Predicting Tobacco and Marijuana Use among Urban African American Adolescents

by

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Abstract

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Adolescent substance use is associated with multiple physical and mental health problems (Arria, Dohey, Mezzich, Bukstein, & Van Thiel, 1995; Newcomb & Bentler, 1988; Newcomb, Scheier, & Bentler, 1993), and concurrent and later difficulties related to social, academic, and occupational functioning (Hawkins, Catalano, & Miller, 1992; Kandel & Yamaguchi; Newcomb, 1994; Yamguchi & Kandel, 1985). Thus, it is important to understand risks for adolescent substance use to inform prevention. The current study utilized prospective longitudinal data to examine early childhood behavioral and academic risks as antecedents to adolescent mental health problems and externalizing problems, which in turn were hypothesized to influence adolescent substance use. Specifically, first grade aggressive behavior and low academic readiness were examined as distal risks for adolescent substance use; sixth grade depressive symptoms, deviant peer affiliation, and conduct problems were examined as proximal risks for adolescent substance use, linking the early risks with later substance use. Data were drawn from a community epidemiologically-defined sample of urban African American adolescents (N = 585; 53.2% male). Findings revealed that aggressive behavior was associated with conduct problems, which in turn predicted later substance use. For females, low academic readiness also was associated with conduct problems, suggesting multiple trajectories to conduct problems and adolescent substance use. Although neither first grade risk was associated with deviant peer affiliation, deviant peer affiliation was associated with tobacco and marijuana use, and these associations varied by gender. Findings underscore the value of utilizing prospective longitudinal data to identify proximal and distal risks for substance use among urban African American adolescents and

highlight the importance of examining gender differences in risk for adolescent substance use.

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Introduction

Adolescent substance use has been identified as a significant public health concern. According to the 2002 Monitoring the Future Study, 21% of eighth graders report that they have smoked cigarettes and 15% indicate they have used marijuana (Johnston, O'Malley, Bachman, & Schulenberg, 2008). Among high-school seniors, as many as 45% report having smoked cigarettes at some time in their lives, and 20% report smoking cigarettes in the past month (Johnston, et al., 2008). Of the 2.1 million Americans who used marijuana for the first time in 2005, the majority was under the age of 18 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2006). Frequent and prolonged consumption of tobacco and marijuana among adolescents not only increases their risk for developing a substance use disorder (Chassin, Presson, Pitts, & Sherman, 2000), but also is linked with concurrent and later problems in several domains, including poor achievement (Brook et al., 1989; Donovan, 1996), dropping out of school (Kaplan & Liu, 1994; Newcomb & Bentler, 1988), mental health problems (Johnson & Kaplan, 1990), unplanned pregnancy (Kandel, 1984; Green & Ensminger, 2006), poor job performance (Stein, Smith, Guy, & Bentler, 1993), and marital instability (Kandel, Davies, Karus, & Yamaguchi, 1986; Yamaguchi & Kandel, 1985). Although many adolescents experiment with substance use without experiencing any adverse consequences, substance use can result in mortality due to impaired driving, increased risk for HIV infection, and risk for smoking related disease (Institute of Medicine, 1994).

Given the multiple severe consequences of adolescent substance use, it is critical to identify risk factors for substance use. Both externalizing (e.g. conduct problems) and internalizing (e.g. depression) behaviors have been identified as factors that may place

adolescents at increased risk for substance use, although the literature on internalizing risks is comparatively less than externalizing risks. Another limitation of the existing substance use literature has been the paucity of research on substance use and abuse among African American adolescents (Wallace, 1999). This is particularly concerning because a recent review of adolescent substance use revealed that African American and white youth are not equally exposed to or vulnerable to the same risk factors for substance use (Wallace & Muroff, 2002). This dissertation research will begin to address these limitations by using prospective longitudinal data to examine internalizing and externalizing risks for substance use among a community, epidemiologically-defined sample of urban African American adolescents. Although most research on adolescent substance use has focused on males (Waislow-Mueller & Erikson, 2001), there is increasing evidence that males and females may experience different substance use trajectories and consequences (Boyd & Mieczkowski, 1990; Brook et al., 1992; Carlson & Siegal, 1991; Hser et al., 1987). Therefore, this study also will examine gender differences in externalizing and internalizing risks for African American adolescents' substance use.

Significance of Substance Use

The health and social consequences of substance use are a serious concern for developing adolescents. Apart from being illegal, adolescent substance use is associated with multiple physical and mental health problems (Arria, Dohey, Mezzich, Bukstein, & Van Thiel, 1995; Newcomb & Bentler, 1988; Newcomb, Scheier, & Bentler, 1993), and concurrent and later difficulties related to social, academic, and occupational functioning (Hawkins, Catalano, & Miller, 1992; Kandel & Yamaguchi; Newcomb, 1994; Yamguchi & Kandel, 1985). Adolescent substance use may undermine motivation, interferes with

cognitive processes, contributes to debilitating mood disorders (McMahon, 1999), and increases risk of accidental injury or death (Hawkins et al., 1992). For society at large, adolescent substance use can result in high costs in health care, mental health services, and drug treatment (Hawkins et al., 1992). In addition to these personal, social, and societal costs of adolescent substance use, there are longer range implications for youth who continue to use substances into adulthood. For example, drug abuse is involved in one third to one half of lung cancer and coronary heart disease cases in adults (Blum, 1987).

Given the public health importance of substance use among adolescents, several epidemiological studies were launched in the 1970's to monitor trends in adolescent substance use prevalence. These studies reveal that tobacco and marijuana have been "drugs of choice" among youth for several decades. In addition, tobacco and marijuana have been labeled as "stepping stones" or a "gateway" drugs into the world of more serious illegal drug use (Ellickson, Hays, & Bell, 1992; Wagner & Anthony, 2002). Numerous studies have confirmed a sequence for drug use initiation beginning with cigarettes which tend to be tried first, followed by marijuana, and then "harder" drugs (e.g., Adler & Kandel, 1981, Andrews, Hops, Ary, Lichtenstein, & Tildseley, 1991; MacKinnon, Anglin, & Thompson, 1987; Wagner & Anthony, 2002). On the basis of these studies, prevention experts have stressed the importance of delaying initiation of tobacco and marijuana use as potential strategy for preventing use of harder drugs (Ellickson & Robyn, 1987; Fleming, Leventhal, Glynn, & Ershler, 1989). In addition, research has provided substantial evidence that use of tobacco and marijuana is associated with several negative short and long term consequences for individuals who use them, and for society as a whole (Brook, Whiteman, Balka, Win, &

Gursen, 1998; Department of Health and Human Services, 1990, NIDA, 2006). Thus, tobacco use and marijuana use are the focus of the present study.

Tobacco Use

According to the Centers for Disease Control (CDC), tobacco use is the leading preventable cause of death and disease in the United States, resulting in more than 440,000 premature deaths per year (CDC, 2005). Approximately sixty million Americans age 12 and older smoke cigarettes (SAMHSA, 1998), and each year tobacco use results in one-sixth of all deaths (over 400,000) in the United States (Department of Health and Human Services, 1990). This mortality rate is twice that associated with motor vehicle accidents, alcohol and drug use, and firearms combined. Although the majority of health and financial effects of smoking manifest in adulthood, cigarette use is a problem that originates in youth. Each day, about 1,300 persons younger than 18 years of age become regular smokers; that is, they begin smoking on a daily basis (SAMHSA, 2007). Eighty-percent of adult smokers started smoking before the age of 18, and each day nearly 5000 adolescents try their first cigarette (CDC, 2002). Findings for youth indicate that 25.9 percent of 8^{th} graders, 38.9 percent of 10^{th} graders, and 50.0 percent of 12^{th} graders had smoked cigarettes in their lifetime (NIDA, 2006). Early adolescence (ages 11-15 years, or grades 6 to 10) is the period when individuals are most likely to try smoking for the first time (U.S. Department of Health and Human Services, 1999). Based on epidemiological data, more than 40% of high school seniors have smoked cigarettes; more than 15% have done so within the past 30 days; and more than 10 percent are daily smokers by the time they graduate from high school (Johnston, et al., 2008).

Concern over smoking in youth is further increased by reports documenting the highly addictive nature of nicotine (Epping-Jordan, Watkins, Koob, & Markou, 1998). For

many adolescents, experimental use of tobacco is self-limiting, but for 30% or more experimentation forecasts a long-term and perhaps lifetime addiction (Chassin, Presson, Rose, & Sherman, 1996). Longitudinal studies indicate that the earlier the onset of tobacco use, the higher the level of daily smoking (Everett et al., 1999) and the lower the probability of cessation (Khuder, Dayal, & Mutgi, 1999). Thus, the National Health Objective for 2010 is to reduce the prevalence of cigarette use among high school students, which was 21.9% in 2003, to 16% or less (MMWR, 2006).

Research on tobacco use among African-American adolescents is limited. Epidemiological data describing the percentage of African American and white 8th, 10th and 12th grade students who report daily cigarette use reveals that the prevalence of cigarette use is generally higher among white youth than among African American youth (Wallace & Muroff, 2002). For example, although between 10% and 30% of white secondary students are daily smokers, fewer than 8% of African American secondary students smoke this frequently (Wallace & Muroff, 2002). Consistent with this prevalence data, the trend for over the past twenty years is that African American high school seniors have been less likely than white high school seniors to smoke cigarettes daily (Wallace & Muroff, 2002). From 1985 until 1996, smoking initiation rates among African American female adolescents declined or remained the same, in contrast to increasing smoking initiation rates among African American males (Anderson & Burns, 2000). Although smoking initiation rates among African American males were increasing until 1996, the overall cigarette use among African American adolescent males declined from 19.3 % in 2003 to 14% in 2005 according to the 2006 Morbidity and Mortality Weekly Report (MMWR, 2006); comparable information was not reported for African American adolescent females. In terms of consequences of tobacco

use, based on a report on tobacco use among ethnic minority groups by the Surgeon General, African-American men bear one of the greatest health burdens among ethnic minority groups, with death rates from lung cancer that are 50% higher than those of white men (CDC, 1998).

Marijuana Use

Marijuana is the most commonly used illicit drug in the United States (NIDA, 2006). Results from the 2004 National Survey on Drug Use and Health indicated that in the last half of 2003, marijuana was the third most commonly abused drug mentioned in drug-related hospital emergency department visits in the continental United States (NSDUH, 2004). Similarly, recent findings indicate that at age 14, marijuana is the most commonly used illicit drug (SAMHSA, 2006). A study conducted by the CDC (2006) found that almost 45% of teenagers had tried marijuana at least once before they finished high school. It has been estimated that within one year of an adolescent's first chance to try marijuana, two-thirds will start to use the drug (Van Etten & Anthony, 1997; 1999).

The health and social consequences of marijuana use are a serious concern for adolescents. For example, adolescents using marijuana may be unable to engage in educational and psychological tasks because of the cognitive (e.g. impaired attention, memory, and learning) and psychological (e.g. mood swings, lack of motivation) impairments resulting from marijuana use. Relatedly, marijuana use in high school is associated with increased risk for school dropout (Green & Ensminger, 2006), poorer achievement (Donovan, 1996), unplanned pregnancy (Green & Ensminger, 2006), and psychiatric symptoms and disorders (Shrier, Harris, Kurland, & Knight, 2003). In addition, depression (Brook, Rosen, & Brook, 2001), anxiety (Brook, Rosen, & Brook, 2001), and

personality disturbances (Brook, Cohen, & Brook, 1998) have been associated with chronic marijuana use. Research has shown that marijuana use can have an adverse impact on memory and learning that may last for days or weeks after the acute effects of the drug wear off (Block & Ghoneim, 1993; Pope, Gruber, Hudson, et al., 2001; Pope & Yurgelun-Todd, 1996). Early marijuana use also has been associated with increased opportunities to use cocaine (Wagner & Anthony, 2002), hallucinogens (Wilcox et al., 2002), and other illicit drugs (Lynskey et al., 2006) later in life. Additionally, marijuana use has been found to increase the likelihood of later deviant behavior, including theft, vandalism, drug-related crimes, assault, and suicide (Brook, Gordon, Brook, & Brook, 1989; Brook, Whiteman, Balka, Win, & Gursen, 1998; Kandel, Davies, Karus, & Yamaguchi, 1986; Newcomb & Bentler, 1988). Marijuana treatment admission rates have been found to peak between the ages of 15 and 17 (SAMSHA, 2002).

There is limited research on the patterns of marijuana use among African-American adolescents. Based on the 2005 Monitoring the Future Study, approximately 20% of African American eighth graders report ever using marijuana (Johnston et al., 2006). The available literature on African Americans indicates that African American youth exhibit lower rates of substance use as compared to whites for all drugs, with the exception of marijuana (Wallace & Muroff, 2002). Data from the Youth Risk Behavior Surveillance (YRBS) system revealed that the prevalence of lifetime marijuana use among high school students was higher among African American males (43.8%) than white males (40.0%) (CDC, 2006). In fact, marijuana is the primary substance of abuse among African-American youth admitted for substance abuse treatment services, representing 66% of all admissions compared to 42% for whites (SAMHSA, 2002). In addition to race differences in treatment of marijuana abuse, gender

differences among African American youth reveal that treatment admissions for marijuana abuse were significantly higher for males (82%) than females (18%) (SAMHSA, 2002). In terms of consequences of marijuana use, African American youths' early adolescent marijuana use has been found to increase their risk of high school non-completion, delinquency, risky sexual behavior, perceiving drugs as not harmful, having problems with substance use, and having more friends that engage in deviant behavior in later adolescence (Brook, Balka, & Whiteman, 1999).

Risks for Adolescent Substance Use

In order to develop intervention programs to prevent adolescent substance use, it is necessary to identify risk factors for substance use. Identification of these risks will provide a better understanding of the etiology of substance use and inform the development of prevention and intervention programs that are effective and relevant for youth. Risk factors for adolescent substance use have been identified on multiple levels ranging from intrapersonal to macroenvironmental (e.g. Hawkins, Catalano, & Miller, 1992). According to Hawkins and colleagues (1992), risk factors for adolescent substance use can be grouped into two broad classes. The first class of risk factors are contextual and include societal and cultural factors. The second class of risk factors includes individual risk factors that focus on important contexts for adolescents, such as the interpersonal environments in youths' life (e.g., family, school classrooms, and peer groups) (Hawkins, Lishner, Catalano, & Howard, 1986; Kandel, Simcha-Fagan, Davies, 1986). Although it is unlikely that one risk factor or pathway explains the development of substance use problems in adolescence, this study will focus on individual and malleable risk characteristics.

It is critical to examine individual risk factors among African American adolescents prior to examining contextual risk factors because the majority of studies on individual risks for substance use have been based exclusively on white samples or mixed ethnic samples that contain too few African American youth to obtain reliable comparisons across groups. In addition, as noted above, Wallace and Muroff (2002) found that African American and white adolescents differed significantly in their exposure and vulnerability to the risk factors for substance use identified in epidemiological research. Therefore, this study will examine internalizing (i.e. depression) and externalizing (i.e. deviant peer affiliation and conduct problems) risk factors that have been identified in prior research and the applicability of these risks for an African American sample. Two risk pathways will be explored: the deviance-proneness pathway which highlights externalizing risk factors, and the affect regulation pathway which focuses on internalizing risk factors.

Deviance Proneness Framework for Substance Use

Models based on a deviance-proneness framework for substance use propose that the development of substance use in adolescence occurs within a broader context of externalizing behavioral problems in early adolescence. Specifically, the deviance-proneness framework highlights the occurrence of adolescent substance use in a broader social context characterized by low behavioral constraint and deviant peer groups where drug use is promoted (Chassin, Presson, Sherman, Montello, & McGrew, 1986; Dishion, Capladi, Spracklen, & Li, 1995). Within these deviant peer groups, adolescent substance use may communicate a social image of toughness and precocity, and be a means to express an adolescent's actual or ideal self-concept (Barton, Chassin, Presson, & Sherman, 1982; Jessor & Jessor, 1977; Sussman et al., 2000). Thus, the deviance-proneness framework posits that

deviant peer affiliation and conduct problems in adolescence are proximal risk factors for adolescent substance use.

Deviant peer groups have been considered a major training ground for delinquent acts and are a common factor leading to all forms of substance use (Ary et al., 1999; Chassin, Presson, Sherman, Montello, & McGrew, 1986; Dishion, Capladi, Spracklen, & Li, 1995; Dishion & Lober, 1985; Duncan, Duncan, & Hops, 1994; Erikson, Crosnoe, & Dornbusch, 2000; Hawkins, Catalano, & Miller, 1992). The majority of initial smoking episodes occur after school, in the company of friends, and in unsupervised households and community settings (Friedman, Lichtenstein, & Biglan, 1995). Brook and colleagues (1989) found that among high school students, regular marijuana users had more friends who exhibited deviant behavior and used drugs, and fewer high achieving friends than did nonusers or infrequent users. In addition, peers provide adolescents with the attitudes, motivations, and rationalizations to support antisocial behavior and provide opportunities to engage in delinquent activities (Patterson, DeBaryshe, Ramsey, 1989). Involvement with deviant peers in early adolescence also has been associated with concurrent and later substance use (Ary et al., 1999; Erikson, Crosnoe, & Dornbusch, 2000). For example, Dishion and colleagues (1995) found that association with deviant peers at age 13-14 accounted for 49% variation in substance use by age 15-16. Research also indicates that peer influence is critical to both early initiation and progression from legal to illegal substances (Graham, Collins, Wugalter, Chung, & Hansen, 1991; Hawkins, Lishner, & Catalano, 1985; Jenkins, 1996).

Consistent with the deviance-proneness framework, there is widespread empirical support for the association between conduct problems and substance use (Hawkins et al., 1992; Henry et al., 1992; Kellam, Brown, Rubin, & Ensminger, 1983). Conduct problems

predict adolescent substance use (Henry et al., 1993; Kellam, Brown, Rubin, & Ensminger, 1983), escalations in use over time (Hill et al., 2000; Hussong, Curran, & Chassin, 1998), and later substance abuse and dependence diagnoses (Chassin, Pitts, DeLucia, & Todd, 1999). In addition, conduct disorder is a strong risk factor for adolescent substance use disorders (Clark, Parker, & Lynch, 1999; Costello et al., 1999; Disney, Elkins, McGue, & Iacono, 1999; Weinberg & Glantz, 1999) and is the most common disorder associated with substance dependence (Crowley & Riggs, 1995). Substance use generally starts earlier in children with conduct disorder than children without conduct disorder (Robins & McEvoy, 1990; Windle, 1992). For instance, youth who displayed high levels of conduct problems during early adolescence were at risk for increased levels of tobacco use (Miller-Johnson, Lochman, Coie, Terry, & Hyman, 1998), and according to a recent study, conduct-disordered youth were more likely to smoke cigarettes earlier than youth without a diagnosis of conduct disorder (Bagot, Berarducci, Franken, Frazier, Ernst, & Moolchan, 2007). In terms of the association between conduct problems and marijuana use, Fergusson and colleagues (1993) found that children who had conduct problems in middle childhood were 2.1 to 2.7 times more likely to engage in early marijuana use than children without conduct problems, even after family social background, parental separation, and parental conflict were taken into account. In a sample of adolescent males diagnosed with conduct disorder, 42% reported that marijuana was the first substance they had ever used (Young et al., 1995).

Research indicates that the associations between externalizing risks, such as deviant peer affiliation and conduct problems, and adolescent substance use are stronger for males than for females (Dishion, Capaldi, & Yoerger, 1999), perhaps due to gender differences in parental monitoring and supervision. The available literature suggests that males generally

have less parental supervision allowing them more unsupervised time outside the home than females (McHale, Crouter, & Tucker, 1999), which has been associated with more involvement with and earlier exposure to deviant peers (Barnes & Farrell, 1992), and a wide range of delinquent behaviors, including substance use (Dishion & Medici Skaggs, 2000; Thornberry & Krohn, 1997). Males' earlier exposure and involvement with deviant peers may include more involvement in substance use as compared to females who become involved with deviant peers later (Gorman-Smith & Loeber, 2005). It should be noted that research suggests even when both males and females exhibit high rates of association with deviant peers, males might participate in more delinquent acts than females (Gorman-Smith & Loeber, 2005). In addition to deviant peer affiliation, gender differences also have been examined among youth with conduct problems and substance use. Conduct problems have been found to predict substance abuse and dependence for both males and females (Chassin et al., 1999; Costello et al., 1999). However, the types of conduct problems relevant for substance use may differ for males and females. For instance, Pedersen and colleagues (2001) found that overt conduct problems were found to have a moderate effect upon marijuana initiation in boys, whereas aggressive and covert conduct problems had strong effects in girls.

Affect Regulation Framework for Substance Use

Models based on an affect regulation framework for substance use propose that adolescents use substances as a form of self-medication to decrease negative affect (Carmody, 1989; Khantzian, 1997). For example, the stress-coping model suggests that substance use is a coping response to distress (Johnson & Kaplan, 1990; Kaplan, Martin, Johnson, & Robbins, 1986; Kaplan, Martin, & Robbins, 1984; Wills & Shiffman, 1985).

Similarly, the social stress model (Rhodes & Jason, 1990) suggests that adolescents initiate substance use as a means of coping with stressors (e.g., poor academic performance, social marginality, conflictual interpersonal relationships, low self-esteem, and depression) that may arise from their family, school, peer group, or community. According to the social stress model (Rhodes & Jason, 1990), adolescents may be at higher risk for substance use if they are unable to develop adaptive coping strategies to offset pressures to use drugs. For example, youth with low adaptive coping skills may be more likely to use substances because they believe using will enhance their social image, and perhaps help provide access to desirable peer groups by making the adolescent appear tougher or more mature (Chassin, Presson, Sherman, Corty, & Olshavsky, 1981). Thus, the social stress model suggests that youth who are comparatively low in basic coping skills will be more likely to experiment with substances.

Minimizing negative mood and maximizing positive mood are two ways that adolescents may use substances for stress-reduction. Specifically, individuals may use a substance to reduce negative affect when they are anxious, nervous, irritated, or over-aroused. In addition, individuals may use the same substance to enhance positive affect when they are fatigued, depressed, or under aroused (Carmody, 1989; Gilberg & Spielberger, 1987; Pomerleau & Pomerleau, 1984; Wills & Shiffman, 1985). The use of substances may increase positive affect through providing physically pleasurable sensations and achieving feelings of relaxation. For example, nicotine can produce arousal or relaxation states depending on the dose, the time since administration, and perhaps the temporary emotional state of the individual (Gilbert, 1979; Golding & Mangan, 1982). Individuals may adjust the physiological level of a particular substance (e.g. tobacco or marijuana) to produce affect

management effects that are consistent with their momentary mood (i.e. anxious or depressed), producing arousing effects or tranquilizing effects as needed. Commonly reported motives among adolescents who start smoking cigarettes include smoking to relax and to reduce stress (Dozois, Farrow, & Miser, 1995; Nichter, Nichter, Vuckovic, Quintero, & Ritenbaugh, 1997).

Consistent with an affect regulation framework, cross-sectional research has found significant co-occurrence between depression and cigarette smoking in adolescents (Brooks, Harris, Thrall, & Woods, 2002; Coogan, Adams, Geller, Brooks, Miller, et al., 1998; Covey & Tam, 1990; Fergusson, Lynskey, & Horwood, 1996; Glied & Pine, 2002; Kelder, Murray, Orpinas, Prokhorov, McReynolds et al., 2001; Whalen, Jammer, Henker, & Delfino, 2001). For example cross-sectional research has revealed the odds of smoking and being nicotine dependent are 2 to 4 times greater for depressed adolescents than for non-depressed adolescents (Fergusson, Lynskey, & Horwood, 1996; Glied & Pine, 2002). Some longitudinal studies have demonstrated that depression predicts smoking cigarettes (Killen, Robinson, Haydel, Hayward, Wilson, et al., 1997; Patton, Carlin, Coffey, Wolfe, Hibbert et al., 1998), whereas others have found that smoking cigarettes precedes depression in adolescents (Albers & Biener, 2002; Choi, Patten, Gillin, Kaplan, & Pierce, 1997; Goodman & Capitman, 2000; Wu & Anthony, 1999). The findings of other studies support a bi-directional association between smoking and depression in adolescents (Breslau, Kilbey, & Andreski, 1993; Brown, Lewinsohn, Seeley, & Wagner, 1996; Lewinsohn, Rohde, & Seeley, 1998; Peterson, Schultz, Chilcoat, & Andreski, 1998; Windle & Windle, 2001). Although the nature of the longitudinal association between substance use and depression in adolescents is somewhat unclear, there is more evidence to support substance use initiation and progression

as a consequence of depression (Anda, Williamson, Escobedo, Mast, et al., 1990; Glass, 1990; Tyas & Pederson, 1998; Wang, Fitzhugh, Green, Turner, Eddy et al., 1999; Cicchetti & Toth, 1998). For instance, one study found serious and persistent depression at baseline predicted cigarette smoking 2 years later (Windle & Windle, 2001). Relatedly, depressed mood has been found to predict first-time use of marijuana in secondary-school students (Paton, Kessler, & Kandel, 1977).

Some studies suggest that associations between mood disorders and symptoms, such as depression, and substance use problems are stronger for females than for males (Federman, Costello, Angold, Farmer, & Erkanli, 1997; Whitmore, 1997). For example, research indicates that depressive symptoms are significantly associated with increased risk for smoking cigarettes in adolescent females and not in adolescent males (Costello et al., 1999; Simantov, Schoen, & Klein, 2000). Similarly, McLean, Paradise, and Cauce (1999) found depression related to a composite substance use index (alcohol, marijuana, and hard drugs) primarily among females, but not among males. The higher rates of adolescent depression in females compared to males provide a partial basis for why the association between depression and substance use may be more common among females than males (Cohen et al., 1993; Fergusson, Horwood, & Lynskey, 1993; Nolen-Hoeksema & Girgus, 1994). Females' earlier development of basic psychobiological, cognitive, and emotion-regulating capacities promote socialization patterns that may direct girls into internalizing, rather than externalizing behaviors (Keenan & Shaw, 1997). Byrne and Mazanov (1999) reported that the impact of different types of stressors and smoking varied by gender such that relationships were stronger for females, particularly with respect to family-related stress and smoking. These results may reflect differences between females and males in the ways

they cope with depressed mood. White and Huselid (1997) have suggested that personal psychological motivations such as relief of stress are more strongly related to substance use in adolescence for females. More empirical research is needed to examine gender differences in the effects of stress and coping, depression and substance use.

Early Childhood Risks and the Development of Substance Use

Research based on deviance proneness and affect regulation frameworks of adolescent substance use primarily have focused on proximal risks for adolescent substance use; specifically, these frameworks have focused on externalizing and internalizing risks during adolescence (Boyle et al, 1992; Hawkins et al., 1992; Wallace & Muroff, 2002). However, developmental models emphasize early childhood risks that may increase the likelihood of developing depression, deviant peer affiliation, and conduct problems, the risks highlighted in the deviance proneness and affect regulation frameworks. These developmental models suggest that to understand maladjustment in adolescence it is important to examine adjustment in early childhood. In addition, these models emphasize the importance of transitions throughout childhood.

Children encounter a variety of ecological transitions throughout childhood that require adjustment to new or altered environments (Bronfenbrenner, 1979). Positive adjustment occurs when children are able to adapt to developmental demands and expectations during these times of transition; such adaptation contributes to competence and better preparedness for resolving subsequent tasks of development. In contrast, compromised or inadequate resolution of developmental tasks or demands results in maladjustment and a decreased likelihood of positive adaptation to later developmental demands. Thus, early

competence tends to foster later competence, and similarly, early incompetence tends to promote later incompetence (Cicchetti & Toth, 1998).

A key developmental challenge early in life is the transition to formal schooling (Cicchetti & Schneider-Rosen, 1986; Kellam, Branch, Agarwal, & Ensminger, 1975; Ladd & Price, 1987; Sroufe, 1979; Sroufe & Rutter, 1984). In the United States, first grade typically represents a child's first legally required full-day educational experience. During this transition, children are required to meet social, academic, and behavioral demands of their teachers, parents, and their classmates, including meeting new academic challenges (Bogat, Jones, & Jason, 1980), learning new school and teacher expectations (Bensen, Haycraft, Steyaert, & Weigel, 1979), and gaining acceptance into a new peer group (Holland et al., 1974). Children who are able to positively adapt in their transition to school exhibit behaviors appropriate to the setting, such as sitting still, paying attention, raising their hand to participate, avoiding fights, and not being disruptive to others. These adaptive behaviors help children to meet the expectations placed on them by teachers and parents, and facilitate the likelihood that they will be able to form new relationships with their peers. Conversely, children unable to positively adapt in their transition to school may develop reactions such as anxiety, aggressive behavior, avoidant behaviors, or negative attitudes toward school that may be indicative of early adjustment difficulties that, in turn, may disrupt children's future progress (Ladd & Price, 1987). These reactions may negatively alter a child's developmental trajectory and increase risk for later depression, deviant peer affiliation, and conduct problems (Kellam & Rebok, 1992). Thus, early childhood maladjustment can serve as an antecedent to adolescent mental health problems and behavior problems. Two markers of

early childhood maladjustment with implications for adolescent behavior are aggressive behavior and low academic readiness.

Early Aggression

The developmental model on antisocial behavior (Patterson, Reid, & Dishion, 1992) and life course/ social field theory (Kellam, Branch, Agarwal, & Ensminger, 1975) have identified early aggressive behavior as a childhood risk for later antisocial behavior, including deviant peer affiliation and conduct problems. Specifically, youth exhibiting aggressive and socially maladaptive behaviors at home and/or school may be rejected by parents, teachers, and well-adjusted peers in the elementary and middle school years. This rejection may lead to inadequate parental supervision and monitoring of the youth's activities (Loeber & Dishion, 1983). Due to the lack of supervision, the youth may drift into a deviant peer group, where they are likely to be offered the opportunity to engage in a wide array of antisocial and delinquent behaviors, including substance use (Hirschi, 1969; Jessor & Jessor, 1977; Brook et al; 1989; Patterson et al., 1992). In terms of the association between aggressive behavior and conduct problems, the severity of aggressive acts may escalate as development occurs. Children exhibiting aggressive behavior may later engage in bullying, taunting, threatening, name calling, breaking rules, and swearing which are characteristic of conduct problems. As children get older, their aggression may be marked by more violent behavior such as initiating physical fights, injuring others, and the use of weapons, which also are indicators of conduct problems. Findings from several prevention trials have emphasized the importance of targeting aggressive behavior during the early elementary grades for preventing later conduct problems (Hawkins, Catalano, Morrison, O'Donnell, Abbott, & Day, 1992; Hawkins, Von Cleve, & Catalano, 1991; Kolvin, Miller, Fleeting, &

Kolvin, 1988; Tremblay et al., 1992). Thus, the existing evidence suggests that deviant peer affiliation and conduct problems, proximal risks for adolescent substance use, may serve as mechanisms linking early aggression with adolescent substance use.

Early Academic Readiness

Life course/social field theory (Kellam, Branch, Agarwal, & Ensminger, 1975) has identified low academic readiness as a childhood risk for later depression. As described in life course/social field theory, low academic readiness is characterized by a lack of adaptive behaviors such as eagerness to learn, engagement in academic activities, ability to pay attention, effort to master concepts presented by the teacher, and achievement on assignments and tests. Children with low academic readiness often are unable to pay attention, do not come prepared for class, and show low effort; as a result they may receive negative feedback from parents, teachers, and well-adjusted peers. This negative reinforcement may lead to negative self-perceptions, demoralization, low perceived academic competence, and decreased motivation, which in turn, may lead to decrements in psychological well-being, including depression (Blechman, McEnroe, Carella, & Audette, 1986; Eccles, Lord, & Roeser, 1996). Perceptions of being academically competent and receiving good grades have been linked with a reduced risk for emotional difficulties, while low perceived academic competence is related to depressive symptoms in children (Blechman, McEnroe, Carella, & Audette, 1986; Cole, 1991). For example, first-grade problems in academic readiness have been found to predict teenage depressive symptoms (Kellam, Brown, Rubin, & Ensminger, 1983). Thus, the existing evidence suggests that depression, a proximal risk for adolescent substance use, may serve as mechanism linking low academic readiness in childhood with adolescent substance use.

Summary of Early Risks

Given the evidence indicating that early maladjustment leads to later maladjustment, it is critical to understand how both proximal and distal risks may be potential antecedents to adolescent substance use. In addition, the ability to forecast negative outcomes in adolescence based on early childhood risks can enable researchers to design programs that facilitate children's adaptation, especially during times of transition, to prevent subsequent maladaptation. Aggressive behavior and low academic readiness in early childhood are particularly important risks, because they may be signs of early adjustment difficulties that are associated with a decreased likelihood of positive adaptation to later developmental demands and risk for adolescent mental health and behavioral problems. In sum, aggression and low academic readiness appear to be early risks that predispose children to adolescent substance use because of their influence on deviant peer affiliation, conduct problems, and depression, proximal risks for adolescent substance use.

Purpose of the Study

The present study will examine the process by which aggressive behavior and low academic readiness in early childhood influences the risk for adolescent substance use among a community epidemiologically-defined sample of urban African American adolescents. It is hypothesized that aggression in grade 1 will lead to deviant peer affiliation and conduct problems in grade 6, which in turn, increase the risk for tobacco and marijuana use in grade 10 (see Figure 1). In addition, it is hypothesized that low academic readiness in grade 1 will lead to depressive symptoms in grade 6, which in turn, increases the risk for tobacco and marijuana use in grade 10 (see Figure 2). Thus, the effects of early maladjustment (i.e.,

aggressive behavior and low academic readiness) on adolescent substance use are hypothesized to occur indirectly through deviant peer affiliation, conduct problems, and depression. Additionally, gender differences in pathways to adolescent substance use will be tested. It should be noted that although there is extensive evidence that early aggression is predictive of deviant peer affiliation and conduct problems, early aggression also may predict later depression. Similarly, while there is more evidence that low academic readiness in early childhood is an antecedent for later depression, it is possible that low academic readiness also may predict later externalizing problems, such as deviant peer affiliation and conduct problems. Therefore, exploratory analyses will be conducted to examine these alternate pathways to adolescent substance use.

Figure 1. Deviance Proneness Framework.

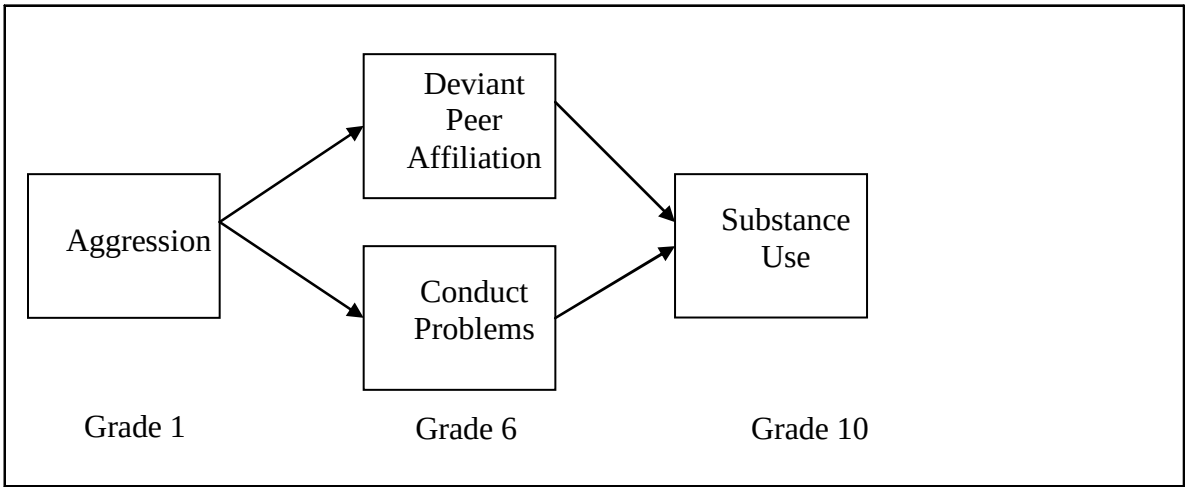
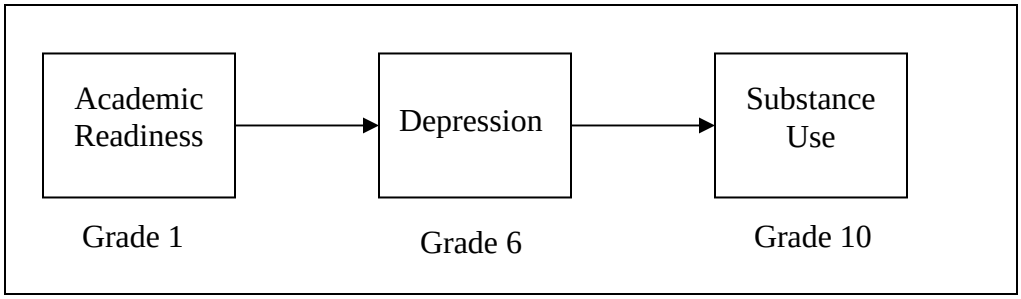


Figure 2. Affect Regulation Framework.



This study will contribute to the existing substance use literature in several ways. The majority of prior research on substance use has been cross-sectional, limiting the ability to understand causal models for adolescent substance use. The current study uses prospective longitudinal data to understand how early childhood and early adolescent risks may influence adolescent substance use, and will enhance understanding of proximal and distal risks for adolescent substance use. Much prior research has focused on risk factors for males despite the evidence that indicates that females are subject to the same or additional consequences from the use of substances (Deykin & Buka, 1994; Glassman et al., 1990; Kandel et al., 1991; Martin et al., 1997). Therefore, this study will examine risks for males and females, as well as gender differences in risks for adolescent substance use. Furthermore, internalizing risk factors for adolescent substance use have been understudied relative to externalizing risk factors. Thus, this study will provide further information about the association between internalizing risks and adolescent substance use. Finally, most research studies on risks for adolescent substance use have focused on white youth; however, as Wallace and Muroff (2002) point out, African American and white youth differ in their vulnerability to the risk factors identified for substance use. Therefore, this study will provide further information

about whether risks for substance use identified with other ethnic groups apply to African American adolescents.

Hypotheses

Deviance Proneness Model

Hypotheses for the indirect effect of early aggressive behavior on adolescent substance use are based on life-course/social field theory (Kellam, Branch, Agarwal, & Ensminger, 1975) and Patterson, Reid, and Dishion's (1992) model of the development of antisocial behavior, each of which provide a theoretical basis for early aggressive behavior as a distal risk for adolescent substance use and deviant peer affiliation and conduct problems as proximal risks for adolescent substance use, particularly for males (see Figure 1).

1. Aggressive behavior in grade 1 will be significantly positively associated with conduct problems and deviant peer affiliation in grade 6.

    1a. Gender will moderate these associations, such that the strength of the associations will be greater for males than for females.

2. Deviant peer affiliation in grade 6 will be significantly positively associated with substance use (i.e., tobacco use and marijuana use) in grade 10.

    2a. Gender will moderate these associations, such that the strength of the associations will be greater for males than for females.

3. Conduct problems in grade 6 will be significantly positively associated with substance use (i.e., tobacco use and marijuana use) in grade 10.

    3a. Gender will moderate these associations, such that the strength of the associations will be greater for males than for females.

Affect Regulation Model

Hypotheses for the indirect effect of low academic readiness on adolescent substance use are based on life course/social field theory (Kellam, Branch, Agarwal, & Ensminger, 1975) which provides a theoretical framework for how academic problems in early childhood can serve as a distal risk for adolescent substance use, and depression can serve as a proximal risk for adolescent substance use, particularly for females.

1. Low academic readiness in grade 1 will be significantly positively associated with depressive symptoms in grade 6.

    1a. Gender will moderate this association, such that the strength of the association will be greater for females than for males.

2. Depressive symptoms in grade 6 will be significantly positively associated with substance use (i.e., tobacco use and marijuana use) in grade 10.

    2a. Gender will moderate these associations, such that the strength of the associations will be greater for females than for males.

Exploratory Analyses

1. As discussed above, considerable research highlights the link between aggression and later externalizing problems. In addition, it is possible that low academic readiness in grade 1 also may predict externalizing risks in grade 6. Specifically, children with academic problems may become frustrated, develop a lowered self-image, feel demoralized, or lack a sense of attachment to school which may increase their risk for externalizing behaviors (i.e. disruptiveness, aggression, defiance) (Hinshaw, 1992). In addition, Patterson and colleagues (1989) suggest that early achievement problems can contribute to rejection by pro-social peers and greater affiliation with deviant peers, which in turn increases the risk for later

aggressive and delinquent behavior. An adolescent may associate with deviant peers and engage in antisocial behaviors in an attempt to boost their self-esteem and sense of belonging (Rosenberg, Schooler, & Schoenbach, 1989). Therefore, exploratory analyses will be conducted to examine whether there is a significant positive association between low academic readiness in grade 1 and deviant peer affiliation and conduct problems in grade 6.

2. Cole, Martin, and Powers (1997) competency-based model of depression and Patterson and Capaldi's (1990) failure model are two theoretical models that provide support for aggressive behavior leading to depressive symptoms. Specifically, early aggression may predict later depression because children exhibiting aggressive and socially maladaptive behaviors at home and/or school may experience rejection and negative appraisals from parents, teachers, and peers in the elementary and middle school years. This negative feedback received from parents, teachers, and peers may lead to negative self-perceptions and subsequent depressive symptoms (Eccles, Lord, & Roeser, 1996). Therefore, exploratory analyses will be conducted to examine whether there is a significant positive association between aggression in grade 1 and depressive symptoms in grade 6.

3. The primary goal for the present study is to examine the indirect paths between grade 1 and grade 6 risks, and grade 6 risks and grade 10 substance use. These indirect effects will be tested because early risks may initiate a sequence that leads to later substance use. However, it is possible that grade 1 risks may exert a direct effect on grade 10 substance use. Results from some prospective studies have indicated that early aggression and low academic readiness assessed as early as first grade predict adolescent substance use (Ensminger, Kellam, Rubin, 1983; Farrington, 1987; Kellam, Brown, Rubin, & Ensminger, 1983; Mitchell & Rosa, 1981; Spivak, Marcus, & Swift, 1986). Therefore, direct effects between

grade 1 risks and grade 10 substance use will be tested. If direct effects between grade 1 risks and grade 10 substance use are present, grade 6 risks will be examined as mediators of the direct effects between grade 1 risks and grade 10 substance use.

Methods

Participants

The sample for this study is comprised of participants in the Second Generation Baltimore Prevention Program at Johns Hopkins University (JHU), an evaluation of two universal school-based preventive interventions. At the start of the 1993 academic year, 678 first-grade students were recruited from 27 classrooms in 9 public elementary schools primarily located in western Baltimore. Using a randomized block design, teachers and students were randomly assigned either to the Family–School Partnership intervention, the Classroom-Centered intervention, or a control condition. The Family–School Partnership intervention and the Classroom-Centered intervention sought to reduce aggressive and disruptive behavior and improve academic achievement by targeting parent discipline practices and classroom behavior management practices, respectively. The interventions were only provided over the first grade year.

Of the 678 children in the original sample, approximately half (53.2%) were male. At entrance into first grade, these children ranged in age from 5.3 to 7.7 years, with a mean age of 6.2 years. Over half of the children (63.4%) were eligible for free or reduced lunch, an indicator of low socio-economic status. Approximately 87% (N= 585) of the sample was African American. These 585 African American youth are the sample of interest for the present study.

Procedure

Of the 678 children available for participation in fall of first grade, written parental consent and assent was obtained for 97% of the children. Three percent of the children's parents or guardians refused to allow their children to participate or refused to respond to the

consent request despite repeated attempts at obtaining consent. There were no significant differences in terms of socio-demographic characteristics (e.g., age and sex) or intervention condition between consenting and non-consenting children. Ninety-three percent of the children remained enrolled in project schools through grade 1 and completed the one-year intervention in their assigned intervention or control condition. Follow-up assessments were conducted in the fall and the spring for grade 1, and then annually in grades 2 and 3. Additional follow-up assessments were conducted on an annual basis in grades 6 through 12 and two subsequent years. In terms of grades 6 through 11 follow-ups, written parental consent was obtained for 588 of the 678 (86.8%) youth for follow-up through the spring of 2004. For the grades 6 through 11 follow-up, parents refused consent for 39 children (5.7%), 3 were deceased (0.4%), and 48 (7.1%) proved unlocatable during the fielding period or failed to provide written consent after repeated requests.

In the present study, 1st grade academic readiness and aggression were assessed via teacher report. In grade 6, youth with consent who provided assent were asked to report about their depressive symptoms, deviant peer affiliations, and conduct problems. A comprehensive substance use assessment was given in grade 10, including assessments of tobacco and marijuana use.

Measures

Demographic Information. Information was collected on participants' gender, age, and receipt of free or reduced lunch, a proxy for low socioeconomic status. Family socioeconomic information, including family income and parent education, also was collected.

Grade 1 Assessments

Aggression and Academic Readiness. Aggression and academic readiness were assessed using the Teacher Observation of Classroom Adaptation-Revised (TOCA-R; Werthamer-Larson, Kellam, & Wheeler, 1991), a structured interview designed to measure teachers' perceptions of their students' adaptation within the classroom. The TOCA-R was developed and employed by the JHU Prevention Intervention Research Center (PIRC) in the evaluation of the 1st and 2nd generation JHU PIRC trials. Teachers were asked to respond to 43-items pertaining to the child's adaptation to classroom task demands over the last three weeks on a frequency scale ranging from 1 to 6 (1 = not at all, 6 = always). The TOCA-R assesses multiple domains including accepting authority (the maladaptive form being aggressive/disruptive behavior), attention/concentration (attention/concentration problems), self-regulation (impulsivity), motor control (hyperactivity), peer likeability (peer rejection), and social participation (or shy and/or withdrawn behavior). Items for these sub-scales were largely drawn from the DSM-III, III-R and IV (American Psychiatric Association, 1994) with the exception of peer likeability/rejection and social participation (shy and/or withdrawn behavior).

Aggressive behavior in grade 1 was measured using the aggressive/disruptive behavior subscale. A summary aggression score was created by taking the mean of the 5 items comprising this scale. Coefficient alpha for the aggressive/disruptive behavior subscale was .94 in grade 1. The 1-year test-retest intra-class reliability coefficients for the aggressive/disruptive subscale ranged from .65 to .79 over grades 2-3, 3-4, and 4-5. The test-retest (intra-class) correlation for the composite score for the aggressive behavior/authority acceptance items was .76 over a two-month interval. In terms of predictive validity, in grades

1-5, respectively, the aggressive/disruptive behavior subscale significantly predicted adjudication for a violent crime in adolescence and a diagnosis of Antisocial Personality Disorder at age 19-20 in the 1st generation JHU PIRC trial and follow-up (Petras, Chilcoat, Leaf, Ialongo, & Kellam, 2004; Schaeffer, Petras, Ialongo, Poduska,& Kellam, 2003).

Academic readiness in grade 1 was measured using 9 TOCA-R items assessing effort, attention, eagerness to learn, and engagement in academic activities. A summary score was created by taking the mean of these items. The coefficient alpha for the academic readiness subscale was .96 in grade 1. In middle school, for each unit increase on the TOCA-R academic readiness subscale, there was a 36% reduction in the odds of receiving special education services.

Grade 6 Assessments

Deviant Peer Affiliation. Deviant peer affiliation was assessed using the Exposure to Deviant Peers (Capaldi & Patterson, 1989) measure. Youth were asked in forced choice format to indicate how often their peers have engaged in antisocial behavior, such as hitting or threatening someone, stealing, and damaging other's property. In the present sample, the coefficient alpha was .76 in grade 6. In terms of the concurrent validity, deviant peer affiliation in grade 6 was significantly related to less parental monitoring, witnessing community violence, and being a victim of community violence in grade 6 (Lambert, Ialongo, Boyd, & Cooley, 2005). In terms of the predictive validity, deviant peer affiliation in grade 6 was significantly related to witnessing community violence in grades 7 and 8 and being a victim of community violence in grade 7 and 8 (Lambert et al., 2005).

Conduct Problems. Conduct problems were assessed using the Teacher Report of Classroom Behavior Checklist (TRCBC), an adaptation of the TOCA-R (Werthamer-Larsson

et al., 1991). The TRCBC was used in grades 6 through 10 to assess the youths' classroom behavior. Items were largely drawn from the DSM-III-R and IV (American Psychiatric Association, 1994). A checklist format was used rather than conducting interviews in middle school due to concerns over the costs and logistical burden of interviewing upwards of 300-400 teachers in over 130 schools. Like the TOCA-R, the domains assessed in the TRCBC were accepting authority (the maladaptive forms being Conduct Problems and Oppositional Defiant Behavior), attention/concentration and readiness for work (or attention/concentration problems), and social participation (or shy behavior). Also measured were students' self-regulation (impulsivity), motor control (hyperactivity), and likeability (peer likeability/rejection).

Conduct problems in grade 6 was measured using 7 TOCA-R items assessing whether the youth skipped school, lied, bullied classmates, started physical fights, took others property, hurt others physically, and damaged other peoples property. A summary score was created by taking the mean of these items. The coefficient alpha for the TRCBC Conduct Problems subscale in middle school was .91. In terms of the concurrent validity, the Conduct Problems subscale was significantly related to whether a child had been suspended from school during elementary and middle school.

Depression. Depressive symptoms were assessed using the Depression subscale of the Baltimore How I Feel-Adolescent Version, Youth Report (BHIF-AY; Ialongo, Kellam, & Poduska, 1999), a 45-item, youth self-report measure of depressive and anxious symptoms. Respondents indicate the frequency of depressive and anxious symptoms over the last two weeks on a four-point scale. Depression items were generated directly from DSM-IV (American Psychiatric Association, 1994) criteria for depressive disorders (i.e. Major

Depression, Dysthymia) or drawn from existing child self-report measures, including the Children's Depression Inventory (Kovacs, 1983), the Depression Self-Rating Scale (Asarnow & Carlson, 1985), the Hopelessness Scale for Children (Kazdin, Rodgers, & Colbus, 1986) the Revised-Children's Manifest Anxiety Scale (Reynolds & Richmond, 1985). For the purpose of this study, a summary score was created by summing across the 19 depression items to yield a Depression subscale score and anxiety symptoms were not examined. The alpha for the depression items in grade 6 was .80. In middle school, the BHIF Depression subscale was significantly associated with a diagnosis of major depressive disorder on the Diagnostic Interview Schedule for Children IV (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000).

Grade 10 Assessments

Substance Use. Substance use was assessed using the Monitoring the Future National Survey (MTFNS, Johnston et al., 1995) using the audio computer assisted self interview (ACASI) method. Each student sat with individualized headphones and a response keyboard connected to a laptop computer which had been pre-programmed to present each standardized item in sequence, using both visual and audio format. The assessment was self-paced, and the students marked their responses under private conditions that were maintained by a member of the assessment staff who took care not to observe the responding and to prevent observation by others in the vicinity. Use of the following substances was assessed: tobacco, alcohol, marijuana, cocaine, crack, heroin, ecstasy, and inhalants. Only tobacco use and marijuana use in Grade 1 were examined the present study. In the MTFNS, tobacco use includes both cigarettes and chewing tobacco. Adolescents were asked about the frequency of their tobacco and marijuana use in the past year with two separate items. Adolescents rated

each item on a Likert scale: 0 (none), 1 (once), 2 (twice), 3 (3-4 times), 4 (5-9 times), 5 (10-19 times), 6 (20-39 times) and 7 (40 or more times).

Data Analytic Strategy

Preliminary Analyses

Means and standard deviations for study constructs were calculated. Correlations were examined to determine associations among each of the variables in the model. Analyses for males and females were conducted separately. Gender differences in the pathways to adolescent substance use were formally tested by using multiple group analyses.

Path Analysis

A structural equation modeling (SEM) framework was used to examine the associations between the study variables. Path analysis was used because analyses were performed using observed variables and not latent variables. A benefit of using an SEM framework is that it allows the examination of each exogenous independent variable simultaneously, and the fit of the hypothesized model can be tested against alternative models. Although multiple regression analysis can be used to analyze path models, it does not provide an overall test of the model fit, making it difficult to compare competing models or test constraints on models. In addition, SEM allows for the examination of correlated error terms, which are likely to occur when collecting data on problem behaviors in childhood. Because of the problem of compounding of measurement error when computing interaction terms, several authors have maintained that SEM strategies provide less biased examination of moderator effects because regression strategies tend to underestimate the effect size of the interaction term, particularly as measurement error in the predictor and moderator variable increases (Jaccard & Wan, 1996; Peyrot, 1996; Ping, 1996). Therefore, hypothesized

moderation by gender will be tested using multiple group analyses, the preferred method for testing moderation in SEM (Holmbeck, 1997).

The overall fit of the deviance proneness and affect regulation models predicting tobacco use and marijuana use will be evaluated using multiple indicators of fit: Chi Square, Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Chi-Square is used as a measure of fit between the sample covariance and fitted covariance matrices. Small, non-significant chi-square values are indicative of good fit (MacCallum et al., 1996). However, it should be noted that chi-square values in large samples are often significant (Bollen, 1990). For models with about 75 to 200 cases, chi-square is a reasonable measure of fit; however, with models with more than 200 cases, the chi square is almost always statistically significant. In order to make chi-square less dependent on sample size, the relative chi-square (the chi-square fit index divided by degrees of freedom) can be used. However, there is no consensus about what value indicates a good fit. According to Ullman (2001), a value of 2 or less reflects a good fit, whereas Kline (1998) says 3 or less is acceptable. Some researchers consider values as high as 5 adequate fit. Given the lack of consensus about chi-square values indicative of good model fit, chi-square should be used with other indicators of fit. Hu and Bentler (1995) suggest that CFI and TLI values above .95 indicate good fit. RMSEA values less than .08 represent acceptable fit and RMSEA values equal or less than .05 represent good fit (Browne & Cudeck, 1993).

Testing the Deviance Proneness and Affect Regulation Paths

The hypothesized path models as shown in Figures 3 and 4 will be analyzed using M*plus* 5.1 statistical software (Muthén & Muthén, 1998-2008). Specifically, grade 10 substance use will be regressed on grade 6 risks (i.e., depression, deviant peer affiliation, and

conduct problems), and grade 6 risks will be regressed on the grade 1 risks (low academic readiness and aggression). Correlations between study variables assessed in the same year (e.g., low academic readiness and aggression) will be examined to account for bias resulting from shared method variance. Tobacco use and marijuana use will be tested in the same model. Analyses will be conducted separately by gender.

Testing Moderation

Multiple group analyses will be performed to determine if there are significant gender differences in the hypothesized paths (See Figures 3 and 4). The overall fit of each model will be tested under two conditions: a) when the association between the predictor and criterion is constrained to be equal (i.e., an equality constraint for males and females) (Farrell, 1994; Jaccard & Wan, 1996), b.) when the association between the predictor and criterion can vary as a function of gender (i.e., no equality constraint for males and females. Gender differences in each of the paths will be examined separately. For example, to test gender differences in the path between low academic readiness and depressive symptoms, a model with all paths constrained to be equal for males and females will be compared with a model in which the path between low academic readiness and depressive symptoms is freely estimated for males and females. The magnitude of the difference between chi-square values for these two models determines whether gender moderates this path. Specifically, a significant improvement in model fit when the paths are freely estimated suggests that gender does moderate the path. A significant improvement in model fit is evidenced by a significant difference in chi-square model fit between these models. This chi-square difference is distributed as a chi square with one degree of freedom (i.e., when the model is constrained, there is one less degree of freedom to estimate).

Figure 3. Proximal and Distal Risks for Tobacco Use.

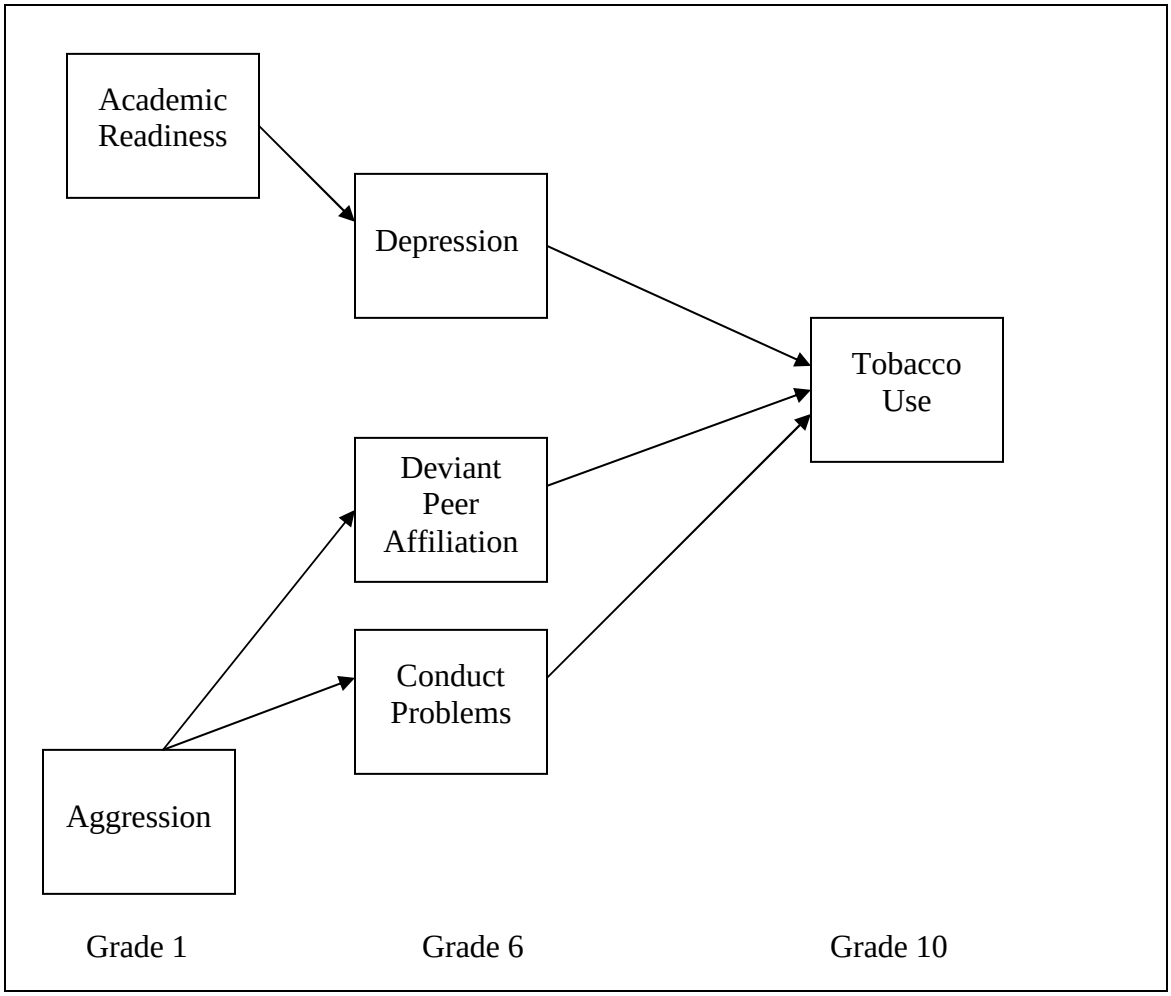
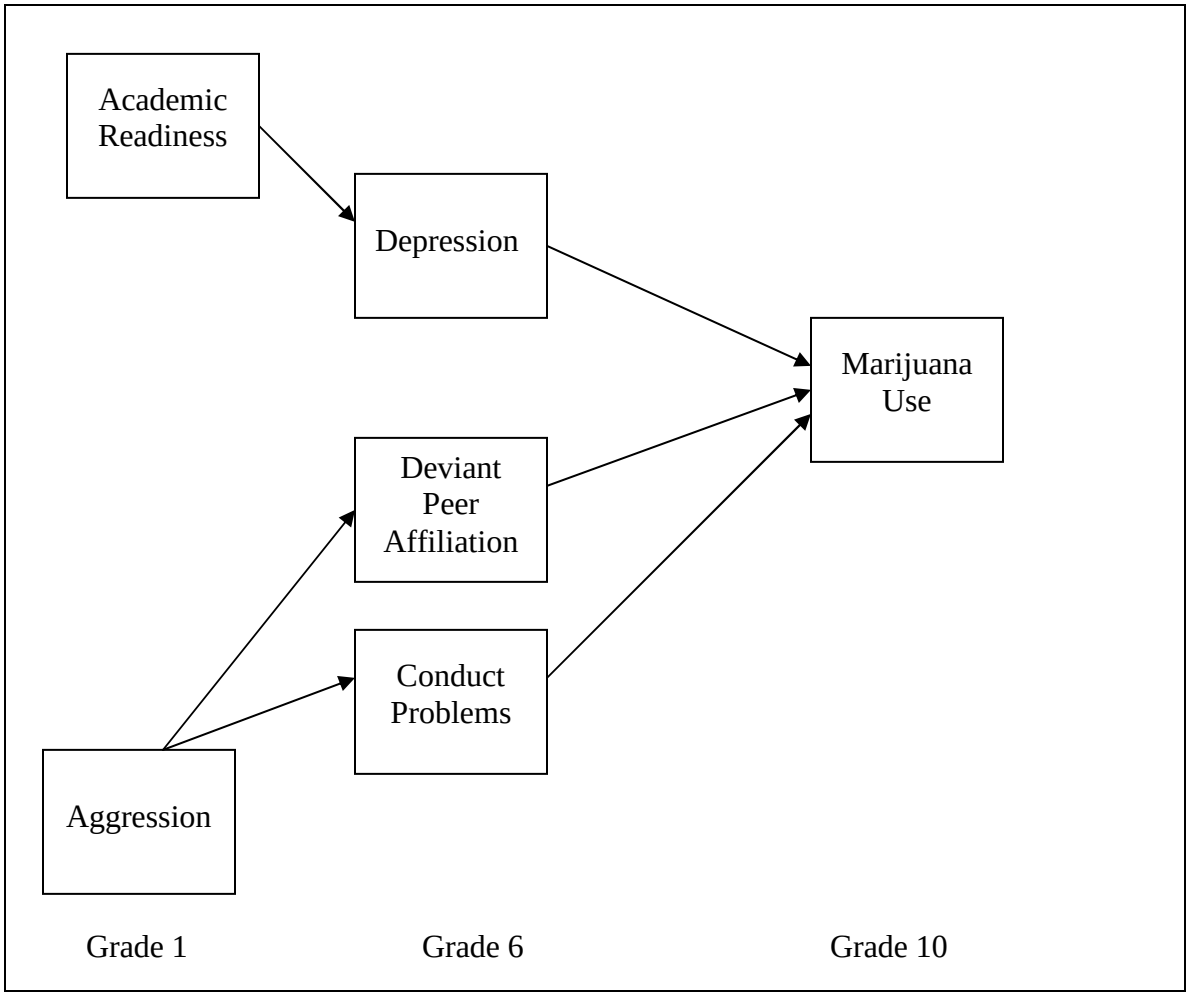


Figure 4. Proximal and Distal Risks for Marijuana Use.



Power Analysis/Sample Size

When using a SEM framework the sample size should not be "small" because SEM relies on tests, which are sensitive to sample size, in addition to the magnitude of differences in covariance matrices. When the sample size is too "small," parameter estimates will be unstable and significance tests will lack power. In the literature, sample sizes commonly run 200 - 400 for models with 10 - 15 indicators. One survey of 72 SEM studies found the median sample size was 198. Loehlin (1992) recommends at least 100 cases, preferably 200. Hoyle (1995) also recommends a sample size of at least 100 - 200. Kline (1998) considers

sample sizes under 100 to be "untenable" in SEM. A sample of 150 is considered too small unless the covariance coefficients are relatively large. With over ten variables, sample size under 200 generally means parameter estimates are unstable and significance tests lack power. In general, the literature on SEM states that sample size should be at least 50 more than 8 times the number of variables in the model (Garson, 1998). In addition, Mitchell (1993) also recommends that there be 10 to 20 times as many cases as variables. Another recommendation is to have at least 15 cases per measured variable or indicator (Stevens, 1996). In contrast, Bentler and Chou (1987) allow as few as 5 cases per parameter estimate (including error terms as well as path coefficients) if one has met all data assumptions.

Although there is no accepted standard when calculating sample size for a SEM framework, as noted above there have been multiple recommendations made to assist in calculating an estimate for a sample size. In order to calculate a minimum sample size, Steven's (1996) recommendation is used. For the present study there are six constructs and if 15 cases are used per measure, a total of 90 cases are needed. The present study's sample size (in excess of 500) provides an adequate sample according to Steven's (1996), Bentler and Chou's (1987), Hoyle's (1995), Loehlin's (1992), and Mitchell's (1993) criteria noted above. In addition, there are enough cases to run models separately by gender.

Results

Descriptive Statistics and Associations among Study Variables

Means, standard deviations, and ranges for all study variables are presented in Table 1. Teachers reported significantly higher levels of academic readiness for girls (M = 4.37) than for boys (M = 3.91), t = -4.36, $p < .001$. Teachers also reported significantly more aggressive behavior for boys (M = 1.80) than for girls (M = 1.40), t = 6.00, $p < .001$. According to teachers' report, boys (M = 1.73) were more likely to exhibit conduct problems than girls (M = 1.39), t = 5.76, $p < .001$. Boys and girls reported similar rates of depressive symptoms (M for boys = -0.71; M for girls = -.72; t = -.26, *ns*), and similar levels of affiliation with deviant peers (M for boys = -0.71; M for girls = -.72; t = 0.81, *ns*). There were no gender differences in youth reports of the frequency of their 10th grade tobacco or marijuana use.

Table 1
Means and Standard Deviations of Study Variables for Total Sample and By Gender

	Total Sample			Males		Females		
Variable	M	(SD)	Maximum Range	M	(SD)	M	(SD)	T-test
Academic Readiness (1st)	4.13	(1.31)	1-6	3.91	(1.31)	4.37	(1.26)	-4.36*
Aggressive Behavior (1st)	1.61	(.84)	1-6	1.80	(.95)	1.40	(.62)	6.00*
Depressive Symptoms (6th)	.72	(.42)	0-2.52	.71	(.40)	.72	(.45)	-.26
Deviant Peer Affiliation (6th)	1.75	(.67)	1-4.83	1.80	(.69)	1.70	(.64)	1.72
Conduct Problems (6th)	1.57	(.66)	1-5	1.73	(.73)	1.39	(.51)	5.76*
Tobacco Use (10th)	.77	(1.75)	0-7	.80	(1.85)	.73	(1.63)	.37
Marijuana Use (10th)	.88	(1.88)	0-7	.97	(2.00)	.77	(1.74)	1.16

Note. *$p <$. 05.

Bivariate associations among independent variables (grade 1), hypothesized mechanisms (grade 6), and substance use outcomes (grade 10) for males and females are presented in Table 2. Lower teacher-reported academic readiness was associated with higher teacher reports of males' aggressive behavior and conduct problems (r = -.52, p < .001; r = -.22, p < .001, respectively). Similarly, lower teacher-reported academic readiness was associated with higher teacher reports of females' aggressive behavior and conduct problems, (r = -.39, p < .001; r = -.27, p < .001, respectively). Teacher reports of academic readiness and depressive symptoms were negatively correlated for females (r = -.15, p < .05); specifically, lower teacher-reported academic readiness was associated with higher reports of depressive symptoms for females. Teacher reports of academic readiness and depressive symptoms were not correlated for males (r = -.11, *ns*).

Table 2
Correlations Among Study Variables for Males and Females

Variable	1.	2.	3.	4.	5.	6.	7.
Grade 1							
1. Academic Readiness	-	-.39***	-.15*	-.04	-.27***	-.08	-.08
2. Aggressive Behavior	-.52***	-	-.03	-.05	.19**	.10	.11
Grade 6							
3. Depressive Symptoms (6^{th})	-.11	.04	-	.27***	.06	.02	.10
4. Deviant Peer Affiliation (6^{th})	-.10	.06	.33***	-	.09	.08	.19**
5. Conduct Problems (6^{th})	-.22***	.26**	.07	.19**	-	.21**	.15*
Grade 10							
6. Tobacco Use (10^{th})	-.03	.04	.09	.19**	.25***	-	.66***
7. Marijuana Use (10^{th})	-.02	-.09	.00	.08	.16**	.55***	-

Note. Correlations for females are above the diagonal; correlations for the males are below the diagonal.
* p <. 05, ** p < .01, *** p < .001.

Teacher reports of aggressive behavior and conduct problems were positively associated for males ($r = .26$, $p < .001$) and females ($r = .19$, $p < .01$), indicating that higher teacher-reported aggressive behavior was associated with higher teacher-reports of conduct problems. Depressive symptoms were positively associated with deviant peer affiliation for males ($r = .33$, $p < .001$) and females ($r = .27$, $p < .001$), indicating that higher youth-reported depressive symptoms were associated with higher reports of deviant peer affiliation. Deviant peer affiliation was significantly positively associated with conduct problems ($r = .19$, $p < .01$) and significantly positively associated with tobacco use ($r = .19$, $p < .01$) for males only.

Deviant peer affiliation was positively associated with marijuana use for females ($r = .19$, $p < .01$), but not for males ($r = .08$, *ns*). Higher teacher-reported conduct problems were associated with higher reports of tobacco use and marijuana use for males ($r = .25$, $p < .001$; $r = .20$, $p < .01$, respectively). Similarly, higher teacher-reported conduct problems were associated with higher reports of tobacco use and marijuana use for females ($r = .21$, $p < .01$; $r = .15$, $p < .05$, respectively). Tobacco use and marijuana use were positively associated for males ($r = .55$, $p < .001$) and females ($r = .66$, $p < .001$).

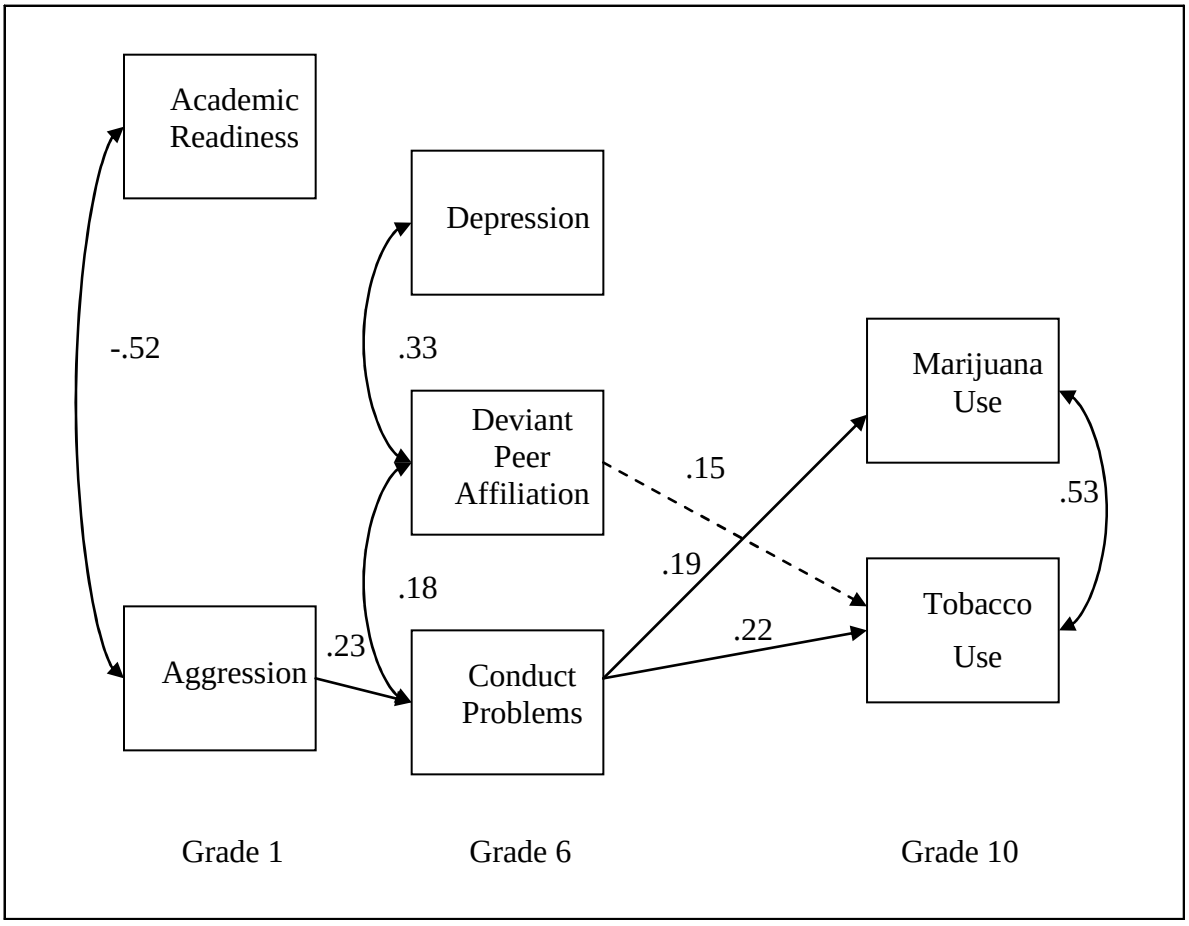
Path Analysis

Path analysis using M*plus* 5.1 (Muthén & Muthén, 1998-2008) was used to examine the hypothesized relationships among study constructs. Tobacco and marijuana use in 10th grade were examined in a single model (see Figures 5 and 6) to increase parsimony in the estimated model. Because it was hypothesized that the association between distal and proximal risk factors for adolescent substance use would vary by gender, models were examined for males and females separately. Intervention status and receipt of free or reduced cost lunch were controlled in each of the path analytic models.

Model for Males

The model predicting tobacco and marijuana use for males had an adequate fit to the data, $\chi 2$ (7) = 10.71, p = .16; CFI = .974; TLI = .893; RMSEA = .04 (90% C.I. = .00-.09). There was a significant positive association between 1st grade aggressive behavior and 6th grade conduct problems (β = .23, p < .01). Specifically, boys rated as exhibiting aggressive behavior by teachers in 1st grade were more likely to exhibit conduct problems in 6th grade. Conduct problems in 6th grade were significantly positively associated with tobacco (β = .22, p < .01) and marijuana use in (β = .19, p < .01) in 10th grade. The indirect pathway from aggressive behavior in 1st grade to conduct problems in 6th grade and tobacco use in 10th grade was significant (z = 2.40, p < .05). Similarly, the indirect pathway from aggressive behavior in 1st grade to conduct problems in 6th grade and marijuana use in 10th grade was significant (z = 2.18, p < .05). These significant indirect effects from early aggressive behavior and later conduct problems and substance use are consistent with the deviance proneness framework (see Figure 5).

Figure 5. Path analysis for associations between 1st grade and 6th grade risks and adolescent substance use for males.



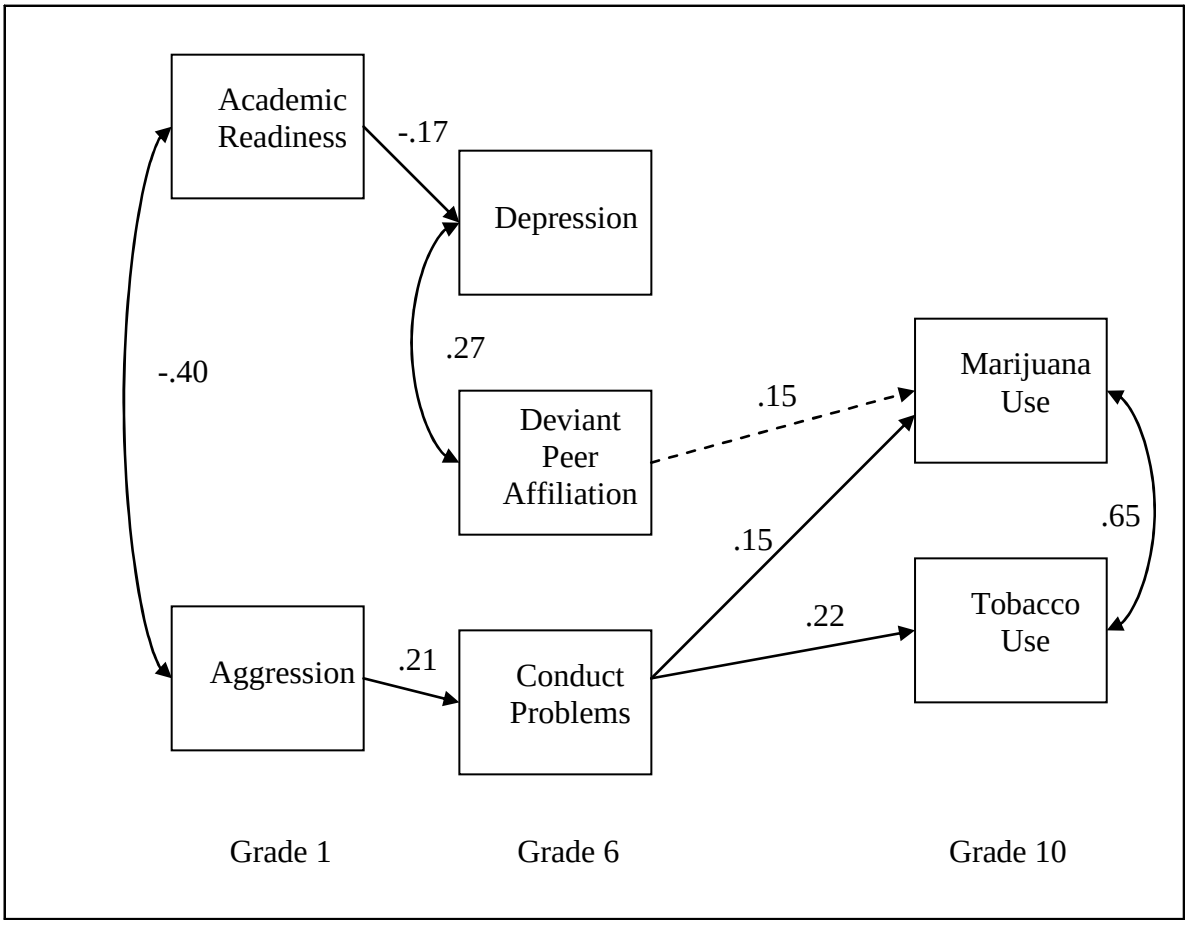
Contrary to predictions, aggressive behavior in 1st grade was not associated with males' deviant peer affiliation in 6th grade. There was a marginal association between deviant peer affiliation in 6th grade and tobacco use in 10th grade (β = .15, p = .06), but no association between 6th grade deviant peer affiliation and marijuana use in 10th grade. The non-significant paths between early aggressive behavior and later deviant peer affiliation and marijuana use are not consistent with the deviance proneness framework; however, the trend detected between deviant peer affiliation and tobacco use does provide partial support for the deviance proneness framework (see Figure 5).

Academic readiness in 1st grade was not significantly associated with depressive symptoms in 6th grade. Depressive symptoms in 6th grade were not associated with tobacco or marijuana use in 10th grade. Thus, the model for males did not provide support for the affect regulation framework (see Figure 5).

Model for Females

For females, the chi-square ($\chi 2(7) = 13.78$, $p = .06$) and CFI indices (CFI = .961) for the model predicting tobacco and marijuana use suggested good fit (see Figure 6); however, the TLI (TLI = .832) and the RMSEA (RMSEA = .06 (90% C.I .= 00-.11) suggested only an adequate fit. There was a significant negative association between academic readiness in 1st grade and depressive symptoms in 6th grade ($\beta = -.17$, $p < .01$). Specifically, children rated as having low academic readiness by teachers in 1st grade were more likely to report depressive symptoms in 6th grade. Depressive symptoms in 6th grade were not significantly associated with tobacco or marijuana use in 10th grade; thus, the model for females demonstrated partial support for the affect regulation framework, with academic readiness being significantly negatively associated with depressive symptoms (see Figure 6).

Figure 6. Path analysis for indirect associations between 1st grade and 6th grade risks and adolescent substance use for females.



Aggressive behavior in 1st grade was not associated with deviant peer affiliation in 6th grade. There was a marginal association between 6th grade deviant peer affiliation and 10th grade marijuana use (β = .15, p = .05), but no significant association between deviant peer affiliation and tobacco use in 10th grade. There was a significant positive association between aggressive behavior in 1st grade and conduct problems in 6th grade (β = .21, p < .01), indicating that as teacher-reports of aggressive behavior increased, teacher reports of conduct problems also increased. Conduct problems in 6th grade were significantly positively associated with tobacco (β = .22, p < .01) and marijuana use (β = .15, p < .01) in 10th grade. Specifically, an increase in teacher reports of conduct problems in 6th grade was associated

with tobacco and marijuana use in 10th grade. The indirect pathway from aggressive behavior in 1st grade to conduct problems in 6th grade and tobacco use in 10th grade was significant ($z = 2.10$, $p < .05$). In contrast, the indirect pathway from aggressive behavior in 1st grade to conduct problems in 6th grade and marijuana use in 10th grade was not significant ($z = 1.68$, $p = .09$). The significant indirect effect from early aggressive behavior and later conduct problems and tobacco use is consistent with the deviance proneness framework (see Figure 6). This partial support for the deviance proneness pathway was not consistent with the stated hypotheses for females.

Exploratory Analyses

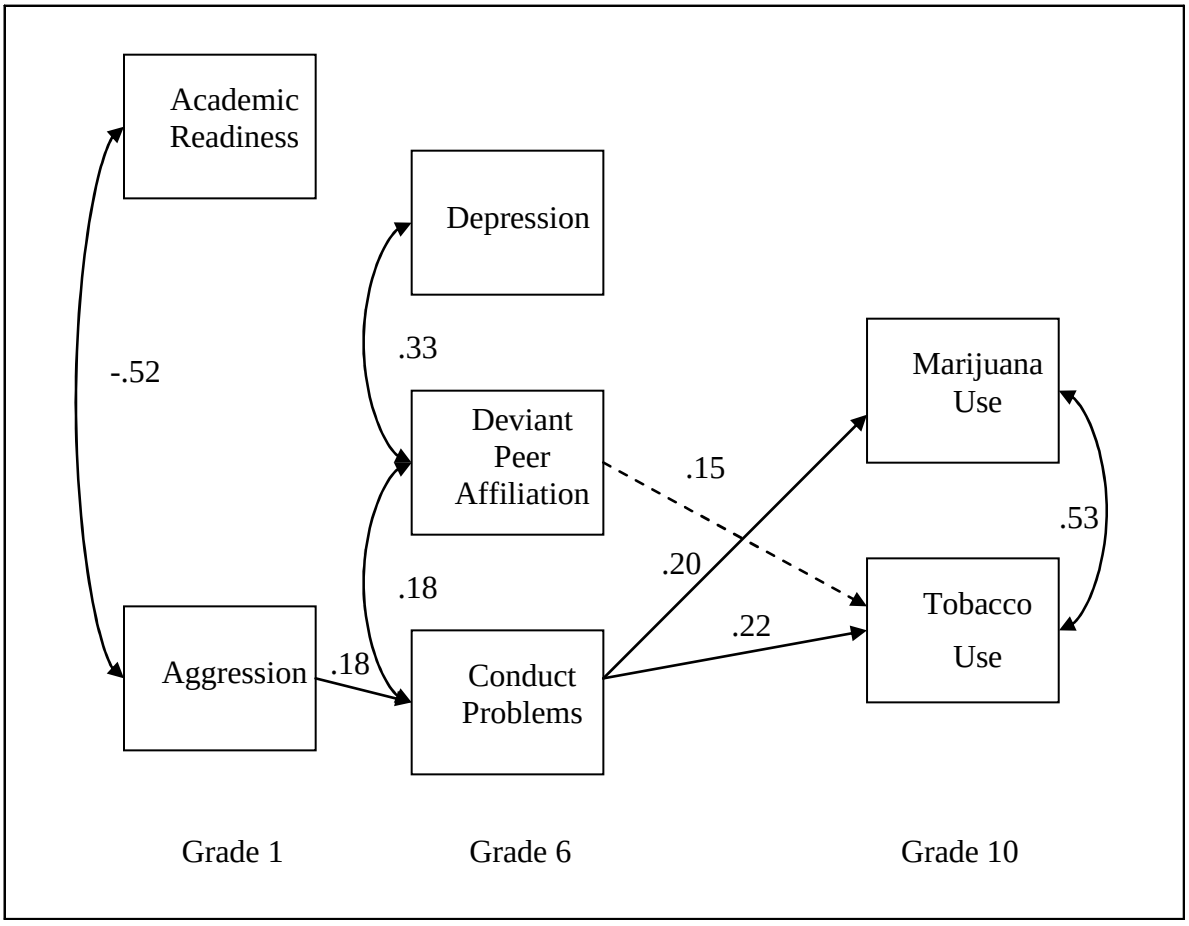
Although indirect effects were the primary focus of this study, exploratory analyses also were conducted to examine whether the 1st grade risks (aggressive behavior and academic readiness) were significantly associated with 10th grade tobacco and marijuana use. If direct effects were present (i.e., these early risks were significantly associated with tobacco and marijuana use), then depressive symptoms, deviant peer affiliation, and conduct problems in 6th grade could be examined as mediators of the direct effects; however, if no direct effects were present, the first condition for mediation is not satisfied and only indirect effects may be examined (Holmbeck, 1997).

The associations between 1st grade aggressive behavior and academic readiness and 10th grade tobacco or marijuana use were not significant for males or females. Thus, the first condition for mediation was not met. Therefore, 6th grade depressive symptoms, deviant peer affiliation, and conduct problems were not tested as possible mediators of 1st grade risks and 10th grade substance use, and moderated mediation was not tested. Instead only the indirect effects of 1st grade risks on 10th grade substance use were examined.

The affect regulation framework (i.e., low academic readiness → depressive symptoms) and the deviance proneness framework (i.e., aggressive behavior → deviant peer affiliation; aggressive behavior → conduct problems) were the primary models examined to understand 10th grade substance use. However, additional analyses were conducted to examine alternative pathways between 1st grade and 6th grade risks. Three additional paths were examined in addition to the affect regulation and deviance proneness frameworks described above: 1st grade academic readiness predicting 6th grade deviant peer affiliation; 1st grade academic readiness predicting 6th grade conduct problems; and 1st grade aggressive behavior predicting 6th grade depressive symptoms. Analyses examining these additional paths were conducted separately by gender.

For males, the CFI (CFI = .973), RMSEA (RMSEA = .06 (90% C.I. = .00-.11) and chi-square ($\chi 2$ (4) = 7.01, p = .10) for the model including exploratory paths suggested good fit (see Figure 7); however, the TLI (TLI = .795) was indicative of only an adequate fit to the data. The three added paths were not significant. Academic readiness in 1st grade was not significantly associated with 6th grade conduct problems or 6th grade deviant peer affiliation. Aggressive behavior in 1st grade was not significantly associated with 6th grade depressive symptoms. Consequently, there were no differences between the initial model examined (Figure 5) and the model including the exploratory paths for males (Figure 7).

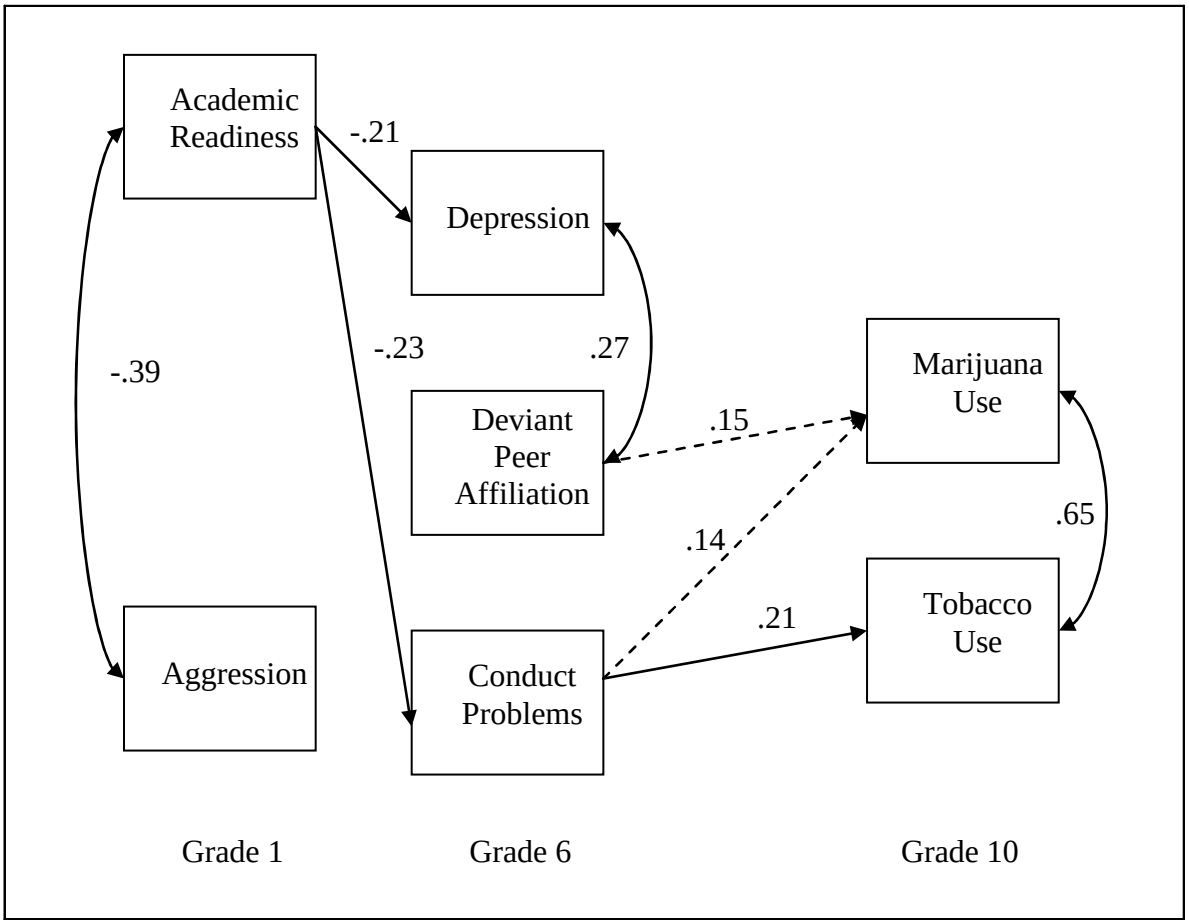
Figure 7. Path analysis for exploratory indirect associations between 1st grade and 6th grade risks and adolescent substance use for males.



For females, the model including the exploratory paths predicting tobacco and marijuana use (see Figure 8) had a good fit to the data, $\chi 2(4) = 2.41$, $p = .66$; CFI = 1.00; TLI = 1.06; RMSEA = .00 (90% C.I. = .00-.07). Academic readiness in 1st grade was significantly negatively associated with 6th grade conduct problems ($\beta = -.23$, $p < .05$), but not significantly associated with 6th grade deviant peer affiliation. First grade aggressive behavior was not significantly associated with 6th grade depressive symptoms. Thus, the exploratory analyses examining the alternate associations between 1st grade risks and 6th grade risks revealed one significant association that was not present in the initial model (i.e., academic readiness predicting increased conduct problems). The significant association

between 1st grade aggressive behavior and 6th grade conduct problems in the initial model was no longer present after accounting for the significant association between academic readiness and conduct problems (see Figure 8). The significant association between 6th grade conduct problems and 10th grade marijuana use in the initial model became marginally significant after accounting for the association between academic readiness and conduct problems. Thus, there were differences between the initial model (see Figure 6) and the model including the exploratory paths for females (see Figure 8).

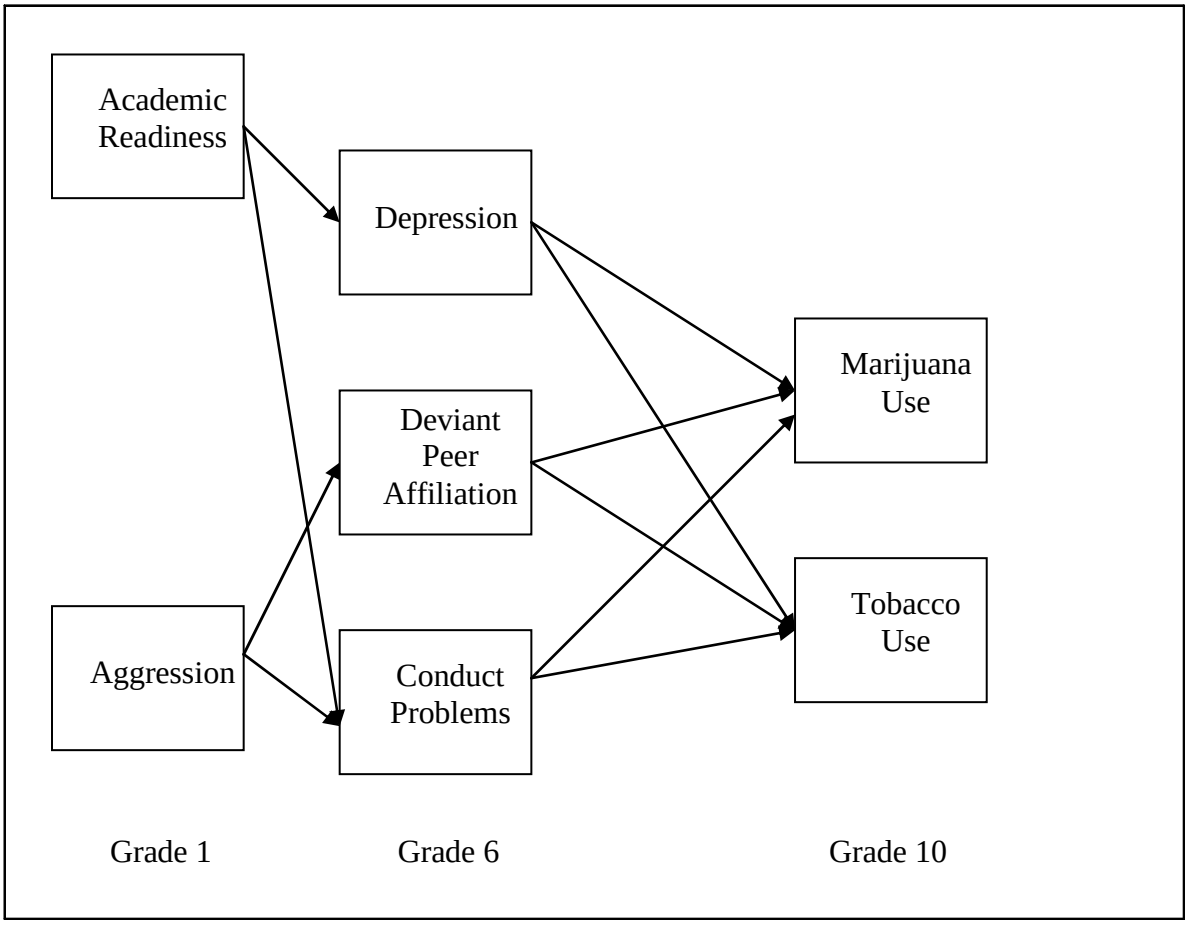
Figure 8. Path analysis for exploratory indirect associations between 1st grade and 6th grade risks and adolescent substance use for females.



Moderation Analyses

The modified model presented in Figure 9 reflects the original hypothesized paths as well as the significant path found in the exploratory analyses (i.e., 1st grade academic readiness → 6th conduct problems). This model was used in the subsequent analyses. To determine whether the associations between study variables varied for males and females, multiple group analyses were performed. Specifically, a model in which paths for males and females were constrained to be equal was compared to models in which paths were freely estimated for males and females. First the model with all paths constrained was compared to the model with all paths freely estimated.

Figure 9. Modified model including indirect associations from original model and exploratory analyses for males and females.



Improved model fit for the model with the freely estimated paths compared to the model with all paths constrained suggests moderation by gender. The model with all paths constrained had a good fit to the data $\chi 2(22) = 24.48$, $p = .32$; CFI = .992; TLI = .979; RMSEA = .02 (90% C.I. = .00-.05). The model including all freely estimated paths also had a good fit to the data $\chi 2(12) = 13.47$, $p = .34$; CFI = .995; TLI = .997; RMSEA = .02 (90% C.I. = .00-.07), but it did not provide improved fit compared to the model with all paths constrained ($\chi^2_{diff}(10) = 11.01$, *ns*).

Moderation also was tested by comparing a model in which paths for males and females were constrained to be equal to models in which each path was freely estimated for males and females. Improved model fit for the model with the freely estimated path compared to the model with all paths constrained suggests moderation by gender. Each path was freed in a separate model. The model with all paths constrained had a good fit to the data $\chi 2(22) = 24.48$, $p = .32$; CFI = .992; TLI = .979; RMSEA = .02 (90% C.I. = .00-.05). Model comparisons for each path are presented in Table 3.

Table 3
Comparison of Paths by Gender

Model	χ^2	df	χ^2 difference	Df difference
Constrained model for males and females	24.48	22	-	-
Path Freely Estimated				
Aggressive Behavior → Conduct Problems	24.47	21	.01	1
Aggressive Behavior → Deviant Peer Affiliation	23.64	21	.83	1
Academic Readiness → Depressive Symptoms	22.82	21	1.66	1
Conduct Problems → Marijuana	24.43	21	.04	1
Deviant Peer Affiliation → Marijuana	19.83	21	4.65*	1
Depressive Symptoms → Marijuana	21.09	21	3.38+	1
Conduct Problems→ Tobacco	24.41	21	.06	1
Deviant Peer Affiliation → Tobacco	18.58	21	4.90*	1
Depressive Symptoms → Tobacco	21.81	21	2.67	1
Academic Readiness → Conduct Problems	23.83	21	.65	1

Note. * p <.05, + p < .10.

Model comparisons revealed a significant improvement in model fit when the path between 6th grade deviant peer affiliation and 10th grade tobacco use was freely estimated as compared to the model with all paths constrained ($\chi^2_{diff}(1) = 4.90$, $p < .05$), thus, suggesting moderation by gender. Examination of path coefficients for males and females revealed that the strength of the association between deviant peer affiliation and tobacco use was significantly stronger for males ($\beta = .15$, $p = .06$) than females ($\beta = .04$, $p = .58$), although neither path was significantly different from zero. Model comparisons revealed a significant improvement in model fit when the path between, 6th grade deviant peer affiliation and 10th grade marijuana use was freely estimated as compared to the model with all paths constrained ($\chi^2_{diff}(1) = 4.65$, $p < .05$), suggesting moderation by gender. The strength of the

association between deviant peer affiliation and marijuana use was stronger for females (β = .15, *ns*) than for males (β = .06, p = .48). Additionally, there was a marginally significant improvement in model fit when the path between 6th grade depressive symptoms and 10th grade marijuana use was freely estimated as compared to the model with all paths constrained ($\chi^2_{diff}(1) = 3.38$, *ns*). The strength of the association between depressive symptoms and marijuana use was marginally stronger for females (β = .07, p = .38) than males (β = -.02, p = .80), although neither path was significantly different from zero. No other gender differences were observed.

Discussion

The current study utilized prospective longitudinal data to examine early childhood behavioral and academic risks as antecedents to adolescent mental health problems and externalizing problems, which in turn were hypothesized to influence adolescent substance use. Specifically, first grade aggressive behavior and low academic readiness were examined as distal risks for adolescent substance use; sixth grade depressive symptoms, deviant peer affiliation, and conduct problems were examined as proximal risks for adolescent substance use, linking the early risks with later substance use. Findings revealed that for this community epidemiologically-defined sample of urban African American adolescents, aggressive behavior was indeed associated with conduct problems, which in turn predicted later substance use. For females, low academic readiness also was associated with conduct problems, suggesting multiple trajectories to conduct problems and adolescent substance use. Although neither first grade risk was associated with deviant peer affiliation, deviant peer affiliation was associated with tobacco and marijuana use, and these associations varied by gender. Findings underscore the value of utilizing prospective longitudinal data to identify proximal and distal risks for substance use among urban African American adolescents and highlight the importance of examining gender differences in risk for adolescent substance use.

Problem behaviors in early childhood, such as poor achievement, difficult peer relations, and externalizing classroom behaviors often co-occur; thus, researchers often have grouped these problem behaviors together conceptualizing them as indicators of general maladjustment (e.g., Block, Block, & Keyes, 1988; Kellam, Brown, Rubin, & Ensminger, 1983; Ladd, 1989). Similarly, in the present study, there were significant correlations

between early aggressive behavior and low academic readiness. Although both aggressive behavior and low academic readiness can be considered indicators of general maladjustment (Bogat, Jones, & Jason, 1980; Eccles, Lord, & Roeser, 1996; Ladd, 1989; Patterson, Reid, & Dishion, 1992), in this study, each risk was examined separately to better understand trajectories to adolescent substance use that may be specific to aggression or low academic readiness. For the same reason, sixth grade risks (i.e., depressive symptoms, deviant peer affiliation, and conduct problems) also were examined separately. Examination of each risk separately permitted tests of gender differences in trajectories to adolescent substance use that might be specific to aggressive behavior or low academic readiness. In fact, there was evidence that the early developmental course of each type of problem (i.e., aggressive behavior and low academic readiness) differed for boys and girls in important ways. For example, low academic readiness emerged as an early risk for later depressive symptoms for females, but not males. In addition to gender-specific pathways, some pathways were common across gender. Thus, although there is evidence to suggest overlap of early problem behaviors, examination of aggressive behavior and low academic readiness separately was useful for identifying specific trajectories to adolescent substance use and gender differences in these trajectories.

Deviance Proneness Pathway

Findings highlight the link between externalizing risks and substance use, providing support for the deviance proneness pathway to substance use. Specifically, conduct problems emerged as a significant risk linking early aggressive behavior and later tobacco and marijuana use. These findings support previous literature suggesting that aggressive acts may escalate as development occurs. For example, as children get older, their aggression may be

marked by more violent behavior such as initiating physical fights, injuring others, and the use of weapons, which are indicators of conduct problems (Miller-Johnson, Coie, Maumary-Gremaud, Bierman, 2002). Additionally, these findings are consistent with the widespread empirical support for the associations between conduct problems and substance use (Hawkins et al., 1992; Henry et al., 1993; Kellam, Brown, Rubin, & Ensminger, 1983). Relatedly, Problem Behavior Theory (Jessor & Jessor, 1977) has been used to provide theoretical support for the associations between conduct problems and substance use. According to Problem Behavior Theory, different problem behaviors are viewed as part of a broader deviance pattern that reflects a single, underlying syndrome and includes many behaviors, including delinquency, substance use, and risky sexual activity (Jessor, 1992).

Although prior research documents an association between aggressive behavior and deviant peer affiliation (Bagwell, Coie, Terry, & Lochman, 2000; Kolvin, Miller, Fleeting, & Kolvin, 1988; Patterson et al., 1992; Tremblay et al., 1992), aggressive behavior did not predict deviant peer affiliation in this study. Context may account for the lack of association between aggressive behavior and deviant peer affiliation in this study. In fact, there is research indicating that social context may affect the incidence and meaning of deviant peer affiliation. For example, in some neighborhood settings, affiliation with deviant peers during adolescence may be normative (Ingoldsby et al., 2006). Neighborhood research has demonstrated that communities characterized by low collective efficacy and high disadvantage experience greater deviant peer group activity (Sampson, 1993), and the peer groups available to young children in more disadvantaged neighborhoods may be more likely to be involved in antisocial behavior (Plybon & Kliewer, 2002). Brody and colleagues (2001, 2003) found that African American adolescents living in poor rural communities with low

levels of collective efficacy were more likely to be involved with antisocial peers than were youth living in more advantaged areas. Thus, in a setting where deviant peer affiliation is normative, not only highly aggressive youth but also low aggressive youth may affiliate with deviant peers. This may partly account for the lack of association between aggressive behavior and deviant peer affiliation observed in this study.

Although there was no association between aggressive behavior and deviant peer affiliation in this study, there were marginal associations between deviant peer affiliation and substance use. These results are consistent with prior research indicating that adolescent smoking is often a social behavior; adolescents frequently smoke in the presence of others (Friedman, Lichtenstein, & Biglan, 1985), use cigarette smoking to achieve social belonging (Mermelstein, 1999; Nichter, Nichter, Vuckovic et al., 1997), and are more likely to smoke cigarettes if their close friends smoke (Chassin, Presson, & Sherman, 1984; Hu, Flay, Hedeker, et al., 1995). In this study, the association between deviant peer affiliation and tobacco use was stronger for males than females, and the association between deviant peer affiliation and marijuana use was stronger for females than males. Although the moderation analyses showed significant differences for males and females, the effect for males and females was marginal. Thus, these findings should be interpreted with caution and warrant replication.

There is evidence in the literature that motives for cigarette smoking may differ by gender (Turner, Mermelstein, & Flay, 2004). For example, higher rates of depressive symptoms among adolescent females may lead them to use marijuana as a form of self-medication to decrease their negative affect. Another possible explanation is that African American females may perceive smoking cigarettes to be an unladylike behavior that would

cost them respect of others and would not be compatible with a promising future (Mermelstein, 1999). Thus, the perception of cigarette smoking may account, at least in part, for the lack of association between deviant peer affiliation and tobacco use among females.

Overall, results provide support for the deviance proneness framework. Most notably, conduct problems emerged as a mechanism linking early aggressive behavior and later tobacco and marijuana use. Although early aggressive behavior was not linked with deviant peer affiliation in early adolescence, there were weak associations between deviant peer affiliation and marijuana use for females and deviant peer affiliation and tobacco use for males. Thus, there was partial support for the deviance proneness framework not only for African American males, but females as well.

Affect Regulation Pathway

Results provide partial support for the affect regulation pathway for females, specifically the association between low academic readiness in early childhood and depressive symptoms in early adolescence. Prior research suggests several reasons why this association between low academic readiness and depression may exist. Children with low academic readiness often are unable to pay attention, do not come prepared for class, and show low effort; as a result they may receive negative feedback from parents, teachers, and well-adjusted peers (Cole, Jacquez, & Maschman, 2001; Herman et al., 2007; Herman & Ostrander, 2007). There is evidence indicating that this negative reinforcement may lead to negative self-perceptions, demoralization, low perceived academic competence, and decreased motivation, which in turn, may lead to decrements in psychological well-being, including depression (Blechman, McEnroe, Carella, & Audette, 1986; Eccles, Lord, & Roeser, 1996). Previous literature also indicates that perceptions of being academically

competent and receiving good grades are linked with a reduced risk for emotional difficulties, while low perceived academic competence is related to depressive symptoms in children (Blechman, McEnroe, Carella, & Audette, 1986; Cole, 1991). In addition, first-grade problems in academic readiness have been found to predict teenage depressive symptoms (Herman, Lambert, Reinke, & Ialongo, 2008; Kellam, Brown, Rubin, & Ensminger, 1983). For example, in a recent study, Herman and colleagues (2008) found that students who performed below average on a basic skills test in first grade were more likely to experience depressive symptoms by the time they had entered seventh grade. Thus, the results of the present study are consistent with existing evidence indicating that low academic readiness in childhood is a risk for depressive symptoms in early adolescence.

Contrary to expectations, there was no evidence for adolescents' use of substances as a form of self-medication to decrease their negative affect. One possible explanation for this finding is that in the present study there was a four-year gap between the examination of depressive symptoms (sixth grade) and substance use (tenth grade); the length of time between assessments may have impacted the results. Additional studies are needed to examine whether there is an association between depressive symptoms and substance use over a shorter time interval in order to better understand whether and how substances are used to minimize distressing feelings associated with negative affect states. For example, examination of substance use immediately following or soon after depressive symptoms emerge may be a better test of self-medication theory.

Another possible explanation for why depressive symptoms were not associated with substance use in this sample is that some studies have found that substance use occurs prior to depression among adolescents. Windle and Windle (2001) found that heavy and persistent

cigarette smoking at baseline predicted depressive symptoms at the two-year follow-up. Findings from another study indicated that teens who smoke appear to be more likely to develop depressive symptoms than their nonsmoking peers (Goodman & Capitman, 2000). In fact, Goodman and Capitman (2000) found that non-depressed teens who smoked in the prior month had approximately a four times greater risk of developing depression than nonsmoking teens. Similarly, frequent cannabis use in teenage girls has been linked with later depression with daily users five times more likely to develop symptoms of depression than those girls who do not smoke marijuana (Patton et al., 2002). Given the literature supporting both directions of association between depression and substance use among adolescents, it is important to consider the possibility of bi-directional associations between smoking and depression in adolescents (e.g., Breslau, Kilbey, & Andreski, 1993; Brown, Lewinsohn, Seeley, & Wagner, 1996; Lewinsohn, Rohde, & Seeley, 1998; Rodriguez, Moss, & Audrain-McGovern, 2005; Windle & Windle, 2001). Thus, longitudinal research should examine reciprocal associations between depression and substance use to help clarify the relationship between depression and substance use.

A third possible reason for the non-significant association between depressive symptoms and substance use in this study is that the self-medication theory may not apply to urban African American adolescents. Way and colleagues (1994) conducted qualitative and quantitative analyses examining the association between depression and substance use among an inner-city sample of depressed youth and a suburban sample of depressed youth. Both samples included substance users and non-users. Interestingly, their quantitative findings suggested a positive association between depression, cigarettes, marijuana, and harder drug use among suburban students, but no association between depression and the use of

substances for the urban students. Findings from their qualitative analysis indicated that among the inner-city sample of depressed youth, substance use was described primarily as a cause of stress rather than an escape from it. In contrast, the depressed suburban sample described substance use both as an escape from problems and as a source of problems or stress. These findings suggest that the association between depression and substance use varies according to context, and may provide a partial explanation for the non-significant associations between depressive symptoms and substance use in the present study.

Overall, results suggest that additional research examining the association between depressive symptoms and substance use is needed. There was support for the first part of the affect regulation pathway (i.e., low academic readiness associated with depressive symptoms) for females; however, there was no evidence to support the second part of the affect regulation pathway linking depressive symptoms with substance use. Lack of support for the entire affect regulation pathway may be attributed to the time interval between depressive symptoms and substance use examined in this study, the direction of association between depressive symptoms and substance use, or the context of participants in the study (i.e., urban sample vs. a suburban sample).

Early Risks Predicting Multiple Outcomes-Multifinaity

Although the main focus of this study was to examine the deviance-proneness and affect regulation pathways separately, results suggested multifinality. In general, there is evidence of multifinality when an initial vulnerability is associated with different behavioral outcomes (Cicchetti & Rogosch, 1996). In this study, low academic readiness in early childhood predicted not only later depressive symptoms but also conduct problems for females. Thus, early childhood risks may initiate multiple trajectories to later problem

behaviors. Prior literature has found that children with academic problems such as reading deficits and poor school performance may not feel a connection with school and may become frustrated or lack a sense of attachment to school; these academic problems may increase their risk for not only internalizing behaviors (e.g., depressive symptoms) but also externalizing behaviors (e.g., disruptiveness, aggression, defiance) (Hinshaw, 1992). In fact, research has shown that a history of learning problems and/or failure may precede or exacerbate the emergence of conduct problems because children who have difficulty grasping concepts taught in class or have trouble completing assignments may spend less time on task, be disruptive to their peers, and act out because of their frustration in the classroom, each of which may lead to subsequent behavior problems (e.g., Hirschi, 1969; Maughan, Gray, & Rutter, 1985; Lahey, et al., 1999; Maguin & Loeber, 1996; Satterfield, Hoppe, & Schell, 1982). The finding that low academic readiness in early childhood was associated with early adolescent depressive symptoms and conduct problems for females highlights the clinical importance of early assessment and detection of low academic readiness in girls and interventions to reduce their risk of later depressive symptoms, conduct problems, and substance use.

Implications

Findings underscore the importance of evaluating early internalizing and externalizing risks, and considering whether these early risks have different implications for male and female adolescents' marijuana and tobacco use. This is important for planning assessments of early childhood risk, as well as interventions, for children exhibiting aggressive behavior and low academic readiness; these malleable risk factors can be targeted in preventive interventions designed to reduce substance use among urban African American

adolescents. For example, the finding that youth who exhibit early aggressive behavior are at risk for adolescent tobacco and marijuana use highlights the importance of helping these children early on to modify their externalizing behaviors. In fact, Kellam and Anthony (1998) found that targeting early aggressive behavior is an important smoking prevention strategy.

The finding that low academic readiness in first grade is indirectly associated with females' later tobacco use and marijuana use suggests that gender-specific components of substance use interventions may be warranted. Although gender-specific prevention programs for girls are limited, some have been tested and have shown favorable results. Schinke and Schwinn (2005) utilized a gender-specific computer intervention with an urban sample of seventh grade girls; their findings revealed that compared to a combined-gender drug abuse prevention program, the gender-specific intervention was superior in reducing risk for substance abuse. Weiss and Nicholson (1998) developed a program to teach leadership development and empowerment to minority early adolescent girls to prevent substance abuse. A delayed entry model was used in which the intervention was given to the comparison group following the intervention group. Findings revealed lower rates of drinking onset and incidence and less association with substance-using peers for intervention girls compared to the girls who did not receive the intervention. Elliot and colleagues (2002) tested a program for high school girls involved with team sports that aimed to prevent drug abuse and eating disorders, and to promote healthy nutrition and exercise training. Girls who participated in the program increased their knowledge of the effects of substance abuse, decreased their abuse of harmful drugs, and increased their intentions to not use drugs and

cigarettes (Elliot et al., 2002). These studies suggest that gender-specific interventions targeting adolescent substance use have promising outcomes.

In this study, aggressive behavior and low academic readiness were associated with conduct problems during early adolescence. This suggests that programs aiming to reduce aggressive behavior and interventions focusing on the promotion of academic readiness and academic skills also may reduce the incidence of later conduct problems, which these data suggest are a proximal risk for adolescent tobacco and marijuana use. Moreover, findings suggest that an additional benefit to developing programs focusing on the promotion of academic readiness and academic skills might be a reduction in the incidence of depressive symptoms for females. Therefore, assessment strategies should be implemented in early elementary school grades to identify students with these behavioral and academic risks; youth with elevated levels of these risks can be engaged in selective and indicated interventions for youth at risk for depressive symptoms, conduct problems, and substance use.

Based on the results of the present study, deviant peer affiliation in early adolescence appears to be a proximal risk for tobacco use for males and marijuana use for females. These findings reinforce the existing evidence that suggests that youth who socialize and form friendships with deviant peers are at increased risk for substance use (Dishion, Capaldi, Spracklen, Li, 1995; Fergusson & Horwood, 1997). In addition to substance use, affiliation with deviant peers also increases the risk for conduct problems (Dishion et al., 1994; Vitaro et al., 1997), criminal offending (Fergusson & Horwood, 1996), school failure (Fergusson & Horwood, 1998), and teenage pregnancy (Woodward & Fergusson, 1999). Thus, it is critical

to identify and develop strategies for reducing involvement with deviant peers and promoting prosocial peer relationships that can be implemented during early adolescence.

Strengths and Limitations

This research makes several important contributions to the substance use literature. This research is among the first to identify risk factors for tobacco and marijuana use among a community sample. Most prior studies of substance use in adolescence have focused on youth in clinical and treatment settings (e.g., Morgenstern et al., 1994; Nurco et al., 1998; Woody et al., 1993). Additionally, the majority of prior research on substance use has been cross-sectional, limiting the ability to understand causal processes for adolescent substance use. Moreover, most research about tobacco and marijuana use has focused on White youth; therefore very little is understood about whether and how the risk for tobacco and marijuana problems may differ for African American youth (Jones-Webb et al., 1995; Wallace & Muroff, 2002). This study is among the few to utilize prospective longitudinal data to understand how early childhood and early adolescent risks may influence adolescent substance use among a community epidemiologically-defined sample of urban African American adolescents. A major strength of this study was the detection of malleable risk factors (e.g., aggressive behavior and academic readiness) to prevent substance use. Given that African Americans suffer disproportionably from the consequences of substance abuse and dependence (Wallace, 1999), this research can inform substance use interventions targeting African American youth.

Despite evidence indicating that females are subject to the same or additional consequences from substance use (Deykin & Buka, 1994), prior research has focused primarily on males. In the present study, both males and females were included in the sample

and gender differences for risks for adolescent substance use were formally tested. Gender differences in the trajectories to tobacco and marijuana use provide additional support for the utility of gender- specific interventions. Additionally, findings from the present study can inform non-gender specific interventions because conduct problems were identified as mechanism linking aggressive behavior to substance use for both males and females.

While there were several strengths of the current study, there also are limitations that warrant mention. The community sample examined in this study is a significant strength. However, results can only be generalized to youth from similar socioeconomic, racial, ethnic, and geographic backgrounds. Additional prospective longitudinal studies of African American youth are necessary to better understand the interplay of proximal and distal risks for substance use for African American youth of other backgrounds and in different contexts. Importantly, this study focused on malleable individual characteristics (i.e., aggressive behavior, academic readiness) as risk factors for adolescent substance use because these are easily integrated into prevention programming. Given this focus on individual characteristics, family and neighborhood characteristics that also have relevance for adolescent substance use were not examined. In future research it will be important to integrate risks across multiple domains, including individual, family, and neighborhood contexts, to gain a more comprehensive understanding of the ecology of risk for substance use among adolescents. The present study relied on youth self-report for affiliation with deviant peers; however, collecting parent or teacher ratings of youth involvement with deviant peers, in addition to youth self-report, may provide additional information about these types of peer relationships. This will be especially important considering the literature on the role context may play on how youth perceive and whether youth affiliate with deviant peer groups.

Future Directions

This study presents several areas to address in future research. Future research should examine whether and how the self-medication theory applies to African American females. Additionally, given evidence supporting both directions of association between depression and substance use among adolescents, longitudinal research should be utilized in future investigations to examine reciprocal associations between depressive symptoms and substance use. This will help clarify the direction of the association between depression and substance use and will inform clinicians providing treatment to adolescents who are exhibiting depressive symptoms or having substance use problems. Furthermore, because the strength of the association between deviant peer affiliation and substance use varied by gender, it will be important for subsequent studies to further examine how different risks may be associated with specific substances. This is particularly important because the physiological and biological characteristics and consequences of tobacco and marijuana use differ, and there is evidence to suggest gender differences in response to the pharmacological agents found in tobacco and marijuana (Jamner, Girdler, Shapiro, Jarvick, & Murray, 1998; Melamede, 2005). Differences in reasons for using and response to each substance may be associated with varying pathways to tobacco and marijuana use for males and females. Additionally, these differences may impact the likelihood of continued substance use. This information will help to develop appropriate substance use intervention and prevention programs for youth and it may provide added support for gender-specific programming.

In this study, aggressive behavior and low academic readiness were associated with conduct problems, but not with deviant peer affiliation. In future research, it will be important to examine other early childhood risks that may be linked to deviant peer

affiliation and could be distal risks for adolescent substance use. Future examinations also should examine childhood and early adolescent risks associated with alcohol use because alcohol has been identified as a "gateway" drug associated with negative outcomes for adolescents (Welte & Barnes, 1985). Replication of this study with alcohol use as an outcome will help to determine if the proximal and distal risks identified for tobacco and marijuana use also are applicable to alcohol use. Additionally, this study examined substance use among adolescents, as opposed to substance dependence or abuse. Distinctions between substance use, dependence, and abuse may have important implications in terms of causal pathways, risk for adult substance disorders, and intervention strategies. Future studies would benefit from inclusion of measures that take into account the multidimensional and heterogeneous nature of substance use, including measures of intensity and quantity of use, adverse social consequences, and dependency and abuse symptoms.

In future research it will be important to integrate risks across multiple domains, including individual, family, and neighborhood contexts, to gain a more comprehensive understanding of the ecology of risk for substance use among adolescents. Although family factors were not examined in this study there is evidence that adolescent substance use is related to family history of substance abuse or dependence, general parenting style, parental monitoring, family climate, and parent-adolescent relationships (e.g., Reifman et al., 1998). Macro-level environments such as neighborhoods and schools also may influence adolescent substance use (Dembo, Blount, Schmeidler, & Burgos, 1986; Wilcox, 2003). Further investigations are needed to understand how these contexts may provide social norms about the acceptability of substance use by providing different ease of access to different substances and by providing different sanctions for use. To date, contextual factors

associated with adolescent substance use often have been examined separately from individual level factors; it will be important for future research to utilize an ecological model to better understand how macro-level factors such as neighborhood and school interact with individual, family, and peer factors. Such research can be used to develop comprehensive prevention programs. It may be that broader community-level interventions are important for adolescent substance use prevention, and may be useful additions to programs that target individual-level risk factors for high-risk subgroups.

Summary

The findings of this study suggest that early childhood risks are indeed related to conduct problems and depressive symptoms in early adolescence. Aggressive behavior predicted conduct problems which in turn predicted substance use. For females, low academic readiness predicted conduct problems and depressive symptoms. These associations highlight the importance of identifying both proximal and distal risks for substance use in order to help prevent adolescent substance use, as well as treat it. Although these results must be replicated, these findings provide further evidence for the associations between conduct problems and adolescent substance use, and highlight the importance of examining gender differences among risks for substance use among urban African American adolescents.

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