbert & Gilbert, 1995). However, the evidence is mixed regarding substance selection and its relationship to a

specific mental health diagnosis; studies have failed to consistently show that a particular substance is used to alleviate a targeted affect (Quello et al., 2005; Mueser et al., 1998).

Others have found the Dysphoria Reduction Theory more appealing. Mueser et al. (1998) proposed that individuals with mental disorders first seek and use alcohol and marijuana in order to feel better. Substances are initially used to alleviate dysphoria, rather than a particular symptom (Mueser et al., 2003). Lastly, according to the Super-Sensitivity Theory, "genetic factors interact with early life events and other environmental stressors, making people with major mental illnesses vulnerable to the effects of even small amounts of alcohol and other drugs" (DiNtto &Webb, 2012, p. 361).

Substance use disorders may bring about symptoms of mental disorders. Another approach to comorbidity is a model that suggests that substance use may trigger mental disorders (McLellan et al., 1985; Mueser et al., 2003; Quello et al., 2005). Researching this hypothesis is complicated because it is difficult to determine whether individuals would have developed mental disorders if they had not abused substances first (Quello et al., 2005). The Stress-Vulnerability Model proposes that substance use disorders may bring about symptoms of mental disorders. For example, social stressors, as well as alcohol and drug use, may increase one's biological vulnerability to developing a mental disorder (Mueser et al., 2003). Research has identified a comorbid relationship between substance use and severe mental disorders, specifically between alcohol abuse and bipolar disorder (Strakowski, DelBello, Fleck & Arndt, 2000; DelBello et al., 1999). Some studies, including Schuckit et al. (1997), posit that depression may develop as result of alcohol dependence (Mueser et al., 2003). However, literature supporting this

model for depression is fairly limited. In general, there appears to be more support for the reverse relationship: that alcohol dependence may develop as a result of depression (National Comorbidity Study [NCS], 1996).

Bidirectional. Lastly, some suggest that comorbidity may be bidirectional; substance use disorders can increase an individual's vulnerability of developing mental disorders, and the reverse is equally true (Mueser et al., 1998; DiNitto & Webb, 2012). Mueser et al. (2003) provide an example of a bidirectional explanation of comorbidity:

> A person who is biologically vulnerable to psychiatric illness may begin using substances while socializing with peers. This substance abuse could trigger the person's psychiatric disorder. Once the psychiatric illness has begun, the individual may continue to use substances as a strategy for coping with dysphoria, gaining social approval, and engaging in recreation, resulting in an intensification of the psychiatric disorder (Mueser et al., 2003, p. 13)

In essence, according to this model, substance use and mental disorders exacerbate each other (DiNitto & Webb, 2012). Regardless of the origin or order of problem development, co-occurrence is complicated and usually complicates treatment. Therefore, comprehensive evaluation of comorbidity is necessary.

APPENDIX C.

Table 2-5a. TTM Variables by Depression Status at Baseline and 9-month Follow-up (N=229)

Time Point	Group	Parameters											
		Precontemplation			Contemplation			Action			Maintenance		
		M	SD	p	M	SD	p	M	SD	p	M	SD	p
Baseline (n=229)	Depressed (n=97)	48.77	10.66	.287	53.51	9.62	**<.001*** **	52.41	10.00	**027***	53.69	10.01	**<.001*** **
	Non-depressed (n=132)	50.40	9.30		47.53	9.06		49.05	9.70		47.28	9.14	
9mfu (n=229)	Depressed (n=97)	50.23	10.87	.893	52.66	9.63	**.002****	52.30	9.81	**.021***	52.05	11.02	**.020***
	Non-depressed (n=132)	50.02	9.59		48.08	9.56		48.46	9.79		48.51	8.86	

*p <.05, **p<.01, ***p<.00

Table 2-5b. TTM Variables by Depression Status at Baseline and 9-month Follow-up (N=229)

Time Point	Group	Parameters																	
		Pros for change			Cons for change			Confidence to Change			Temptation not to Change			Experiential POC			Behavioral POC		
		M	SD	p	M	SD	p	M	SD	p	M	SD	p	M	SD	p	M	SD	p
Baseline (n=229)	Depressed (n=97)	53.02	9.91	**.003**	54.56	10.46	**<.001**	45.57	7.57	**<.001**	54.33	8.61	**<.001**	52.94	9.81	**.001**	51.60	9.36	.186
	Non-depressed (n=132)	48.42	10.08		47.05	7.89		52.88	9.53		47.28	9.09		48.01	9.33		49.60	10.17	
9mfu (n=1229)	Depressed (n=97)	52.04	10.12	**.020**	53.42	11.72	**<.001**	46.27	9.42	**<.001**	53.22	10.29	**<.001**	51.81	10.50	.051	50.59	10.09	.893
	Non-depressed (n=132)	48.49	9.61		47.51	7.38		52.54	9.60		47.56	9.25		48.84	9.31		50.38	9.93	

*p <.05, **p<.01, ***p<.00

Table 2-6a. TTM Variables by Marijuana Use status at Baseline and 9-month Follow-up (N=176)

Time Point	Group	Parameters											
		Precontemplation			Contemplation			Action			Maintenance		
		M	SD	p	M	SD	p	M	SD	p	M	SD	p
Baseline (n=176)	Marijuana (n=106)	49.94	9.85	.673	50.53	9.65	.561	50.43	9.61	.874	50.03	1.00	.893
	Non-Marijuana (n=70)	49.29	10.09		49.65	9.93		50.68	10.49		50.24	10.13	
9mfu (n=176)	Marijuana (n=106)	50.75	9.81	.318	50.50	9.06	.572	50.56	9.52	.522	50.31	9.37	.710
	Non-Marijuana (n=70)	49.18	10.61		49.59	10.91		49.57	10.59		49.73	10.92	

*p <.05, **p<.01, ***p<.001

Table 2-6b. TTM Variables by Marijuana Use status at Baseline and 9-month Follow-up (N=176)

Time Point	Group	Parameters																	
		Pros for change			Cons for change			Confidence to change			Temptation not to change			Experiential POC			Behavioral POC		
		M	SD	p	M	SD	p	M	SD	p	M	SD	p	M	SD	p	M	SD	p
Baseline (n=176)	Marijuana (n=106)	51.03	10.36	.376	51.03	9.71	.013*	48.46	8.87	.045*	52.22	8.518	.002**	50.22	10.01	.963	50.71	9.34	.713
	Non-Marijuana (n=70)	49.62	10.06		48.14	9.64		51.39	9.99		47.74	10.32		50.15	9.63		50.15	10.61	
9-month follow up (n=176)	Marijuana (n=106)	49.81	10.11	.695	50.36	9.64	.710	49.30	9.17	.460	51.35	9.57	.042*	50.76	10.29	.334	51.60	9.98	.074
	Non-Marijuana (n=70)	50.4163	9.81		49.78	10.47		50.45	11.11		48.17	10.62		49.27	9.40		48.83	9.80	

*p <.05, **p<.01, ***p<.001

References

Allen, J. P., Litten, R. Z., Fertig, J. B., & Babor, T. (1997). A review of research on the Alcohol Use Disorders Identification Test (AUDIT). *Alcoholism: clinical and experimental research*, *21*(4), 613-619.

American Academy of Family Physicians (2015). Primary care. Retrieved from http://www.aafp.org/about/policies/all/primary-care.html.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.

Andrews, G. (1996). Comorbidity and the general neurotic syndrome. *The British Journal of Psychiatry*.

Angold, A., Costello, E. J., & Erkanli, A. (1999). Comorbidity. *Journal of child psychology and psychiatry*, *40*(1), 57-87.

Annis, H., & Davis, C. S. (1988). Self-efficacy and the prevention of alcoholic relapse: Initial findings from a treatment trial.

Babor, T. F. (2001). Higgins--Biddle JC. *World Health Organization. Dept. of Mental Health and Substance Dependence. Brief Intervention For Hazardous and harmful Drinking: A Manual for Use in Primary Care[Internet]. Geneva: World Health Organization*.

Bachrach, R. L., & Read, J. P. (2012). The role of posttraumatic stress and problem alcohol involvement in university academic performance. *Journal of Clinical Psychology*, *68*(7), 843-859.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychology Rev, 84*(2), 191-215.

Barry, K. L., & Fleming, M. F. (1993). The Alcohol Use Disorders Identification Test (AUDIT) and the SMAST-13: predictive validity in a rural primary care sample. *Alcohol and alcoholism*, *28*(1), 33-42.

Barth, J., Munder, T., Gerger, H., Nüesch, E., Trelle, S., Znoj, H., ... & Cuijpers, P. (2016). Comparative efficacy of seven psychotherapeutic interventions for patients with depression: a network meta-analysis. *Focus*, *14*(2), 229-243.

Berman, A. H., Forsberg, L., Durbeej, N., Källmén, H., & Hermansson, U. (2010). Single-session motivational interviewing for drug detoxification inpatients: effects on self-efficacy, stages of change and substance use. *Substance use & misuse*, *45*(3), 384-402.

Bessa, M. A., Mitsuhiro, S. S., Chalem, E., Barros, M. M., Guinsburg, R., & Laranjeira, R. (2010). Underreporting of use of cocaine and marijuana during the third trimester of gestation among pregnant adolescents. *Addictive Behaviors*, *35*(3), 266-269.

Boulet, J., & Boss, M. W. (1991). Reliability and validity of the Brief Symptom Inventory. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, *3*(3), 433.

Boyette, C. & Wilson, J. (2015) It's 2015: Is Weed Legal in Your State?, CANN (Jan. 7, 2015), http://www.cnn.com.2015/01/07/us/recreational-marijuana-laws/.

Bradley, K.A., Epler, A.J., Bush, K.R., Sporleder, J.L.,Dunn, C.W., Cochran, N.E., … Fihn, S.D. (2002). Alcohol-related discussions during general medicine appointments of male VA patients who screen positive for at-risk drinking. *Journal of General Internal Medicine*, *17*, 315-326.

Breslin, F. C., Sobell, L. C., Sobell, M. B., & Agrawal, S. (2000). A comparison of a brief and long version of the Situational Confidence Questionnaire. *Behaviour research and therapy*, *38*(12), 1211-1220.

Brown et al., 2005

Byrne, B. M. (2013). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Psychology Press.

Byrne, B. M., Lam, W. W., & Fielding, R. (2008). Measuring patterns of change in personality assessments: An annotated application of latent growth curve modeling. *Journal of personality assessment*, *90*(6), 536-546.

Cadigan, J. M., Martens, M. P., Arterberry, B. J., Smith, A. E., & Murphy, J. G. (2013). Examining a curvilinear model of readiness to change and alcohol consumption. *Addiction research & theory*, *21*(6), 507-515.

Caetano, R., & Babor, T. F. (2006). Diagnosis of alcohol dependence in epidemiological surveys: an epidemic of youthful alcohol dependence or a case of measurement error?. *Addiction*, *101*(s1), 111-114.

Callaghan, R. C., & Herzog, T. A. (2006). The relation between processes-of-change and stage-transition in smoking behavior: A two-year longitudinal test of the Transtheoretical Model. *Addictive behaviors*, *31*(8), 1331-1345.

Callaghan, R. C., Taylor, L., Moore, B. A., Jungerman, F. S., Vilela, F. A. D. B., & Budney, A. J. (2008). Recovery and URICA stage-of-change scores in three marijuana treatment studies. *Journal of Substance Abuse Treatment*, *35*(4), 419-426.

Carbonari, J.P. and DiClemente, C.C. (2000). Using theoretical model profiles to differentiate levels of alcohol abstinence success. Journal of Consulting and Clinical Psychology, 68, 810-817.

Carey, K. B., Henson, J. M., Carey, M. P., & Maisto, S. A. (2010). Perceived norms mediate effects of a brief motivational intervention for sanctioned college drinkers. *Clinical Psychology: Science and Practice*, *17*(1), 58-71.

Carey, M. P., Carey, K. B., Maisto, S. A., Gordon, C. M., & Weinhardt, L. S. (2001). Assessing sexual risk behaviour with the Timeline Followback (TLFB) approach: continued development and psychometric evaluation with psychiatric outpatients. *International journal of STD & AIDS*, *12*(6), 365-375.

Carney, M.M. and Kivlahan, D.R. (1995). Motivational subtypes among veterans seeking substance abuse treatment: Profiles based on stages of change. Psychology of Addictive Behaviors, 9, 135-142.

Caron, C., & Rutter, M. (1991). Comorbidity in child psychopathology: Concepts, issues and research strategies. *Journal of Child Psychology and Psychiatry*, *32*(2), 1063–1080.

Carpenter, K. M., Miele, G. M., & Hasin, D. S. (2002). Does motivation to change mediate the effect of DSM-IV substance use disorders on treatment utilization and substance use?. *Addictive Behaviors*, *27*(2), 207-225.

Caviness, C. M., Hagerty, C. E., Anderson, B. J., de Dios, M. A., Hayaki, J., Herman, D., & Stein, M. D. (2013). Self-Efficacy and Motivation to Quit Marijuana Use among Young Women. *The American journal on addictions*, *22*(4), 373-380.

Center for Disease Control (2014). Comorbidities. Retrieved from http://www.cdc.gov/arthritis/data_statistics/comorbidities.htm

Center for Disease Control (CDC) (2015). Alcohol Use. Retrieved from http://www.cdc.gov/nchs/fastats/alcohol.htm

Center for Substance Abuse Research (CESAR) (2013). Marijuana. Retrieved from http://www.cesar.umd.edu/cesar/drugs/marijuana.asp

Centers for Disease Control and Prevention (CDC) (2015). Fetal Alcohol Spectrum Disorders (FASDs). Retrieved from https://www.cdc.gov/ncbddd/fasd/features/drinking-childbearing-age.htmlCenter for Disease Control (2012). Mental Health and Chronic Diseases. Retrieved from http://www.cdc.gov/nationalhealthyworksite/docs/Issue-Brief-No-2-Mental-Health-and-Chronic-Disease.pdf

Centers for Disease Control and Prevention (CDC) (2016). Alcohol Use in Pregnancy. Retrieved from https://www.cdc.gov/ncbddd/fasd/alcohol-use.html

Centers for Disease Control and Prevention (CDC) (2018). Alcohol Use and Public Health. Retrieved from http://www.cdc.gov/alcohol/fact-sheets/alcohol-use.htm

Chacko, M.R., von Sternberg, K., & Velasquez, M.M. (March 2003). Screening for gonorrhea and Chlamydia in young women: The processes of change. Annual Meeting, Society of Adolescent Medicine, Seattle, WA.

Chan, S. C., & Chan, C. C. (2011). Attitude, social influence, and self-efficacy among Chinese participants of chronic disease self-management program: A latent growth curve modeling study. *Rehabilitation psychology*, *56*(3), 191.

Chan, S. C., Chan, C. C., Siu, A. M., & Poon, P. K. (2015). A conceptual model of patient-professional communication as a self-management skill: A latent growth change modeling. *Disability and health journal*, *8*(4), 602-610.

Cherpitel, C.J., & Ye, Y. (2012). Trends in alcohol and drug related emergency department and primary care visits: Data from four US national surveys (1995-2010). *Journal of Study of Alcohol Drugs, 73*(3), 454-458.

Choi, S., Adams, S. M., Morse, S. A., & MacMaster, S. (2015). Gender differences in treatment retention among individuals with co-occurring substance abuse and mental disorders. *Substance use & misuse*, *50*(5), 653-663.

Chudley, A. E. (2017). Fetal Alcohol Spectrum Disorder—High Rates, High Needs, High Time for Action. *JAMA pediatrics*, *171*(10), 940-941.

Chung, T. K., Lau, T. K., Yip, A. S., Chiu, H. F., & Lee, D. T. (2001). Antepartum depressive symptomatology is associated with adverse obstetric and neonatal outcomes. *Psychosomatic Medicine*, *63*(5), 830-834.

Connors, G.J., DiClemente, C.C., Velasquez, M.M., & Donovan, D.M. (2013). *Substance Abuse Treatment and the Stages of Change: Selecting and Planning Interventions*. New York, NY: Guildford Press.

Cornelius, J.R., Salloum, I.M., Haskett, R.F., Daley, D.C., Cornelius, M.D., Thase, M.E., & Perel, J.M. (2000). Fluoxetine versus placebo in depressed alcoholics: A 1-year follow up study. *Addictive Behaviors*, *25*(2), 307-310.

Corrao, G., Bagnardi, V., Zambon, A., & Le Vechhia, C. (2004). A meta-analysis of alcohol consumption and the risk of 15 diseases. *Prevention Medicine*, *38*(5), 613-619.

Cummings, N.A., & Cummings, J.L. (2000). The first session with substance abusers: A step-by-step guide. San Francisco, CA: Jossey-Bass.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development*, *11*(2), 121-136.

D'Angelo, D., Williams, L., Morrow, B., Cox, S., Harris, N., Harrison, L., ... & Hood, J. R. (2007). *Preconception and interconception health status of women who recently gave birth to a live-born infant: A pregnancy risk assessment monitoring system (PRAMS), United States, 26 reporting areas, 2004*. US Department of Health & Human Services, Centers for Disease Control and Prevention.

D'Souza, D.C., Braley, G., Blasie, R., Vendetti, M., Oliver, S., Pittman, B., … Perry, E (2008). Effects of haloperidol on the behavioral, subjective, cognitive, motor, and

neuroendocrine effects of Δ-9-tetrahydrocannabinol in humans. *Psychopharmacology*, *198*(4), 587–603.

Daeppen, J. B., Yersin, B., Landry, U., Pécoud, A., & Decrey, H. (2000). Reliability and validity of the Alcohol Use Disorders Identification Test (AUDIT) imbedded within a general health risk screening questionnaire: results of a survey in 332 primary care patients. *Alcoholism: Clinical and Experimental Research*, *24*(5), 659-665.

Danaei, G., Ding, E.L., & Mozaffarian, D., Taylor, B., Rehm, J., Murray, C.J., & Ezzati, M. (2009). The preventable causes of death in the US: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PloS Med*, *6*(4), 1-23.

Danielsson, A. K., Lundin, A., Agardh, E., Allebeck, P., & Forsell, Y. (2016). Cannabis use, depression and anxiety: A 3-year prospective population-based study. *Journal of affective disorders*, *193*, 103-108.

de Meneses-Gaya, C., Zuardi, A. W., Loureiro, S. R., & Crippa, J. A. S. (2009). Alcohol Use Disorders Identification Test (AUDIT): An updated systematic review of psychometric properties. *Psychology & Neuroscience*, *2*(1), 83.

Degenhardt, L., Hall, W., & Lynskey, M. (2003). *Comorbid Mental Disorders and Substances Use Disorders: Epidemiology, Prevention, and Treatment*.

DelBello, M.P., Strakowski, S.M., Sax, K.W., McElroy, S.L., Keck, P.E.J., West, S.A., & Kmetz, G.F. (1999). Effections of familial rates of affective illness and substance abuse on rates of substance abuse in patients with first-episode mania. *Journal of Affective Disorders*, *56*, 55-60.

Derogatis, L. R. (1993). *Brief Symptom Inventory: BSI; Administration, scoring, and procedures manual*. Pearson.

Derogatis, L. R. (2001). *Brief symptom inventory 18*. Johns Hopkins University.

DiClemente, C. C., Carbonari, J. P., Montgomery, R. P., & Hughes, S. O. (1994). The alcohol abstinence self-efficacy scale. *Journal of studies on alcohol*, *55*(2), 141-148.

DiClemente, C.C. (2003). Addiction and Change: How Addictions Develop and Addicted people Recover. New York: Guilford Press.

DiClemente, C.C., and Hughes, S.O. (1990). Stages of Change Profiles in Outpatient Alcoholism Treatment. *Journal of Substance Abuse*, 2, 217-235.

DiClemente, C.C., Schlundt, D., & Gemmell, L. (2004). Readiness and stages of change in addiction treatment. American Journal on Addictions, 13(2), 103-119.

DiClemente, CC, Prochaska, JO, Fairhurst, SK, Velicer, WF, Velasquez, MM, & Rossi, JS. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation, and preparation stages of change. Journal of Consulting and Clinical Psychology, 59, 295-304.

DiClemente, CC, Prochaska, JO, Fairhurst, SK, Velicer, WF, Velasquez, MM, & Rossi, JS. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation, and preparation stages of change. Journal of Consulting and Clinical Psychology, 59, 295-304.

DiNtto, D.M., & Webb, D.K. (2012). Substance use disorders and co-occurring disabilities. In C.A. McNeece & D.M. DiNitto (Eds.), *Chemical dependency* (p. 354- 406). Upper Saddle River, NJ: Pearson.

Dishman, R. K., Vandenberg, R. J., Motl, R. W., & Nigg, C. R. (2010). Using constructs of the transtheoretical model to predict classes of change in regular physical activity: a multi-ethnic longitudinal cohort study. *Annals of Behavioral Medicine*, *40*(2), 150-163.

Donaldson, M. S., Yordy, K. D., Lohr, K. N., & Vanselow, N. A. (Eds.). (1996). *Primary care: America's health in a new era*. National Academies Press.

Dozois, D. J., Westra, H. A., Collins, K. A., Fung, T. S., & Garry, J. K. (2004). Stages of change in anxiety: psychometric properties of the University of Rhode Island Change Assessment (URICA) scale. *Behaviour research and therapy*, *42*(6), 711-729.

Drake, R.E., Osher, F.C., & Wallach, M.A. (1989). Alcohol use and abuse in schizophrenia: A prospective community study. *Journal of Nervous and Mental Disease*, *177*, 408-414.

Dupont, H. B., Candel, M. J., Lemmens, P., Kaplan, C. D., van de Mheen, D., & De Vries, N. K. (2017). Stages of change model has limited value in explaining the change in use of cannabis among adolescent participants in an efficacious motivational interviewing intervention. *Journal of psychoactive drugs*, *49*(5), 363-372.

Duvall, J. L., Oser, C. B., & Leukefeld, C. G. (2008). Readiness to change as a predictor of drug-related behaviors in a sample of rural felony probationers. *The American journal of drug and alcohol abuse*, *34*(6), 741-748.

Elliott, J. C., & Carey, K. B. (2013). Pros and cons: Prospective predictors of marijuana use on a college campus. *Psychology of Addictive Behaviors*, *27*(1), 230.

Ernhart, C. B., Morrow-Tlucak, M., Sokol, R. J., & Martier, S. (1988). Underreporting of alcohol use in pregnancy. *Alcoholism: Clinical and Experimental Research*, *12*(4), 506-511.

Eysenck, H. J., & Eysenck, S. B. G. (1991). *Manual of the Eysenck Personality Scales (EPS Adult)*. London: Hodder & Stoughton

Fabbri, S., Farrell, L. V., Penberthy, J. K., Ceperich, S. D., & Ingersoll, K. S. (2009). Toward prevention of alcohol exposed pregnancies: characteristics that relate to ineffective contraception and risky drinking. *Journal of behavioral medicine*, *32*(5), 443-452.

Fergusson, D. M., Lynskey, M.T., & Horwood, L. J. (1996). Comorbidity between depressive disorders and nicotine dependence in a cohort of 16-year-olds. *Archives of General Psychiatry*, *53*(11), 1043–1047.

Fergusson, D., Horwood, L., & Lynskey, M. (1994). Parental separation, adolescent psychopathology and problem behaviors. *Journal of the American Academy of Child and Adolescent Psychiatry*, *33*, 1122–1131.

Field, C. A., Adinoff, B., Harris, T. R., Ball, S. A., & Carroll, K. M. (2009). Construct, concurrent and predictive validity of the URICA: Data from two multi-site clinical trials. *Drug & Alcohol Dependence*, *101*(1), 115-123.

Finnell, D. S. (2003). Use of the transtheoretical model for individuals with co-occurring disorders. *Community Mental Health Journal*, *39*(1), 3-15.

Fleming, M.F., Balouseck, S.K., Grossberg, P.M., Mundt, M.P., Brown, D., Wiegel, J.R., … Saewyc, E.M. (2010). Brief physician advice for heavy drinking college students: A randomized controlled trial in college health clinics. *Journal of Studies on Alcohol and Drug*s, *71*, 23-31.

Floyd, R. L., Sobell, M., Velasquez, M. M., Ingersoll, K., Nettleman, M., Sobell, L., ... & Skarpness, B. (2007). Preventing alcohol-exposed pregnancies: a randomized controlled trial. *American journal of preventive medicine*, *32*(1), 1-10.

Freedy, J.R., & Ryan, K. (2011). Alcohol use screening and case finding: Screening tools, clinical clues, and making diagnosis. *Primary Care Clinical Office Practice*, *38*, 91–103.

Gardner, E.L. (2005). Endocannabinoid signaling system and brain reward: emphasis on dopamine. *Pharmacological Biochemical Behavior, 81*(2), 263–284.

Geier, M. L., Hills, N., Gonzales, M., Tum, K., & Finley, P. R. (2015). Detection and treatment rates for perinatal depression in a state Medicaid population. *CNS spectrums*, *20*(1), 11-19.

Gilbert, D. G., & Gilbert, B. O. (1995). Personality, psychopathology and nicotine response as mediators of the genetics of smoking. *Behavior Genetics, 25*(2), 133–147.

Gold, M.S., & Aronson, M.D. (2010). Epidemiology, clinical manifestations, and diagnosis. In D. S. Basow (Ed.)., *Alcohol abuse and dependence*. Waltham, MA

Goldfinger, S. M., Schutt, R. K., Tolomiczenko, G. S., Seidman, L., Penk, W. E., Turner, W., et al. (1999). Housing Placement and Subsequent Days Homeless Among Formerly Homeless Adults with Mental Illness. *Psychiatr Serv*, *50*(5), 674-679.

Goldschmidt, L., Richardson, G. A., Cornelius, M. D., & Day, N. L. (2004). Prenatal marijuana and alcohol exposure and academic achievement at age 10. *Neurotoxicology and teratology*, *26*(4), 521-532.

Gómez-Peña, M., Penelo, E., Granero, R., Fernández-Aranda, F., Álvarez-Moya, E., Santamaría, J. J., ... & Jimenez-Murcia, S. (2012). Correlates of Motivation to Change in Pathological Gamblers Completing Cognitive-Behavioral Group Therapy. *Journal of clinical psychology*, *68*(7), 732-744.

Grant, B.F, Dawson, D.A., Stinson, F.S., Chou, S.P., Dufour, M.D., & Pickering, R.P. (2004). The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence: United States, 1991–1992 and 2001–2002. *Drug and Alcohol Dependence*, *74*, 223-234.

Grant, B.F., Moore, T.C., Kaplan, K. (2003). *Source and Accuracy Statement: Wave 1 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)*. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.

Grant, B.F., Stinson, F.S., Hasin, D.S., Dawson, D.A., Chou, S.P. Dufour, M.C., … Kaplan, K. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: results from the national epidemiology survey on alcohol and related conditions (NESARC). *Archives of General Psychiatry*, *61*, 807-816.

Grant, T. M., Graham, J. C., Carlini, B. H., Ernst, C. C., & Brown, N. N. (2018). Use of Marijuana and Other Substances Among Pregnant and Parenting Women With Substance Use Disorders: Changes in Washington State After Marijuana Legalization. *Journal of studies on alcohol and drugs*, *79*(1), 88-95.

Hall, K. S., Kusunoki, Y., Gatny, H., & Barber, J. (2014). The risk of unintended pregnancy among young women with mental health symptoms. *Social Science & Medicine*, *100*, 62-71.

Hall, W., & Pacula, R.L. (2003). *Cannabis Use and Dependence*. New York, NY: Cambridge Press.

Hall, W., & Weier, M. (2015). Assessing the public health impacts of legalizing recreational cannabis use in the USA. *Clinical pharmacology & therapeutics*, *97*(6), 607-615.

Harrell, P. T., Trenz, R. C., Scherer, M., Martins, S. S., & Latimer, W. W. (2013). A latent class approach to treatment readiness corresponds to a transtheoretical ("Stages of Change") model. *Journal of substance abuse treatment*, *45*(3), 249-256.

Harris, T. R., Walters, S. T., & Leahy, M. M. (2008). Readiness to change among a group of heavy-drinking college students: correlates of readiness and a comparison of measures. *Journal of American College Health*, *57*(3), 325-330.

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

Hasin, D.S., Stinson, F.S., Ogburn, E., & Grant, B.F. (2007). Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States. *Archives of General Psychiatry*, *64*(7), 830-842.

Helfrich, C. A., Chan, D. V., Simpson, E. K., & Sabol, P. (2012). Readiness-to-change cluster profiles among adults with mental illness who were homeless participating in a life skills intervention. *Community mental health journal*, *48*(6), 673-681.

Hurd, Y. L., Wang, X., Anderson, V., Beck, O., Minkoff, H., & Dow-Edwards, D. (2005). Marijuana impairs growth in mid-gestation fetuses. *Neurotoxicology and teratology*, *27*(2), 221-229.

Jacobson, J. L., & Jacobson, S. W. (1999). Drinking moderately and pregnancy. *Alcohol Research and Health*, *23*(1), 25-30.

Janis, I. L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment*. Free press.

Jarlenski, M., Koma, J. W., Zank, J., Bodnar, L. M., Bogen, D. L., & Chang, J. C. (2017). Trends in perception of risk of regular marijuana use among US pregnant and

nonpregnant reproductive-aged women. *American Journal of Obstetrics & Gynecology*, *217*(6), 705-707.

Johns A. (2001). Psychiatric effects of cannabis. *British Journal of Psychiatry*. *178*,116–122.

Johnson, S. K., von Sternberg, K., & Velasquez, M. M. (2017). A Comparison of Profiles of Transtheoretical Model Constructs of Change among Depressed and Nondepressed Women at Risk for an Alcohol-Exposed Pregnancy. *Women's Health Issues*, *27*(1), 100-107.

Kalant (2004). Adverse effects of cannabis on health: An update of the literature since 1996, *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *28* (5), 849–863.

Kanfer, R., & Zeiss, A. M. (1983). Depression, interpersonal standard setting, and judgments of self-efficacy. *Journal of abnormal psychology*, *92*(3), 319.

Kendler, K. S., Neale, M., Kessler, R., Heath, A., & Eaves, L. (1993). A twin study of recent life events and difficulties. *Archives of General Psychiatry*, *50*(10), 789–796.

Kessler, R.C., & Merikangas, K.R. (1996). The national comorbidity survey replication (NCS-R): Background and aims. *International Journal of Methods in Psychiatric Research*, *13*(2), 60- 68.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., &Walters, E.F. (2005). Lifetime prevalence and age-of-onset distribution of DSM-IV disorders in

the national comorbidity survey replication. *Archives of General Psychiatry*, *62*, 593-602.

Kessler, R.C., Crum, R.M., Warner, L.A., Nelson, C.B. Schulenburg, J., & Anthony, J.C. (1997). Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence with other psychiatric disorders in the National Comorbidity Survey. *Archives of General Psychiatry*, *54*, 313-321.

Kessler, R.C., Foster, C.L., Saunders, W.B., & Stang, P.D. (1995). Social consequences of psychiatric disorders, I: Educational attainment. *American Journal of Psychiatry*, *152*, 1026- 1032.

Kessler, R.C., Nelson, C.B., & McGonagle, K.A. (2004). Epidemiology of co–occurring addictive and mental disorders: Implications for prevention and service utilization. *American Journal of Orthopsychiatry,* 66(1), 17–31.

Khan, S. S., Secades-Villa, R., Okuda, M., Wang, S., Pérez-Fuentes, G., Kerridge, B. T., & Blanco, C. (2013). Gender differences in cannabis use disorders: results from the National Epidemiologic Survey of Alcohol and Related Conditions. *Drug & Alcohol Dependence*, *130*(1), 101-108.

Khan, S., Okuda, M., Hasin, D. S., Secades-Villa, R., Keyes, K., Lin, K. H., ... & Blanco, C. (2013). Gender differences in lifetime alcohol dependence: results from the national epidemiologic survey on alcohol and related conditions. *Alcoholism: Clinical and Experimental Research*, *37*(10), 1696-1705.

Khantzian, E.J. (1985). The self-medication hypothesis of addictive disorders: Focus on heroin and cocaine dependence. *American Journal of Psychiatry*, *142*, 1259-1264.

Kingston, R. E., Marel, C., & Mills, K. L. (2017). A systematic review of the prevalence of comorbid mental disorders in people presenting for substance use treatment in Australia. *Drug and alcohol review*, *36*(4), 527-539.

Ko, J. Y., Farr, S. L., Dietz, P. M., & Robbins, C. L. (2012). Depression and treatment among US pregnant and nonpregnant women of reproductive age, 2005–2009. *Journal of women's health*, *21*(8), 830-836.

Kosma, M., Ellis, R., & Bauer, J. J. (2012). Longitudinal changes in psychosocial constructs and physical activity among adults with physical disabilities. *Disability and health journal*, *5*(1), 1-8.

Krueger, R.F., Hicks, B.M., Patrick, C.J., Carlson, S.R., Iacono, W.G., & McGue, M. (2002). Etiologic connections among substance abuse dependence, antisocial behavior and personality: Modeling the externalizing spectrum. *Journal of Abnormal Psychology*, *111*, 411-424.

Kushner, M.G., Abrams, K., & Borchardt, C. (2000). The relationship between anxiety disorders and alcohol use disorders: A review of major perspectives and findings. *Clinical Psychology Review, 20*(2), 149-171.

Lai, H. M. X., Cleary, M., Sitharthan, T., & Hunt, G. E. (2015). Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: a systematic review and meta-analysis. *Drug & Alcohol Dependence*, *154*, 1-13.

Langås, A. M., Malt, U. F., & Opjordsmoen, S. (2011). Comorbid mental disorders in substance users from a single catchment area-a clinical study. *BMC psychiatry*, *11*(1), 25.

Laviolette, S.R., Grace, A.A. (2006). Cannabinoids potentiate emotional learning plasticity in neurons of the medial prefrontal cortex through basolateral amygdale inputs. *Journal of Neuroscience*, *26*(24), 6458–6468.

Letourneau, N., Secco, L., Colpitts, J., Aldous, S., Stewart, M., & Dennis, C. L. (2015). Quasi-experimental evaluation of a telephone-based peer support intervention for maternal depression. *Journal of advanced nursing*, *71*(7), 1587-1599.

Lev-Ran, S., Roerecke, M., Le Foll, B., George, T., McKenzie, K., & Rehm, J. (2013). 892–The association between cannabis use and depression: a systematic review and meta-analysis of longitudinal studies. *European Psychiatry*, *28*, 1.

Levin, A. (2012). Look for comorbidities in youth with addiction. *Psychiatric News*, *47*(12), 5-7.

Li, Y., & Lerner, R. M. (2011). Trajectories of school engagement during adolescence: implications for grades, depression, delinquency, and substance use. *Developmental psychology*, *47*(1), 233.

López-Torrecillas, F., López-Quirantes, E. M., Maldonado, A., Albein-Urios, N., del Mar Rueda, M., & Verdejo-Garcia, A. (2017). Decisional balance and processes of change in community-recruited with moderate-high versus mild severity of cannabis dependence. *PloS one*, *12*(12), e0188476.

Lovejoy, T. I., & Heckman, T. G. (2014). Depression moderates treatment efficacy of an HIV secondary-prevention intervention for HIV-positive late middle-age and older adults. *Behavioral Medicine*, *40*(3), 124-133.

Macleod, J., Oakes, R., Copello, I., Crome, M., Egger, M., …Hickman, M. (2004). Psychological and social consequence of cannabis and other illicit drug use by young people: A systematic review of longitudinal, general population studies, *Lancet*, *363*(9421), 1579-1588.

Maisto, S. A., Krenek, M., Chung, T., Martin, C. S., Clark, D., & Cornelius, J. (2011). Comparison of the concurrent and predictive validity of three measures of readiness to change marijuana use in a clinical sample of adolescents. *Journal of studies on alcohol and drugs*, *72*(4), 592-601.

Marcus, S. M., & Heringhausen, J. E. (2009). Depression in childbearing women: when depression complicates pregnancy. *Primary Care: Clinics in Office Practice*, *36*(1), 151-165.

Mark, K., Gryczynski, J., Axenfeld, E., Schwartz, R. P., & Terplan, M. (2017). Pregnant women's current and intended cannabis use in relation to their views toward legalization and knowledge of potential harm. *Journal of addiction medicine*, *11*(3), 211-216.

Martin, C. S. (2008). Timing of alcohol and other drug use. *Alcohol Research & Health*, *31*(2), 96.

Martin, L. A., Neighbors, H. W., & Griffith, D. M. (2013). The experience of symptoms of depression in men vs women: analysis of the National Comorbidity Survey Replication. *JAMA psychiatry*, *70*(10), 1100-1106

May, P. A., Chambers, C. D., Kalberg, W. O., Zellner, J., Feldman, H., Buckley, D., ... & Taras, H. (2018). Prevalence of fetal alcohol spectrum disorders in 4 US communities. *JAMA*, *319*(5), 474-482.

McConnaughy, E. A., Prochaska, J. O., & Velicer, W. F. (1983). Stages of change in psychotherapy: Measurement and sample profiles. Psychotherapy: Theory, Research, and Practice, 20, 368-375.

McLellan, A.T., Childress, A.R., & Woody, G.E. (1985). Drug abuse and psychiatric disorder: Role of durg choice. In A.I. Alterman (Ed.), *Substance abuse and psychopathology* (pp. 137-172). New York, NY: Plenum Press.

McMaKen, R. (2016). 63 Million Americans now live in states with legal recreational marijuana. Retrieved from: https://mises.org/wire/63-million-americans-now-live-states-legal-recreational-marijuana

McNeece, C.A., & DiNitto, D.M. (2012). *Chemical Dependency: A Systems Approach* (4th Ed). Upper Saddle River, NJ: Pearson.

Meschke, L. L., Holl, J., & Messelt, S. (2013). Older not wiser: risk of prenatal alcohol use by maternal age. *Maternal and child health journal*, *17*(1), 147-155.

Metz, T. D., & Stickrath, E. H. (2015). Marijuana use in pregnancy and lactation: a review of the evidence. *American Journal of Obstetrics & Gynecology*, *213*(6), 761-778.

Midanik, L. T., Tam, T. W., & Weisner, C. (2007). Concurrent and simultaneous drug and alcohol use: results of the 2000 National Alcohol Survey. *Drug & Alcohol Dependence*, *90*(1), 72-80.

Mokdad, A. H., Marks, J. S., Stroup, D. F., & Gerberding, J. L. (2004). Actual causes of death in the United States, 2000. *Jama*, *291*(10), 1238-1245.

Monte, A.A., Zane, R.D., & Heard, K.J. (2015). Implications of marijuana legalization in Colorado. *Journal of American Medical Association*, *313*(3), 241-242.

Mueser, K.T., Corrigan, P.W., Hilton, D., Tanzaman, B., Schaub, A., Gingerich, S., …Herz, M.I. (1998). Illness management and recovery for severe mental illness: A review of the research. *Psychiatric Services*, 53, 1272- 1284.

Mueser, K.T., Drake, R.E., & Wallach, M.A. (1998). Integrated mental health and substance abuse treatment for severe psychiatric disorders. *Journal of Practical Psychiatry and Behavioral Health*, *4*, 129-139.

Mueser, K.T., Essock, S.M., Drake, R.E., Wolfe, R.S., & Frisman, L. (2001). Rural and urban differences in dually diagnosed patients: Implications for services needs. *Schizophrenia Research*, *48*, 93-107.

Mueser, K.T., Noordsy, D.L., Drake, R.E., & Fox, L. (2003). *Integrated Treatment of Dual Disorders: A Guide to Effective Practice*. New York: NY: Guilford Press.

Myers et al., 2014

Naar-King, S., Parsons, J. T., Murphy, D., Kolmodin, K., & Harris, D. R. (2010). A multisite randomized trial of a motivational intervention targeting multiple risks

in youth living with HIV: Initial effects on motivation, self-efficacy, and depression. *Journal of Adolescent Health*, *46*(5), 422-428.

National Institute of Alcohol Abuse and Alcoholism (NIAAA) (2002). Special Populations & Co-occurring Disorders. http://www.niaaa.nih.gov/alcohol-health/special-populations-co-occurring-disorders

National Institute of Alcohol Abuse and Alcoholism (NIAAA) (2015). Alcohol Facts and Statistics. Retrieved from http://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/alcohol-facts-and-statistics.

National Institute of Alcohol Abuse and Alcoholism (NIAAA) (2017). Drinking Levels Defined. https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking

National Institute of Mental Heatlh (NIMH) (2017). Major Depression. Retrieved from https://www.nimh.nih.gov/health/statistics/major-depression.shtml

National Institute on Drug Abuse (NIDA) (2010). Comorbidity. Retrieved from http://www.drugabuse.gov/related-topics/comorbidity

National Institute on Drug Abuse (NIDA) (2014). Marijuana. Retrieved from http://www.drugabuse.gov/drugs-abuse/marijuana

Nidecker, M., DiClemente, C. C., Bennett, M. E., & Bellack, A. S. (2008). Application of the transtheoretical model of change: Psychometric properties of leading measures in patients with co-occurring drug abuse and severe mental illness. *Addictive Behaviors*, *33*(8), 1021-1030.

Nordström, A., & Bodlund, O. (2008). Every third patient in primary care suffers from depression, anxiety or alcohol problems. *Nordic journal of psychiatry*, *62*(3), 250-255.

Normand, J., Lempert, R. O., O'Brien, C. P., & National Research Council. (1994). Employee assistance programs.

Norton, R., & Colliver, J. (1988). Prevalence and patterns of combined alcohol and marijuana use. *Journal of studies on alcohol*, *49*(4), 378-380.

O'Cleirigh, C., Newcomb, M. E., Mayer, K. H., Skeer, M., Traeger, L., & Safren, S. A. (2013). Moderate levels of depression predict sexual transmission risk in HIV-infected MSM: a longitudinal analysis of data from six sites involved in a "prevention for positives" study. *AIDS and Behavior*, *17*(5), 1764-1769.

O'Donohue, W.T., Bryd, M.R., Cummings, N.A., & Henderson, D.A. (2005). *Behavioral Integrative Care: Treatments that Work in the Primary Care Settings*. New York, NY: Brunner-Routledge

Oh, S., Salas-Wright, C. P., Vaughn, M. G, & DiNitto, D. M. (2017). Marijuana use during pregnancy: A comparison of trends and correlates among married and unmarried pregnant women. *Drug and Alcohol Dependence, 181*(1), 229-233.

Oh, S., Gonzalez, J. M. R., Salas-Wright, C. P., Vaughn, M. G., & DiNitto, D. M. (2017). Prevalence and correlates of alcohol and tobacco use among pregnant women in the United States: evidence from the NSDUH 2005–2014. *Preventive medicine*, *97*, 93-99.

Ondersma, S. J., Winhusen, T., Erickson, S. J., Stine, S. M., & Wang, Y. (2009). Motivation Enhancement Therapy with pregnant substance-abusing women: Does baseline motivation moderate efficacy?. *Drug & Alcohol Dependence*, *101*(1), 74-79.

Orr, S. T., James, S. A., & Blackmore Prince, C. (2002). Maternal prenatal depressive symptoms and spontaneous preterm births among African-American women in Baltimore, Maryland. *American journal of epidemiology*, *156*(9), 797-802.

Osterman, R. L. (2011). Decreasing women's alcohol use during pregnancy. *Alcoholism Treatment Quarterly*, *29*(4), 436-452.

Pantalon, M. V., Nich, C., Franckforter, T., & Carroll, K. M. (2002). The URICA as a measure of motivation to change among treatment-seeking individuals with concurrent alcohol and cocaine problems. *Psychology of Addictive Behaviors*, *16*(4), 299.

Parker, P. D., Martin, A. J., Martinez, C., Marsh, H. W., & Jackson, S. (2010). Longitudinal approaches to stages of change measurement: Effects on cognitive and behavioral physical activity factors. *Measurement and Evaluation in Counseling and Development*, *43*(2), 108-120.

Passey, M. E., Sanson-Fisher, R. W., D'Este, C. A., & Stirling, J. M. (2014). Tobacco, alcohol and cannabis use during pregnancy: clustering of risks. *Drug & Alcohol Dependence*, *134*, 44-50.

Pettianti, H.M., Oslin, D.W., Kampman, K.M., Dundon, W.D. Xie, H., Gallis, T.L., … O'Brien, C.P. (2010). A double-blind, placebo-controlled trial combining

sertraline and naltrexone for treating co-occurring depression and alcohol dependence. *American Journal of Psychiatr*y, *167*, 668-675.

Pettigrew, S., Jongenelis, M., Chikritzhs, T., Pratt, I. S., Slevin, T., & Glance, D. (2016). A Comparison of Alcohol Consumption Intentions Among Pregnant Drinkers and Their Nonpregnant Peers of Child-Bearing Age. *Substance use & misuse*, *51*(11), 1421-1427.

Prochaska, J. J., Rossi, J. S., Redding, C. A., Rosen, A. B., Tsoh, J. Y., Humfleet, G. L., ... & Hall, S. M. (2004). Depressed smokers and stage of change: implications for treatment interventions. *Drug and alcohol dependence*, *76*(2), 143-151.

Prochaska, J. O. (1994). Strong and weak principles for progressing from precontemplation to action on the basis of twelve problem behaviors. *Health psychology*, *13*(1), 47.

Prochaska, J. O., & Velicer, W. F. (1997). The Transtheoretical model of health behavior change. *American journal of health promotion*, *12*(1), 38-48.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American psychologist*, *47*(9), 1102.

Prochaska, J. O., Velicer, W. F., DiClemente, C. C., & Fava, J. (1988). Measuring processes of change: applications to the cessation of smoking. *Journal of consulting and clinical psychology*, *56*(4), 520.

Prochaska, J.O., & DiClemente, C.C. (1984). *The Transtheoretical Approach: Crossing the Traditional Boundaries of Therapy*. Homewood, IL: Dorsey Press.

Quello, S.B., Brady, K.T., & Sonne, S.C. (2005). Mood disorders and substance use disorder: A complex comorbidity. *Mood and Substance Use Disorders*, 13-21.

Redding, C. A., Rossi, J. S., Armstrong, K. A., Coviello, D., Barron, D., Evers, K., & Prochaska, J. O. (1996). Stages and processes of condom use adoption in at-risk female teens [Abstract]. *Annals of Behavioral Medicine: Proceedings of the Fourth International Congress of Behavioral Medicine*, *18*(Suppl.), S194.

Riley, E. P., Infante, M. A., & Warren, K. R. (2011). Fetal alcohol spectrum disorders: an overview. *Neuropsychology review*, *21*(2), 73.

Robinson, S. M., Sobell, L. C., Sobell, M. B., & Leo, G. I. (2014). Reliability of the Timeline Followback for cocaine, cannabis, and cigarette use. *Psychology of addictive behaviors*, *28*(1), 154.

Roesch, S. C., Norman, G. J., Adams, M. A., Kerr, J., Sallis, J. F., Ryan, S., ... & Patrick, K. (2009). Latent growth curve modeling of adolescent physical activity: testing parallel process and mediation models. *Journal of Health Psychology*, *14*(2), 313-325.

Roesch, S. C., Norman, G. J., Villodas, F., Sallis, J. F., & Patrick, K. (2010). Intervention-mediated effects for adult physical activity: A latent growth curve analysis. *Social Science & Medicine*, *71*(3), 494-501.

Rosenberg, S.D., Goodman, L.A., Osher, F.C., Swartz, M.S., Essock, S.M., Butterfield, M.I., … Salyers, M.P. (2001). Prevalence of HIV, Hepatitis B, and Hepatitis C in people with severe mental illness. *American Journal of Public Health*, *91*(1), 31-37.

Saarnio, P., & Knuuttila, V. (2007). A study of readiness to change profiles in alcohol and other drug abusers. *Journal of Addictions Nursing*, *18*(3), 117-122.

Salas-Wright, C. P., Vaughn, M. G., Cummings-Vaughn, L. A., Holzer, K. J., Nelson, E. J., AbiNader, M., & Oh, S. (2017). Trends and correlates of marijuana use among late middle-aged and older adults in the United States, 2002–2014. *Drug & Alcohol Dependence*, *171*, 97-106.

Saraceno, L., Munafo, M., Heron, J., Craddock, N., & van den Bree, M.M. (2009). Genetic and nongenetic influences on the development of co-occurring alcohol problem use and internalizing symptomatology in adolescents: A review. *Addiction*, *104*, 1100-1121.

Schuckit, M.A. (2009). An overview of genetic influences in alcoholism. *Journal of Substance Abuse Treatment*, *36*(1), 5014.

Schuckit, M.A., Smith, T.L. & Tipp, J.E. (1997). The self-rating of the effects of alcohol (SRE) form as a retrospective measure of the risk of alcoholism. *Addiction*, *92*, 979-988.

Sherman, B. J., Baker, N. L., & McRae-Clark, A. L. (2016). Gender differences in cannabis use disorder treatment: Change readiness and taking steps predict worse cannabis outcomes for women. *Addictive behaviors*, *60*, 197-202.

Simons, J. S., Clarke, C. J., Simons, R. M., & Spelman, P. J. (2016). Marijuana consequences in a motivational context: Goal congruence reduces likelihood of taking steps toward change. *Addictive behaviors*, *52*, 83-90.

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back. In *Measuring alcohol consumption* (pp. 41-72). Humana Press, Totowa, NJ.

Sobell, L.C. & Sobell, M.B. (1996). Alcohol Timeline Followback Users' Manual. Toronto,Canada: Addiction Research Foundation.

Sood, B., Delaney-Black, V., Covington, C., Nordstrom-Klee, B., Ager, J., Templin, T., ... & Sokol, R. J. (2001). Prenatal alcohol exposure and childhood behavior at age 6 to 7 years: I. dose-response effect. *Pediatrics*, *108*(2), e34-e34.

Stafford, R. S., Ausiello, J. C., Misra, B., & Saglam, D. (2000). National patterns of depression treatment in primary care. *Primary care companion to the Journal of clinical psychiatry*, *2*(6), 211.

Stein, M. D., Caviness, C. M., & Anderson, B. J. (2014). Alcohol use potentiates marijuana problem severity in young adult women. *Women's Health Issues*, *24*(1), e77-e82.

Steinmetz, K. (2016). These states just legalized marijuana. *CNN*, Retrieved from http://time.com/4559278/marijuana-election-results-2016/

Sterling, S.S., Chi, F.C., & Hinman, A. (2011). Integrating care for people with co-occurring alcohol and other drug, medical, and mental health conditions. *Alcohol Research and Health*, *33*(4), 338-349.

Strakowski, S.M., DelBello, M.P., Fleck, D.E., & Anrdt, S. (2000). The impact of substance abuse on the course of bipolar disorder. *Biological Psychiatry*, *48*, 477-485.

Subbaraman, M. S., & Kerr, W. C. (2016). Opinions on the privatization of distilled-spirits sales in Washington State: did voters change their minds?. *Journal of studies on alcohol and drugs*, *77*(4), 568-576.

Substance Abuse and Mental Health Services Administration (SAMHSA) (2013). National Survey on Drug Use and Health (NSDUH). Table 2.46B—Alcohol Use, Binge Alcohol Use, and Heavy Alcohol Use in the Past Month among Persons Aged 18 or Older, by Demographic Characteristics: Percentages, 2012 and 2013. Available at: http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabsPDFWHTML2013/Web/HTML/NSDUH-DetTabsSect2peTabs43to84-2013.htm#tab2.46b

Substance Abuse and Mental Health Services Administration (SAMHSA) (2013). National Survey on Drug Use and Health (NSDUH). Table 5.8A—Substance Dependence or Abuse in the Past Year among Persons Aged 18 or Older, by Demographic Characteristics: Numbers in Thousands, 2012 and 2013. Available at: http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabsPDFWHTML2013/Web/HTML/NSDUH-DetTabsSect5peTabs1to56-2013.htm#tab5.8a

Substance Abuse and Mental Health Services Administration (SAMHSA). 2013 National Survey on Drug Use and Health (NSDUH). Table 2.41B—Alcohol Use in Lifetime, Past Year, and Past Month among Persons Aged 18 or Older, by Demographic Characteristics: Percentages, 2012 and 2013. Available at: http://www.samhsa.gov/data/sites/default/files/NSDUH-

DetTabsPDFWHTML2013/Web/HTML/NSDUH-DetTabsSect2peTabs1to42-2013.htm#tab2.41b

Substance Abuse and Mental Health Services Administration (SAMSHA) (2016). Marijuana (Cannabis). Retrieved from https://www.samhsa.gov/atod/marijuana

Substance Abuse and Mental Health Services Administration (SAMSHA)-HRSA Center for integrated health solutions (2013). A standard framework for levels of integrated healthcare. Retrieved from http://www.integration.samhsa.gov/integrated-care-models/A_Standard_Framework_for_Levels_of_Integrated_Healthcare.pdf.

Swendsen, J.D., & Merikangas, K.R. (2000). The comorbidity of depression and substance use disorders. *Clinical Psychology Review*, *20*(2), 173-189.

Tabachnick, B. G., & Fidell, L. S. (2007). Profile analysis: the multivariate approach to repeated measures. *Using multivariate statistics*, 311-374.

True, W. R., Xian, H., Scherrer, J. F., Madden, P. A., Bucholz, K. K., Heath, A. C., ... & Tsuang, M. (1999). Common genetic vulnerability for nicotine and alcohol dependence in men. *Archives of general psychiatry*, *56*(7), 655-661.

Tsai, J., Floyd, R. L., & O'Connor, M. J. (2008). Paradigms for alcohol use and co-occurring behavioral health risk factors among women of childbearing age. *Binge drinking research progress*, 87-100.

Tsuang, M.T., Simpson, J.C., & Kronfol, Z. (1982). Subtypes of drug abuse with psychosis. *Archives of General Psychiatry*, *39*, 141-147.

U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th Edition, p. 31. Available at: http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf

Unützer, J., & Park, M. (2012). Strategies to improve the management of depression in primary care. *Primary Care: Clinics in Office Practice*, *39*(2), 415-431.

Van Gastel, W. A., MacCabe, J. H., Schubart, C. D., van Otterdijk, E., Kahn, R. S., & Boks, M. P. M. (2014). Cannabis use is a better indicator of poor mental health in women than in men: a cross-sectional study in young adults from the general population. *Community mental health journal*, *50*(7), 823-830.

Varner, M. W., Silver, R. M., Hogue, C. J. R., Willinger, M., Parker, C. B., Thorsten, V. R., ... & Stoll, B. (2014). Association between stillbirth and illicit drug use and smoking during pregnancy. *Obstetrics and gynecology*, *123*(1), 113.

Velasquez et al., 2004 (choices)

Velasquez, M. M., Crouch, C., Stephens, N. S., & DiClemente, C. C. (2015). *Group treatment for substance abuse: A stages-of-change therapy manual*. Guilford Publications.

Velasquez, M. M., Ingersoll, K. S., Sobell, M. B., Floyd, R. L., Sobell, L. C., & von Sternberg, K. (2010). A dual-focus motivational intervention to reduce the risk of alcohol-exposed pregnancy. *Cognitive and Behavioral Practice*, *17*(2), 203-212.

Velasquez, M. M., von Sternberg, K. L., Floyd, R. L., Parrish, D., Kowalchuk, A., Stephens, N. S., ... & Mullen, P. D. (2017). Preventing Alcohol and Tobacco

Exposed Pregnancies: CHOICES Plus in Primary Care. *American journal of preventive medicine*, *53*(1), 85-95.

Velasquez, M. M., von Sternberg, K., & Parrish, D. E. (2013). CHOICES: An integrated behavioral intervention to prevent alcohol-exposed pregnancies among high-risk women in community settings. *Social work in public health*, *28*(3-4), 224-233.

Velasquez, M. M., von Sternberg, K., & Parrish, D. E. (2013). CHOICES: An integrated behavioral intervention to prevent alcohol-exposed pregnancies among high-risk women in community settings. *Social work in public health*, *28*(3-4), 224-233.

Velasquez, M.M., Carbonari, J.P., & DiClemente, C.C. (1999). Psychiatric severity and behavior change in alcoholism: The relation of the Transtheoretical model variables to psychiatric distress in dually diagnosed patients. *Addictive Behaviors*, *24*(4), 481-496.

Velasquez, M.M., Maurer, G., Crouch, C., & DiClemente, C.C. (2001). *Group Treatment for Substance Abuse: A Stages-of-Change Therapy Manual*. New York, NY: Guildford Press.

Velicer, W. F., Prochaska, J. O., Fava, J. L., Norman, G. J., & Redding, C. A. (1998). Smoking cessation and stress management: applications of the transtheoretical model. *Homeostasis*, *38*, 216-233.

Velicer, W.F., DiClemente, C.C., Rossi, J. S., Prochaska, J. O. (1990). Relapse situations and self-efficacy: An integrative model. Addictive Behaviors, 15, 271-283.

von Sternberg, K., Velasquez, M. M., & DiClemente, C. C. (2012). Transtheoretical model construct profiles of women who reduced alcohol consumption in project

CHOICES: Roadmap to success. *Alcoholism: Clinical & Experimental Research*, *36*, 72A.

VonSternberg, K. (2005). Comparing the factorial structure, invariance, and predictive validity of Transtheoretical model constructs for alcohol use across restricted and unrestricted settings. Dissertation Abstracts International: Section B: The Sciences and Engineering, 66, 3094).

Wagner, J., Burg, M., & Sirois, B. (2004). Social support and the transtheoretical model: Relationship of social support to smoking cessation stage, decisional balance, process use, and temptation. *Addictive behaviors*, *29*(5), 1039-1043.

Ward, R. M., Velicer, W. F., Rossi, J. S., Fava, J. L., & Prochaska, J. O. (2004). Factorial invariance and internal consistency for the decisional balance inventory—short form. *Addictive behaviors*, *29*(5), 953-958.

Wasserman, D. A., Havassy, B. E., & Boles, S. M. (1997). Traumatic events and post-traumatic stress disorder in cocaine users entering private treatment. *Drug and alcohol dependence*, *46*(1), 1-8.

White, S. L., Noar, S. M., Redding, C. A., Meier, K. S., Rossi, J. S., Morokoff, P. J., & Gazabon, S. A. (2001). Preparation stage criteria for condom use in three adult samples [Abstract]. *Annals of Behavioral Medicine*, *23*(Suppl.), S100.

Wickrama, K. A. S., Beiser, M., & Kaspar, V. (2002). Assessing the longitudinal course of depression and economic integration of south-east Asian refugees: an application of latent growth curve analysis. *International journal of methods in psychiatric research*, *11*(4), 154-168.

Wieland, J., Wardenaar, K. J., Fontein, E., & Zitman, F. G. (2012). Utility of the Brief Symptom Inventory (BSI) in psychiatric outpatients with intellectual disabilities. *Journal of Intellectual Disability Research*, *56*(9), 843-853.

Wittchen, H.U., Kessler, R.C., Beesdo, K., Krause, P., Hofler, M., & Hoyer, J. (2002). Generalized anxiety and depression in primary care: Prevalence, recognition, and management. *Journal of Clinical Psychiatry*, *63*(8), 24-34.

Wu, C. S., Jew, C. P., & Lu, H. C. (2011). Lasting impacts of prenatal cannabis exposure and the role of endogenous cannabinoids in the developing brain. *Future neurology*, *6*(4), 459-480.

Zuckerman, B., Bauchner, H., Parker, S., & Cabral, H. (1990). Maternal depressive symptoms during pregnancy, and newborn irritability. *Journal of Developmental and Behavioral Pediatrics*.

Zunhammer, M., Eberle, H., Eichhammer, P., & Busch, V. (2013). Somatic symptoms evoked by exam stress in university students: The role of alexithymia, neuroticism, anxiety, and depression. *PLoS One*, *8*(12), 1-11.