**Patterns of Anxiety, Stress, and Substance
Use during Adolescence**

BY

PETER J. COLVIN

B.A., Wesleyan University, 2007

M.A., University of Illinois at Chicago, 2009

THESIS

Submitted as partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Psychology
in the Graduate College of the
University of Illinois at Chicago, 2013

Chicago, Illinois

Defense Committee:

       Robin Mermelstein, Chair and Advisor
       Evelyn Behar
       Raul Gonzales, Florida International University
       Ellen Herbener
       Jon Kassel

DEDICATION

This thesis is dedicated to the many mentors, colleagues, and friends who have challenged and inspired me to be my best.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AADIS   Adolescent Alcohol and Drug Involvement Scale

ANOVA   Analysis of variance

CDC   Centers for Disease Control

DF   Degrees of Freedom

M   Mean

MASQ   Mood and Anxiety Symptom Questionnaire

ML   Maximum Likelihood Estimation

N   Number in total group

n   Number in subgroup

PSS   Perceived Stress Scale

r   Pearson Product-Moment Correlations

SAS   Statistical Analysis System

SD   Standard Deviation

USDHHS   United States Department of Health and Human Services

SUMMARY

Adolescence is a critical period of vulnerability for the initiation, increase, and regular use of substances. The multiple life-changes and transitions that converge during adolescence such as the onset of puberty, school transitions, and emerging romantic relationships, make adolescence a developmentally vulnerable period for increased levels of anxiety. Within the self-medication model of substance use, drugs serve a coping function whereby they help regulate heightened emotions. The goal of the current study ($N = 1263$) was to investigate the complex relationship between type of substance use (cannabis, alcohol, and cigarettes), level of substance use (non-user and regular user), and anxiety (somatic anxiety and perceived stress) over time in an adolescent population. This study examined independent and joint contributions of anxiety and stress in predicting three different kinds of adolescent drug use over two years. It was hypothesized that higher levels of baseline anxiety would predict higher levels of substance use two years later. Results showed that while somatic anxiety and perceived stress independently predicted higher levels of cannabis and cigarette use, only perceived stress predicted future cannabis and cigarette use when examined together. However, neither perceived stress nor somatic anxiety predicted future alcohol use. Our second goal was to investigate baseline levels and changes in anxiety and stress over time as a function of the three different kinds of adolescent drug use and level of substance use groups (adolescents who did not use substances at any time point versus adolescents who used substances at each of the time points). The study used hierarchical linear modeling to test the hypothesis that regular users would show higher levels of baseline anxiety than non-users for all substances. Additionally, it was hypothesized that over a two-year period, regular users would decrease anxiety faster than non-users for each substance. Results were complex and varied depending upon level of substance

SUMMARY (Continued)

use, type of substance use, and type of anxiety examined. Overall, results showed that for all adolescents, both somatic anxiety and perceived stress decreased over time. Adolescents who smoked cigarettes and marijuana across all time points showed higher levels of baseline perceived stress and somatic anxiety than non-users. Contrary to the self-medication model and hypotheses, perceived stress decreased at the same rate for all three substances and all levels of use. However, the differences in perceived stress at baseline and changes over time are unlikely to be clinically significant given the small statistical estimates. This suggests that adolescents who are using substances regularly do not have higher perceptions of stress than individuals who are not using substances at all and that ultimately, perceived stress may actually be quite stable over time. Somatic anxiety had a markedly different relationship to cannabis and cigarette use than perceived stress. The bodily sensation of anxiety was heightened at baseline for any adolescents who were smoking cigarettes or cannabis regularly. Additionally, somatic anxiety decreased over time at a faster rate for individuals who were smoking cigarettes and cannabis regularly, suggesting that the anxiolytic effects of cannabis and cigarettes may be effective at decreasing some aspects of anxiety. Level of alcohol use did not influence the perception of stress an adolescent experienced at baseline but regular alcohol drinkers did show higher baseline somatic anxiety than non-users. However, regular drinking did not affect the decrease of the perception of stress nor somatic anxiety over time. Potential explanations for the findings, study limitations, and suggestions for future research are discussed.

1. INTRODUCTION

1.1. Project Overview and Significance

The majority of adults who are addicted to substances started using substances at or prior to the age of 18 (USDHHS, 2004). In 2010, the annual prevalence of use by persons under age 18 of using any illicit drug was 38% of 12th graders and 30% of 10th graders (Johnston, O'Malley, Bachman, & Schulenberg, 2011). Adolescence is a critical period of vulnerability for the initiation of substance use, for increases in substance use, and for the development of substance-use problems. Adolescent substance use is related to increased mental health problems, violence, addiction, and other long-term health risks (Durant, Altman, Wolfson, Barkin, Kreiter, & Krowchuk, 2000; Fryar, Merino, Hirsch, & Porter, 2009; Miller, Naimi, Brewer, & Jones, 2007; Munafò, Hitsman, Rende, Metcalfe, & Niaura, 2008).

Adolescence is a uniquely labile period biologically, cognitively, emotionally, and socially (Cicchetti & Rogosch, 2002). The multiple life-changes and transitions that converge during adolescence (e.g., onset of puberty, school transitions, emerging romantic relationships; Cicchetti & Rogosch, 2002) place increasing pressure on adolescents. As a result, adolescents experience increased levels of anxiety (Larson, Moneta, Richards, & Wilson, 2002), which may put them at risk for increased substance use. Data from the National Comorbidity Survey show that 15- to 24-year-olds have the highest risk of comorbid anxiety and substance use compared with other age groups (Kessler et al., 1994). Comorbidity of anxiety and substance use is particularly common and has been linked to various detrimental outcomes (Swendsen et al., 2009). Understanding fully the co-occurrence of anxiety and substance use, thus, has important implications for prevention and intervention programs, as well as for understanding the overall pattern of adolescent mental health. Although prior research has documented a positive overall association between anxiety and

substance use, there is a need for longitudinal research that investigates this relationship throughout development.

Internal emotional-regulation processes have received a lot attention in the literature as one factor in adolescent substance use. Mounting evidence collectively suggests that individuals use drugs, in part, to regulate affective experience (e.g., tension reduction, mood enhancement). Findings from this body of research suggest that negative emotionality is related to the initiation and progression of substance use (e.g., Novak & Clayton, 2001; Simons & Carey, 2002; Wills, Walker, Mendoza, & Ainette, 2006). Specifically, anxiety has been shown to relate to adolescent alcohol use (Kaplow, Curran, Angold, & Costello, 2001; Swendsen, Merikangas, Canino, Kessler, Rubio-Stipec, & Angst, 1998; Zimmermann, Wittchen, Fler, Pfister, Kessler, & Lieb, 2003), cigarette use (Johnson, Cohen, Pine, Klein, Kasen, & Brook, 2000; Patton, Carlin, Coffey, Wolfe, Hibbert, & Bowes, 1988), and cannabis use (Buckner, Schmidt, Lang, Small, Schlauch, & Lewinsohn, 2008; Comeau, Stewart, & Loba, 2001; Penning & Barnes, 1982). However, there is less understanding of the reciprocal relationship between anxiety and substance use.

Many previous studies have utilized diagnosed anxiety disorders rather than measures of anxiety symptomatology. The use of continuous measures of anxiety symptomatology could help to target a significant proportion of the adolescent population that has often been overlooked through the use of more stringent diagnostic criteria (Angold, Costello, Farmer, Burns, & Erkanli, 1999). Examining aspects of anxiety symptoms and the perception of stress may help increase our understanding of their respective relations to substance use (Hussong & Chassin, 1994): that is, specific types of anxiety and beliefs about stress may have different relationships to substance use. This will be especially useful for consolidating the findings of multiple definitions of anxiety and use of anxiety constructs in the literature. For example, symptoms of somatic anxiety and

perceived stress have each been found to positively correlate with adolescent substance use (Comeau, Stewart, & Loba, 200; Kaplow et al., 2001; Bonn-Miller, Zvolensky, & Bernstein, 2007). However, it is unknown how the different aspects of anxiety influence adolescent substance use together.

The most commonly used substances during adolescence are alcohol, marijuana, and cigarettes (Johnson, O'Malley, Bachman, & Schulenberg, 2013). An important issue in the investigation of the dimensions of comorbidity between anxiety and substance use is that the relationships may vary for different types of substances. While the use of cigarettes, alcohol, and marijuana and other illicit drugs is commonly correlated with anxiety for adolescents (Kandel, 1982), the physiological effects of the substances and the social context in which they are used may differ (American Psychiatric Association, 2000). It is therefore useful to examine the relationship between anxiety and substance use separately for alcohol, marijuana, and cigarettes.

A developmental model of substance use can shed light on the relationship between adolescent substance use and anxiety. By using the heuristics of substance-use categories (i.e., non-user, regular user), we can better understand the use-specific relationships between anxiety and substance use that fall outside the overall average trajectories (Hussong et al., 2001; Jackson & Sher, 2003; Jackson, Sher, & Wood, 2000). That is, an adolescent trying marijuana for the first time and a regular marijuana smoker may have unique starting levels of anxiety and different changes in anxiety over time, despite quantity, duration, and substance choice being identical. Non-users, initiating substance use, and regular use are common categories in the substance use literature (e.g., Byrne, Byrne, & Reinhart, 1995; Munafo, Zetteler, & Clark, 2007).

Theory and research suggest that anxiety in adolescence is positively correlated to smoking, drinking, and cannabis use. Understanding factors that predict the use of adolescent

substance use can inform early prevention strategies and intervention programs, as well as advance our overall understanding of adolescent health. The current study will focus on the role of anxiety in the development of substance use among adolescents considering cigarette smoking, alcohol use, and cannabis use.

Several dimensions of the relationship between anxiety and substance use through adolescence should be investigated. The relationship between levels of anxiety and substance use is the most commonly studied dimension of the relationship between these variables. A second dimension is the association between changes in the two variables across adolescent development. Such an association provides evidence that anxiety and substance use are developmentally intertwined and supports developmental interventions that focus either on preventing the emergence of anxiety in adolescence by lessening escalation of substance use or on dampening increases in substance use by lessening the development of anxiety. A third dimension of the relationship between anxiety symptoms and substance use stems from the heuristic of substance-use categories. It is possible for both anxiety and substance use to have use-specific relationships (i.e., users, non-users) that fall outside the overall average trajectories (Hussong, Hicks, Levy, & Curran, 2001; Jackson & Sher, 2003; Jackson, Sher, & Wood, 2000). That is, an adolescent trying marijuana for the first time and a regular marijuana smoker may have unique starting levels of anxiety and changes in anxiety over time despite substance quantity, duration of use, and substance choice being identical at a given time point. For example, within the self-medication model, an adolescent regularly using cannabis may have higher levels of anxiety than a non-user. However, over time and continued use, the anxiety would be "regulated" and expected to equal that of the non-user user. Unique to the extant literature, the similarities and differences with regard to anxiety type and several substances over time will be explored.

The goal of this study is to investigate the complex relationship between type of substance use (cannabis, alcohol, and cigarettes), level of substance use (non-user, regular user), and anxiety (somatic anxiety and perceived stress) over time in an adolescent population. We employed several continuous measures of anxiety that capture somatic symptoms and perceived stress. We examined a time span through adolescence when use of substances becomes common and increases (Johnson et al., 2013) and when diagnosed anxiety becomes prevalent (Kaplow, Curran, Angold, & Costello, 2001). Within each substance use category non-users and regular users will be defined the same way to increase direct comparisons. Non-users are defined as any adolescents who did not use over the course of the two-year study. This may include individuals who previously tried substances but did not use during our study. Regular users are defined as adolescents who use at every time point of our study. This will limit the individuals who try a drug or experiment and then stop using, thus maximizing the ability to test the self-medication model.

The current study goes beyond prior work in several ways. First, this study assessed several conceptual views of anxiety (anxious arousal and perceived stress) to allow for a more thorough understanding of the role of anxiety in substance use. Second, we used continuous measures of anxiety symptomatology to target a significant proportion of the adolescent population that has often been overlooked due to the traditional use of more stringent diagnostic criteria such as anxiety disorders (Angold et al., 1999). Third, we used multiple substances (cigarette, alcohol, and cannabis use) from the same cohort to allow direct comparisons among the differential effects on anxiety. Fourth, this study examined the dynamic reciprocal relationship of the proposed variables over time. Finally, we used several categories of drug use (non-user, regular user) to increase the understanding of how adolescent anxiety changes as function of regular substance-use beyond overall average trajectories.

Our premise is that the overall relationship between anxiety and use can be parsed into hypothesized positive associations in concurrent level, concurrent change, and type of use, as well as reciprocal predictive associations. It was expected that higher levels of baseline anxiety would predict higher levels of future substance use. Reciprocally, it was expected that regular users would have both higher levels of initial anxiety and faster decreases in anxiety over time than non-users (i.e., steeper slope). We expect these findings to generalize across substances and anxiety type.

2. CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

2.1 Problems of Use Examined

2.1.1 Cigarette Use

Tobacco use is the leading preventable cause of premature death in the United States, accounting for approximately 438,000 deaths each year (CDC, 2005a). Although rates of smoking have decreased in the past decade, the rate of decline has slowed in recent years (CDC, 2005b), and smoking remains a major public health concern. The majority of adults who are addicted to cigarette smoking started smoking at or prior to the age of 18 (USDHHS, 1994), making adolescence a crucial developmental period with regard to which smoking-related behaviors should be examined. Recent national data show that 42% of U.S. high school students try smoking by senior year; 12.2% of 12th and 7.6% of 10th graders smoke daily, and 5.9% of seniors and 3.3% of 10th graders smoke a minimum of a half pack of cigarettes per day (Johnson, O'Malley, Bachman, & Schulenberg, 2011a).

Smoking causes a wide range of diseases, including many types of cancer, chronic obstructive pulmonary disease, coronary heart disease, stroke, peripheral vascular disease, and peptic ulcer disease (Fagerstrom, 2002; McBride, 1992). Among smokers, rates of cancer of the cervix, pancreas, bladder, kidney, stomach, and hematopoietic tissue are increased 50% to 200% over rates in nonsmokers (Newcomb & Carbone, 1992). In addition, smoking during pregnancy adversely affects fetal and neonatal growth and development.

2.1.2 Alcohol Use

Alcohol use remains extremely widespread among today's adolescents. Johnston and colleagues' Monitoring the Future study (2011) shows that, despite recent declining rates, nearly three quarters of students (71%) have consumed alcohol ("more than just a few sips") by the end of

7

high school, and more than one third (36%) have done so by 8th grade; more than half (54%) of 12th graders and one sixth (16%) of 8th graders in 2010 report having been drunk at least once in their life.

Rates of alcohol use among adolescents are problematic across all social strata. In a comparison of three national surveys with data on adolescent drug use (the Monitoring the Future study, the National Household Survey on Drug Abuse, and the Youth Risk Behavior Survey), O'Malley, Johnston, and Bachman (1998) found extremely small differences among sociodemographic subgroups. These subgroups were defined by geographical region, population density, parental education, and family structure. These findings imply that the prevalence of alcohol use among adolescents is a widespread problem that affects all sociodemographic groups similarly.

Adolescent drinking is associated with serious psychological and physiological risks (Bonomo et al., 2001). Heavy alcohol use has been shown to lead to liver disease and other psychiatric disorders, such as depression, anxiety, and antisocial personality disorder (Naimi et al., 2003). Alcohol use has also been shown to have a connection to tobacco use in adolescents. Johnson, Boles, Vaughan, and Klever (2000) found that adolescents who were categorized as binge drinkers were significantly more likely to engage in tobacco use. Alcohol use at younger ages has been shown to serve as a "gateway drug" (King & Chassin, 1997), which puts adolescents at higher risk later for use of illegal drugs such as LSD, cocaine, amphetamines, and heroin (Johnson et al., 2005b). Alcohol use in adolescents has been shown to be associated with the top three leading causes of death among adolescents: unintentional injuries, homicide, and suicide (Anderson & Smith, 2003). Additionally, according to Cooper, Peirce, and Farmer-Huselind (1994), alcohol use in adolescence has been shown to lead to higher rates of risky sexual activity.

Finally, alcohol use is associated with higher rates of suicide (Reifman & Windle, 1995) and driving while under the influence of alcohol (CDC, 2003).

2.1.3 Cannabis Use

Adolescent cannabis use is on the rise (Johnson et al., 2011). Johnston and colleagues' Monitoring the Future (2011b) shows that nearly half of students (44%) have tried cannabis by the end of high school and that nearly one in five students (17%) have done so by 8th grade. Additionally, daily cannabis use is on the rise, with 6% of 12th graders and 1% of 8th graders engaging in use; this does not account for high school dropouts who report a much larger daily use. Moreover, recent research has indicated increased rates of cannabis abuse and dependence among young adults (Compton, Grant, Colliver, Glantz, & Stinson, 2004). These data are alarming from a public health perspective, as regular and heavy users of cannabis are at increased risk for a variety of problems including, but not limited to, medical illness (e.g., chronic bronchitis; Bloom, Kaltenborn, Paoletti, Camilli, & Lebowitz, 1987), risk-taking behavior (e.g., unprotected sexual intercourse; McDonald, Schleifer, Richards, & de Wit, 2003), and interpersonal impairment (Stephens, Roffman, & Simpson, 1993).

2.2 Definitional Issues: Negative Emotions and Anxiety

Negative affect has been shown to be a major risk factor for adolescent substance use and abuse. Nonspecific negative affect has been linked to cigarette, alcohol, and cannabis use (Brown, Lewinsohn, Seeley, & Wagner, 1996; Chassin, Pillow, Curran, Molina, & Barrera, 1993; Windle and Windle 2001; Buckner et al., 2008; Comeau et al., 2001; Penning & Barnes, 1982). However, several theories regarding emotions propose that emotional states are not meaningfully reducible to a smaller set of common, nonspecific dimensions (e.g., Ekman, 1984; Kassel, Stroud, & Paronis,

2003; Oatley & Jenkins 1992) and need to be expanded to include a wider range of emotional, physical, and cognitive experiences. While anxiety includes aspects of negative emotionality, Watson, Clark, and Carey (1988) make the distinction that anxiety also includes heightened levels of arousal, hostility, anger, neuroticism, physical complaints, and irrational beliefs. As such, it is useful to examine predictors beyond a two-dimensional definition of negative emotionality (i.e., negative and positive). Indeed, Johnson, Bonn-Miller, Leyro, and Zvolensky, (2009) found that anxious arousal symptoms, but not negative affect (a trait shared by depression and anxiety), were significantly and uniquely related to the frequency of cannabis use in young adults.

Many studies use diagnosed anxiety disorders instead of more specific measures of anxiety symptomatology. For example, generalized anxiety disorder was associated with the progression from a first drink to alcohol dependence (Sartor et al., 2006) in a sample of older adolescents. However, the use of continuous measures of anxiety symptomatology could help to target a significant proportion of the adolescent population that has often been overlooked through the use of more stringent diagnostic criteria (Angold et al., 1999). Examining aspects of anxiety symptoms may help increase our understanding of their respective relations to substance use (Hussong & Chassin, 1994): that is, specific types of anxiety may have differential relationships to substance use, especially given the wide range of definitions of anxiety and the use of anxiety constructs in the literature. For example, symptoms of somatic anxiety and perceived stress were found to positively correlate with adolescent substance use (Comeau et al., 2001; Kaplow et al., 2001; Bonn-Miller, Zvolensky, & Bernstein, 2007); it is unknown whether different aspects of anxiety vary in predictive power.

Examining several definitions of anxiety within one study may allow for a greater understanding of the relative contribution of alternative anxiety constructs to drug use outcomes.

The two anxiety conceptualizations this study will examine are consistent with Watson, Clark, and Carey's (1988) definitions of anxiety and include somatic anxiety and perceived stress. Somatic anxiety symptoms are defined as level of anxious arousal (i.e., somatic tension and hyperarousal). Perceived stress is the degree of the subjective sense of feeling out of control, overwhelmed, and unable to cope (Cohen, Kamarck, & Mermelstein, 1983). Perceived stress captures the cognitive and subjective nature of interpreting stressful events, no matter how insignificant they might seem to outsiders.

2.3   Theoretical Relationship Between Anxiety and Drug Use

The stress-coping (Wills & Shiffman, 1985), self-medication (Khantzian, 1997), tension reduction (Greeley & Oei, 1999), and stress-response-dampening (Sher & Levenson, 1982) models of substance use are prominent in the adolescent-drug-use literature. These models maintain that drugs serve a coping function whereby they help regulate emotion. A common theme across these models of substance use is that adolescents with a limited ability to self-regulate emotions choose to use drugs as a means for coping with, and controlling, distress and heightened affective states (Kassel et al., 2003). Alcohol, for example, has been viewed as addictive because of its tension reduction (Cappell & Greeley, 1987) or stress-response-dampening (Sher, 1987) effect. Because alcohol's effects on stress and tension are immediate and often more effective in handling stressful events than other, more adaptive, coping responses, alcohol becomes the preferred coping mechanism for dealing with heightened levels of anxiety (DiClemente, 2003).

These models share the common assumption that anxiety leads individuals to use substances for the reinforcing effects that result (Morris, Stewart, & Ham, 2005). A variety of mechanisms, including neurobiological, cognitive, and psychophysiological mechanisms, could explain this potential pathway. Cigarettes, alcohol, and cannabis share the negatively reinforcing

anxiolytic, stress-response-dampening properties, which are perhaps particularly comforting to an individual suffering from high levels of anxiety. Indeed, there is evidence that adolescents use drugs, including alcohol (e.g., Cooper, Frone, Russell, & Mudar, 1995), cannabis (e.g., Schafer & Brown, 1991), and tobacco (e.g., Colvin & Mermelstein, 2010), as a way of regulating anxiety.

Mechanisms have been suggested for a causal relationship between anxiety and substance use. Some have argued that elevated levels of anxiety can lead to increases in substance use as a form of self-medication (Khantzian, 1997). Another possible explanation for the connection between substance use and anxiety is that substance use promotes the onset of anxiety by cognitive, psychological, and biological changes or by adding to environmental stressors (Kushner, Sher, & Beitman, 1990). Both psychological and neurobiological theories have been developed to explain this substance-induced anxiety enhancement model (e.g., Sabourin & Stewart, 2011). However, Chilcoat and Breslau (1998) suggest that in at least 75% of cases of comorbidity involving substance dependence, the anxiety disorder developed first. An epidemiological study by Grant et al. (2004) examined whether anxiety persisted beyond acute withdrawal and showed that substance-induced anxiety was rare. These findings suggest that the self-medication theory is more consistent than the substance-induced anxiety theory with the epidemiological data on comorbidity.

Another factor to consider is that different stages of drug use (i.e., non-use, initiation, regular use) may have different relationships to anxiety. The factors involved in maintaining substance use are likely to be different from the factors influencing initiation. Once the relationship between anxiety and drug use is created, one may serve to maintain or exacerbate the other. Kushner and colleagues (1990) suggest that substance withdrawal experiences lead to heightened levels of anxiety and substance-induced disruptions in the stress-response system, furthering the

need to use substances. According to this, the reinforcing effects of mitigating anxiety that coincide with withdrawal play an important role in the continued use of the substance (Barrett, 1985). As such, it is possible that general symptoms of anxiety will increase as use increases. It could be argued that adolescents do not experience withdrawal symptoms due to, typically, limited substance use. However, Stewart and Brown (2006) show evidence of dependence and withdrawal symptoms in adolescents across several drug categories. Therefore, it will be important to examine adolescent substance use over time to examine how substance use and anxiety change.

In their conceptual framework, Wills and Shiffman (1985) described the role of appraisal in the perception of stress. They suggested that the presence of environmental stressors alone might not be enough to create stress in an individual. Distressing events can occur that are beyond personal control. These uncontrollable negative events or inescapable stressors often lead to a perceived loss of control, perhaps even to a sense of powerlessness, inefficacy, or helplessness (e.g., Bandura, 1982; Fleming, Baum, & Singer, 1984). Wills and Shiffman suggested that a cognitive appraisal of the environmental stressors causes the stress; substance use can then be undertaken to either increase or reduce arousal based on the appraisal process. Newcomb and Harlow (1987) found evidence that a perceived loss of control had a direct influence on drug use in college-age individuals. Furthermore, there is no single source of influence to explain any single drug preference (Chassin, Presson, Sherman, & Edwards, 1991; Schulenberg et al., 2001).

2.4   Cigarettes, Alcohol, and Cannabis: Similarities and Differences

In examining the relationship between drug use and anxiety, cigarettes, alcohol, and cannabis seem to share some of the same negatively reinforcing anxiolytic, stress-response-reducing properties. Many drugs share common vulnerabilities such as availability, modeling, potentiation, brain mechanisms, cross-tolerance, and peer influences (Comeau et al., 2001; Kaplow

et al., 2001; Bonn-Miller, Zvolensky, & Bernstein, 2007). The particular pharmacological effects of the various substances studied support this finding. Specifically, the anxiolytic properties of nicotine (Kassel et al., 2007; Pomerleau, Turk, & Fertig, 1984), alcohol (Cooper et al., 1995; Merikangas et al., 1998), and cannabis (Johnson et al., 2009; Schafer & Brown, 1991) may help explain the positive relationship between anxiety and all three substances.

Despite their common vulnerabilities, each drug also has a unique psychopharmacological effect, social environment, and motive for use each drug may have distinctive effects on anxiety. For example, Marmorstein, White, Loeber, and Stouthamer-Loeber (2010) found in an adolescent sample that while first tobacco use and alcohol use were associated with generalized and social anxiety, anxiety did not predict first use of cannabis. Wills, Sandy, Yaeger, Cleary, and Shinar (2011) found that the perceived stress of negative life events predicted substance use in a sample of adolescents; this has been shown specifically with alcohol and marijuana (e.g., Labouvie, 1986) and with cigarette use (Byrne et al., 1993). Overall, it is difficult to compare the effects of different drugs on anxiety as most studies that examine the relationship use only a single drug (i.e., smoking, drinking, or cannabis use); thus, any comparisons to the etiology of different drug-use behaviors must be inferred.

2.5   Relationships Between Anxiety and Substance Use

2.5.1   Relationships Between Anxiety and Tobacco Use

The self-medication model of substance use posits that adolescents who experience higher levels of anxiety are at greater risk to initiate smoking and to progress to dependence. Anecdotally, virtually all smokers attribute their smoking to its anxiolytic and sedative properties (Frith, 1971; Leventhal & Cleary, 1980). Research supports this with findings showing that state and trait stressors (Koval, Pederson, Mills, McGrady, & Carvajal, 2000) and perceived stress (Dugan,

Lloyd, & Lucas, 1999; Siqueira, Diab, Bodian, & Rolnitzky, 2000) have been found to increase the risk for smoking uptake.

The relationship between anxiety and adolescent smoking seems to be dependent upon the stage of smoking being examined. For example, in studies that examined the role of anxiety in the onset of smoking, the findings were mixed. Cross-sectional research indicated that adolescents with symptoms of anxiety are at higher risk for smoking initiation than asymptomatic adolescents (Patton et al., 1996). However, several longitudinal studies found that anxiety disorders do not reliably predict the onset of cigarette smoking during adolescence (Costello et al., 1999; Johnson et al., 2000; McGee, Williams, & Stanton, 1998; Patton et al., 1998). This may be due to using anxiety disorders as the predictor rather than more dynamic and sensitive constructs of anxiety.

Whereas the relationship between anxiety and smoking onset may be weak, the relationship between anxiety and nicotine dependence seems to be more robust (Dierker et al., 2001; Johnson et al., 2000). Dierker et al. (2001) found that anxiety disorders did not differentiate smoking experimenters from nonsmokers—nor regular smokers from light smokers—but anxiety did significantly differentiate light smokers from dependent smokers.

In several studies young adult and adolescent smokers reported more perceived stress than nonsmokers (e.g., Kirkcaldy, Cooper, Brown, & Althanasou, 1994; Naquin & Gilbert, 1996; Vollrath, 1998). For example, among the many adolescents who try cigarettes, those who go on to become regular smokers are more likely to be stressed (Chassin et al., 1981; Stein, Newcomb & Bentler, 1996).

The mutual-maintenance model seems to be a fitting theoretical model for characterizing the negative reinforcing effects of longer-term cigarette use. Studies have demonstrated that when a nicotine-dependent smoker abstains from nicotine, there is a predictable and reliable withdrawal

period (Hughes & Hatsukami, 1986; Shiffman, 1979). Additionally, the withdrawal symptomology comprises several manifestations of anxiety: increases in general anxiety symptoms, tension (Hatsukami, Hughes, & Pickens, 1984; Hughes & Hatsukami, 1986), and dysphoria (Hatsukami et al., 1984; West, Russell, Jarvis, & Feyerabend, 1984). This suggests that smoking reduces anxiety only through nicotine's ability to relieve withdrawal symptoms (Hughes & Hatsukami, 1986; Parrott, 1999) in longer-term smokers.

2.5.2   Relationships Between Anxiety and Alcohol Use

The self-medication models suggest that adolescents drink to regulate negative emotionality and, thus, individuals with high levels of anxiety are at risk for increased drinking (Wills, DaHammel, & Vaccar, 1995). However, the studies that examined the relation between anxiety and alcohol use in adolescence provided mixed results. Whereas some studies show that anxiety is an important risk factor for alcohol use in adolescence (Colder & Chassin, 1993; Kushner, Abrams, & Borchardt, 2000; Newcomb & Harlow, 1986), others conclude that anxiety is not related to alcohol use (Biederman, Wilens, Mick, & Faraone, 1997; Hussong, Curran, & Chassin, 1998). One study found that anxiety among adolescent boys was a protective factor and was associated with lower levels of alcohol-use disorder symptoms and lower risk of alcohol dependence by early adulthood (Pardini et al., 2007). Several studies have found that alcohol use and anxiety disorders are frequently comorbid (e.g., Kushner et al., 2000) but the directionality of this relationship is unclear. This also contributes to the limited conclusions drawn about anxiety and alcohol use.

Several studies found a relationship between anxiety and alcohol use. For example, anxiety among 9-to-13-year-olds was associated with increased risk for the initiation of alcohol use (Kaplow et al., 2001). Among older youth, anxiety was associated with the progression from first

drink to alcohol dependence (Sartor et al., 2006, Colder & Chassin, 1993; Kushner et al., 1999; Newcomb & Harlow, 1986). However, many studies did not support the relationship between anxiety and substance use. Hill, Shen, Lowers, and Locke (2000) found that general anxiety did not predict drinking onset in a high-risk adolescent sample. Poikolainen, Tuulop-Henriksson, Steala, Marttunen, and Lonnqvist (2000) showed that trait anxiety did not predict average alcohol intake and heavy drinking 5 years later in young adults in Finland. Perhaps sociocultural differences may affect coping styles. (e.g., Clark, Parker, & Lynch, 1999; Swaim, Oetting, Edwards, & Beauvais, 1989; Hussong, Curran, & Chassin, 1998). In one study, higher levels of anxiety were shown to be a protective factor against alcohol use disorders and alcohol dependence (Pardini et al., 2007).

Given the mixed results, the importance of anxiety as a predictor of alcohol use is opaque. One possible reason for these findings may be that many of these studies utilized a wide variety of anxiety experiences, including *DSM* diagnoses, anger, depression, general anxiety, loss of control, and meaninglessness, to create a single measure of anxiety. Integrating different types of negative emotions into a single construct confounds the ability to determine which specific types of symptoms play a critical role in predicting alcohol use at any stage. Alcohol outcomes vary by study and add to the mixed literature. For example, Sartor and colleagues (2006) found a relationship between anxiety and alcohol dependence while Hill and colleagues (2000) found no relationship between anxiety and drinking onset. Another possibility could be the normative and social nature of adolescent alcohol use decreases the variability needed to capture the relationship.

2.5.3 <u>Relationships Between Anxiety and Cannabis Use</u>

Cannabis users frequently report relief from tension (Hathaway, 2003; Reilly, Didcott, Swift, & Hall, 1998) and negative emotions (Schafer & Brown, 1991) as primary reasons for use.

Studies have found that certain anxiety symptoms, generally those of somatic origin, are associated with greater degrees of current cannabis use among users (e.g., Zvolensky et al., 2006). Anxiety symptoms and the associated disorders co-occur with frequent and problematic cannabis use (Agosti, Nunes, & Levin, 2002; Bovasso, 2001; Brook, Cohen, & Brook, 1998; Brook, Brook, Zhang, Cohen, & Whiteman, 2002; Dannon, Lowengrub, Amiaz, Grunhaus, & Kotler, 2004; Grant, 1995; Weller & Halikas, 1985; Zvolensky, Lewinsohn et al., 2008). However, these studies did find that in adolescents already using cannabis, anxiety predicted an increase in problems associated with cannabis such as chronic bronchitis, risk-taking behavior (e.g., unprotected sexual intercourse), and interpersonal impairment. Beyond first use, Zvolensky et al., (2008) found that both general and social anxiety predicted the progression from first use to problems related to cannabis.

The social context of substance use may help to explain why particular anxiety variables are related to cannabis use. While cannabis has anxiolytic effects, Stewart and colleagues (2011) found that cannabis related only to conformity motives. This suggests that cannabis use may only be related to a more general anxiety that appears only in social contexts. Buckner and Schmidt (2008; 2009) found that social anxiety predicted marijuana use problems.

Another possible explanation for the above findings is that cannabis use is highly comorbid with other substance use, with data indicating that only 1% of users were using only cannabis (National Household Survey on Drug Abuse, 1995). As such, it is possible that variance explaining anxiety and drug use could be taken up by cigarette and alcohol use.

2.6   Goals

The goal of this study is to investigate the complex relationship between the type of adolescent substance use (cannabis, alcohol, cigarette use), level of substance use (non-user,

regular user), and anxiety (somatic anxiety, perceived stress) over time. This study used hierarchical linear modeling to examine the relationship of adolescent cigarette smoking, alcohol use, and cannabis use on somatic anxiety and perceived stress over time. We examined a time in adolescence when use of substances becomes common and increases. This study had the following aims: (1) to examine independent and joint contributions of anxiety and stress in predicting three different kinds of adolescent drug use over two years; (2) to investigate how initial levels and changes in anxiety and stress over time differ as a function of substance type (cannabis, alcohol, cigarette use) and level of use (non-users, regular users).

2.7   Hypotheses

Hypotheses were developed based on both theory (the self-medication model of substance use) and empirical evidence supporting reciprocal pathways between anxiety and substance use. Our guiding framework is that the overall relationship can be parsed into positive associations in concurrent level, concurrent change, and type of use (non-users, regular users). Overall, it was expected that higher levels of baseline anxiety would predict higher levels of substance use two years later. Specifically, both somatic anxiety and perceived stress would independently predict cigarette, cannabis, and alcohol use.

To understand how substance use affects anxiety over time, we used hierarchical linear modeling. We hypothesized that regular users would show the higher levels of baseline anxiety than non-users for all substances. Additionally, over a two-year period, regular users will have faster decreases in anxiety than non-users.

3. METHODS

3.1   Overview

Data for this study come from a longitudinal study of smoking among adolescents ("Social-Emotional Contexts of Adolescent Smoking Patterns"; $N = 1263$). The longitudinal study utilized a multi-method approach to assess many components of adolescent smoking at multiple time points from baseline through a 7-year follow-up. All adolescents completed extensive self-report questionnaires and in-depth interviews at each measurement wave, and subsets of adolescents completed ecological momentary assessments, video-taped family discussions, and laboratory-based psychophysiological assessments. Data for the current study are from baseline, 6-, 15-, and 24-month self-report questionnaires only.

3.2   Participants

Participants were recruited from 16 Chicago-area high schools. The sample was derived in a multi-stage process. All 9th and 10th graders at the schools were asked to complete a brief screening survey. Invitations were mailed to eligible students and their parents. Students were eligible to participate in the longitudinal study if they fell into one of four levels of smoking experience: 1) never smokers; 2) former experimenters (smoked at least one cigarette in the past, have not smoked in the last 90 days, and have smoked fewer than 100 cigarettes in their lifetime); 3) current experimenters (smoked in the past 90 days, have smoked between 20 and 99 cigarettes in their lifetime, but were not yet daily smokers); and 4) regular smokers (smoked in the past 30 days and have smoked more than 100 cigarettes in their lifetime, but smoked 5 or less cigarettes per day). Of the participants screened, 11,718 (90.3%) met inclusion criteria for the larger parent study based on smoking history and patterns, and 3,695 of these (31.5%) were invited to participate in the longitudinal study. Of those who were invited, 1,344 were willing to participate,

20

and 1,263 completed the baseline measurement wave. Agreement to participate did not vary by smoking history, race/ethnicity, or parental smoking, but girls were slightly more likely to agree to participate than boys. The participants were enrolled into the longitudinal study after written parental consent and participant assent was obtained.

Approximately half of the participants in the current study were female (56.6%; $n = 715$); 50.7% were in 9th grade at baseline ($n = 640$) and 49.3% were in 10th grade at baseline ($n = 623$). At baseline, participants ranged in age from 14 years to 17 years ($M = 15.7$, $SD = 0.62$). In terms of race/ethnicity, participants were Caucasian ($n = 713$, 56.5%), Hispanic ($n = 217$, 17.2%), African-American ($n = 214$, 16.9%), Asian/Pacific Islander ($n = 50$, 2%), or Other ($n = 69$, 5.5%).

3.3   Procedures

"Paper and pencil" questionnaires were mailed to the participants a few weeks prior to each data collection wave. Participants were instructed to complete the questionnaires and send them back. Participants received a payment of $20 for each completed questionnaire (at baseline, 6-, 15 months and $40 at 24 months) that was returned at each time point.

3.4   Measures

3.4.1   Current Cigarette Smoking Behavior Current smoking behavior was assessed with number of days smoked in the past 30 days and number of cigarettes smoked during the past 30 days. Sample questions included, "Think about the past 30 days. On the days you smoked cigarettes, about how many cigarettes did you smoke each day?" and "Now think about the past 30 days. On how many days did you smoke or try cigarettes?" (see Appendix A).

3.4.2   Current Alcohol and Cannabis Use Current alcohol and drug involvement was assessed using a modified version of the Adolescent Alcohol and Drug Involvement Scale (AADIS; Moberg, 2000). Participants were asked about the frequency of their use of alcohol and

eight other drug categories (e.g., cannabis, cocaine, steroids) over the past 3 months with response

options of: 0 times; once a month or less; more than once a month but less than once a week; one

or more times a week but not every day; and every day. For the current study, only alcohol and

cannabis use were used (see Appendix B).

3.4.3 <u>**Substance Use Categories**</u> Adolescent cannabis and alcohol use categories (non-

users and regular users) were created using the AADIS and about the frequency of their use over

the past 3 months with response options of: 0 times; once a month or less; more than once a month

but less than once a week; one or more times a week but not every day; and every day (see

Appendix B). Cigarette categories were created using the number of cigarettes smoked during the

past 30 days (see Appendix A). For each substance, the categories created were non-users (did not

endorse using at any point in our study) and regular users (endorsed using at every time-point).

3.4.4 <u>**Somatic Anxiety Symptoms**</u> Adolescent somatic anxiety was assessed with 7 items

from the Mood and Anxiety Symptom Questionnaire (MASQ; Watson & Clark, 1991; Watson,

Weber, Assenheimer, Clark, Strauss, & McCormick, 1995) that represent somatic arousal.

Research supports the reliability and validity of the MASQ with youth (Richey, Lonigan, &

Phillips, 2002). The MASQ is a 12-item measure that contains three subscales assessing: (1)

general distress symptoms of anxiety (e.g., "feeling nervous"); (2) anxious arousal, with items

addressing specific anxiety symptoms of somatic tension and hyperarousal (e.g., "feeling dizzy or

lightheaded"; "muscles were tense or sore"); and (3) anhedonic depression symptoms specific to

depressive disorders (e.g., "was proud of myself"). However, the anhedonic aspect of the MASQ is

more representative of general negative emotionality than anxiety. This was confirmed using

principal component analysis with Varimax (orthogonal) rotation where anhedonic symptoms

loaded cleanly onto a second factor. Given this, anhedonic symptoms were removed for the current

study. Adolescents rated the extent to which they had experienced each symptom in the past week according to a 5-point Likert-type scale, ranging from 1 (not at all) to 5 (extremely). The anxious arousal questions were summed to yield a scale score, with strong internal reliability in the current sample (coefficient alpha = .80; see Appendix C).

3.4.5 <u>**Perceived Stress**</u> Perceived stress, including the degree of subjective stress and the impact of stressful situations in an adolescent's life, was measured with the four-item version of the Perceived Stress Scale (PSS; Cohen et al., 1983); coefficient alpha = .66. The PSS items are rated on a 5-point scale according to the frequency of occurrence in the previous month, from 1 (never) to 5 (very often). Substantial internal reliability, test-retest reliability, and validity have been documented for the original, 14-item measure as well as the 4-item version of the PSS (Cohen, Kamarck, & Mermelstein, 1983). Examples include: "In the last month how often have you felt difficulties were piling up so high that you could not overcome them" and "In the last month how often have you felt that you were unable to control the important things in your life?" Internal reliability among the current sample was strong (coefficient alpha = .66; see Appendix E).

3.4.6 <u>**Demographics**</u> Demographic information included gender, age, and race/ethnicity.

4. RESULTS

4.1   <u>Analytic Approach</u>

Regression analyses were used to examine how somatic anxiety and perceived stress predict adolescent cigarette, alcohol, and cannabis use two years later. For each substance, three regressions were run. First, we ran regressions to examine somatic anxiety and perceived stress as independent predictors of substance use. we ran a third regression with both somatic anxiety and perceived stress together as predictors of substance use. All regression controlled for gender.

Multilevel models, or mixed effects models, for predicting change were used to investigate the effect of substance use categories (non-user, user) on anxiety variables over time for each substance. Ordinary regression models are limited because they can only assess the influence of anxiety on substance use for the sampled population as a whole. As such, very little information can be derived about individual variability for these constructs over time. Mixed Regression Models, in contrast, explicitly model individual change over time and also possess several features that add flexibility to the model. This study employed a series of hierarchical linear regression models to determine the unique anxiety trajectories by substance use categories. Models were estimated using PROC MIXED in the Statistical Analysis System (SAS) version 9.2. Full information maximum likelihood estimation (ML) was used to compare directly the fit of models to the data and to use all available data, given the presence of missing observations, which were treating as missing at random (Singer & Willett, 1994). Briefly, models include: (1) baseline intercept; (2) a linear slope; and (3) interaction of slope terms plus substance use categories. Models were independently created for each substance and for each anxiety outcome variable resulting in six models.

These analyses resulted in models in which effects of each group (non-user, regular user) reflected a significantly different influence on the initial level of the anxiety. Non-significant results indicate that the baseline level of anxiety is the same for each group. The main effect for time on the dependent variable represents the average linear change of anxiety over the course of 2 years. Non-significant results would indicate that anxiety, on average, does not change over time. The interaction effects of the predictor (non-user, regular user) with the slope terms (time) indicate how the non-user group's change in anxiety over time (slope) in relation to the regular user group's change in anxiety over time. In models of this type, if the association between these problems change at the same rate as a function of group (parallel lines), that would be indicated by a non-significant interaction between the independent variable (substance use category) and the terms in the equation that represented slope (time). In contrast, a significant interaction between the independent variable and slope terms would indicate that the effects of the predictor groups have different linear slopes. The intercepts and slopes are estimated independently, so while earlier levels of the dependant variable are not statistically "controlled for" the estimate of initial values is separated from the estimate of change over time.

4.2   **Compliance and Attrition**

Of the 1263 adolescents who provided questionnaire data, 101 (8.0%) did not complete the questionnaire at 6 months, 135 participants (10.7%) did not complete the questionnaire at 15 months, and 116 participants (9.2%) did not complete the questionnaire at 24 months. There were no significant differences between 6-, 15-, or 24-month questionnaire completers and non-completers on any of the baseline anxiety variables.

Individuals who did not complete the 6-month questionnaire smoked cigarettes on more days in the past 30 days ($M = 5.32$, $SD = 8.61$) than individuals who completed the questionnaire

($M = 3.73$, $SD = 7.61$; $t = -2.00$, $df = 1260$, $p < .05$). Individuals who did not complete the 15-month questionnaire smoked cigarettes on more days ($M = 5.24$, $SD = 8.96$) and smoked more cigarettes in the past 30 days ($M = 1.21$, $SD = 2.73$) than individuals who completed the questionnaire ($M = 3.69$, $SD = 7.52$; $t = -2.23$, $df = 1260$, $p < .001$; $M = 0.86$, $SD = -1.99$; $t = -1.99$, $df = 1261$, $p < .01$). Individuals who did not complete the 24-month questionnaire smoked cigarettes on more days ($M = 5.79$, $SD = 9.18$) and smoked more cigarettes in the past 30 days ($M = 1.37$, $SD = 2.90$) than individuals who completed the questionnaire ($M = 3.67$, $SD = 7.51$; $t = -2.86$, $df = 1260$, $p < .001$; $M = 0.84$, $SD = 1.85$; $t = -2.79$, $df = 1261$, $p < .001$).

Additionally, there were differences in baseline alcohol use in the past 3 months between 6- and 15-month completers and non-completers ($\chi^2 (1, N = 1263) = 12.97$, $p < .05$; $\chi^2 (1, N = 1263) = 10.52$, $p < .05$). There were also differences in baseline cannabis use in the past 3 months between 15-month completers and non-completers ($\chi^2 (1, N = 1263) = 12.96$, $p < .05$). Finally, girls were more likely to complete the 15- and 24-month questionnaire than boys ($\chi^2 (1, N = 1263) = 4.41$, $p < .05$; $\chi^2 (1, N = 1263) = 6.20$, $p < .05$).

4.3 **Preliminary Analyses**

Table 1 presents the means and standard deviations for the continuous variables over time. Table 2 presents the means and standard deviations for the anxiety variables over time as a function of substance use and substance use categories (non-users and regular users). T-tests were used to compare differences in anxiety between non-users and users at each time point. Table 3 shows the proportions of reported categories for both alcohol and marijuana use over time. Bivariate correlations among the continuous variables are shown in Table 4.

TABLE I
MEANS AND STANDARD DEVIATIONS OF VARIABLES FOR THE TOTAL SAMPLE OVER TIME

Variables	Baseline			6 Months			15 Months			24 Months		
	N	M	SD	N	M	SD	N	M	SD	N	M	SD
Somatic Anxiety	1262	14.61	(5.16)	1159	14.13	(5.41)	1113	13.26	(5.03)	1137	12.73	(4.71)
Perceived Stress	1262	2.67	(0.75)	1157	2.55	(0.78)	1114	2.48	(0.79)	1140	2.51	(0.76)
Days Smoked	1262	3.85	(7.70)	1156	4.42	(8.48)	1117	5.57	(9.98)	1140	6.49	(10.64)
Cigs per Day	1263	0.89	(1.97)	1161	1.29	(2.73)	1124	1.54	(3.42)	1141	1.60	(3.33)

TABLE II

MEANS AND STANDARD DEVIATIONS OF ANXIETY VARIABLES FOR THE USERS AND NON-USERS OVER TIME BY SUBSTANCE USE CATEGORY

	Non-Use/ n	User n	Baseline Non-User M SD	User M SD		6 Months Non-User M SD	User M SD		15 Months Non-User M SD	User M SD		24 Months Non-User M SD	User M SD	
Cannabis Use														
Somatic Anxiety	330	283	13.96 (0.30)	15.52 (0.35)	**	13.09 (0.29)	15.06 (0.34)	***	12.44 (0.26)	13.91 (0.31)	***	12.52 (0.26)	12.88 (0.31)	
Perceived Stress	330	283	2.61 (0.04)	2.76 (0.05)	*	2.46 (0.05)	2.63 (0.05)	*	2.39 (0.04)	2.64 (0.05)	***	2.43 (0.04)	2.58 (0.05)	*
Alcohol Use														
Somatic Anxiety	100	660	13.47 (0.55)	14.98 (0.22)	*	12.85 (0.59)	14.65 (0.24)	**	11.99 (0.54)	13.72 (0.22)	**	12.01 (0.51)	12.88 (0.20)	*
Perceived Stress	100	660	2.56 (0.08)	2.66 (0.03)		2.46 (0.08)	2.56 (0.03)		2.30 (0.08)	2.54 (0.03)	**	2.37 (0.08)	2.52 (0.03	
Cigarette Use														
Somatic Anxiety	365	287	13.97 (0.26)	15.18 (0.34)	**	13.08 (0.26)	14.71 (0.34)	***	12.60 (0.26)	13.79 (0.34)	**	12.64 (0.24)	12.67 (0.32)	
Perceived Stress	365	287	2.60 (0.04)	2.73 (0.05)	*	2.49 (0.04)	2.65 (0.05)	**	2.40 (0.04)	2.60 (0.05)	**	2.44 (0.04)	2.63 (0.06)	*

Note. * $p<.05$; ** $p<.01$; *** $p<.001$.

TABLE III

PROPORTIONS OF REPORTING CATEOGIRES FOR ALCOHOL AND MARIJUANA USE ACROSS TIME

Variables	Baseline n = 1262	6 Months n = 1159	15 Months n = 1113	24 Months n = 1137
Alcohol				
0 times	.27	.28	.27	.25
1x per month	.33	.30	.25	.24
< 1x per month	.28	.28	.31	.29
< 1x per week	.12	.13	.17	.22
Every Day	.001	.003	.004	.002
Cannabis				
0 times	.62	.61	.57	.52
1x per month	.17	.16	.17	.17
< 1x per month	.10	.09	.10	.11
< 1x per week	.08	.10	.11	.12
Every Day	.03	.04	.06	.08

TABLE IV

INTERCORRELATIONS BETWEEN BASELINE CONTINOUS VARIABLES (N = 1263)

Variables	1.	2.	3.	4.	5.
1. Somatic Anxiety	---				
2. Perceived Stress	.47***	---			
3. Days Smoked	.09**	.10***	---		
4. Cigs per Day	.12 ***	.09***	.75***	---	
5. Cannabis Use	.03	.08**	.41***	.38***	---
6. Alcohol Use	.13***	.05	.25***	.27***	.44***

*Note. * p<.05; ** p<.01; *** p<.001.*

Substance use groups (non-users, regular users) were examined to confirm differences in actual substance use at each time point, for each substance. Of the 613 adolescents used in the cannabis groups, 283 adolescents (46%) smoked cannabis at each time point and were in the regular groups while 330 adolescents (54%) did not use at all. Of the 760 adolescents in the alcohol analyses, 660 adolescents (87%) drank alcohol at each time point while only 100 adolescents did not drink at any of the time points (13%). Of the 652 adolescents in the cigarette analyses, 287 adolescents smoked cigarettes at each time point (44%) and 365 adolescents did not smoke at any time point (56%).

To explore the cross-use between substances, chi-squared analyses were run examining the differences between users and non-users for each substance. Of the adolescents who did not smoke cannabis, 46% ($n = 76$) did not drink, while 54% ($n = 76$) drank at each time point. However, adolescents who did smoke cannabis regularly only 1% ($n = 2$) did not drink while 99% ($n = 245$) drank regularly $\Box\chi^2 (1, N = 411) = 160.96 \, p < .001$). Of the adolescents who did not smoke cannabis, 91% ($n = 212$) did not smoke cigarettes, while 9% ($n = 20$) smoked cigarettes at each time point. Adolescents who did smoke cannabis regularly only 7% ($n = 11$) did not smoke cigarettes as well, while 93% ($n = 140$) smoked cigarettes regularly $\Box\chi^2 (1, N = 383) = 265.93 \, p < .001$). Of the adolescents who did not smoke cigarettes, 41% ($n = 65$) did not drink alcohol, while 59% ($n = 95$) drank alcohol at each time point. Adolescents who did smoke cigarettes regularly only 2% ($n = 5$) did not drink as well, while 98% ($n = 217$) drank regularly $\Box\chi^2 (1, N = 382) = 91.48 \, p < .001$). Finally, 125 adolescents smoked cigarettes, cannabis, and drank alcohol at each time point, while 62 adolescents did not use any drugs at any time point.

T-tests were run for each substance at each time point. Results showed the regular users used more substances at all 4 time points ($p < .001$ for all analyses) for cigarette, alcohol, and

cannabis use. Each of the non-using groups showed no use at each of the time points. Adolescents who smoked cannabis at every time point showed a baseline mean of 3.10 (SD = 1.00), 6-month mean of 3.39 (SD = 1.06), 15-month mean of 3.31 (SD = 1.32), and 24-month mean of 3.69 (SD = 1.12). Adolescents who drank alcohol at every time point showed a baseline mean of 2.83 (SD = 0.76), 6-month mean of 2.90 (SD = 0.76), 15-month mean of 3.05 (SD = 0.76), and 24-month mean of 3.10 (SD = 0.78). Adolescents who smoked cigarettes at every time point showed a baseline mean of 2.52 (SD = 3.11), 6-month mean of 3.80 (SD = 4.18), 15-month mean of 4.94 (SD = 5.15), and 24-month mean of 4.93 (SD = 4.67).

T-tests were run to examine age differences between regular users and non-users for each substance. Adolescents who smoked cannabis regularly were slightly older at baseline (M = 15.71, SD = 0.61) than non-users (M =15.55, SD = 0.59; t = -3.11, df = 611, p < .01). Adolescents who drank alcohol regularly were slightly older at baseline (M = 15.67, SD = 0.62) than non-users (M =15.52, SD = 0.59; t = -2.24, df = 759, p < .05). Adolescents who smoked cigarettes regularly were slightly older at baseline (M = 15.70, SD = 0.64) than non-users (M =15.56, SD = 0.61; t = -2.96, df = 651, p < .01).

Chi-square tests were used to explore differences in gender between users and non-users for each substance. For adolescents who smoked cannabis regularly 53% (n = 149) were girls and 47% (n = 134) were boys; however, for adolescents who did not smoke cannabis at all 65% (n = 213) were girls and 35% (n = 117) were boys (χ^2 (1, N = 613) = 8.92, p < .01). There were no differences between girls (52%; n = 149) and boys (48%; n = 139) who smoked cigarettes regularly or girls (59%; n = 214) and boys (41%; n = 151) who did not smoke cigarettes at all (χ^2 (1, N = 653) = 3.10, ns). There were also no differences in the percentage of girls (56%; n = 371)

and boys (44%; $n = 290$) who drank regularly or girls (47%; $n = 47$) and boys (53%; $n = 53$) who did not drink at all (χ^2 (1, $N = 760$) = 2.92, ns).

4.4 Anxiety Variables Predicting Substance Use

To examine the relationship between baseline anxieties predicting substance use 24-months later we used a series of regressions analyses. For each substance use outcome (cigarette use, cannabis use, and alcohol use) three regressions were run 1) using somatic anxiety as an independent predictor; 2) using perceived stress as an independent predictor; and 3) using both somatic anxiety and perceived stress together. All substance use was used as continuous outcomes. Cannabis and alcohol use were used as continuous outcomes since there are many categories, a large sample size, and are ordinal variables that represents unmeasured continuous variables (Winship & Mare, 1984). All analyses controlled for gender.

As hypothesized, higher levels of perceived stress and somatic anxiety independently predicted a greater number of cigarettes per day and number of days smoked in the last month (see Table 5). However, contrary to hypotheses, when both anxiety predictors were used together, only perceived stress predicted future cigarette use. In all analyses, gender was significant such that boys showed higher levels of cigarette use than girls.

Similar results were shown in cannabis use where higher levels of perceived stress and somatic anxiety independently predicted future cannabis use (see Table 6). When both anxiety predictors were used together, again, only perceived stress predicted future cannabis use. Gender was significant in all analyses such that boys showed higher levels of cannabis use than girls. Interestingly, neither perceived stress nor somatic anxiety independently or together predicted alcohol use (see Table 7).

TABLE V

BASELINE ANXIETY ON 24-MONTH CIGARETTE USE (N = 1137)

Number of Cigarettes per day	β	SE	t	p	
Gender	0.14	0.20	4.45	0.001	***
Perceived Stress	0.10	0.13	3.13	0.002	**
Gender	0.12	0.20	2.12	0.034	*
Somatic Anxiety	0.06	0.20	4.11	0.001	***
Gender	0.14	0.20	4.50	0.001	***
Somatic Anxiety	0.03	0.02	0.81	0.42	
Perceived Stress	0.08	0.15	2.43	0.015	*

Number of Days Smoked last Month	β	SE	t	p	
Gender	0.11	0.65	3.69	0.001	***
Perceived Stress	0.11	0.43	3.55	0.001	***
Gender	0.10	0.64	3.28	0.001	***
Somatic Anxiety	0.07	0.06	2.43	0.015	*
Gender	0.11	0.65	3.75	0.001	***
Somatic Anxiety	0.03	0.07	0.95	0.34	
Perceived Stress	0.09	0.48	2.75	0.006	**

TABLE VI

BASELINE ANXIETY ON 24-MONTH CANNABIS USE (N = 1137)

Cannabis Use	β	SE	t	p	
Gender	0.16	0.83	5.44	0.001	***
Perceived Stress	0.09	0.06	3.07	0.002	**
Gender	0.15	0.08	5.13	0.001	***
Somatic Anxiety	0.06	0.01	2.17	0.03	*
Gender	0.17	0.08	5.49	0.001	***
Somatic Anxiety	0.03	0.01	0.89	0.37	
Perceived Stress	0.08	0.06	2.35	0.02	*

TABLE VII

BASELINE ANXIETY ON 24-MONTH ALCOHOL USE (N = 1137)

Alcohol Use	β	SE	t	p	
Gender	0.05	0.07	1.77	0.08	
Perceived Stress	-0.02	0.04	-0.68	0.50	
Gender	0.06	0.07	1.99	0.05	*
Somatic Anxiety	0.00	0.01	0.13	0.90	
Gender	0.06	0.07	1.80	0.07	
Somatic Anxiety	0.02	0.01	0.49	0.63	
Perceived Stress	-0.03	0.05	-0.82	0.41	

4.5 The Influences of Drug Use on Anxiety Across Time

Parameter estimates, standard errors, and fit statistics for all models predicting anxiety over time are presented in Table 8. Separate models were estimated using somatic anxiety and perceived stress as the dependent variable and substance use as the grouping category (non-user, regular users). These analyses result in models in which the differences of each substance use category reflect the difference between groups on the initial level of anxiety. An effect for time indicates that, on average, everyone changes in anxiety symptoms over time. Interaction effects of the substance use categories with the slope terms (time) indicate how anxiety changes at different rates over time depending upon the level of substance use.

TABLE XIII

PARAMETER ESTIMATES AND STANDR ERRORS FROM THE MIXED-EFFECTS
REGRESSION MODELS OF SUBSTANCE USE CATEGORIES ON ANXIETY

	Somatic Anxiety		Perceived Stress	
	Estimate	SE	Estimate	SE
Cigarettes				
Intercept	15.1117***	0.2567	2.7000***	0.0405
Time	-0.1075***	0.0128	-0.0059**	0.0021
Non-User VS User	-1.4148***	0.3412	-0.1423**	0.0539
Time X Non-User VS User	0.0545**	0.0166	-0.0010	0.0027
-2LL	14285.40		5217.70	
Alcohol				
Intercept	14.9633***	0.1742	2.6286***	0.0260
Time	-0.0878***	0.0085	-0.0055**	0.0013
Non-User VS User	-1.5614**	0.4790	-0.0817	0.0715
Time X Non-User VS User	0.0176	0.0228	-0.0032	0.0034
-2LL	16403.00		5759.30	
Cannabis				
Intercept	15.3575***	0.2565	2.7114***	0.0401
Time	-0.1036***	0.0130	-.0062**	0.0021
Non-User VS User	-1.6269***	0.3484	-0.1452**	0.0544
Time X Non-User VS User	0.04197*	0.0173	-0.0007	0.0027
-2LL	13413.30		4814.90	

4.6   Cannabis Use and Somatic Anxiety

There was a main effect for time on somatic anxiety such that anxiety decreased for

everyone sampled. Cannabis use categories showed a main effect for differences between

categories (see Figure 1). Results showed that non-users had lower levels of somatic anxiety than

cannabis regular users at baseline. The interaction of time and substance use categories showed

that anxiety decreased at different rates depending upon the substance use group where showed non-users declined slower in anxiety over time than cannabis regular users.

4.7   <u>Cannabis Use and Perceived Stress</u>

In terms of perceived stress, there was a main effect for time on perceived stress such that stress decreased for everyone sampled (see Figure 1). Cannabis use categories showed differences between categories. Specifically, similar patterns to somatic anxiety were found where non-users showed lower levels of baseline stress than cannabis regular users. The interaction of time and substance use categories was not significant. This indicates that perceived stress decreases at the same rate regardless of the cannabis use category. However, it is important to note that while statistically significant, the estimates for baseline differences and changes over time are minimal. This suggests the clinical significance of these differences between regular users and non-users and the changes over time are negligible.
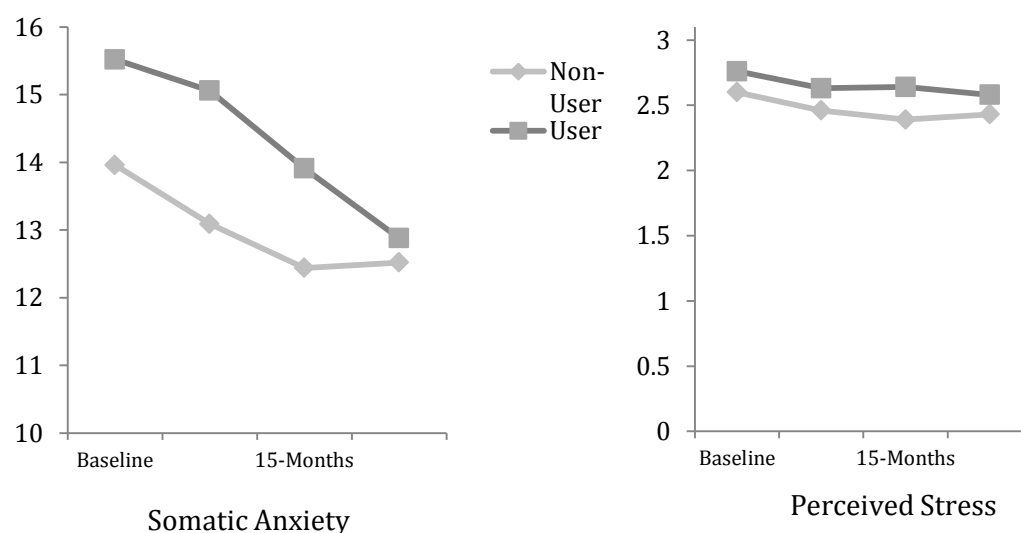

Figure 1. Somatic anxiety and perceived stress over time as a function of cannabis use categories.

4.8 <u>**Cigarette Use and Somatic Anxiety**</u>

There was a main effect for time on somatic anxiety such that anxiety decreased for everyone sampled (see Figure 2). Cigarette smoking categories showed differences between categories where non-users experienced lower levels of somatic anxiety than cigarette regular users at baseline. The interaction of time and cigarette smoking categories showed that anxiety decreased at different rates depending upon the substance use group. Results indicate that non-users' anxiety decreased at slower rates than regular cigarette smokers.

4.9 <u>**Cigarette Use and Perceived Stress**</u>

In terms of perceived stress, there was a main effect for time on perceived stress such that stress decreased for everyone sampled (see Figure 2). Cigarette use categories demonstrated a main effect for differences between categories at baseline. Specifically, non-users exhibited lower levels of stress than cigarette regular users at baseline. Contrary to hypotheses, the interaction of time and substance use categories was not significant. This indicates that perceived stress decreases at the same rate regardless of cigarette use category. As seen with cannabis use and perceived stress, the estimates for baseline differences and changes over time are minimal.
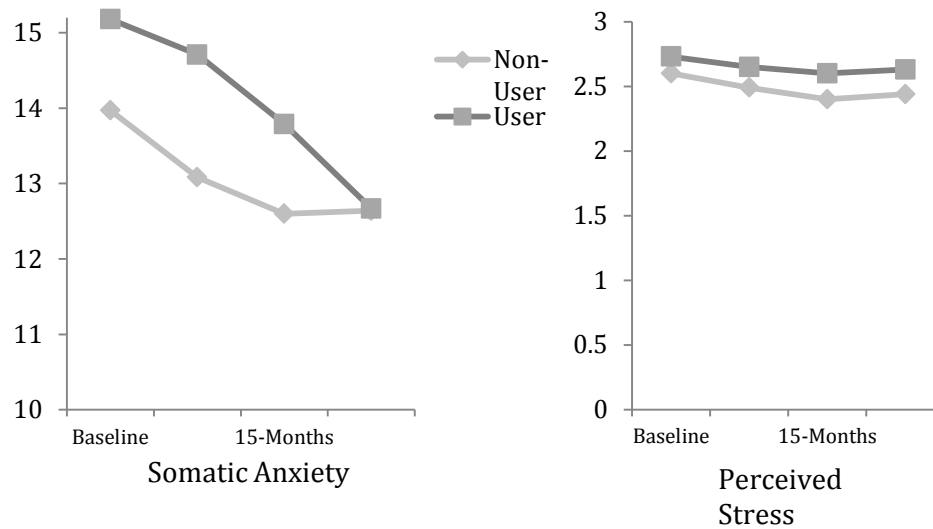
Figure 2. Somatic anxiety and perceived stress over time as a function of cigarette use categories.

4.10   <u>Alcohol Use and Somatic Anxiety</u>

There was a main effect for time on somatic anxiety such that anxiety decreased for everyone sampled (see Figure 3). Alcohol use categories demonstrated differences between categories where non-users had lower levels of baseline anxiety than regular alcohol drinkers. The interaction of time and substance use categories was not significant demonstrating that anxiety decreased at the same rates regardless of the substance use group.

4.11   <u>Alcohol Use and Perceived Stress</u>

There was a main effect for time on perceived stress such that stress decreased for everyone sampled (see Figure 3). However, there were no differences by alcohol use groups for baseline stress such that all groups had the same levels of baseline perceived stress. Additionally, there were no differences between groups in the change of stress over time. Thus, both groups are decreasing in perceived stress at the same rate, regardless of level of alcohol use. Similar patterns

emerged with alcohol and perceived stress where the estimates for baseline differences and
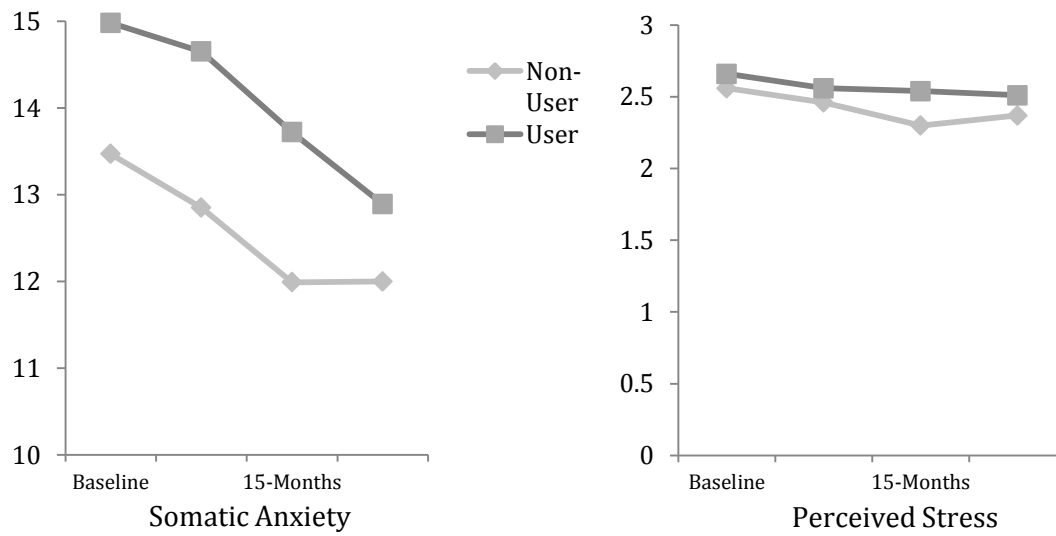
changes over time are minimal.

Figure 3. Somatic anxiety and perceived stress over time as a function of alcohol use categories.

5. DISCUSSION

This study examined the complex relationships between several types of anxiety and cannabis, alcohol, and cigarette use in an adolescent population during a developmentally vulnerable period. Specifically, this study examined whether perceived stress and somatic anxiety predicted alcohol, cigarette, and cannabis use two years later. We also examined how perceived stress and somatic anxiety changed over time as a function of substance use type (alcohol, cigarette, and cannabis) and level of substance use group (non-user, regular user). Although previous research has shown that adolescents may use drugs in part to regulate anxiety, we know less about the impact of anxiety type, drug type, or level of drug use in a single cohort over time. This study went beyond prior research by examining the multifaceted components of anxiety and drug use in an adolescent population. We employed a continuous measure of anxiety, as well as a cognitive perception of stress, to develop a broader understanding of the role of anxiety in substance use. We used multiple substances from a single cohort, maximizing cross study and cross cohort inferences. Using a longitudinal model, we followed the adolescents over a developmentally vulnerable period for anxiety and substance use. Finally, we predicted that an adolescent's anxiety changes at different rates depending upon level of substance use; specifically, we hypothesized that regular users who used at each time point will decrease their anxiety at a faster rate than non-users.

The first goal of the study was to examine whether perceived stress and somatic anxiety predicted alcohol, cigarette, and cannabis use two years later. As hypothesized, findings confirmed that both somatic anxiety and perceived stress independently predicted cannabis and cigarette use. These findings are consistent within the literature. Zvolensky et al. (2006) found that somatic anxiety predicted cannabis use, and Hughes and Hatsikami (1986) found that somatic anxiety

40

predicted cigarette smoking. Dugan et al., (1999) and Siqueira et al. (2000) found that perceived stress predicted cigarette smoking. Our findings initially suggest that anxiety as a broad concept may be generalizable and not broken down into facets of anxiety such as anxious physiological arousal or the degree of subjective stress perceived. However, going beyond previous research, only perceived stress predicted cannabis and cigarette use when both somatic anxiety and perceived stress were examined together. This is consistent with Hussong and Chassin's (1994) suggestion that facets of anxiety have different relationships to the effects of substances.

These findings suggest that cannabis and cigarette use are attributable, in part, to a common vulnerability through perceived anxiety. One possibility is that the particular anxiolytic properties of nicotine (Kassel et al., 2007; Pomerleau et al., 1984) and cannabis (Johnson, Bonn-Miller, Leyro, & Zvolensky, 2009; Schafer & Brown, 1991) are similar enough and may help explain the shared relationship we found. Another possibility is that nicotine and cannabis use are connected to other common vulnerabilities such as availability, modeling, potentiation, brain mechanisms, cross-tolerance, or peer influences (Comeau, Stewart, & Loba, 2001; Kaplow et al., 2001; Bonn-Miller et al., 2007) that interact with perceived anxiety in similar patterns. Future research can further explore these relationships.

The perception of stress in an adolescent's life that leads to cigarette and cannabis use has important implications for prevention and intervention programs. This finding suggests that not all anxiety predicts substance use, but rather it is the perception of stress in an adolescent's life that drives future cannabis and cigarette use. Shifting an adolescent's perception of stress or increasing his or her coping skills for handing stress may reduce the need to regulate the stress with cigarettes and cannabis. Since perceived stress predicted both cannabis use and cigarette use, the implication

of this on interventions suggests that both cannabis use and cigarette use may also decrease through the same intervention.

Contrary to hypotheses neither somatic anxiety nor perceived stress predicted alcohol use two years later. One possibility is that the specific constructs of anxiety that we used do not correlate with alcohol use; that is, perhaps only anxiety disorders such as generalized anxiety disorder (Kushner et al., 2000; Sartor et al., 2007) predict future alcohol use. Another possibility explaining the mixed results on alcohol use could be the limits of the alcohol use variables. It is possible that the number of drinks or number of days drinking is not related to anxiety, but consequences of drinking, such as getting into trouble, heavy regular drinking, binge drinking, blacking out, or alcohol dependence, may be.

Another explanation of the lack of findings between alcohol and anxiety may be because our study is comprised of a high-risk sample of adolescents. Thus, the relationships found with anxiety with a more normative sample may not apply here where alcohol use is so prevalent. This idea is supported in our study, as only 7.9% (n = 100) of participants in the current study never used alcohol. Given the normative nature of drinking in our study, moderators can help identify sub-groups of adolescents whose drinking is affected by anxiety. This idea is further supported in the literature where Hussong and Chassin (1994) showed that moderators are needed to understand alcohol use and anxiety in adolescence. They found that impulsivity was an important moderator to adolescent drinking in that individuals who were anxious and impulsive were more likely to drink than individuals who were anxious and not impulsive. This is another avenue to explore with future studies.

Our study examined how perceived stress and somatic anxiety changed over time as a function of substance use type (alcohol, cigarette, cannabis) and amount of substance use category

(non-user, regular user). Results were complex and varied depending upon substance use type, level of substance use category, and type of anxiety examined. Overall, results showed that for all adolescents, both somatic anxiety and perceived stress statistically decreased over time. This suggests a developmental and dynamic aspect of anxiety and further suggests that early adolescence is a uniquely vulnerable time to learn coping strategies for higher levels anxiety. However, when examining the effect sizes and estimated change in perceived stress over time, it is unclear how clinically relevant these changes are. As such, the decrease in anxiety over a two-year period in a high-risk adolescent population is most likely applicable only to the changes in the bodily sensations of anxiety and not applicable to the perception of stress in an adolescent's life.

Adolescents who smoked cigarettes, marijuana, or drank alcohol regularly over a two-year period exhibited higher levels of baseline somatic anxiety than non-users. This suggests a common pattern found in using any of the three substances with the heightened bodily sensations of anxiety. Similar to the changes over time and perceived stress, results showed statistical differences in baseline level of perceived stress for cannabis users and cigarette users (but not alcohol use) when compared to non-users; however, the estimated differences are minimal suggesting nominal clinical significance. Taken together, this suggests that individuals who are regularly using any substance do not have clinically significant differences in how they perceive stress than individuals who are not using substances at all.

Contrary to the self-medication model and hypotheses, there were no differences in how perceived stress decreased as a function of level of use for any of the drugs examined. This suggests that level of substance use does not influence the perception of stress an adolescent experiences, nor do substances particularly help the adolescent decrease his or her perception of stress over time: Using substances is not an effective coping skill for decreasing feelings of stress

or lack of control. Taken together, this suggests that the appraisal of stress and the perceived loss of control, inefficacy, or helplessness may be quite steady over adolescence and is not affected by alcohol, cannabis, or cigarette use. However, another possibility is that the relationship between regular substance use and perceived stress are confounded with all the other reasons for regular substance use, such as social motives, risk taking, expectancies, family factors, and genetics to name a few.

Somatic anxiety has a markedly different relationship to cannabis and cigarette use compared to alcohol use. The bodily sensation of anxiety is heightened at baseline for adolescents who are smoking cigarettes or cannabis. Additionally, somatic anxiety decreases over time at a faster rate for individuals who are smoking cigarettes and cannabis, indicating that the anxiolytic effects of cannabis and cigarettes are effective at regulating some aspects of anxiety. Given that cigarettes and cannabis' anxiolytic effects on physical stress and tension are immediate, they may be more effective in handling stressful events than other, more adaptive coping responses. Thus, these drugs become the preferred coping mechanism for dealing with physical anxiety (DiClemente, 2003). Additionally, these coping mechanisms seem to lessen the physical aspects of anxiety, such that individuals who are smoking cigarettes and cannabis more are decreasing their somatic anxiety faster. This was not the case with alcohol use.

Individuals who were drinking regularly decrease their somatic anxiety at the same rate as adolescents who are not drinking at all. So while cannabis and cigarettes do decrease somatic anxiety, alcohol is not an effective coping skill for decreasing the bodily sensation of anxiety.

The mutual-maintenance model may help characterize our results on somatic anxiety. We know that cigarettes have a predictable and reliable withdrawal period (Hughes & Hatsukami, 1986; Shiffman, 1991) during which the symptomology is very similar to tension (Hatsukami et

al., 1984; Hughes & Hatsukami, 1986) and dysphoria (Hatsukami et al., 1984). Cigarettes may reduce somatic anxiety but only because of nicotine's ability to relieve the physical withdrawal symptoms of dependence. It is less clear how the mutual-maintenance model works with cannabis use, given the social context of cannabis use (Stewart at al., 2011). It is possible that the patterns seen with cannabis are actually explained through the comorbid use of cigarettes. The National Household Survey on Drug Abuse (1995) found that 99% of cannabis users also smoked cigarettes. In our sample, of the 984 adolescents who smoked either cannabis or cigarettes, 17% (n = 169) smoked cigarettes alone, 20% (n = 201) smoked cannabis alone, and 62% (n = 614) smoked both cannabis and cigarettes in the same three-month period. Given the comorbidity of cannabis and cigarette use, it is unclear which substance explains the decrease in somatic anxiety, or if there is an interaction effect on anxiety by using both substances.

5.1   Strengths and Limitations

This study has several strengths, including its use of a large sample of both males and females who were followed for several years. The fact that the study followed participants from early adolescence through early adulthood, an important developmental period for the development of anxiety symptoms and substance use, is also a strength. The study integrated previous studies' use of anxiety by using several conceptual views of anxiety (anxious arousal and perceived stress) to allow for a more thorough understanding of the role of anxiety in substance use. We moved beyond the use of more stringent diagnostic criteria such as anxiety disorders (e.g., Angold, Costello, Farmer, Burns, & Erkanli, 1999) and used continuous measures of anxiety symptomatology to target a significant proportion of the adolescent population that has often been overlooked due to the traditional use of diagnostic criteria. We used multiple substances - cigarette, alcohol, and cannabis use - from the same cohort to allow direct comparisons and limit

inferences across studies and cohorts. This study used mixed regression models to examine the dynamic relationship of the proposed variables over time. Finally, we used several categories of drug use (non-user, regular user) to increase the understanding of how adolescent anxiety changes as function of substance use.

The current study is not without its limitations. As previously mentioned, given the propensity for cross-use, it is difficult to know whether alcohol, cannabis, or cigarettes account for the reduction in anxiety. It is possible that the patterns seen with cannabis use are actually explained through the concurrent use of cigarettes or vice versa. More likely, given the anxiolytic effects of the substances, it is probable that there is an additive effect of using several substances at one time. While both cigarette and cannabis use help decrease the bodily sensation of anxiety at faster rates over time, using them concurrently may be even more effective.

A further limitation of the current study relates to the ecological validity of the substance use groups. While regular users and non-users of substances are clear thresholds, it is more difficult to capture escalation or light use over a period of two years. Latent growth curve modeling is effective at creating viable groups over time for continuous data, such as the number of days smoked in the past 30 days. It is less viable with ordinal data, as is used in our study's cannabis and alcohol use variables. Given this, it is probable that many practical and ecologically valid groups got collapsed into the larger group of regular users, thus losing important information about individual relationships between substances and anxiety.

A limitation and strength of the current study is the high-risk population recruited. The adolescents were selected to capture regular use of substances at an early developmental time point. Given this, it allows for a more thorough understanding of regular use at a vulnerable age. The shortcoming of this method is the generalizability to the adolescent population as a whole.

A final limitation of the study was using linear change in the mixed regression models. Given the fact that the study only had four time points, we decided to limit models to linear change over time. It is possible that over time, anxiety decreases in a non-linear or quadratic fashion, leveling out as the reciprocal effects of substance use become effective over time. However, to successfully capture a more natural change in anxiety (i.e., non-linear), following adolescents beyond four time points will be critical.

REFERENCES

Agosti, V., Nunes, E., & Levin, F. (2002). Rates of psychiatric comorbidity among U.S. residents with lifetime cannabis dependence. *The American Journal of Drug and Alcohol Abuse, 28*(4), 643-652.

Anderson, R. N., & Smith, B. L. (2003). Deaths: Leading causes for 2001. *National Vital Statistics Reports : From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, 52*(9), 1-85.

Angold, A., Costello, E. J., Farmer, E. M., Burns, B. J., & Erkanli, A. (1999). Impaired but undiagnosed. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*(2), 129-137.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Barrett, L. F. (2006). Solving the emotion paradox: Categorization and the experience of emotion. *Personality and Social Psychology Review : An Official Journal of the Society for Personality and Social Psychology, Inc, 10*(1), 20-46.

Bloom, J.W., Kaltenborn, W.T., Paoletii, P., Camilli, A., & Lebowitz, M.D., (1987). Respiratory effects of non-tobacco cigarettes. *Br Med J (Clin Res Ed) 295(6612)*, 1516.

Bonn-Miller, M. O., Zvolensky, M. J., & Bernstein, A. (2007). Marijuana use motives: Concurrent relations to frequency of past 30-day use and anxiety sensitivity among young adult marijuana smokers. *Addictive Behaviors, 32*(1), 49-62.

Bonn-Miller, M. O., Zvolensky, M. J., Bernstein, A., & Stickle, T. R. (2008). Marijuana coping motives interact with marijuana use frequency to predict anxious arousal, panic related catastrophic thinking, and worry among current marijuana users. *Depression and Anxiety, 25*(10), 862-873.

Bonn-Miller, M. O., Zvolensky, M. J., Bernstein, A., & Stickle, T. R. (2008). Marijuana coping motives interact with marijuana use frequency to predict anxious arousal, panic related catastrophic thinking, and worry among current marijuana users. *Depression and Anxiety, 25*(10), 862-873.

Bonomo, Y., Coffey, C., Wolfe, R., Lynskey, M., Bowes, G., & Patton, G. (2001). Adverse outcomes of alcohol use in adolescents. *Addiction (Abingdon, England), 96*(10), 1485-1496.

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

Brook, D. W., Brook, J. S., Zhang, C., Cohen, P., & Whiteman, M. (2002). Drug use and the risk of major depressive disorder, alcohol dependence, and substance use disorders. *Archives of General Psychiatry, 59*(11), 1039-1044.

Brook, J. S., Cohen, P., & Brook, D. W. (1998). Longitudinal study of co-occurring psychiatric disorders and substance use. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*(3), 322-330.

Brown, R. A., Lewinsohn, P. M., Seeley, J. R., & Wagner, E. F. (1996). Cigarette smoking, major depression, and other psychiatric disorders among adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*(12), 1602-1610.

Buckner, J. D., & Schmidt, N. B. (2008). Marijuana effect expectancies: Relations to social anxiety and marijuana use problems. *Addictive Behaviors, 33*(11), 1477-1483.

Buckner, J. D., & Schmidt, N. B. (2009). Social anxiety disorder and marijuana use problems: The mediating role of marijuana effect expectancies. *Depression and Anxiety, 26*(9), 864-870.

Buckner, J. D., Bonn-Miller, M. O., Zvolensky, M. J., & Schmidt, N. B. (2007). Marijuana use motives and social anxiety among marijuana-using young adults. *Addictive Behaviors, 32*(10), 2238-2252.

Buckner, J. D., Schmidt, N. B., Lang, A. R., Small, J. W., Schlauch, R. C., & Lewinsohn, P. M. (2008). Specificity of social anxiety disorder as a risk factor for alcohol and cannabis dependence. *Journal of Psychiatric Research, 42*(3), 230-239.

Buckner, J. D., Zvolensky, M. J., Smits, J. A., Norton, P. J., Crosby, R. D., Wonderlich, S. A., et al. (2011). Anxiety sensitivity and marijuana use: An analysis from ecological momentary assessment. *Depression and Anxiety, 28*(5), 420-426.

Byrne, D. G., Byrne, A. E., & Reinhart, M. I. (1995). Personality, stress and the decision to commence cigarette smoking in adolescence. *Journal of Psychosomatic Research, 39*(1), 53-62. Cappell, H., & Greeley, J., (1987). Alcohol and tension reduction. An update on research and theory. In Blane, T. & Leonard, K. (Eds.), *Psychological theories of drinking and alcoholism (15-54).* New York; Guilford Press.

Centers for Disease Control and Prevention (CDC). (2005a). Annual smoking-attributable mortality, years of potential life lost, and economic costs--united states, 1997-2001. *Morbidity and Mortality Weekly Report, 54*(25), 625-628.

Centers for Disease Control and Prevention (CDC). (2005b). Cigarette smoking among adults – united states, 2003. *Morbidity and Mortality Weekly Report, 54*(20), 509-513.

Chassin, L., Pillow, D. R., Curran, P. J., Molina, B. S., & Barrera, M.,Jr. (1993). Relation of parental alcoholism to early adolescent substance use: A test of three mediating mechanisms. *Journal of Abnormal Psychology, 102*(1), 3-19.

Chassin, L., Presson, C. C., Bensenberg, M., Corty, E., Olshavsky, R. W., & Sherman, S. J. (1981). Predicting adolescents' intentions to smoke cigarettes. *Journal of Health and Social Behavior, 22*(4), 445-455.

Chassin, L., Presson, C. C., Sherman, S. J., & Edwards, D. A. (1991). Four pathways to young-adult smoking status: Adolescent social-psychological antecedents in a midwestern community sample. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association, 10*(6), 409-418.

Chilcoat, H. D., & Breslau, N. (1998). Posttraumatic stress disorder and drug disorders: Testing causal pathways. *Archives of General Psychiatry, 55*(10), 913-917.

Cicchetti, D., & Rogosch, F. A. (2002). A developmental psychopathology perspective on adolescence. *Journal of Consulting and Clinical Psychology, 70*(1), 6-20.

Clark, D. B., Parker, A. M., & Lynch, K. G. (1999). Psychopathology and substance-related problems during early adolescence: A survival analysis. *Journal of Clinical Child Psychology, 28*(3), 333-341.

Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology, 100*(3), 316-336.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396.

Colder, C. R., & Chassin, L. (1993). The stress and negative affect model of adolescent alcohol use and the moderating effects of behavioral undercontrol. *Journal of Studies on Alcohol, 54*(3), 326-333.

Colvin, P. J., & Mermelstein, R. J. (2010). Adolescents' smoking outcome expectancies and acute emotional responses following smoking. *Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco, 12*(12), 1203-1210.

Comeau, N., Stewart, S. H., & Loba, P. (2001). The relations of trait anxiety, anxiety sensitivity, and sensation seeking to adolescents' motivations for alcohol, cigarette, and marijuana use. *Addictive Behaviors, 26*(6), 803-825.

Compton, W. M., Grant, B. F., Colliver, J. D., Glantz, M. D., & Stinson, F. S. (2004). Prevalence of marijuana use disorders in the united states: 1991-1992 and 2001-2002. *JAMA : The Journal of the American Medical Association, 291*(17), 2114-2121.

Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology, 69*(5), 990-1005.

Cooper, M. L., Peirce, R. S., & Huselid, R. F. (1994). Substance use and sexual risk taking among black adolescents and white adolescents. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association, 13*(3), 251-262.

Costello, E. J., Erkanli, A., Federman, E., & Angold, A. (1999). Development of psychiatric comorbidity with substance abuse in adolescents: Effects of timing and sex. *Journal of Clinical Child Psychology, 28*(3), 298-311.

Dannon, P. N., Lowengrub, K., Amiaz, R., Grunhaus, L., & Kotler, M. (2004). Comorbid cannabis use and panic disorder: Short term and long term follow-up study. *Human Psychopharmacology, 19*(2), 97-101.

DiClemente, C.C. (2003) *Addiction and Change: How Addictions Develop and Addicted People Recover*. New York: Guilford Pres.

Dierker, L., Avenevoli, S., Merikangas, K., Flaherty, B., & Stolar, M. (2001) Association between Psychiatric Disorders and the Prgoression of Tobacco Use Behaviors. *Journal of the American Academy of Child and Adolscent Psychiatry, 40(10),* 1159-1167.

Dugan, S., Lloyd, B., Lucas, L. (2006) Stress and Coping as Determinants of Adolescent Smoking Behavior. *Journal of Applied Social Psychology, 29 (4),* 870-886.

Durant, R. H., Altman, D., Wolfson, M., Barkin, S., Kreiter, S., & Krowchuk, D. (2000). Exposure to violence and victimization, depression, substance use, and the use of violence by young adolescents. *The Journal of Pediatrics, 137*(5), 707-713.

Ekman, P. (1984). Expression and the nature of emotion. In K. Scherer & P. Ekman (eds). *Approaches to Emotion.* Hillsdale, NJ: Erlbaum, 319-344.

Fagerstrom, K. (2002). Smoking reduction in the management of COPD. *Monaldi Archives for Chest Disease = Archivio Monaldi Per Le Malattie Del Torace / Fondazione Clinica Del Lavoro, IRCCS [and] Istituto Di Clinica Tisiologica e Malattie Apparato Respiratorio, Universita Di Napoli, Secondo Ateneo, 57*(5-6), 281-284.

Fleming, R., Baum, A., & Singer, J. E. (1984). Toward an integrative approach to the study of stress. *Journal of Personality and Social Psychology, 46*(4), 939-949.

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

Frith, C. D. (1971). Smoking behaviour and its relation to the smoker's immediate experience. *The British Journal of Social and Clinical Psychology, 10*(1), 73-78.

Fryar, C. D., Merino, M. C., Hirsch, R., & Porter, K. S. (2009). Smoking, alcohol use, and illicit drug use reported by adolescents aged 12-17 years: United states, 1999-2004. *National Health Statistics Reports, (15)*(15), 1-23.

Grant, B. F., Stinson, F. S., Dawson, D. A., Chou, S. P., Dufour, M. C., Compton, W., et al. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry, 61*(8), 807-816.

Greeley, J., & Oei, T., (1999). Alcohol and tension reduction. In Blane, T. & Leonard, K. (Eds.), *Psychological theories of drinking and alcoholism* (2nd ed.). New York: Guilford Press.

Hathaway, A. (2003) Cannabis effects and dependency concerns in long-term frequent users: a missing piece of the public health puzzle. *Addiction Research and Theory, 11(6)* 441-458.

Hatsukami, D. K., Hughes, J. R., Pickens, R. W., & Svikis, D. (1984). Tobacco withdrawal symptoms: An experimental analysis. *Psychopharmacology, 84*(2), 231-236.

Hill, S. Y., Shen, S., Lowers, L., & Locke, J. (2000). Factors predicting the onset of adolescent drinking in families at high risk for developing alcoholism. *Biological Psychiatry, 48*(4), 265-275.

Hughes, J. R., & Hatsukami, D. (1986). Signs and symptoms of tobacco withdrawal. *Archives of General Psychiatry, 43*(3), 289-294.

Hussong, A. M., & Chassin, L. (1994). The stress-negative affect model of adolescent alcohol use: Disaggregating negative affect. *Journal of Studies on Alcohol, 55*(6), 707-718.

Hussong, A. M., Curran, P. J., & Chassin, L. (1998). Pathways of risk for accelerated heavy alcohol use among adolescent children of alcoholic parents. *Journal of Abnormal Child Psychology, 26*(6), 453-466.

Hussong, A. M., Hicks, R. E., Levy, S. A., & Curran, P. J. (2001). Specifying the relations between affect and heavy alcohol use among young adults. *Journal of Abnormal Psychology, 110*(3), 449-461.

Jackson, K. M., & Sher, K. J. (2003). Alcohol use disorders and psychological distress: A prospective state-trait analysis. *Journal of Abnormal Psychology, 112*(4), 599-613.

Jackson, K. M., Sher, K. J., & Wood, P. K. (2000). Prospective analysis of comorbidity: Tobacco and alcohol use disorders. *Journal of Abnormal Psychology, 109*(4), 679-694.

Johnson, J. G., Cohen, P., Pine, D. S., Klein, D. F., Kasen, S., & Brook, J. S. (2000). Association between cigarette smoking and anxiety disorders during adolescence and early adulthood. *JAMA : The Journal of the American Medical Association, 284*(18), 2348-2351.

Johnson, K. A., Bonn-Miller, M. O., Leyro, T. M., & Zvolensky, M. J. (2009). Anxious arousal and anhedonic depression symptoms and the frequency of current marijuana use: Testing the mediating role of marijuana-use coping motives among active users. *Journal of Studies on Alcohol and Drugs, 70*(4), 543-550.

Johnson, P. B., Boles, S. M., Vaughan, R., & Kleber, H. D. (2000). The co-occurrence of smoking and binge drinking in adolescence. *Addictive Behaviors, 25*(5), 779-783.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2013). *Monitoring the Future national results on adolescent drug use: Overview of key findings, 2012*. Ann Arbor: Institute for Social Research, The University of Michigan.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2011a). *Monitoring the Future national survey results on drug use, 1975-2010. Volume I: Secondary school students*. Ann Arbor: Institute for Social Research, The University of Michigan, 734.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2011b). *Monitoring the Future national results on adolescent drug use: Overview of key findings, 2010*. Ann Arbor: Institute for Social Research, The University of Michigan, 77.

Johnston, L.D., O'Malley, P.M., Bachman, J.G., & Schulenberg, J.E. (2011). *Monitoring the Future: National Results on Adolescent Drug Use. Overview of Key Findings, 2011.* (NIH Publication No. 06-5882). Bethesda, MD: National Institute on Drug Abuse.

Kandel, D., (1982) Epidemiological and Psychosocial Perspectives on Adolescent Drug Use. *Journal of the American Academy of Child Psychiatry, 21(4), 328-347.*

Kaplow, J. B., Curran, P. J., Angold, A., & Costello, E. J. (2001). The prospective relation between dimensions of anxiety and the initiation of adolescent alcohol use. *Journal of Clinical Child Psychology, 30*(3), 316-326.

Kassel, J.D., Evatt, D.P., Greenstein, J.E., Wardle, M.C., Yates, M.C., & Veilleux, J.C. (2007). The acute effects of nicotine on positive and negative affect in adolescent smokers. *Journal of Abnormal Psychology, 116*(3), 543-553.

Kassel, J.D., Stroud, L.R., & Paronis, C.A. (2003). Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. *Psychological Bulletin, 129*(2), 270-304.

Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., et al. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the united states. results from the national comorbidity survey. *Archives of General Psychiatry, 51*(1), 8-19.

Kessler, R. C., Nelson, C. B., McGonagle, K. A., Edlund, M. J., Frank, R. G., & Leaf, P. J. (1996). The epidemiology of co-occurring addictive and mental disorders: Implications for prevention and service utilization. *The American Journal of Orthopsychiatry, 66*(1), 17-31.

Khantzian, E. J. (1997). The self-medication hypothesis of substance use disorders: A reconsideration and recent applications. *Harvard Review of Psychiatry, 4*(5), 231-244.

King, K. M., & Chassin, L. (2007). A prospective study of the effects of age of initiation of alcohol and drug use on young adult substance dependence. *Journal of Studies on Alcohol and Drugs, 68*(2), 256-265.

Kirkcaldy, B., Cooper, C., Brown, J., Litt, A. (2006) Job Stress and health profiles of smokers, ex-smokers and non-smokers. *Stress and Health, 10 (3),* 159 -166.

Koval, J. J., Pederson, L. L., Mills, C. A., McGrady, G. A., & Carvajal, S. C. (2000). Models of the relationship of stress, depression, and other psychosocial factors to smoking behavior: A comparison of a cohort of students in grades 6 and 8. *Preventive Medicine, 30*(6), 463-477.

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.

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.

Kushner, M. G., Sher, K. J., & Beitman, B. D. (1990). The relation between alcohol problems and the anxiety disorders. *The American Journal of Psychiatry, 147*(6), 685-695.

Labouvie, E. (1986) Alcohol and Marijuana Use in Relation to Adolescent Stress. *Substance Use and Misuse, 21(3)* 333-345.

Larson, R. W., Moneta, G., Richards, M. H., & Wilson, S. (2002). Continuity, stability, and change in daily emotional experience across adolescence. *Child Development, 73*(4), 1151-1165.

Leventhal, H., & Cleary, P. D. (1980). The smoking problem: A review of the research and theory in behavioral risk modification. *Psychological Bulletin, 88*(2), 370-405.

Marmorstein, N. R., White, H. R., Loeber, R., & Stouthamer-Loeber, M. (2010). Anxiety as a predictor of age at first use of substances and progression to substance use problems among boys. *Journal of Abnormal Child Psychology, 38*(2), 211-224.

McBride, P. E. (1992). The health consequences of smoking. cardiovascular diseases. *The Medical Clinics of North America, 76*(2), 333-353.

McCrae, R. R., Costa, P. T.,Jr, & Bosse, R. (1978). Anxiety, extraversion and smoking. *The British Journal of Social and Clinical Psychology, 17*(3), 269-273.

McDonald, J., Schleifer, L., Richards, J. B., & de Wit, H. (2003). Effects of THC on behavioral measures of impulsivity in humans. *Neuropsychopharmacology : Official Publication of the American College of Neuropsychopharmacology, 28*(7), 1356-1365.

McGee, R., Williams, S., & Stanton, W. (1998). Is mental health in childhood a major predictor of smoking in adolescence? *Addiction (Abingdon, England), 93*(12), 1869-1874.

Merikangas, K. R., Mehta, R. L., Molnar, B. E., Walters, E. E., Swendsen, J. D., Aguilar-Gaziola, S., et al. (1998). Comorbidity of substance use disorders with mood and anxiety disorders: Results of the international consortium in psychiatric epidemiology. *Addictive Behaviors, 23*(6), 893-907.

Miller JW, Naimi TS, Brewer RD, Jones SE (2007). Binge drinking and associated health risk behaviors among high school students. *Pediatrics 119*, 76–85.

Moberg, D. P. (1983). Identifying adolescents with alcohol problems. A field test of the adolescent alcohol involvement scale. *Journal of Studies on Alcohol, 44*(4), 701-721.

Morris, E.P., Stewart, S.H., & Ham, L.S. (2005). The relationship between social anxiety disorder and alcohol use disorders: A critical review. *Clinical Psychology Review 25(6),* 734-760.

Munafò MR, Hitsman B, Rende R, Metcalfe C, Niaura R. (2008). Effects of progression to cigarette smoking on depressed mood in adolescents: Evidence from the National Longitudinal Study of Adolescent Health. *Addiction 103*, 162–71.

Munafo, M. R., Zetteler, J. I., & Clark, T. G. (2007). Personality and smoking status: A meta-analysis. *Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco, 9*(3), 405-413.

Naimi, T. S., Brewer, R. D., Mokdad, A., Denny, C., Serdula, M. K., & Marks, J. S. (2003). Binge drinking among US adults. *JAMA : The Journal of the American Medical Association, 289*(1), 70-75.

Naquin, M. R., & Gilbert, G. G. (1996). College students' smoking behavior, perceived stress, and coping styles. *Journal of Drug Education, 26*(4), 367-376.

Newcomb, M. D., & Harlow, L. L. (1986). Life events and substance use among adolescents: Mediating effects of perceived loss of control and meaninglessness in life. *Journal of Personality and Social Psychology, 51*(3), 564-577.

Newcomb, P. A., & Carbone, P. P. (1992). The health consequences of smoking. cancer. *The Medical Clinics of North America, 76*(2), 305-331.

Novak, S. P., & Clayton, R. R. (2001). The influence of school environment and self-regulation on transitions between stages of cigarette smoking: A multilevel analysis. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association, 20*(3), 196-207.

O'Malley, P. M., Johnston, L. D., & Bachman, J. G. (1998). Alcohol use among adolescents. *Alcohol Health and Research World, 22*(2), 85-93.

Oatley, K., & Jenkins, J. M. (1992). Human emotions: Function and dysfunction. *Annual Review of Psychology, 43*, 55-85.

Pardini, D., White, H. R., & Stouthamer-Loeber, M. (2007). Early adolescent psychopathology as a predictor of alcohol use disorders by young adulthood. *Drug and Alcohol Dependence, 88 Suppl 1*, S38-49.

Parrott, A. C. (1999). Does cigarette smoking cause stress? *The American Psychologist, 54*(10), 817-820.

Patton, G. C., Carlin, J. B., Coffey, C., Wolfe, R., Hibbert, M., & Bowes, G. (1998). Depression, anxiety, and smoking initiation: A prospective study over 3 years. *American Journal of Public Health, 88*(10), 1518-1522.

Patton, G. C., Hibbert, M., Rosier, M. J., Carlin, J. B., Caust, J., & Bowes, G. (1996). Is smoking associated with depression and anxiety in teenagers? *American Journal of Public Health, 86*(2), 225-230.

Penning, M., & Barnes, G. E. (1982). Adolescent marijuana use: A review. *The International Journal of the Addictions, 17*(5), 749-791.

Poikolainen, K., Aalto-Setala, T., Marttunen, M., Tuulio-Henriksson, A., & Lonnqvist, J. (2000). Predictors of somatic symptoms: A five year follow up of adolescents. *Archives of Disease in Childhood, 83*(5), 388-392.

Pomerleau, O. F., Turk, D. C., & Fertig, J. B. (1984). The effects of cigarette smoking on pain and anxiety. *Addictive Behaviors, 9*(3), 265-271.

Reifman, A., & Windle, M. (1995). Adolescent suicidal behaviors as a function of depression, hopelessness, alcohol use, and social support: A longitudinal investigation. *American Journal of Community Psychology, 23*(3), 329-354.

Reilly, D., Didcott, P., Swift, W., & Hall, W. (1998). Long-term cannabis use: Characteristics of users in an australian rural area. *Addiction (Abingdon, England), 93*(6), 837-846.

Richey, J. A., Lonigan, C. J., & Phillips, B. M. (2002) Exploratory Factor Analysis of the Mood and Anxiety Symptom Questionnaire (MASQ) in a Youth Sample.

Sartor, C., Lynskey, M., Heath, A., Jacob, T, & True, W. (2006) The role of childhood risk factors in initiation of alcohol use and progression to alcohol dependence. *Addiction, 102(2),* 216 – 225.

Schafer, J., & Brown, S. A. (1991). Marijuana and cocaine effect expectancies and drug use patterns. *Journal of Consulting and Clinical Psychology, 59*(4), 558-565.

Schulenberg, J., Maggs, J. L., Long, S. W., Sher, K. J., Gotham, H. J., Baer, J. S., et al. (2001). The problem of college drinking: Insights from a developmental perspective. *Alcoholism, Clinical and Experimental Research, 25*(3), 473-477.

Sher, K. J., & Levenson, R. W. (1982). Risk for alcoholism and individual differences in the stress-response-dampening effect of alcohol. *Journal of Abnormal Psychology, 91*(5), 350-367.

Sher, K.J. (1987) Stress response dampening. In Blane, T. & Leonard, K. (Eds.), *Psychological theories of drinking and alcoholism* (227 -271). New York; Guilford Press.

Shiffman, S. (1991). Refining models of dependence: Variations across persons and situations. *British Journal of Addiction, 86*(5), 611-615.

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

Singer, J. D., & Willett, J. B. (1994). Designing and analyzing studies of onset, cessation, and relapse: Using survival analysis in drug abuse prevention research. *NIDA Research Monograph, 142*, 196-263.

Siqueira, L., Diab, M., Bodian, C., & Rolnitzky, L. (2000). Adolescents becoming smokers: The roles of stress and coping methods. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine, 27*(6), 399-408.

Stein, J. A., Newcomb, M. D., & Bentler, P. M. (1988). Structure of drug use behaviors and consequences among young adults: Multitrait-multimethod assessment of frequency, quantity, work site, and problem substance use. *The Journal of Applied Psychology, 73*(4), 595-605.

Stephens, R. S., Roffman, R. A., & Simpson, E. E. (1993). Adult marijuana users seeking treatment. *Journal of Consulting and Clinical Psychology, 61*(6), 1100-1104.

Stewart, D.G. & Brown, S.A. (2006). Withdrawal and dependency symptoms among adolescent alcohol and drug abusers. *Journal of Addiction, 90(5),* 627 -635.

Swaim, R. C., Oetting, E. R., Edwards, R. W., & Beauvais, F. (1989). Links from emotional distress to adolescent drug use: A path model. *Journal of Consulting and Clinical Psychology, 57*(2), 227-231.

Swendsen, J. D., Merikangas, K. R., Canino, G. J., Kessler, R. C., Rubio-Stipec, M., & Angst, J. (1998). The comorbidity of alcoholism with anxiety and depressive disorders in four geographic communities. *Comprehensive Psychiatry, 39*(4), 176-184.

Swendsen, J., Conway, K. P., Degenhardt, L., Dierker, L., Glantz, M., Jin, R., et al. (2009). Socio-demographic risk factors for alcohol and drug dependence: The 10-year follow-up of the national comorbidity survey. *Addiction (Abingdon, England), 104*(8), 1346-1355.

U.S. Department of Health and Human Services (1994). *Preventing Tobacco Use Among Young People: A Report of the Surgeon General*. Atlanta, Georgia: Author.

U.S. Department of Health and Human Services (2004). *2002 National Survey on Drug Use & Health*. Office of Applied Studies. Rockville, MD: Author.

Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology, 97*(3), 346-353.

Watson, D., Weber, K., Assenheimer, J. S., Clark, L. A., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: I. evaluating the convergent and discriminant validity of anxiety and depression symptom scales. *Journal of Abnormal Psychology, 104*(1), 3-14.

Weller, R. A., & Halikas, J. A. (1985). Marijuana use and psychiatric illness: A follow-up study. *The American Journal of Psychiatry, 142*(7), 848-850.

West, R. J., Jarvis, M. J., Russell, M. A., Carruthers, M. E., & Feyerabend, C. (1984). Effect of nicotine replacement on the cigarette withdrawal syndrome. *British Journal of Addiction, 79*(2), 215-219.

Wills, T. A., & Shiffman, S. (1985). Coping behavior and its relation to substance use: A conceptual framework. In S. Shiffman & T. A. Wills (Eds.), *Coping and substance use* (3-24). New York: Academic Press.

Wills, T. A., DuHamel, K., & Vaccaro, D. (1995). Activity and mood temperament as predictors of adolescent substance use: Test of a self-regulation mediational model. *Journal of Personality and Social Psychology, 68*(5), 901-916.

Wills, T. A., Sandy, J. M., Yaeger, A. M., Cleary, S. D., & Shinar, O. (2001). Coping dimensions, life stress, and adolescent substance use: A latent growth analysis. *Journal of Abnormal Psychology, 110*(2), 309-323.

Wills, T. A., Walker, C., Mendoza, D., & Ainette, M. G. (2006). Behavioral and emotional self-control: Relations to substance use in samples of middle and high school students. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors, 20*(3), 265-278.

Windle, M., & Windle, R. C. (2001). Depressive symptoms and cigarette smoking among middle adolescents: Prospective associations and intrapersonal and interpersonal influences. *Journal of Consulting and Clinical Psychology, 69*(2), 215-226.

Zimmermann, P., Wittchen, H. U., Hofler, M., Pfister, H., Kessler, R. C., & Lieb, R. (2003). Primary anxiety disorders and the development of subsequent alcohol use disorders: A 4-year community study of adolescents and young adults. *Psychological Medicine, 33*(7), 1211-1222.

Zvolensky, M. J., Lewinsohn, P., Bernstein, A., Schmidt, N. B., Buckner, J. D., Seeley, J., et al. (2008). Prospective associations between cannabis use, abuse, and dependence and panic attacks and disorder. *Journal of Psychiatric Research, 42*(12), 1017-1023.

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

Appendix A

Current Cigarette Smoking Behavior: Days Smoked

Think about the past 30 days. On the days you smoked cigarettes, about how many cigarettes did you smoke each day?

Current Cigarette Smoking Behavior: Cigarettes per Day

Think about the past 30 days. On the days you smoked cigarettes, about how many cigarettes did you smoke each day?

Appendix B

Current Alcohol and Cannabis Use

	During the past 3 months, how often did you:	Zero Times	Once a Month or Less	More than once a month but less than once a week	One or more times a week but not every day	Every day
1.	Have at least one drink of alcohol.......…	1	2	3	4	5
2.	Smoke cannabis.............……………	1	2	3	4	5

Appendix C

Somatic Anxiety

	In the past week…	Not at all	A little bit	Moderately	Quite a bit	Extremely
1.	Felt Nervous	1	2	3	4	5
2.	Felt Faint	1	2	3	4	5
3.	Felt dizzy or lightheaded	1	2	3	4	5
4.	Was unable to relax	1	2	3	4	5
5.	Felt like I was going crazy	1	2	3	4	5
6.	Heart was racing or pounding	1	2	3	4	5
7.	Muscles were tense or sore	1	2	3	4	5

Appendix D

Perceived Stress Scale

		Never	Almost never	Sometimes	Fairly often	Very often
1.	In the last month how often have you felt that you were unable to control the important things in your life?	1	2	3	4	5
2.	In the last month how often have you felt confident about your ability to handle your personal problems?	1	2	3	4	5
3.	In the last month how often have you felt that things were going your way?	1	2	3	4	5
4.	In the last month how often have you felt difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

Peter Johnson Colvin

University of Illinois at Chicago
Department of Psychology
W. Harrison (M/C 285)
Chicago, IL 60608

7055 Charmant Dr
San Diego, CA
(312) 550-3884
PColvi2@uic.edu

Education

2011 - 2013   **Candidate, Doctor of Philosophy in Psychology**
University of Illinois at Chicago, *Chicago, IL*
Major**:** Clinical Psychology (APA Accredited, Accredited member of the Academy of Psychological Clinical Science)
Advisor: Robin Mermelstein, Ph.D.
Dissertation Title: *Patterns of Anxiety, Stress, and Substance Use Through Adolescence*
Dissertation Proposal Accepted: September 2011
Dissertation Defense: June 2013

2012/2013   **UCSD/SDVA Predoctoral Clinical Psychology Internship**
OEF/OIF/OND PTSD and Substance Abuse/Mental Illness Clinic
Chief Intern Representative

2011   **Completion of Preliminary Paper**
Title: *Examining the Direct and Indirect Influence of Temperament on Adolescent Smoking Trajectories: Is this Relationship Mediated by Deviant Peer Group Affiliation?*

2009   **Master of Arts in Psychology**
University of Illinois at Chicago, *Chicago, IL*
Major: Clinical Psychology
Thesis: *Adolescents' Acute Emotional Responses Following Smoking: Examining the Role of Expectancies*
Committee: Robin Mermelstein, Ph.D., Raul Gonzales, Ph.D., & Evelyn Behar, Ph.D.

2001   **Bachelor of Arts**
Wesleyan University, *Middletown, CT*
Major: College of Social Studies - Government, History, Economics, and Social Theory
Thesis Title: *Examining the Relationship between Gender and Violence*

Clinical Experience

July 2012 – *present*   **Internship in OEF/OIF/OND PTSD Clinic and Substance Abuse/Mental Illness**

Institution: UCSD/San Diego VA   *Hours Per Week: 40*
Responsibilities: Chief Intern Representative– liaison between internship class and training directors

OEF/OIF/OND PTSD Clinic – Supervisor: Abigail Goldsmith, Ph.D.
- Conduct evidence-based, time-limited Prolonged Exposure, Cognitive Processing Therapy, and Acceptance and Commitment Therapy
- Run Seeking Safety, CPT, DBT, and Skills groups
- Administer semi-structured PTSD intake interviews and needs assessments
- Administer research protocols for comorbid PTSD and substance dependence
- Supervise trainees under the supervision of the psychology faculty
- Work within a multidisciplinary treatment team of psychologists, psychiatrists, practicum students, chaplains, and social workers

Substance Abuse/Mental Illness Clinic – Supervisor: Ryan Trim, Ph.D.
- Provide individual and group treatment for comorbid substance use and bipolar, PTSD, anxiety, and schizophrenia disorders
- Conduct semi-structured Dual-Diagnosis intake interviews and needs assessments
- Engage veterans in motivational enhancement for substance use disorders and mental illness
- Supervise trainees under the supervision of the psychology faculty
- Work within a multidisciplinary treatment team of psychologists, psychiatrists, practicum students, chaplains, and social workers
- Participate in weekly group and individual supervision meetings

July 2011 – June 2012   **Advanced Practicum in Trauma Services and Addiction Treatment**

Institution: Edward Hines, Jr. VA Hospital   *Hours Per Week: 18*

Supervisor: Elizabeth Frazier, Ph.D.
- Provided evidence-based, time-limited Prolonged Exposure and Cognitive Processing Therapy with veterans who present with PTSD and comorbid substance abuse
- Conducted semi-structured Dual-Diagnosis (Trauma and Addiction Services) intake interviews and needs assessments
- Conducted semi-structured Addiction Services intake interviews, needs assessments, and orientations
- Facilitated Seeking Safety harm reduction groups and CPT for dual-diagnosis veterans
- Provided individual substance abuse interventions
- Led Problem Area Review motivational enhancement groups
- Participated in weekly supervision meetings
- Developed initial and ongoing treatment plans, prepared summary reports of therapeutic progress and goals

July 2010 – June 2011   ***Practicum in Trauma Services***

Institution: Edward Hines, Jr. VA Hospital   *Hours Per Week: 18*

Supervisors: Barbara Pamp, Ph.D. & Elizabeth Frazier, Ph.D.
- Provided evidence-based, time-limited Prolonged Exposure and Cognitive Processing Therapy to veterans with PTSD
- Conducted Dual-Diagnosis (Trauma and Addiction Services) intake interviews
- Led psychoeducational groups on PTSD for veterans

- Co-facilitated dialectical behavior therapy derived Mindfulness Based Coping Skills Group
- Participated in weekly supervision meetings
- Developed initial and ongoing treatment plans, prepared summary reports of therapeutic progress and goals

July 2008 – Sept 2011   **Practicum in Clinical Intervention**

Institution: University of Illinois at Chicago   Hours Per Week: 18

Supervisors: Gloria Balague, Ph.D., Nancy Dassoff, Ph.D., Jon Kassel, Ph.D., & Stewart Shankman,
- Provided individual CBT psychotherapy for Axis I and Axis II disorders. Specifically, anxiety, depression, trauma, borderline personality disorder, and obsessive-compulsive disorders. Treatment focused on cognitive-behavioral approaches and components of dialectic behavior therapy
- Participated in weekly group and individual supervision meetings
- Conducted comprehensive intake interviews
- Prepared complete psychological reports including case formulation, initial psychiatric diagnoses, and treatment recommendations and goals
- Trained and mentored first-year clinical graduate students in intake interview

May 2008 – Aug 2010   ***Practicum in Psychological Assessment***

Institution: University of Illinois at Chicago   Hours Per Week: 5

Supervisors: Audrey Ruderman, Ph.D. & Nancy Dassoff, Ph.D.
- Conducted clinical intake interviews with children, adolescents, and adults. Assessments issued included anxiety, depression, ADHD, disruptive behaviors, schizotypal personality disorder, and intellectual, learning, and developmental disabilities
- Administered and scored diagnostic, neuropsychological, cognitive, and personality assessments
- Prepared integrated assessment reports and participated in feedback sessions with clients
- Participated in supervision meetings

Aug 2002 – June 2007   ***Staff Field Mentor***

Institution: Second Nature, Duchesne, UT   Hours Per Week: 40

Supervisor: Steven DuBois, Ph.D.
- Used evidence-based cognitive behavioral therapy model to work with at-risk adolescents to help foster self-regulation, positive adjustment, and positive behavioral choices
- Led individual, group, and family therapy sessions under the supervision of a Ph.D. psychologist
- Assisted adolescents who had behavioral issues, substance abuse, low self-esteem, physical abuse, and trauma
- Supervised and trained staff, under the supervision of a Ph.D. psychologist, in basic cognitive therapy approaches and appropriate behavioral interventions

Specialized Training and Workshops

2012   *Cognitive Processing Therapy Training (Group + Individual).* University of California San Diego.
            Facilitators: Rodgers, C., Ph.D.
            Consultation: Rodgers, C., Ph.D.

2012   *Prolonged Exposure for PTSD.* University of California San Diego.
            Facilitators: Thorp, S., Ph.D.

2012   *Motivational Interviewing.* University of California San Diego.
            Facilitators: Carlson, M., Ph.D.

2009   *Treating Our Wounded Warriors: Prolonged Exposure Therapy for Combat-Related PTSD.* ABCT
            conference, NY. Facilitators: Peterson, M., Riggs, D., & Cigrang, J.

2009   *Learning ACT.* ABCT conference, NY. Facilitators: Hayes, S., Ph.D.

2009   *Mindfulness, Radical Acceptance, and Willingness.* ABCT conference, NY
            Facilitators: Linehan, M., Ph.D.

2009   *Acceptance and Commitment Therapy for Anxiety Disorders.* ABCT conference, NY.
            Facilitators: Forsyth, J., Ph.D. & Eifert, G. Ph.D.

2008   *Treating Trauma Survivors: Prolonged Exposure Therapy Training for PTSD with a Focus On Our
            Returning Warriors.* – 3 day training. College of DuPage, IL.
            Facilitators: Domenici, P., Ph.D., & Ermold, J., Ph.D.

2008   *Motivational Interviewing.* University of Illinois at Chicago and University of Utah.
            Facilitators: Kassel, J., Ph.D.

Research Experience

May 2009 – June 2011 **Graduate Research Assistant**

Institution: University of Illinois at Chicago, Department of Psychiatry   Hours Per Week: 8
Supervisor: Raul Gonzales, Ph.D.
Funded by: K23 DA023560 from National Institute of Drug Abuse

Cannabis Addiction and Neuroscience study attempts to examine the relationship between neurocognitive disinhibition and cannabis use among a sample of participants between the ages of 18 and 24. Specifically, the study aims to delineate neurocognitive vulnerabilities for development of substance use disorders; neurocognitive impairments that may result from dependence on substances of abuse; neurocognitive processes associated with drug addiction (e.g., decision making, disinhibition, and other executive functions); and the neurocognitive interactions between sexually risky behaviors and substance use disorders.

Responsibilities:
- Managed and analyzed data set

- Retained large adolescent participant pool
- Conducted clinical interviews
- Prepared posters and manuscripts
- Recruited participants

May 2007 – June 2010   **Graduate Research Assistant**

     Institution: Institute for Health Research Policy   Hours Per Week: 20
     Supervisor: Robin Mermelstein, Ph.D.
     Funded by: 5PO1 CA98262 from the National Cancer Institute

Social-Emotional Contexts of Adolescent Smoking Patterns focused on increasing understanding of the patterns of adolescent smoking. Specifically, tracked the natural history of these patterns and examined in-depth some key selected contextual factors that may influence them. A major focus was on the social-emotional contexts with an emphasis on depression, anxiety, problem behaviors, and positive affective domains.

Responsibilities:
- Attended multidisciplinary Project Investigator meetings
- Managed and analyzed multi-level longitudinal data set
- Retained large adolescent participant pool
- Prepared posters and manuscripts

April 2005 – May 2007   **Research Assistant**

     Institution: University of Utah, Department of Psychology   Hours Per Week: 8
     Supervisor: Paul Florsheim, Ph.D.

Youth Alcohol and Drug Study focused on clinical and developmental issues relevant to at-risk youth, including the development and treatment of antisocial behavior and substance abuse, factors related to the adjustment of adolescent parents, and the role of adolescent romantic relationships in development. Evaluated the effectiveness of personalized imagery techniques to stimulate and reduce craving in an adolescent population.

Responsibilities:
- Prepared posters and manuscripts
- Managed data collection and participant database
- Administered clinical interviews to research participants
- Scored and coded responses to surveys
- Data Entry
- Recruited participants

April 2005 – May 2007   **Research Assistant**

     Institution: University of Utah, Department of Psychology   Hours Per Week: 8
     Supervisor: Erin Ingoldsby, Ph.D.

Kids in Context Study examined relations among child and family factors, peer and school, and community and cultural contexts. Specifically, the study focused on the development and

functioning of these relationships in the context of impoverished, at-risk neighborhoods. Examined pre-adolescents and adolescents and the time spent with deviant peer groups. **GIS Study** used Geographic Information Systems to examine the effects of the neighborhood on externalizing problems in 10-year-old boys.
Callous-Unemotional Adolescents and Relationships examined the interpersonal relationships and callous-unemotional traits in juvenile justice adolescents.

Responsibilities:
- Managed data collection and participant database
- Administered clinical interviews to research participants
- Scored and coded responses to surveys
- Data Entry
- Recruited participants
- Prepared posters and manuscripts

Publications

Colvin, P. & Mermelstein, R. (*Under Review*, 2012). Examining the direct and indirect influence of novelty seeking on adolescent smoking trajectories: Is this relationship mediated by deviant peer group affiliation? *Addictive Behaviors.*

Colvin, P. & Mermelstein, R. (2010). Adolescents' acute emotional responses following smoking: Examining the role of expectancies. *Nicotine and Tobacco Research, 12*(12), 1203-1210.

Veilleux, J.C., **Colvin, P.J.**, Anderson, J., York, C., & Heinz, A.J. (2010). A review of opioid dependence treatment: Pharmacological and psychosocial interventions to treat opioid addiction. *Clinical Psychology Review, 30*(2), 155-166.

Mermelstein, R. J., **Colvin, P. J**., & Klingemann, S. D. (2009). Dating and changes in adolescent cigarette smoking: Does partner smoking behavior matter? *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, 11*(10), 1226-1230.

Florsheim, P., Heavin, S., Tiffany, S., **Colvin, P**., & Hiraoka, R. (2007). An experimental test of a craving management technique for adolescents in substance-abuse treatment. *Journal of Youth and Adolescence, 37,* 1205 - 1215.

Conference Presentations and Symposium

Colvin, P., Mermelstein, R., & Schuster, R. (March, 2011). Pathways Between Unsupervised Time at Home and Substance Use Among Adolescents. *Association for Psychological Science.* Washington, DC.

Schuster, R., **Colvin, P.,** & Gonzales, R. (February, 2011). Compensatory Effects of Nicotine on Declarative Memory Among Recent Cannabis and Nicotine Using Young Adults. *International Neuropsychology Society.* Boston, MA.

Colvin, P., & Mermelstein, R. (February, 2010). Adolescents' Sources of Cigarettes and Future Smoking Behavior. *Society for Research on Nicotine and Tobacco*, Baltimore, MD.

Pagkas-Bather, J., Schuster, R., Labuschagne, Z., **Colvin, P.**, Martin-Thormeyer, E., & Gonzalez, R. (April, 2010). Cannabis Use and Sexual Risk Behaviors Among Adolescents and Young Adults. *Society of Teachers of Family Medicine.* Vancouver, British Columbia.

Schuster, R. M., **Colvin, P. J**., Labuschagne, Z., Pagkas-Bather, J., Diviak, K., Mermelstein, R., Vassileva, J., & Gonzalez, R. (February, 2010). Neurocognitive disinhibition and risky sexual behavior among emerging adults with and without cannabis use. *International Neuropsychological Society.* Acapulco, Mexico.

Colvin, P., & Mermelstein, R. (April, 2009) Adolescents' acute negative affect change following smoking: Examining the role of expectancies. In A. McNeill (Co-Chair) and D. Rodriguez (Co-Chair), *Teens and Tobacco: What They Do and What to Do.* Symposium conducted at the annual meeting of Society for Research on Nicotine and Tobacco. Dublin, Ireland.

Richmond, M.J., Schuster, R.M., **Colvin, P.J**., Mermelstein, R.J., & Metzger, A. (April, 2009). The longitudinal effects of complex friendship groups on adolescent health behaviors. *Society of Behavioral Medicine*, Montreal, Canada.

Schuster, R.M., **Colvin, P. J.**, Richmond, M. J., & Mermelstein, R. (April, 2009). Gender differences in sexual risk taking and smoking acceleration in adolescents. *Society for Research on Nicotine and Tobacco*, Dublin, Ireland.

Colvin, P., Ingoldsby, E., Florsheim, P., & Hossli, J. (October, 2006) Understanding relations among callous-unemotional traits and the development of therapeutic alliance for antisocial adolescents. *The Kansas Conference in Clinical Child and Adolescent Psychology.* Lawrence, KS.

Heavin, S., **Colvin, P.**, Florsheim, P., & Tiffany, S. (October, 2006). Individual differences in craving experience among adolescents with substance use disorders. *The Kansas Conference in Clinical Child and Adolescent Psychology.* Lawrence, KS.

Heavin, S., **Colvin, P.**, Florsheim, P., & Tiffany, S. (April, 2006). Examining the effects of parental drug use on children's substance use, craving, and effectiveness of imagery techniques. *Rocky Mountain Psychological Association*. Park City, UT.

Invited Lectures

Colvin, P. (October, 2011) *Lessons in Being a Graduate Student Teacher.* Talk presented to the University of Illinois, Chicago's graduate level Teaching Practicum.

Colvin, P. (August, 2011) *Understanding PTSD and Engaging a Veteran Population in the Workplace.* Talk presented to the Chicago Social Security Administration, Regional Directors.

Colvin, P. (June, 2011) *An Introduction to Post Traumatic Stress Disorder.* Talk presented to the Chicago Social Security Administration, General Staff Team.

Colvin, P. (May, 2011) *Minimizing Attrition Rates in Veteran's with PTSD.* Talk presented to the Trauma Services Clinical Team, Edward Hines, Jr. VA.

Colvin, P. (April, 2011) *Understanding PTSD and Engaging a Veteran Population in the Workplace*. Talk presented the Chicago Social Security Administration, District Managers.

Colvin, P. (September, 2010) *An Introduction to PTSD in a Returning Veteran Population*. Talk presented to the University of Illinois, Chicago's graduate level Current Topics in Clinical Psychology.

Colvin, P. (November, 2009) *A Cursory Introduction to Personality Disorders*. Talk presented to the University of Illinois, Chicago's Abnormal Psychology class.

Colvin, P. (October, 2009) *Writing a Literature Review*. Talk presented to the University of Illinois, Chicago's Fieldwork in Psychology class.

Colvin, P. (September, 2009) *How to Run a Study: From Conceptualization to Publication*. Talk presented to the University of Illinois, Chicago's Fieldwork in Psychology class.

Colvin, P., & Mermelstein, R. (March, 2009). *An Examination of the Relationship between Adolescents' Expectancies and Acute Positive and Negative Mood Change following Smoking*. Talk presented to the University of Illinois, Chicago's graduate level Current Topics in Clinical Psychology.

Teaching Experience

Summer 2010 – 2012   **Graduate Student Teacher: Theoretical Foundations of Personality**
   Responsibilities:
   - Prepared and administered bi-weekly lectures
   - Prepared homework assignments and exams
   - Managed a team of teaching assistants
   - Held weekly office hours to assist students with course material, paper completion, and completion of their final paper

Spring 2010   **Graduate Student Teacher: Abnormal Psychology**
   Responsibilities:
   - Prepared and administered bi-weekly lectures
   - Prepared homework assignments and exams
   - Held weekly office hours to assist students with course material, paper completion, and completion of their final paper

Spring 2010, Fall 2011 **Teaching Assistant: Developmental Psychology**
   Responsibilities:
   - Graded weekly homework assignments and bi-semester term papers
   - Held weekly office hours to assist students with course material, paper completion, and completion of their term project

Fall 2009, Spring 2011 **Teaching Assistant: Fieldwork in Psychology**
   Responsibilities:
   - Assisted students with the creating, implementation, and analyses of research projects

- Graded research proposals and revisions, taught several class sections focusing on statistical analysis, writing results sections, and writing discussion sections

Fall 2008, Spring 2009 **Teaching Assistant: Introduction to Psychology**
Responsibilities:
- Led bi-weekly discussion sections
- Graded weekly homework assignments and term papers
- Held weekly office hours to assist students with course material, paper completion, and completion of their term project

Honors and Awards

2012	UCSD/SDVA Chief Intern Representative
2011	Teaching Assistantship Award
2009, 2010	Graduate Student Council Presenter's Award
2009, 2010	Psychology Department Presenter's Award
2009, 2010	Graduate College Student Presenter's Award
2009	Masters Thesis Research Award
2009	Excellence in Research Award, DMPE Foundation
2007-2010	Research Assistantship

Professional Memberships

2010 – Present	Midwestern Psychological Association
2010 – Present	Association for Contextual Behavioral Science
2009 – Present	Society for research on Nicotine and Tobacco
2009 – Present	Association for Behavioral and Cognitive Therapies
2008 – Present	American Psychological Association
2007 – Present	Psi Chi National Honor Society
2006 – June 2007	Psi Chi National Honor Society Officer (University of Utah)
2005 – June 2007	Rocky Mountain Psychology Association member

Volunteer Work

2009 - Present	Big Brother, Big Brother Big Sister of Chicago Foundation, Chicago, IL
1991 - Present	Eagle Scout, Boy Scout Troop 52, Washington, DC
2001 - 2002	Head Coach, Hockey Club, 13-15 year old males, Washington, DC
1999	Prince of Peace Orphanage, Guatemala