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# The Effect of a Substance Use Intervention on Co-occurring Adolescent Depression Symptoms

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The Effect of a Substance Use Intervention on Co-occurring Adolescent Depression Symptoms

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A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

In

Clinical Psychology

Seattle Pacific University

School of Psychology, Family, & Community

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Dedication

I dedicate this manuscript to my family and friends who have encouraged and supported me throughout my dissertation journey. To Dr. David G. Stewart and the Stewart research vertical team without whom this project would not have been possible. I am beyond grateful for your commitment to the development and implementation of Project READY.

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**Abstract**

The comorbidity of substance use and depression among adolescents has been strongly established but less is known about their reciprocal impact over time. Examining these variables in the context of an intervention provides information about how changes in one effect the other. The current study examines the effect of a school-based Motivational Interviewing (MI) intervention, Project READY, on co-occurring substance use and depressive symptoms in adolescents ( $N = 103$ ; ages 13-18, mean = 16) from the greater Seattle area. We hypothesized: (a) the quantity and frequency of substance use will decrease from pre-treatment to post-treatment follow up; (b) the number of substance-related consequences will decrease from pre-treatment to post-treatment follow up; (c) depression symptoms will decrease from pre-treatment to post-treatment follow up; and (d) a reduction in substance use from pre-treatment to post-treatment, and the subsequent reduction in substance use consequences, will predict a reduction in depression symptoms at post-treatment follow up compared to pre-treatment levels. Participants were diverse in ethnicity with Caucasian (32%), Asian American (22%), Hispanic (18%), African American (11%), Multiethnic (10%), and Native American/Alaskan Native (1%) adolescents represented in the sample. The sample mostly included male participants (70%). Three serial mediation analyses were conducted, examining change in substance use and change in consequences of substance use as mediating the effect of the intervention on change in depression symptoms. Total substance use (alcohol and marijuana), alcohol use, and marijuana use were examined as three separate models. We found that the analysis examining marijuana use only was statistically significant. The indirect effect of the intervention on depression symptoms through marijuana consequences ( $B = -1.416$ ,  $CI95 = -3.083$  to  $-0.132$ ) was

significantly stronger ( $B = -1.154$ ,  $CI_{95} = -2.657$  to  $-0.102$ ) than the indirect effect of the intervention through marijuana use through marijuana use consequences to depression symptoms ( $B = -0.262$ ,  $CI_{95} = -0.706$  to  $-0.015$ ). The findings from this study suggest that reductions in substance use and consequences of use may effectively reduce co-occurring depression symptoms. Furthermore, the findings highlight the efficacy of brief MI interventions in decreasing co-occurring depression symptoms in addition to substance use.

## Chapter I: Introduction and Review of Literature

### Purpose

The purpose of this study is to enhance our understanding of processes that influence change in co-occurring substance use and depression symptoms in the context of a motivational interviewing intervention. A repeated finding in the extensive literature examining substance use and misuse among adolescents is that substance use disorders are often comorbid with other mental health conditions such as depression. Recent estimates have found that approximately 359,000 adolescents aged 12 to 17 have met criteria for both a substance use disorder and a major depression episode during the past year (SAMHSA, 2014). Twenty-eight percent of adolescents with a substance use disorder also had a major depression episode during the past year (SAMHSA, 2014). Among individuals with substance use disorders, the presence of co-occurring depression presents increased impairment. In adults, co-occurring alcoholism and depression has been associated with elevated depression symptoms and an increased risk of suicide (Conner, McCloskey, & Duberstein, 2008; Swendsen, Merikangas, Canino, Kessler, Rubio-Stipec, & Angst, 1998). The presence of major depression has been associated with a greater risk for drinking relapse following hospitalization for detoxification as well (Greenfield, Weiss, Muenz, Vagge, Kelly, Bello, & Michael, 1998). Co-occurring substance use and depression has a negative impact for adolescents as well as adults. Adolescents who endorse using substances with comorbid depression symptoms have been shown to have a heavy drinking pattern in that they drank large quantities of alcohol in a short period of time. (Stewart, Arlt, Felleman, Athenour, & Arger, 2015). Comorbid depression among adolescents in substance use treatment programs has been associated with greater alcohol dependence (Grella, Hser, Joshi, & Rounds-Bryant, 2001). The prevalence and subsequent impairment associated with comorbid

substance use and depression indicate a necessity for thorough examination of how the two disorders influence each other. Furthering our understanding of the relationship between depression and substance use has important implications for interventions targeting these disorders. The aim of my dissertation is to examine the effects of a brief substance use intervention on co-occurring substance use and depression symptoms in adolescents.

### **Theoretical Model**

The process of understanding the mechanisms that underlie the associations between substance use and depression requires a theoretical framework from which hypothesis can be tested. The learned helplessness theory or cognitive diathesis-stress theory of depression (Abramson, Metalsky, & Alloy, 1989) proposes that attributional styles are involved in the development of depression. Attributional styles are the ways that people explain the causes of negative experiences or events. People who view the causes of negative events as internal, global, and stable are likely to experience negative affect following negative events due to this attributional style. This cognitive tendency results in a diathesis and overall vulnerability for depression. The negative events, or stress, are thought to be a prerequisite for the development of depression in that the attributional style in itself does not directly lead to depression unless there is a negative event to interpret.

The emotional cascades model extends the cognitive diathesis-stress theory by describing behavioral consequences of depression that serve to maintain themselves and the depression (Selby, Anestis, & Joiner, 2008). The emotional cascades model suggests a synergistic relationship between rumination and negative affect in impulsive individuals. The “emotional cascade” is an aversive experience that follows from the rapid escalation of negative affect and rumination and can result in impulsive behaviors. This theory proposes that impulsive behaviors

such as substance use are used as coping or distraction methods that reduce rumination and inhibit the emotional cascade (Selby, Kranzler, Panza, & Fehling, 2016). This idea is supported by several studies that have found an association between negative affect and adolescent substance use (Colder & Chassin, 1993; Mason, Hitch, & Spoth, 2009). In this model, substance use is maintained through negative reinforcement in that the individual avoids experiencing negative affect while under the influence of the substance (Selby et al. 2008). The behavior is distracting but only provides short-term relief from the emotional cascade resulting in a heightened frequency of the behavior. Coping with negative affect has been found to be related to patterns of heavy substance use in adolescents (Labouvie, Pandina, White, & Johnson, 1990; Wills, Sandy, Shinar, & Yaeger, 1999). The individual, then, experiences negative consequences related to heavy substance use. Binge drinking among adolescents has been shown to predict consequences such as withdrawal effects, giving up important activities, and legal problems (Harris et al., 2017). These consequences are likely to maintain negative affect as proposed by the cognitive diathesis-stress theory in that they are negative events which the individual experiences and attributes to in a way that leads to negative affect or depression. Based on this model, interventions aimed at reducing substance use would likely see a reduction in negative affect as well. Negative affect abates when the consequences related to heavy patterns of use diminish. The emotional cascades model provides a possible explanation for the high prevalence of co-occurring substance use and depression in adolescents as well as potential mechanisms for treatment.

### **Co-Occurring Depression and Substance Use**

Our understanding of the relationship between substance use and depression in adolescents is limited by the lack of research examining these disorders in conjunction. In

addition, the methodology used to examine these disorders has made it difficult to make meaningful conclusions. There is a need for research that measures current symptoms of depression and substance use among adolescents in addition to identifying changes over time. The strength of the research design determines our ability to understand the influence that these disorders have on adolescents.

The association between substance use, specifically alcohol and cannabis use, and depression in adolescents has been established across several studies (Arendt & Munk, 2004; Rey, Sawyer, Raphael, Patton, & Lynskey, 2002; Tomlinson & Brown, 2012; Weinberg, Rahdert, Colliver, & Glantz, 1998; White, Xie, Thompson, Loeber, & Stouthamer Loeber, 2001). In Weinberg and colleagues' (1998) review of adolescent substance use literature, the authors note that population-based studies have found high rates of comorbid addictive behaviors and psychiatric disorders including depression. Clinical populations of adolescents, specifically, have been found to have a high prevalence of comorbid substance use and psychiatric disorders with depression and conduct disorder identified as the most frequent comorbid conditions (Weinberg et al. 1998). Depressive symptoms have been associated with a greater quantity and frequency of alcohol use among a sample of middle school students (Tomlinson & Brown, 2012). In a sample of adolescent males, depression symptoms were positively associated with alcohol use but not marijuana use at age 13 (White et al., 2001). The authors note, however, that the sample in general did not begin using marijuana until later in adolescence which could be why they did not find a positive association between depression and marijuana. This highlights one of the limitations of cross-sectional studies; the findings may not hold across time or after accounting for possible confounding variables. In contrast to White et al.'s findings, depression and marijuana use has been linked in a sample of treatment-seeking adolescents (Arendt & Munk,

2004) and an Australian population-based adolescent sample (Rey, Sawyer, Raphael, Patton, & Lynskey, 2002). While correlational designs provide some clues towards the way constructs might relate to each other, they do not allow comprehensive conclusions to be made about the relationship between constructs.

Longitudinal designs have been used to enhance our understanding of the temporal direction of substance use and depression, but studies that investigate these disorders over time show mixed findings regarding the temporal sequence. Some studies suggest that depression predicts substance use (King, Iacono, & McGue, 2004; McCarty, Wymbs, King, Mason, Vander Stoep, McCauley, & Baer, 2012) while others suggest that substance use predicts the development of depression (Shuckit, 2006). The discrepancy between these findings are likely due to differences in participant characteristics and timing of data collection. Degenhardt, Hall, & Lynskey's (2003) review of the literature examining depression and cannabis use shows that most studies do not examine the concurrent impact of depression and cannabis use on each other but rather examine how one variable effects the other after several years or longer. Longitudinal studies generally suggest that cannabis use predicts later depression (Fergusson, Horwood, & Swain-Campbell, 2002) but depression does not predict later cannabis use (Patton, Coffey, Carlin, Degenhardt, Lynskey, & Hall, 2002). Again, a limitation of these studies is that they do not address the immediate impact that either mood or drug use has on the other. Studies that examine outcomes in the days or weeks following endorsement of depression symptoms or substance use are likely to be useful in the development of treatment interventions.

Another method for examining the relationship between depression and substance use is by looking at how different levels of severity of each impacts the other. Compared to low levels of depressive symptoms, high levels of depressive symptoms has been associated with drinking

to cope with negative affect among adolescents (Stewart, Arlt, Felleman, Athenour, & Arger, 2015). The severity of the symptoms of either depression or alcohol dependence has been shown to more strongly predict the development of the other disorder across the span of one year (Gilman & Abraham, 2001). Examining levels of severity helps us determine how the relationship between substance use and depressive symptoms is impacted by changes in the severity of either disorder.

A more rich depiction of how these disorders relate to each other involves examining how they change in conjunction over time. Recent research with greater methodological strength has found evidence of a reciprocal relationship between substance use and depression (Fleming, Mason, Mazza, Abbott, & Catalano, 2008). Changes in depressive symptoms in adolescents has been shown to be positively correlated with changes in substance use such that adolescents who increased rapidly in substance use were likely to increase rapidly in depressive symptoms (Fleming et al., 2008). These results suggest that substance use and depression are strongly enmeshed with each other and support the need for interventions that attenuate the negative effects of one disorder on the other. As our understanding of the reciprocal relationship between substance use and depression develops, it will be important for researchers to examine factors that may play a role in the fluctuations between these co-occurring disorders. Examining the effect of constructs that are theorized to contribute to this relationship, such as the significance of the consequences experienced from substance use, will allow for the development of a more detailed picture that better represents the complexity of the relationship between substance use and depression. A better understanding of the factors that contribute to the complexity of this relationship can be used to inform and improve existing treatment approaches.

### **Intervention Effects**



Due to the evident reciprocal relationship of depression and substance use, there is a need for research examining the impact that interventions may have on this relationship. However, most intervention research only examines the effects of an intervention on the intended disorder by either excluding participants with co-occurring disorders or only reporting outcomes related to the disorder of interest. Of the studies that do examine the impact of one disorder on the other during an intervention, a majority of the literature uses a linear method of analysis (Hersh, Curry, & Kaminer, 2014). Among the limitations of this method is that depression symptoms are frequently measured by lifetime occurrence. Measuring current depressive symptoms will be better able to capture the influence of mood on intervention outcomes. Another limitation is that a linear method of analysis is not able to examine the likely reciprocal relationship of depressive symptoms and substance use which has previous support (Fleming et al. 2008). Hersh and colleagues' (2014) review of studies examining the effects of comorbid depression on substance use treatment outcomes shows that there are conflicting findings. Depression had a negative influence on substance use treatment outcomes in some studies and a positive influence in others, while some researchers found that depression did not have a significant influence on treatment outcome. These findings indicate that a more complex method of examining the influence of depression and substance use on treatment outcomes is warranted. Changes in either depression or substance use across treatment may have differential effects on treatment outcomes.

Among the few studies that examine the effect of an intervention on changes in co-occurring substance use and depression in adolescents, results vary. Mason, Kosterman, Hawkins, Haggerty, Spoth, & Redmond (2007) examined the effects of a family-focused substance use intervention, Preparing for the Drug Free Years, on the development of depressive symptoms. They found that the indirect effect of the intervention on depressive symptoms

through substance use change was marginally significant. This intervention targets parenting behaviors, family interaction patterns, and adolescent substance use. The authors suggest that the length of the study, four years, might have made it difficult to detect an effect of the intervention on co-occurring depression. This study demonstrates that interventions that target substance use can have effects on depression. More research is needed to determine if different types of interventions may show similar effects on co-occurring disorders. It is also important to examine potential intervening processes. Interestingly, an intervention targeting adolescent depression (McKowen, Tompson, Brown, & Asarnow, 2013) found that change in one process is associated with changes in the other process but this relationship was unidirectional such that higher depressive symptoms predicted less substance use change across the intervention. Initial levels of substance use did not predict a change in depressive symptoms. The authors note that this finding may be due to the participants being recruited for depression and the fact that the interventions, cognitive behavior therapy and medication, were targeting depression symptoms. The substance use variable in this study also did not examine alcohol and drug use separately. The mixed findings of these two interventions indicate that some interventions may be more effective in treating co-occurring substance use and depression than others. It appears that the length of intervention and differentiation of associations by substance type are important to consider.

### **Motivational Interviewing**

Motivational Interviewing (MI; Miller, 1983) is a collaborative style of treatment engagement which is used to guide the client toward behavior change. This style of brief intervention focuses on eliciting reasons for change and responding effectively to client change talk. Although MI can be used in conversation about any behavior or lifestyle change, much of the literature on MI describes its use with substance abuse. As such, MI has been established as

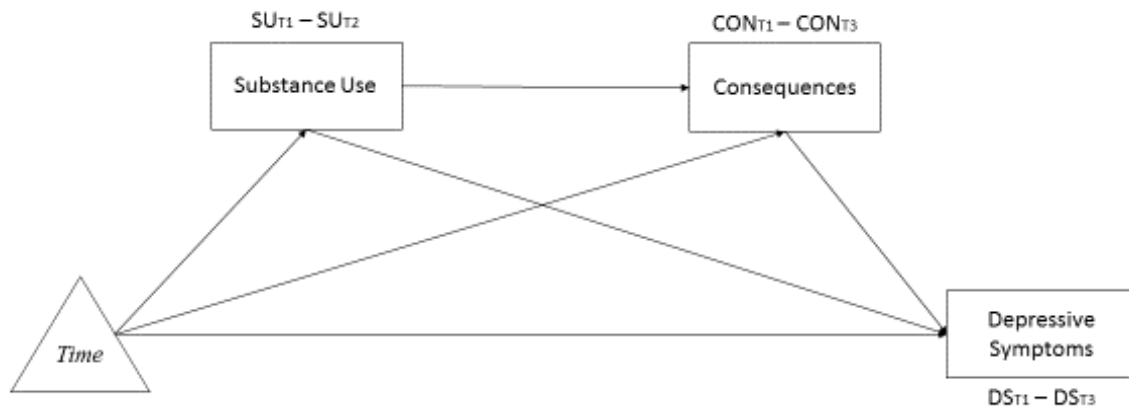
an effective treatment for substance use disorders (Miller & Rollnick, 2013). Tevyaw and Monti's (2004) review of Motivational Enhancement interventions with adolescents support the efficacy of MI in treating substance use disorders with adolescents. MI interventions have been shown to decrease alcohol use, alcohol-related risky behavior, and negative consequences related to substance use (Tevyaw & Monti, 2004).

The use of MI for behaviors other than substance use disorders in adolescents is in its preliminary stages. While there is support for the use of MI with health behaviors such as weight management, diabetes, and sexual health (Cushing, Jensen, Miller, & Leffingwell, 2014), less is known about how changes in target behaviors effect co-occurring disorders such as depression. The literature examining comorbid depression and substance use in the context of an MI intervention largely investigates the impact that depression has on the efficacy of the intervention on reducing substance use. Stein, Lebeau, Colby, Barnett, Golembeske, and Monti (2011) found that for adolescents in a juvenile correction facility, MI significantly reduced alcohol and marijuana use in adolescents who had low levels of depressive symptoms but this effect was not found for adolescents with high levels of depressive symptoms. Other studies, however, have found that depression did not have a significant influence on MI treatment outcomes such as post-treatment follow-up rates of alcohol use (Tapert, Colby, Barnett, Spirito, Rohsenow, Myers, & Monti, 2003) and the rate of reduction in frequency of substance use (Becker, Curry, & Yang, 2011). More research is needed that examines the impact of MI interventions on disorders that frequently co-occur with substance use. Specifically, treatment studies are needed to investigate the impact of changes in substance use on co-occurring depression. As an established intervention for reducing adolescent substance use, MI is a treatment approach well-suited for this future direction in research.

## **Current Study**

The present study seeks to examine associations between depressive symptoms and substance use over time in the context of an intervention targeting substance use in order to increase our understanding of processes that influence change over time. Project READY is a school-based substance use intervention implemented in several high schools across the greater Seattle area. Adolescents who have completed Project READY have been shown to have significant decreases in their substance use post-treatment compared to a waitlist control group (Stewart, Siebert, Arlt, Moise-Campbell, & Lehinger, 2016). Depressive symptoms have been shown to be associated with increased alcohol use disorder severity in the context of Project READY (Stewart, Arlt, Felleman, Athenour, & Arger, 2015). This study is unique in that it examines the effect of the intervention on the comorbidity of depression and substance use in adolescents. We first hypothesized that the quantity and frequency of substance use will decrease from pre-treatment (Time 1) to post-treatment check-in (Time 2). Second, the number of substance-related consequences will decrease from Time 1 to the fourth post-treatment check-in session (Time 3). Third, depression symptoms will decrease from Time 1 to Time 3. Fourth, we hypothesize that a reduction in substance use and substance related consequences will predict reduction in depression symptoms at Time 3. Our hypothesis are derived from the emotional cascades model in that we predict that Project READY is breaking the emotional cascade effect. The reduction in substance use, which is an effect of the intervention, also reduces substance related consequences. The consequence driven depression symptoms are reduced as a result.

Figure 1.



*Figure 1.* Serial mediation model being tested. Rectangles denote the construct being measures. Triangle on the left denotes the time course of the intervention. SU = substance use; CON = substance use related consequences; DS = depressive symptoms; T1 = intake timepoint; T3 = session 8.

## Chapter II: Method

### Participants

The current study is an archival analysis of a large substance use intervention, Project READY, conducted in high schools located in a large urban area of the greater Seattle area. Study participants consisted of 103 adolescents enrolled in Project READY. Students between the ages of 13 and 18 and who endorsed using drugs or alcohol within the prior three months were eligible for enrollment. See Table 1 for demographic information and relevant characteristics of the sample.

Table 1

*Demographics and baseline means and standard deviations of sample by type of user (N = 103)*

	Alcohol only user (n = 7)	Marijuana only user (n = 8)	Alcohol + marijuana user (n = 88)	Total (%)
	Frequency	Frequency	Frequency	
Gender				
Male	6	8	54	68 (66)
Female	1	0	32	33 (32)
Ethnicity				
Caucasian	2	0	26	28 (27.2)
Asian American	1	2	22	25 (24.3)
Hispanic	0	2	16	18 (17.7)
African American	1	4	13	18 (17.5)
Multiethnic	3	0	11	14 (13.6)
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Baseline alcohol consequences	13.86 (8.07)	--	17.53 (11.27)	14.79 (11.97)
Baseline marijuana consequences	--	19.38 (12.01)	24.07 (11.24)	22.00 (12.09)
Baseline depression symptoms	14 (7.70)	21.50 (7.63)	20.92 (10.69)	20.03 (9.88)

## **Sampling Procedures**

Participants were recruited by referral for Project READY. Students were either self-referred or referred by the school staff including counselors, teachers, administrators, and security officers. Common reasons for referral to Project READY included substance-related discipline, self-report of substance use, and affiliation with students known to use substances. The research and intervention procedures were approved by a university institutional review board and participating school district research committees. Informed consent was obtained from participants prior to the intervention procedures. Students were eligible for participation in Project READY if they endorsed using drugs or alcohol in the prior three months. Students who did not wish to participate in the research component of the study were provided with the intervention and their assessment responses were not included in the data. Washington state law states that minors above the age of 13 are allowed to consent to treatment for substance use without parental consent (Revised Code of Washington [RCW] 71.34.530). The assessment responses for each participant were given an identification number so that their responses were not linked to any identifying information.

## **Measures**

**Substance Use.** Quantity and frequency of alcohol and drug use was measured using the Customary Drinking and Drug Use Record (CDDR; Brown et al., 1998). The CDDR is a 101-item interview-administered measure that examines current and lifetime alcohol and drug use. There are four domains the CDDR examines including rate of use, withdrawal symptoms, psychological and behavioral dependence symptoms, and negative consequences due to substance use. Sample items include “In your life, how many times have you been drunk?” and “When was the last time you used marijuana?” Support for the reliability of the CDDR has been

shown with samples of substance-abusing and community adolescents. Specifically, alpha coefficients were high for alcohol and drug dependence as well as withdrawal symptoms across both samples. Alpha coefficients, which measure internal consistency, range from .72 to .94 (Brown et al., 1998). Cronbach's alpha for this study was .60 for alcohol use at Time 1 and .80 for alcohol use at Time 2. Alpha coefficients were likely impacted by the small number of items that were used to measure alcohol use. Reliability for marijuana use was not calculated for this study because only one question from the marijuana items was used.

The CDDR was administered in this study at Time 1 and 2. A total score for alcohol use was measured by multiplying the quantity and frequency of use. For alcohol, quantity was measured as the average number of drinks consumed in a 24-hour period. Frequency was measured as the number of days per month the participant drank alcohol. A total score for marijuana use was calculated as the frequency of use due to limitations in the accuracy of quantity reports. Frequency was measured as the number of days per month the participant used marijuana. Items that examined withdrawal, dependence, and consequences of use were not used for this study because there are different items for alcohol and drug use which would not allow for a comparison of the two substances.

**Substance Use Consequences.** The Alcohol and Drug Use Consequences Questionnaire (ADUCQ; Hall, Stewart, Arger, Athenour, Effinger, 2014) was used to measure self-reported alcohol and drug use consequences. The ADUCQ is a 51-item measure examining past year and past month substance use consequences across various domains such as school, social support, family, and legal consequences. This measure consists of items from the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989) and the Diagnostic Interview Schedule for Children, Fourth Edition (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000).



Sample items include the number of times during the past year the participant “neglected your responsibilities” and “noticed a change in your personality” due to alcohol or drug use.

Participants are asked to rate the frequency of these consequences on the following scale: 0 = *Never*, 1 = *1 or 2 times*, 2 = *3 to 5 times*, 3 = *6 to 10 times*, and 4 = *More than 10 times*. The ADUC-Q was administered in this study at Time 1 and 3. Total consequences for alcohol use was calculated by summing the number of consequences endorsed due to alcohol use. Total consequences for drug use was calculated by summing the number of consequences endorsed due to drug use. Cronbach’s alpha for this study was calculated to measure internal consistency. Alpha values of .95 for alcohol consequences at Time 1, .95 for alcohol consequences at Time 3, .95 for marijuana consequences at Time 1 and .95 for marijuana consequences at Time 3 indicate strong internal consistency.

**Depressive Symptoms.** The severity of depressive symptoms was measured using the Center for Epidemiological Studies Depression scale (CES-D; Radloff, 1977). The CES-D scale is a 20-item self-report measure designed to assess depressive symptoms. This measure was developed by researchers at the National Institute of Mental Health to be used in studies of the epidemiology of depressive symptoms in the general population (Radloff, 1977). Examinees rate how often each item has occurred during the past week on a four-point Likert type scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). Sample items include “I was bothered by things that usually don’t bother me” and “I felt fearful”. A total score is calculated by summing the weight of each item, with a range from 0 to 60. Higher scores indicate greater severity of depressive symptoms, with a cutoff score of 16 indicating clinical depression (Radloff, 1977).

The CES-D has been shown to be a reliable measure of depression symptomology in adults (Orme, Reis, & Herz, 1986; Radloff, 1977; Roberts, 1980). More specific to the interests of this study, several researchers have examined the reliability of this measure using child and adolescent samples as well (Garrison, Addy, Jackson, McKeown, & Waller, 1991; Roberts, Andrews, Lewinsohn, & Hops, 1990; Roberts et al. 1991). Internal consistency reliability coefficients are high, ranging from 0.87-0.88 (Garrison et al. 1991; Roberts et al. 1990; Roberts et al. 1991). Cronbach's alpha for this study were 0.86 for Time 1 and 0.86 for Time 3, indicating strong internal consistency. Test-retest reliability over a one month period was moderately stable with a coefficient of 0.61 (Roberts et al. 1991). Test-retest reliability over the eight-week intervention was 0.72 for the current study. The CES-D has discriminated well between psychiatric inpatient populations and the general population. It has also shown to have moderate correlations with other scales assessing depression symptoms including the Lubin scale and Bradburn Negative Affect scale, and was negatively correlated with the Bradburn Positive Affect scale, suggesting adequate convergent and discriminant validity (Radloff, 1977).

In its original development, the CES-D was found to have a four-factor structure (Radloff, 1977) which has been supported in more recent studies examining factors with younger adolescent (Phillips et al. 2006) and older adolescent (Roberts et al. 1990) populations. These factors are Depressed Affect, Positive Affect, Somatic Complaints, and Interpersonal. Altogether, using the total score as an estimate of depressive symptoms is recommended due to the strong correlations between factors (Phillips et al. 2006; Radloff, 1977). Additionally, the original four-factor structure has not been found to hold across different racial/ethnic groups (Kim, DeCoster, Huang, & Chiriboga, 2011), which further supports the use of the total score.

The CES-D was administered in this study at Time 1 and 3. A total score was calculated by summing all items.

Table 2 shows the constructs and time point administered for each measure.

Table 2

*Constructs and time points for measures used in study*

<u>Construct</u>	<u>Measure</u>	<u>Time Point(s) Administered</u>
Substance Use	CDDR	Session 1, 4
Consequences of Substance use	ADUCQ	Session 1, 8
Depressive Symptoms	CES-D	Session 1, 8

## **Research Design**

Project READY was conducted within school hours of participating high schools. Clinical psychology graduate students conducted the intervention. Interventionists attended a yearly training and received weekly group supervision from a licensed psychologist. They also had a manual which outlined the intervention procedure and contained emergency protocol information. A confidential referral list was coordinated between the interventionist and a designated school personnel. Interventionists met with students in spaces that were quiet and private, typically in an available classroom or office.

Project READY consists of four active intervention sessions followed by four “check-in” sessions. Two additional sessions occurred at one-month intervals following the fourth check-in session. Altogether, interventionists met with students for a maximum of 10 sessions. Interventionists utilized a motivational-interviewing style throughout the intervention and activities were chosen to elicit and reinforce participants’ motivation to change their substance

use behaviors. The duration of each session varied depending on the activity and engagement of the participant. During session one, the intervention and study were described to the student and consent documents were signed. Interventionists then spent twenty minutes learning about the participant including their reasons for using drugs or alcohol. A decisional balance was completed, eliciting the participants' pros and cons of using substance as well as the pros and cons of reducing substance use. Then the interventionist administered an intake assessment battery to the participant. Session two consisted of providing feedback for the participant based on their responses to the assessment questions. A goals setting worksheet was completed and participants identified how using substances could get in the way of reaching their goals. During session three participants completed a second decisional balance. Depending on the stage of change of the participant, session four consisted of the completion of either a relapse prevention plan or a "change plan". A post-treatment assessment battery was administered during session four as well. The four weekly check-in sessions that followed the active intervention were brief, unstructured MI-based sessions. Assessments were administered during the fourth check-in session. The final two sessions which occurred at one-month intervals following the fourth check-in session consisted of assessments. For the purposes of this study Time 1 will be used to refer to the intake session. Time 2 will refer to the post-treatment session, and Time 3 will refer to the fourth check-in session. Time points were chosen in this way in order to establish a temporal precedence where the change in substance use predicts the change in consequences and depression symptoms. Data from the final two sessions were not included in this study because we wanted to determine the more immediate impact of change in substance use and consequences on depression symptoms. Previous studies have indicated that testing indirect

effects of interventions on non-targeted outcomes becomes more difficult as the length of time increases (Mason et al., 2007).

## **Chapter III: Results**

### **Power Analysis**

A power analysis was performed to determine the sample size necessary to achieve adequate statistical power. Due to the limited literature on the estimation of power in two-condition within-participant mediation analysis, power was estimated using Cohen's (1992) guidelines. The analysis was treated as a multiple regression with six predictors, one for each timepoint of the measured variables. Cohen's  $f^2$  effect size was set at .15, the alpha level was set at .05, and the power level was set at .80. Using these guidelines, a minimum of 97 participants would be required to adequately power hypotheses and analyses.

### **Data entry and preparation**

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 25 software with the MEMORE macro provided by Montoya and Hayes (2016). Several items (4, 8, 12, 16) are reverse items on the CES-D. These items were reverse scored before computing the total CES-D score. Prior to statistical analyses, data was prepared by (1) identifying and managing missing variables, (2) examining for outliers and (3) evaluating assumption of normality for continuous variables.

Of the 238 participants who enrolled in Project READY, 135 (56.7%) participants had incomplete data and were not included in the analysis. Participants were included in the analysis if they had data at timepoints 1, 2 and 3 for the variables of interest: substance use, consequences of use, and depression symptoms. The pattern of missingness was observed to be largely monotonic where once a variable was missed, the missingness continued across the later timepoints. Explanations for the high rate of attrition are largely due to the logistical limitations of the school setting in which data was collected as well as characteristics of the population

involved in the intervention. Participants had high rates of school suspension and truancy. In addition, the intervention was often interrupted by school breaks such as summer vacation. There were no significant differences in substance use at Time 1,  $F(1, 234) = 0.311, p = 0.578$ , substance use at Time 2,  $F(1, 182) = 1.193, p = 0.276$ , substance use consequences at Time 1,  $F(1, 237) = 0.657, p = 0.419$ , substance use consequences at Time 3,  $F(1, 125) = 1.617, p = 0.206$ , or Time 1 depressive symptoms,  $F(1, 237) = 0.218, p = 0.641$ , between those participants who remained in the study and those who dropped out. Although there were no significant differences at Time 1 between those who remained in the intervention and those who dropped out, we chose not to attempt to impute missing data that was a result of treatment dropout because we cannot assume that were other factors related to dropout that were not observed and could impact the analysis of the current study. Three cases were missing data on alcohol quantity and frequency at Time 2. Data for alcohol use was imputed for these cases from their Time 1 data as a conservative estimate. Two cases were missing a single item on the Time 1 CES-D. A person-mean imputation was used to substitute the missing values. The total sample size included in the analyses was 103.

Data was examined for outliers using standardized scores and box plots for each continuous measure. There were few extreme cases identified among the alcohol use variable for Time 1 and 2 but these were determined to be acceptable due to the clinical nature of the sample and the feasibility of the rate of alcohol use reported. Next, the assumptions of normality were assessed including normality, linearity, homoscedasticity, independence and the absence of multicollinearity. Values of skewness and kurtosis indicated that several variables were positively skewed. These included alcohol use at Time 1, alcohol use at Time 2, marijuana use at Time 2, alcohol consequences at Time 1, alcohol use consequences at Time 3, and marijuana use

consequences at Time 3. Several variables were also kurtotic including alcohol use at Time 1, marijuana use at Time 1, alcohol use at Time 2, and marijuana use consequences at Time 3.

Although the skewed and kurtotic values suggest a non-normal distribution of the data, variables were not transformed given the nature of the analyses proposed. The bootstrapping procedure does not assume a normal distribution. The assumption of homoscedasticity was assessed for by examining a scatter plot of the standardized predictor and residual values which appeared to meet this assumption. Multicollinearity was assessed by examining the Variance Inflation Factor which indicated that multicollinearity was not present in the current data. Independence was examined using the Durbin-Watson Test which indicated that this assumption was not violated.

### **Statistical Analyses**

**Preliminary analyses.** The first set of analyses were bivariate correlations between alcohol use at Time 1 and Time 2, marijuana use at Time 1 and Time 2, alcohol and marijuana use consequences at Time 1 and Time 3, and depression symptoms at Time 1 and Time 3. Most of the relationships among the variables were positive with variable strengths. Marijuana use at Time 1 and alcohol use at Time 2 had a slightly negative relationship with depression symptoms at Time 1 (see Table 3). Means and standard deviations for all variables were also examined (see Table 4). The range for the number of consequences endorsed at Time 1 was 0-86 for total substance use, 0-45 for alcohol consequences alone, and 0-48 for marijuana consequences alone.



Table 3

*Variable Correlations*

	Time 1 MJ Freq	Time 2 Alc QXF	Time 2 MJ Freq	Time 1 Alc Cons	Time 1 MJ Cons	Time 3 Alc Cons	Time 3 MJ Cons	Time 1 Dep Sx	Time 3 Dep Sx
Time 1 Alc QXF	.197**	.367**	.251**	.333**	.116	.233**	.135	.032	.074
Time 1 MJ Freq		.247**	.594**	.122	.316**	.145	.323**	-.020	.071
Time 2 Alc QXF			.319**	.182**	.045	.386**	.132	-.022	.130
Time 2 MJ Freq				.040	.172*	.155	.401*	.037	.046
Time 1 Alc Cons					.481**	.552**	.265**	.260**	.292**
Time 1 MJ Cons						.315**	.555*	.493**	.396**
Time 3 Alc Cons							.367**	.134	.217*
Time 3 MJ Cons								.333**	.362**
Time 1 Dep Sx									.724**

Note: \* p < .05 \*\* p < .01 \*\*\* p < .001.

Table 4

*Variable Means and Standard Deviations*

Variable	Description	M (SD)	Variable	Description	M (SD)
Time 1 Alc QXF	Alcohol quantity (drinks per day) multiplied by frequency (drinking days per month)	32.18 (63.12)	Time 2 Alc QXF	Alcohol quantity (drinks per day) multiplied by frequency (drinking days per month)	14.27 (34.07)
Time 1 MJ Freq	Marijuana frequency (days per month)	13.31 (10.48)	Time 2 MJ Freq	Marijuana frequency (days per month)	8.69 (9.97)
Time 1 Alc Cons	Number of consequences experienced due to alcohol use	14.79 (11.97)	Time 3 Alc Cons	Number of consequences experienced due to alcohol use	6.40 (8.46)
Time 1 MJ Cons	Number of consequences experienced due to marijuana use	22.00 (12.09)	Time 3 MJ Cons	Number of consequences experienced due to marijuana use	10.56 (10.45)
Time 1 Dep Sx	Depression symptoms total score	20.03 (9.88)	Time 3 Dep Sx	Depression symptoms total score	16.69 (9.89)

Table 5

*Frequency of Negative Consequences Endorsed by a Majority of the Sample at Time 1*

Item	Frequency	
	Marijuana	Alcohol
Craving or strong desire	82	61
Tried to cut down or quit using	79	44
Went to work/school under the influence	77	51
Had to use more to get desired effect	77	29
Break rules, miss curfew, or break the law	75	62
Use large quantities at parties	71	69
Used more than you thought you would	70	59
Tried to control use	69	45
Told by someone to stop or cut down	68	46
Neglected responsibilities	67	33
Noticed a change in personality	65	43
Not able to do homework or study	64	25
Trouble resisting using	63	41
Kept using when your promised self not to	62	30
Don't get the same effect from same amount	61	34
Change from very happy to very sad	57	42
Felt you were "hooked"	55	23
Kept using after you planned to stop	54	30
Missed days at school or work	53	18
Problem remembering what you had done	53	71
Spent a lot of time trying to get substance	53	26
Experienced nausea or vomiting	31	62
Had hangovers	17	58

Note: Percent of sample was not included because the sample size is close to 100, the percent is not meaningfully different from the frequency.

### **Main analyses.**

The effect of the substance use intervention, Project READY, on self-reported measures of substance use, substance use consequences, and depressive symptoms was determined by using an SPSS macro called MEMORE provided by Montoya and Hayes (2016). This is a syntax file which is used to estimate the total, direct, and indirect effects of  $X$  on  $Y$  through one or more mediators in a repeated measures design. Using the MEMORE macro we analyzed the strength

and significance of four sets of effects: specific indirect, the total indirect, the direct, and total. Bootstrap analysis, a nonparametric sampling procedure, was used to test the significance of the indirect effects with 5000 bootstrap samples. Indirect effects were declared to be statistically significant if the 95% bias-corrected bootstrap confidence interval for the parameter estimate did not contain zero.

In the MEMORE code there is no specification of the  $X$  variable. This is because the  $X$  variable is represented in the data by two repeated measurements of the mediators and dependent variable in the data file. In the current study,  $X$  is represented by the repeated measurements of substance use ( $M_1$ ), consequences of use ( $M_2$ ) and depression symptoms ( $Y$ ). These repeated measurements are longitudinally observed across the Project READY intervention so  $X$  can be thought of as the effect of the intervention on the mediator and dependent variable.

#### **Serial multiple mediation analyses.**

A serial mediation analysis was conducted to examine the degree to which changes in substance use and substance use consequences mediated the relationship between a substance use intervention on changes in depression symptoms. Three serial mediation analyses were conducted: one for total substance use (alcohol and marijuana use), one for alcohol use alone, and one for marijuana use alone. Alcohol and marijuana use were run separately given the conflicting literature on the relationship between marijuana use and depression symptoms (Arendt & Munk, 2004; White et al., 2001). For each serial mediation analysis, the first mediator entered was Time 1 and Time 2 substance use, the second mediator was Time 1 and Time 3 substance use consequences, and the dependent variable was Time 1 and Time 3 depression symptoms. See Tables 6-8 for path coefficients and 95% confidence intervals.

Four main hypotheses were examined. The first hypothesis, that the quantity and frequency of substance use will decrease from pre-treatment (Time 1) to post-treatment check-in (Time 2), was found to be significant. Results were significant for total substance use ( $B = -27.405$ ,  $CI95 = -39.125$  to  $-15.684$ ), alcohol use only ( $B = -23.017$ ,  $CI95 = -34.336$  to  $-11.697$ ), and marijuana use only ( $B = -4.563$ ,  $CI95 = -6.310$  to  $-2.816$ ). The second hypothesis, that the number of substance-related consequences will decrease from Time 1 to the fourth post-treatment check-in session (Time 3), was found to be significant. Results were significant for total substance use consequences ( $B = -18.166$ ,  $CI95 = -22.328$  to  $-14.004$ ), alcohol consequences only ( $B = -8.234$ ,  $CI95 = -10.524$  to  $-5.944$ ), and marijuana consequences only ( $B = -9.120$ ,  $CI95 = -11.513$  to  $-6.727$ ). The third hypothesis, that depression symptoms will decrease from Time 1 to Time 3, was also found to be significant ( $B = -2.426$ ,  $CI95 = -4.805$  to  $-0.0465$ ).

The fourth hypothesis, that a reduction in substance use and substance related consequences will predict reduction in depression symptoms at Time 3, was partially supported. When total substance use (alcohol and marijuana combined) was analyzed, the results suggest that 5.2% of the variance in depressive symptoms is accounted for by the variables in the model. There was a significant main effect of the intervention on the change in depression symptoms for total substance use ( $B = -2.426$ ,  $CI95 = -4.805$  to  $-0.0465$ ), alcohol use alone ( $B = -3.066$ ,  $CI95 = -5.247$  to  $-0.885$ ), and marijuana use alone ( $B = -2.544$ ,  $CI95 = -4.639$  to  $-0.448$ ). None of the specific indirect effects were significant for total substance use. However, when alcohol use and marijuana use were analyzed separately, marijuana use and related consequences appeared to play a role in the change in depression symptoms. In this analysis, 6.3% of the variance in depressive symptoms is accounted for by marijuana use and marijuana use consequences. Two of

the specific indirect effects were significant and were statistically different from each other (see Table 8). The effect of the intervention on depression symptoms through marijuana use consequences ( $B = -1.416$ ,  $CI95 = -3.083$  to  $-0.132$ ) was stronger than the indirect effect of the intervention through marijuana use through marijuana use consequences to depression symptoms ( $B = -0.262$ ,  $CI95 = -0.706$  to  $-0.015$ ). The associated pairwise contrast was  $B = -1.154$ ,  $CI95 = -2.657$  to  $-0.102$ . The total indirect effect was not statistically significant ( $B = -1.194$ ,  $CI95 = -2.873$  to  $0.195$ ), and the total effect ( $B = -3.738$ ,  $p < .001$ ) and direct effect ( $B = -2.544$ ,  $p = 0.0179$ ) of the intervention on depression symptoms remained significant. That is, the effect of the intervention on the change in depression symptoms had a statistically significant effect when it was both the only predictor of depression symptoms (i.e., total effect) and when marijuana use and marijuana use consequences were statistically controlled (i.e. the direct effect). Interpretation of the results suggests that a change in substance use consequences across the intervention led to a change in depression symptoms.

Table 6

*Direct, Indirect, and Total Effects of the Intervention on Depressive Symptoms through Total Substance Use (Alcohol and Marijuana use;  $M_1$ ) and Substance Use Consequences ( $M_2$ )*

Effect	B (unstandardized path coefficient and product)			SE	<i>p</i>	95% CI	
						Lower	Upper
INT → SU → DEP SYM	-27.405	X -.009 = .2466		.5578			
INT → SU → CON → DEP	-27.405 X .068 X .078 =	-.1454		.1905			
INT → CON → DEP SYM	-18.166	X .078 = -1.4169		.8462			
Total indirect effect		-1.3123		.9853			
Total effect of X on Y (c)		-3.7379		.7522	.000	-5.2298	-2.2459
Direct effect of X on Y (c')		-2.4256		1.1988	.046	-4.8046	-.0465

*Note.* INT = The effect of the intervention, Project READY; SU = total substance use (alcohol and marijuana use); CON = consequences of substance use; DEP SYM and DEP = depression symptoms. The significance of the indirect effects was calculated with bias-corrected confidence intervals (.95) bootstrap analysis.

Table 7

*Direct, Indirect, and Total Effects of the Intervention on Depressive Symptoms through Alcohol Use (M<sub>1</sub>) and Alcohol Use Consequences (M<sub>2</sub>)*

Effect	B (unstandardized path coefficient and product)				SE	p	95% CI		
							Lower	Upper	
INT → ALC → DEP SYM	-23.017	X -.004	= .0921		.4900		-1.0289	.9223	
INT → ALC → CON → DEP	-23.017	X .043	X .083	= -.0821	.1481		-.4655	.1171	
INT → CON → DEP SYM	-8.234	X .083	= -.6834		.7416		-2.2503	.6132	
Total indirect effect					-.6716	.9301	-2.6889	.9454	
Total effect of X on Y (c)					-3.7379	.7522	.000	-5.2298	-2.2459
Direct effect of X on Y (c')					-3.0663	1.0990	.006	-5.2472	-.8854

*Note.* INT = The effect of the intervention, Project READY; ALC = alcohol use; CON = consequences of alcohol use; DEP SYM and DEP = depression symptoms. The significance of the indirect effects was calculated with bias-corrected confidence intervals (.95) bootstrap analysis.

Table 8

*Direct, Indirect, and Total Effects of the Intervention on Depressive Symptoms through Marijuana Use (M<sub>1</sub>) and Marijuana Use Consequences (M<sub>2</sub>)*

Effect	B (unstandardized path coefficient and product)				SE	p	95% CI		
							Lower	Upper	
INT → MAR → DEP SYM	-4.5631	X -.106	= .4837		.4252		-.2742	1.4065	
INT → MAR → CON → DEP	-4.5631	X .370	X .155	= -.2617	.1810		-.7197	-.0119	
INT → CON → DEP SYM	-9.1198	X .155	= -1.4136		.7631		-3.0637	-.1109	
Total indirect effect					-1.1941	.7948	-2.8702	.2355	
Total effect of X on Y (c)					-3.7379	.7522	.000	-5.2298	-2.2459
Direct effect of X on Y (c')					-2.5437	1.0559	.018	-4.6392	-.4483

*Note.* INT = The effect of the intervention, Project READY; MAR = marijuana use; CON = consequences of marijuana use; DEP SYM and DEP = depression symptoms. The significance of the indirect effects was calculated with bias-corrected confidence intervals (.95) bootstrap analysis.

## **Chapter IV: Discussion**

This study tested the effect of a brief substance use intervention on co-occurring substance use and depressive symptoms in adolescents. The following hypotheses were tested in this study: (1) the quantity and frequency of substance use will decrease from pre-treatment (Time 1) to post-treatment check-in (Time 2), (2) the number of substance-related consequences will decrease from Time 1 to the fourth post-treatment check-in session (Time 3), (3) depression symptoms will decrease from Time 1 to Time 3, and (4) a reduction in substance use and substance related consequences will predict reduction in depression symptoms at Time 3. The results of this study supported hypotheses 1, 2, 3, and partially 4. Additionally, the results showed an effect of the intervention, Project READY, on overall depression symptoms. In regards to hypothesis 4, only the change in consequences predicted a change in depression symptoms from Time 1 to Time 3 for marijuana use only. Hypothesis 4 was not supported for total substance use or alcohol use alone.

### **Interpretation of Results**

The decrease of substance use and consequences of use across the Project READY intervention supports the effectiveness of using school-based MI interventions for adolescents. The current study adds to the existing literature that supports the efficacy of MI interventions for decreasing substance use and negative consequences in adolescents (Tevyaw & Monti, 2004). This study also adds to the existing literature, which often discusses alcohol use, by supporting the effectiveness of MI interventions for marijuana use. Furthermore, most studies examining the relationship between substance use and mood rely on retrospective reporting (Degenhardt, Hall, & Lynskey, 2003). This study is unique in that it examines the impact of substance use changes on mood after four weeks rather than several years. The findings showed that depression

symptoms significantly decreased in the weeks following the Project READY intervention, supporting the third hypothesis.

The results of this study highlight important factors that play a role in the change in depression symptoms for adolescents who enrolled in a substance use intervention. The data shows that both the serial mediated model for marijuana and the indirect effect of change in marijuana use consequences were significant. The results can be interpreted in the context of the cognitive diathesis-stress theory of depression as well as the emotional cascades model. The adolescents in this study experienced a range of different consequences related to their use, presented in Table 5. The consequences of use can be thought of as the “negative events” that are generally described in the cognitive diathesis-stress theory which precipitate depression. As the participants engaged in Project READY, the frequency of substance use decreased as well as the consequences of use. With less consequences, there is less stress and fewer events that can be interpreted in such a way that contribute to depression symptoms. Examples of frequently endorsed consequences of substance use in this sample are “going to work/school under the influence”, “breaking rules, missing curfew, or breaking the law”, “neglecting responsibilities”, and “told by someone to stop or cut down”. The negative consequences of substance use can also be thought of as events that may serve as the content of rumination. If adolescents have lots of consequences in their life related to their use they may experience high levels of rumination about these consequences which amplifies negative affect. For example, if an adolescent is being told by their friends that they use marijuana too much they may ruminate about this experience if their friendships are very important to them. This then leads to the rapidly escalating and aversive state that results in the impulsive behavior of using the substance in order to distract from the emotional cascade (Selby et al., 2016).



The results of this study suggest that there are differential relations with alcohol use and marijuana use in the hypothesized model. When three separate models were run examining total substance use (alcohol and marijuana use combined), alcohol use, and marijuana use, only the model examining marijuana use showed a significant indirect effect of changes in use and consequences on depression symptoms. Differences between alcohol and marijuana use have been observed in several studies examining the processes of substance use motivations and outcomes. The use of daytime adaptive emotion regulation strategies has been associated with a lower likelihood of evening marijuana use but not heavy drinking in a sample of college students (Weiss, Bold, Sullivan, Armeli, & Tennen, 2017). Stein, Lebeau, Colby, Barnett, Golembeske, & Monti (2011) found that a Motivational Interviewing-based intervention was more effective at reducing alcohol compared to marijuana for adolescents with high depressive symptoms, whereas greater marijuana reductions were observed in adolescents with low levels of depressive symptoms. The results of the current study similarly suggest that alcohol and marijuana use may differ in the way they function as tools for affect regulation. It's possible that among our sample, marijuana is more likely to be used to cope with negative affect which, as suggested by the emotional cascades model, would be followed by consequences that leads to increasing negative affect.

Although there were statistical differences between alcohol use and marijuana use in the analyses, it is important to be cautious with the conclusions made about the unique effect of each substance type due to the fact that many of the participants were using both alcohol and marijuana. See Table 1 for frequency of demographic variables separated by participants who used alcohol only, marijuana only, or alcohol and marijuana users. The use of at least two different psychoactive substances in a defined period of time, either simultaneously or

separately, is broadly known as polysubstance use (Connor, Gullo, White, & Kelly, 2014). The number of potential variations of patterns of polysubstance use makes it extremely difficult to determine the unique effect of one of the substances used. The impact of using alcohol and marijuana within several minutes or hours of each other may be different than the impact of using these substances several days or weeks apart from one another. Participants in this study were not asked to estimate the frequency in which they used alcohol and marijuana simultaneously or the length of time between the use of each substance. There are relatively few studies that examine polysubstance use and particularly among adolescents. Conway et al. (2013) found a four-class solution among a nationally representative sample of adolescents in the United States. The four classes consisted of nonusers, predominant alcohol users, predominant marijuana users, and a predominant polysubstance user group. The predominant polysubstance users had significantly higher levels of depressive symptoms compared to all other classes and the predominant alcohol users did not significantly differ from the predominant marijuana users in depressive symptoms (Conway et al., 2013). Consistent with these results, participants in this study, which consisted of predominant polysubstance users, had an average CES-D total score at Time 1 that indicates a clinical level of depression symptoms. However, the group of marijuana only users also exhibited a clinical level of depression symptoms and the alcohol only users did not (Table 1). The MEMORE macro does not allow for covariates to be entered so we were not able to test if the serial mediation would have remained significant after accounting for alcohol use. However, the non-significant correlations of alcohol and marijuana use with the consequences of the other substance indicate consequences are specific by substance. The consequences of marijuana use appear to have a greater impact on co-occurring depression

symptoms than the consequences of alcohol use among adolescents who are using both substances.

It is important to consider the social context of marijuana use in this sample as well. Participants were recruited from high schools in the greater Seattle area. Washington state legalized the recreational use of marijuana in 2012 and this change in policy may reflect greater approval of marijuana use in this geographic area. There is evidence supporting a substantial relationship between public opinion and policy decisions (Nielsen, 2010). Cerdá, Wall, Keyes, Galea, and Hasin (2012) found that states that legalized marijuana use for medical purposes have significantly higher rates of marijuana use and of marijuana abuse and dependence. The authors propose that a potential underlying mechanism for the higher rates of marijuana use and dependence may be that community norms are more supportive of marijuana use. Several studies indicate that the perception of more approving norms is associated with greater adolescent marijuana use (Beyers, Toumbourou, Catalano, Arthur, & Hawkins, 2004; Botvin, Griffin, Diaz, & Ifill-Williams, 2001). The high rates of marijuana use observed in this study could be explained by internalized beliefs about peer and group norms which influence the decision to engage in marijuana use. Although the recreational use of marijuana is legal in Washington, the use of marijuana for those under the age of 21 remains illegal so adolescents who choose to use marijuana will continue to experience consequences for their use because policies towards marijuana use for their age group have not changed. Much of the literature examining substance use as a form of coping with negative affect looks at alcohol use specifically. The present study indicates the importance of examining other substances used for coping such as marijuana. As national trends observe increasingly permissive attitudes about marijuana use among adolescents

(Schmidt, Jacobs, & Spetz, 2016), it is incumbent upon researchers to consider how marijuana use and consequences of its use impact co-occurring depression.

### **Clinical Implications**

This study has important implications for the treatment of adolescents who are using substances and have co-occurring depression symptoms. The significant effect of the intervention on depression symptoms through changes in substance use and consequences of use indicates that treatments targeting substance use are effective at decreasing co-occurring depression symptoms. Reducing substance use helps to reduce the consequences of use which then improves depression symptoms. These results also support the clinical utility of addressing substance use in order to interrupt the process of emotional cascades leading to impulsive substance use in adolescents. The significance of the role of consequence reduction in predicting changes in depression symptoms indicates that the consideration of consequences in treatment approaches for substance use will be beneficial for reducing co-occurring depression symptomology.

A harm reduction approach to substance use intervention is very much aligned with the results of this study. A harm reduction approach suggests that substance use can be categorized along a spectrum of experiences related to use. This spectrum ranges from beneficial to problematic experiences. Using a harm reduction approach in the context of the results of this study, it is likely that reducing marijuana use to the point of reducing the negative events or consequences related to use would ameliorate depression symptoms. Project READY fits the tenants of a harm reduction approach in that the MI-based style and activities embraces incremental change in substance use rather than emphasis on abstinence. The assessment feedback session of the Project READY intervention addresses perceived norms by providing

information about how the participant's frequency of drug use differs from the national average among adolescents. Furthermore, this intervention emphasizes collaboration and meeting the client where they are at related to motivation for making changes in substance use. In the context of the Emotional Cascade Model, the elicitation and self-reflection of important consequences of substance use may help adolescents more effectively choose how they would like to respond to an emotional cascade. It may also be that Project READY allows an avenue for adolescents to think about the consequences of their substance use in a reflective rather than ruminative manner, which may affect the experience of emotional cascades.

This study provides a meaningful contribution to research examining the treatment of co-occurring disorders. Of note, participants in this study were not recruited based on depression symptom endorsement and the intervention was not designed to target depression yet decreases in depression symptoms were observed across treatment. This is clinically relevant in that it suggests separate treatments approaches for co-occurring disorders, known as sequential or parallel treatment, is not necessary to see improvements in both disorders. The results of the study indicate that MI-based interventions may be effective at treating co-occurring depression symptoms. More research is needed to determine if there is a unique effect of MI-based interventions that contributes to a decrease in co-occurring depression symptoms or if other treatment approaches would show a similar effect.

### **Limitations**

There are several limitations of the current study to consider when interpreting the findings. First, this study did not include a control condition of participants who did not receive the intervention. Therefore, it is difficult to determine if the effects were due to the intervention itself or if they would have occurred naturally. However, a previous study examining the

effectiveness of Project Ready indicates that, compared to a waitlist-control group, participants in Project READY had significantly greater decreases in substance use and related consequences (Stewart et al., 2016). These previous findings suggest that Project READY produces changes above and beyond those that would occur naturally.

Second, the variables were measured over a relatively small time period, eight weeks. Although this study adds to the literature examining short-term effects of alcohol and marijuana use on mood, the results of this study cannot be extended to long-term effects of these substances. Additionally, the consequences variable was measured as a total count of the number of consequences endorsed. Therefore, the effect of specific consequences (e.g. causing difficulties in relationships) on depression symptoms were not examined. The substance use literature to date does not examine consequences of substance use in a similar way as this study. Consequences are often examined singularly such as examining drinking and driving on its own. Although it is clinically useful to enhance our understanding of the impact of substance use related consequences, it is difficult to make comparisons with the current substance use literature. It is also difficult to make conclusions about the impact of consequences because, as a construct, there are likely many additional processes that contribute to consequence outcomes of substance use.

Lastly, interpretations of the results of the current study includes consideration of the context of the characteristics of the sample. Participants do not represent the general population. Rather, participants were recruited from a specific region, the Pacific Northwest. Participants' rate of marijuana and alcohol use may reflect the region's beliefs or norms related to the approval of using these substances. Therefore, the results cannot be generalized to adolescents in the general population.

## **Future Studies**

The results of the current study highlight important areas for future research. Future studies should aim to examine substance use, consequences of use, and depression changes over a longer period of time (e.g. one year) in order to better our understanding of how changes in these variables affect each other over time. This is particularly important when considering the reciprocal interaction between co-occurring disorders as well as the high rates of relapse of either disorder (Torrens, Rossi, Martinez-Riera, Martinez-Sanvisens, & Bulbena, 2012). Future studies should also consider using a control or waitlist-control condition in order to determine if the changes in depression symptoms observed in this study would occur naturally without intervention. It will be important to determine the mechanisms of change that motivational enhancement interventions may have for co-occurring depression symptoms as well.

The unique role of substance use consequences in the current study suggests that future research should further investigate this variable. Future studies should examine which types of consequences are most closely associated with depression symptoms and examine how reductions of specific consequences contributes to changes in depression symptoms. For example, if school related consequences, such as suspension, are the greatest contributor to depression symptoms then school systems may use this information to inform their policies about substance use behavior discipline. Studies that are able to tease apart the effects of specific consequences on mood would inform treatment and policy recommendations. Furthermore, there is a need for further research to better understand the use of marijuana as a way to cope with negative affect. Overall, improvements in the treatment of co-occurring substance use and depression may progress with the continued development of motivational enhancement interventions.

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