

GENDER SPECIFIC AND COMMON DEVELOPMENTAL TRAJECTORIES OF
AGGRESSION, DELINQUENCY, AND SUBSTANCE USE ACROSS MIDDLE SCHOOL:
THE ROLE OF DEVIANT PEER ASSOCIATION AND SENSATION SEEKING

By

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To my mother, Karen, my brother and sister, Jonathan and Elyse, and my ever supportive husband, Matthew

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During adolescence, increases are observed in rates of aggression, delinquency, and drug use with strong evidence of differences between males and females. Future prevention efforts would be greatly aided by a better understanding of gender specific and common pathways to drug use that incorporate interconnections with pathways to aggression/delinquency. The current study evaluated bi-directional and temporal associations between drug use and aggression/delinquency across 6th, 7th, and 8th grades using data available from the control group of an evaluation of a drug use and violence prevention program. Group-based trajectory analysis revealed trajectories of aggression, delinquency, and substance use which support the existence of both adolescent-limited and life-course persistent offenders. In addition, unexpected patterns of increasing/decreasing change were observed during middle school for both aggression and delinquency. Clear temporal associations were observed between developmental changes in aggression, delinquency, and substance use. There were few gender differences in the developmental progression of these problem behaviors during middle school with only two exceptions, males were more like to follow trajectories of increasing/decreasing aggression and high stable delinquency. Evaluations of ethnic/racial differences in the trajectory group

membership revealed that significantly more African American adolescents followed trajectories of increasing/decreasing, high increasing, and chronic high aggression and delinquency compared to Latino and White/other adolescents. Hierarchical linear modeling revealed a more pronounced influence of sensation seeking and deviant peer association on the development of antisocial behaviors among females compared to males. In addition, individual changes in sensation seeking conferred a stronger risk for aggression among Latinos compared to other race/ethnicities. Changes in association with delinquent peers were less influential for Latinos compared to other race/ethnicities. Finally, associations between sensation seeking and delinquent peer association on substance use were partially mediated by individual changes in both aggressive and delinquent behavior. The results of this study provide important information regarding interconnections between developmental changes in antisocial behavior that occur during the middle school years. The knowledge gained from this study regarding individual and contextual factors and their connection to pathways for drug use and aggression/delinquency will inform etiology of drug use, drug prevention content, and program implementation strategies.

CHAPTER 1

A DEVELOPMENTAL MODEL OF RECIPROCAL INFLUENCES AMONG ANTISOCIAL BEHAVIORS

The etiology and prevention of adolescent substance initiation and subsequent use and abuse have been the focus of extensive research and evaluation. The literature on this topic is broad and varies by how substance use is conceptualized. Reviews on the topic of substance use have covered such aspects as the distinction between use and abuse (Newcomb & Bentler, 1989), multiple risk and protective factors over the lifespan (Mayes & Suchman, 2006; Newcomb, 1997), and gender differences in substance abuse (Andrews, 2005). In addition, some studies focus on correlates and developmental pathways for specific substances (e.g., alcohol or tobacco) whereas others examine any or multiple substance initiation and use. Moreover, it has been widely acknowledged that the prevention and treatment of adolescent drug use benefits from consideration of other types of antisocial behaviors in adolescence (Newcomb, 1997). Notably, the development of aggression and delinquency across childhood and adolescence has also been the focus of extensive evaluation. Numerous books, chapters, and review articles have been published on aggression and delinquency reflecting definitional issues, the emergence of these behaviors, correlates of aggression and delinquency, and prevention efforts (Dishion & Patterson, 2006; Dodge, Coie, & Lynam, 2006; Moffitt, 2006; Moffitt, Caspi, Rutter, & Silva, 2001). The purpose of this review is to integrate research findings regarding interconnections between substance use and other antisocial behaviors such as aggression and delinquency with particular attention to the role of gender and ethnicity. Given the large number of studies that have been reported on each of these topics individually, this review focuses on only those studies which have evaluated the predictive influence of aggression or delinquency on substance use during adolescence and early adulthood, or the predictive influence of substance use on aggression and delinquency during this same time period.

Several widely accepted conclusions have been drawn about antisocial behaviors such as aggression, delinquency, and substance use (Piquero, Farrington, & Blumstein, 2007). The current paper focuses on one of these conclusions: Different types of antisocial behaviors begin to emerge at distinctively different ages. For instance, aggressive behavior in childhood tends to precede the onset of delinquent behavior which more often increases in adolescence, delinquent behavior in early adolescence tends to precede substance use in mid to late adolescence, and so forth. Despite this relatively well established conclusion, there are still areas which require further inquiry to clarify points of contention within the field. While certain antisocial behaviors have clearly been shown to precede other behaviors in a predictable sequence, it is unclear if this is due to developmentally appropriate changes in the manifestation of an underlying construct of general deviance, or if the onset of one behavior serves as an impetus or stepping stone towards engagement in future antisocial behaviors. In particular, very little is known about how antisocial behavior in childhood may serve as a stepping stone to engagement in delinquent behavior and substance use in adolescence and how this relates to adulthood criminal offending. This leads to a number of questions regarding the developmental sequencing of antisocial behaviors. What is the relationship between past engagement in antisocial behavior and future antisocial behaviors? Does the predictable sequencing in onset of these behaviors reflect specific causal associations among behaviors? Or is it reflective of persistent individual differences which are manifested as different antisocial behaviors depending on developmental stage? Or does the predictable sequencing of antisocial behaviors arise due to bi-directional associations between an individual's past behavior and their personal characteristics?

A great deal of research has been published regarding risk and protective factors associated with aggression, delinquency, and substance use individually. In addition, a variety of theories

have been developed addressing the co-occurrence of antisocial behaviors as either stemming from an underlying construct of general deviance (Gottfredson & Hirschi, 1990) or from common risk factors associated with the development of multiple antisocial behaviors (Jessor, 1992). These theories have inspired a large body of research, a subset of which has evaluated engagement in aggressive or delinquent activities as predictive of substance use in early adolescence, the time during which onset of delinquent behavior and substance use often occurs (Farrell, Sullivan, Esposito, Meyer, & Valois, 2005; Scheier & Botvin, 1996). A separate body of research has evaluated substance use as predictive of engagement in delinquent and criminal behavior in late adolescence and adulthood (Stacy & Newcomb, 1995). There is also international interest in reciprocal influences between antisocial behaviors; however, the literature is sparse (Laventure, Déry, & Pauzé, 2006). The present discussion is not meant to serve as a comprehensive review of the descriptive and etiological studies of these behaviors. However, previous models of antisocial behavior have not attempted to explain the reciprocal influences between aggression, delinquency, and substance use implied by these lines of research. The present paper proposes a Developmental Model of Reciprocal Influences (DMRI) which integrates and expands upon the interconnections between aggression, delinquency, and substance use across time; specifically modeling both causal associations among these antisocial behaviors as well as interindividual differences in risks factors.

The goals in presenting the DMRI are to (a) integrate findings from disparate areas of antisocial behavior research (e.g., criminology, developmental psychology); (b) offer a model capable of explaining developmental sequences in onset of aggression, delinquency, and substance use from late childhood through adulthood that is consistent with current theories of antisocial behavior; and (c) explicate particular mechanisms contributing to the sequential

emergence of aggression, delinquency, and substance use including both interconnections between these antisocial behaviors as well as interindividual differences associated with the development of these antisocial behaviors. In so doing, we offer a framework through which future research can clarify the mechanisms underlying the developmental sequencing of aggression, delinquency, and substance use from childhood through adulthood.

We begin by discussing construct definitions and assessment issues followed by a section on current prevalence rates of aggression, delinquency, and substance use. We then provide a brief discussion of current models and theories which address risk factors associated with the onset of these behaviors individually as well as associations among these antisocial behaviors. The following section introduces the Developmental Model of Reciprocal Influences (DMRI) among aggression, delinquency, and substance use. This section directly addresses the influence of an individual's past behavior on their future behavior and presents research that supports this model. We also discuss factors that seem most salient to testing reciprocal influences both in terms of constructs (e.g., gender and ethnicity) and methodology (e.g., analytic approaches). Finally, the concluding section makes recommendations and highlights important issues to consider in the development of future studies of aggression, delinquency, and substance use, including the major limitations of this type of research and suggestions for addressing these limitations. Implications for prevention scientists, policy makers, and developmental researchers are addressed.

Definition and Assessment of Antisocial Behaviors

Prior to discussing developmental models of aggression, delinquency, and substance use, it is important to note that different models will use different terms to refer to groups of antisocial behaviors (e.g., reckless behavior, deviant behavior, problem behavior, etc.). In fact, the lack of consensus regarding terminology in this area of inquiry creates a challenge for the interpretation

and integration of results across studies. For the purposes of clarity, throughout this review the term “antisocial behavior” refers to engagement in aggressive, delinquent, or substance using behaviors. When discussing models which use different terminology, definitions will be provided to clarify what behaviors are encompassed by such terms. In the present section, we discuss in more detail issues surrounding the definition and measurement of antisocial behaviors.

Aggression

The term aggression is commonly applied to acts intended to cause harm to others (Dodge et al., 2006; Parke & Slaby, 1983). Initial evaluations of aggression often did not distinguish between different forms of aggressive behavior. Physically aggressive behavior received the most attention until Crick and Grotpeter (1995) introduced the concept of relational aggression. While physical aggression results from the intent to physically harm another individual, relational aggression is the intent to harm via social mechanisms such as exclusion from the group or spreading rumors. Distinct from, but often co-occurring with, physical and relational aggression, is verbal aggression. Verbal aggression and hostility includes threats or insults aimed at harming another individual. In addition, aggression has been distinguished by the motive of the aggressor with instrumental aggression seen as a means to an end and hostile aggression seen as an emotional reaction (Hartup, 1974). A conceptually similar subclassification of aggression is proactive versus reactive aggression. Proactive aggression is similar to instrumental aggression in that the individual aggresses in anticipation of attaining some self-serving goal. Reactive aggression is similar to hostile aggression in that it occurs in response to an antecedent such as provocation (Dodge et al., 2006). In more extreme cases of chronic aggressive behavior, children are diagnosed with psychiatric conditions such as oppositional defiant disorder or conduct disorder. While these children are at the highest risk for

future violence and delinquency, sub-clinical levels of oppositional behavior during childhood are also a pathway to future aggression and delinquency (Loeber & Hay, 1997).

In research on aggression, multiple forms of assessment have been used. In childhood, aggressive behavior has been quantified through naturalistic observation of children interacting with one another. Participants have also been placed in experimental conditions meant to illicit aggressive responses (Dodge et al., 2006). Similarly, there are adolescent activities and vignettes employed which are meant to potentially illicit aggressive responses. Each of these methodological designs utilizes a coding format with which behaviors are categorized according to degree of aggressive behavior. Along with these more objectively observable measures of aggression, perceptions of aggressive behavior are often measured via parent, teacher, and self report as these are the individuals most likely to be aware of a child's or adolescent's behaviors. Evaluations of consistency between informants reveal low but significant associations (average *rs* ranging from .22 to .28) indicating that different informants present unique perspectives on child/adolescent/self behavioral and emotional problems (Achenback, McConaughy, & Howell, 1987; Phares, Compas, & Howell, 1989). Consistency between informants is slightly higher among children (up to age 11) rather than adolescents (ages 12 -19). Typically, adolescents, in comparison to children, have more opportunities to engage in aggressive behaviors that are not observed by parents or teachers.

Due to the variety of ways that aggression has been conceptualized and measured across studies, it is important to be cautious when attempting to generalize effects. Consideration should be paid not only to the operational definition of aggression used but also to characteristics of the participants in the study. While large numbers of studies have evaluated aggression within the normal population, a substantial portion of research on aggression has involved children and

adolescents from clinical populations, such as those diagnosed with conduct disorder. Studies of these individuals provide necessary information about the most severe forms of aggressive behavior. However, results from such studies may not generalize to individuals within the subclinical range of aggressive behavior.

Delinquency

Delinquent behavior is typically defined as any behavior which is considered a criminal offense if committed by an adult (Dishion & Patterson, 2006). In the United States, status offenses have also been included under the rubric of delinquency, as they refer to specific behaviors which are considered criminal offenses if committed by a minor (e.g., truancy or alcohol use). However, most European countries consider status offenses to be a form of antisocial behavior rather than a criminal offense (Junger-Tas, Marshall, & Ribeaud, 2003). Hence, some assessments of delinquent behavior in adolescence include substance use items while others do not and caution should be taken when evaluating studies of delinquent behavior. However, studies that include both substance use and delinquency as separate outcomes consistently remove all substance use items from the assessment of delinquency to reduce multicollinearity.

Delinquency in adolescence is most frequently evaluated via adolescent self report or government records of criminal offenses. Typically, self report provides a more complete picture of rates of delinquent behavior. Throughout adolescence, 15% - 33% of individuals who commit delinquent acts are arrested. Of those arrested, only 64% are referred to court where between 2% and 10% are ultimately convicted (Dodge et al., 2006). Hence, those individuals involved in the criminal justice system during adolescence represent a specific subset of adolescents who engage in more delinquent behavior in general. This results in a comparable sample selection bias as when using clinical samples of adolescents to evaluate aggression. In

addition, first arrest often occurs years after an individual first begins engaging in delinquent behavior. Therefore, capturing the initial onset and escalation of delinquent behavior requires self-report.

Research on delinquency has evaluated this construct in general as well as violent and non-violent subtypes. Despite the high correlation between violent and non-violent delinquency, the distinction between these forms of delinquent behavior merit separate analysis due to the real world implications associated with each.

Substance Use

As with aggression and delinquency, studies that evaluate substance use define and measure this construct in a variety of different ways making it difficult to summarize all of the known literature on the topic. As noted, distinctions are made between initiation of substance use, frequency of substance use, and distinguishing substance use from substance abuse. Some studies evaluate single substances such as tobacco use or alcohol use only. Others combine multiple substances into a single measure of overall substance use (e.g., polydrug use) while still others combine substance use with other antisocial behaviors including aggression and delinquency into a construct of general deviance.

While a few studies have experimentally investigated tobacco and alcohol use in samples of college students and adults, there are obvious ethical restrictions on experimental manipulation of substance use with adolescents or children (Fischman & Johanson, 1998). Hence, this construct is most frequently evaluated via self-report. This, of course, introduces bias resulting in either underreporting or exaggerating of substance use, and antisocial behaviors more globally (McCord, 1990). A number of techniques have been developed to attenuate this bias. First, confidentiality of participant responses is frequently discussed with the adolescent before they begin responding to the survey and random identification codes are often used in

place of names or other identifying information. In addition, the bogus pipeline procedure has also been developed to increase the accuracy of reports of tobacco use (Evans, Hansen, and Mittelmark, 1977). In this procedure, adolescents provide a breath sample which they are told will be analyzed for levels of carbon monoxide to verify the accuracy of their reports of cigarette smoking behaviors. In fact, these samples are not analyzed but this procedure has been shown to increase the validity of self reported cigarette smoking as well as other antisocial behaviors (Tourangeau, Smith, & Rasinski, 1997). Similarly, studies have also utilized saliva samples for information regarding cigarette use. Samples are analyzed to determine levels of carbon monoxide and thiocyanate. However, this technique has not been established as a valid alternative to self-reported tobacco use, as these methods prove unreliable with adolescent populations (Snow, Gilchrist, & Schinke, 1985).

A methodological technique used to increase the validity of self reported substance use involves the format of the questions asked. Often individuals are reluctant to discuss current substance use as often times it is frowned upon by society and may even involve illegal behavior. To avoid this situation, substance use questions are often phrased to refer to past events (Day, Wagener, & Taylor, 1985). This allows participants to more honestly discuss their past behavior without indicating that they necessarily plan on continuing that behavior in the future.

In addition, changes in survey format have also increased the validity of self reported antisocial behaviors. Computer based survey formats, as opposed to paper and pencil surveys or interviews, have been shown to yield greater reports of engagement in antisocial behaviors such as substance use, delinquent behavior, and sexual behavior (Booth-Kewley, Larson, & Miyoshi, 2007; Turner, Ku, Rogers, Lindberg, & Pleck, 1998). The greater reports of antisocial behaviors that result from computer based surveys are hypothesized to be more accurate due to participants

increased comfort answering sensitive questions as a result of the impersonal context of the computer.

Rates of Aggression, Delinquency, and Substance Use in Adolescence

Given societal concerns about adolescent engagement in antisocial behaviors, two large national survey studies monitor rates of these behaviors on a regular basis. No comparable databases exist for the childhood years; hence, behavioral frequencies in childhood are drawn from recent reviews.

Nationally representative historical records of rates of adolescent health-related behaviors during high school have been maintained biennially since 1991 via the Youth Risk Behavior Surveillance System (YRBSS). The YRBSS includes extensive records of substance use, as well as more serious forms of aggression and delinquency. The YRBSS is aimed at evaluating the historical prevalence of antisocial behaviors (e.g., aggression, delinquency, substance use) among high school students and how these behaviors are distributed among subgroups of adolescents (CDC, 2006).

Monitoring the Future (MTF) is a nationally representative survey of the beliefs, attitudes, and behaviors of adolescents with an emphasis on monitoring adolescent alcohol and other substance use (Johnston, O'Malley, Bachman, & Schulenberg, 2006). This project has surveyed high school seniors since 1975 and has included eighth grade and tenth grade students annually since 1991 with a subsample of youth completing follow-up surveys at later points in time. However, given that the results of MTF focus heavily on substance use, the rates reported below will focus on results from the YRBSS.

Previous research has indicated that males tend to engage in higher rates of aggression, delinquency, and substance use compared to females (Dodge et al., 2006; Mayes & Suchman, 2006). In addition, differences have been observed between ethnic and racial groups such that

White adolescents report higher rates of substance use and lower rates of delinquent behavior compared to Black adolescents (Johnston et al., 2006; Mayes & Suchman, 2006). Given the previous findings of gender and race/ethnicity differences, it is important to discuss changes in rates of antisocial behaviors separately for these subgroups in addition to trends over time.

Aggression and Delinquency

Developmental increases in frequency of aggressive behavior peak in toddlerhood; however, aggressive behavior in adolescence and early adulthood is more dangerous to both victims and perpetrators (Dodge et al., 2006). Increases in both aggression and delinquency occur in early adolescence (ages 11 – 14) peaking in late adolescence and early adulthood. Most commonly, minor forms of aggressive and delinquent behavior precede engagement in more serious offenses, including substance use, which is typically followed by desistance in adulthood. However, a small group of offenders may maintain high levels of aggressive and delinquent behavior well into adulthood (Dodge et al., 2006).

Historical trends in the prevalence of more serious forms of aggression and delinquency during mid adolescence, including physical fighting and carrying a weapon, have been evaluated in the YRBSS biennially since 1991. Rates of other forms of aggressive or delinquent behaviors were not tracked by this survey. After steady declines from 1991- 2003, the prevalence of engagement in physical fights over the past year has since increased from 33% to 35.9% among adolescents. Decreases are also reported in other serious forms of aggression and delinquency from between 1991 and 1999 at which point no further change in rates has occurred. This includes carrying a weapon both in and out of school as well as carrying a gun during the previous month. These more recent trends highlight the importance of continued research as well as evaluation and revision of current intervention strategies in these areas.

Data from the YRBSS support previous research findings that males engage in higher levels of aggressive and delinquent behaviors than females (CDC, 2006). High school age males were more likely than females to have carried a weapon in the past month (29.8% vs. 7.1%) and to have been involved in a physical fight (43.4% vs. 28.1%). Importantly, this gender difference is most notable for physically aggressive and delinquent behavior with some evidence that females may engage in higher or comparable levels of relational aggression (see Dodge et al., 2006, for a review of this literature). In addition there is some evidence that the gender gap in physical aggression may be narrowing, either generally, or in specific subgroups of adolescents or adolescents living in certain contexts such as urban communities (e.g., Nichols, Graber, Brooks-Gunn, & Botvin, 2006).

Ethnic differences in aggressive and delinquent behaviors reported in the YRBSS revealed that White students were less likely than Black and Hispanic students to have been involved in a physical fight (33.1% vs. 43.1% and 41%), and to have been involved in dating violence (8.2% vs. 11.9% and 9.9%). There were equal reports of having carried a weapon in the past month (18.7%, 16.4%, and 19%) and of having carried a gun specifically (5.3%, 5%, and 6.5%) among White, Black, and Hispanic high school age adolescents.

In summary, the historical trend in aggressive and delinquent behavior has shown no changes in rates among high school students since 1999 with the exception of increases in the occurrence of physical fights since 2003. Prevalence of aggressive and delinquent behavior among high school students is high with 1 out of 3 adolescents having been involved in a physical fight. Black and Hispanic males are at particularly high risk for engagement in aggressive and delinquent behavior. Males in general, report carrying weapons more frequently

than females and engaging in physical fights more frequently; however, White males are less likely than Black or Hispanic males to have been involved in a physical fight or dating violence.

Substance Use

Initiation of substance use seems to follow a typical sequence beginning with experimentation with alcohol or tobacco in early adolescence (Newcomb & Bentler, 1989). Increases in use occur between ages 11 and 14. Initiation of marijuana use typically occurs after experimentation with tobacco or alcohol but precedes initiation of more serious substance use. Use of substances such as alcohol and tobacco do not necessarily lead to marijuana use and use of other substances such as cocaine, heroine, or other amphetamines and narcotics; however, use of such substances is almost always preceded by experimentation with alcohol and tobacco. This sequence in substance use initiation is described by the gateway drug model (Kandel, Kessler, & Margulies, 1978) which will be discussed in the following section.

Between 1991 and 2003, the use of most substances among high school aged adolescents had been decreasing (CDC, 2006). However, current trends in the rates of substance use reveal no changes in use since 2003. This includes rates of lifetime (used substance one or more times during their life) as well as current (used substance one or more times during the past 30 days) cigarette use, lifetime alcohol use, current alcohol use, and episodic binge drinking, lifetime and current marijuana use, lifetime and current cocaine use, and lifetime inhalant use. This change in the trend highlights the continued importance of investigating mechanisms that underlie the initiation of substance use in adolescence.

In addition, there are important differences in rates of substance use by both gender and ethnicity during the high school years (CDC, 2006). For the most part, males show higher rates of drinking and driving (11.7% vs. 8.1%), current smokeless tobacco use (13.6% vs. 2.2%), current cigar use (19.2% vs. 8.7%), episodic binge drinking (27.5% vs. 23.5%), lifetime

marijuana use (40.9% vs. 35.9%), lifetime cocaine use (8.4% vs. 6.8%), lifetime illegal steroid use (4.8% vs. 3.2%), lifetime hallucinogenic drug use (10.2% vs. 6.8%), and lifetime ecstasy use (7.2% vs. 5.3%). Females and males have equal rates of current and frequent cigarette use (23.0% vs. 22.9% and 9.3% vs. 9.3%, respectively), lifetime and current alcohol use (74.8% vs. 73.8% and 42.8% vs. 43.8%, respectively), and lifetime methamphetamine use (6.0% vs. 6.3%). Females tend to have higher rates of lifetime inhalant use (13.5% vs. 11.3%) compared to males.

Overall, Black adolescents tend to have lower rates of substance use compared to White and Hispanic adolescents, including current cigarette use (12.9% vs. 25.9% and 22%), smokeless tobacco use (1.7% vs. 10.2% and 5.1%), cigar use (10.3% vs. 14.9% and 14.6%), lifetime alcohol use (69% vs. 75.3% and 79.4%) current alcohol use (31.2% vs. 46.4% and 46.8%), drinking and driving (4.9% vs. 11.3% and 10.5%), episodic binge drinking (11.1% vs. 29.9% and 25.3%), lifetime cocaine use (2.3% vs. 7.7% and 12.2%), lifetime inhalant use (6.8% vs. 13.4% and 13%), lifetime hallucinogen use (2.8% vs. 9.4% and 9.4%), lifetime methamphetamine use (1.7% vs. 6.5% and 8.8%), and lifetime ecstasy use (3.9% vs. 5.8% and 9.6%). White adolescents are more likely to engage in frequent cigarette use (11.2% vs. 3.7% and 6.5%) and smokeless tobacco use, as well as episodic binge drinking compared to Black and Hispanic adolescents (see above). Hispanic adolescents are more likely than both Black and White adolescents to engage in lifetime cocaine, heroin (3.6% vs. 1.5% and 2.2%), methamphetamine, or ecstasy use. Rates of lifetime cigarette use (54.7%, 57.1%, and 54%) and current marijuana use (20.4%, 23%, and 20.3%) are equal among Black, Hispanic, and White adolescents.

To summarize, the historical trend in substance use among high school students has not changed in recent years (since 2003). Prevalence of problem substance use is astounding with 1 out of 4 high school age adolescents having engaged in binge drinking and roughly 1 out of 10

having driven after drinking. In addition, 1 out of 3 high school age adolescents have tried marijuana. White and Hispanic males appear to be at the highest risk for substance initiation. While there are no gender differences in cigarette and alcohol use, males do continue to have higher rates of binge drinking and drinking and driving as well as higher rates of more serious drug use. Black high school students engage in less substance use than their White and Hispanic peers. This highlights the need for further evaluation of the mechanisms leading to the initiation of substance use during early adolescence with attention to individual differences or contextual variations.

Moreover, understanding factors that promote or prevent the onset of substance use as well as aggressive and delinquent behavior during adolescence is critical to promoting a healthy transition from adolescence into adulthood. Carrying a weapon, being involved in physical fights, current cigarette use, smokeless tobacco use, alcohol use, binge drinking, and marijuana use, as well as lifetime cocaine and inhalant use during adolescence contribute to the leading causes of death from adolescence to adulthood--motor vehicle crashes, homicide, and suicide during adolescence, as well as cardiovascular disease and cancer in adulthood (CDC, 2006). Given the relevance of preventing substance use, aggression, and delinquency during adolescence to the promotion of health in both adolescence and adulthood, numerous intervention strategies have been developed aimed at reducing the onset of these antisocial behaviors during adolescence. The first step to developing effective interventions involves understanding the etiology of substance use, aggression, and delinquency.

Developmental Models of Aggression, Delinquency, and Substance Use

Current literature provides several existing models for pathways for aggression and delinquency, as well as initiation of substance use. There are a couple of general models of human development that are applicable to the development of antisocial behaviors. At the same

time, some models are specific to only one outcome such as substance use (e.g., the gateway drug model). Other models, specific to the development of antisocial behaviors, can be applied to aggression, delinquency, and substance use; however, these models do not posit direct associations among these behaviors. The following section briefly reviews general developmental models, outcome specific models, general models of antisocial behaviors, and models of associations among outcomes. The definition of broad terms such as deviant behavior or problem behavior is also addressed for relevant models.

General Developmental Models

A general developmental framework that has been influential in understanding interactions between individuals and the context in which they live is Bronfenbrenner's (1979) ecological model of human development. This model emphasizes the concept of an individual as embedded within, interacting with, influencing, and being influenced by a social context. For example, not only do contextual factors influence individual development, but individual characteristics also influence or form the social contexts in which individuals interact. As discussed in the following sections, most models incorporate some element of a person-context interaction while some more simplified models emphasize particular contexts or person factors.

Social learning theory (Bandura, 1977) emphasizes the concept that individuals learn behaviors through the observation and imitation of others as opposed to simply through punishment and reinforcement of behavior. Hence, observing substance use, aggression, and delinquency among adult role models, peers, and even via media consumption can influence adolescent behavior. Moreover, when individuals see models rewarded or receive reinforcement for the behavior, the behavior is more likely to be modeled. Social learning theory emphasizes the role of multiple contexts on the development of antisocial behavior.

Outcome Specific Models

Aggression and delinquency. Numerous individual and contextual factors have been determined to influence the development of aggression and delinquency. Notably, there is a great deal of similarity and overlap between predictors of aggression and delinquency and predictors of substance use. In their most recent review, Dodge, Coie, and Lynam (2006) note that individual aggressive acts are largely determined by situational or contextual factors. In contrast, stable patterns of aggression are more often linked to individual difference factors (e.g., genetics, temperament). However, aggressive behavior also develops “contingently” based on contextual factors (e.g., reinforcement of aggressive behavior) that may be stable over the course of development. Dodge and colleagues (2006) further assert that the field is close to achieving a consensus model of the development of aggression based on the voluminous literature on childhood and adolescent aggression and the individual and contextual factors that shape this development. In particular, a few theories have focused specifically on explaining the developmental patterning or pathways of aggressive or antisocial behaviors.

Moffitt’s theory of adolescent limited versus life-course persistent deviant behavior posits two different life course trajectories for the development of deviant behavior which includes both aggressive and delinquent behavior (Moffitt, 2006). Most individuals who engage in deviant behavior first begin during early adolescence, peak in mid-adolescence, and subsequently decline upon entry into adulthood. This group is labeled adolescence limited offenders and research indicates that social/contextual factors are most salient to the development of deviant behavior among these individuals. A smaller group of individuals begin engaging in deviant behavior in childhood. This group evinces higher levels of deviant behavior throughout adolescence compared to the adolescence limited group and deviant behavior persists well into adulthood. This group is labeled life-course persistent offenders and research indicates that individual

characteristics are most salient to the development of deviant behavior among these individuals. Moffitt and colleagues have presented a thorough analysis of gender differences and multiple risk factors associated with membership in these trajectories (2001). Additionally, other groups have documented similar characteristics and trajectories for an “early-starter” group that can be identified in the early school years and persists in aggressive behavior throughout childhood and adolescence (e.g., Broidy et al., 2003).

Loeber and Hay (1997) outline three developmental pathways to boys’ antisocial behavior. The authority conflict pathway outlines the connection between oppositional and defiant behavior in childhood, such as being disobedient and disrespectful to adults, with aggressive and delinquent behavior in adolescence. The overt pathway begins with physical aggression which escalates over time into violent behavior during adolescence. The covert pathway begins with minor forms of delinquent behavior (e.g., shoplifting) during early adolescence which escalate to more serious forms of delinquency (e.g., fraud, burglary) over time. This model emphasizes the risk associated with early initiation of aggressive and defiant behavior on future engagement in violence and delinquency.

Substance use. As is true for aggression and delinquency, a wide range of individual and contextual factors have been determined to influence initiation of drug use with some factors proving to be drug specific while others have comparable effects across drugs. As noted, an influential behavioral model of substance use initiation is the gateway drug model (Kandel et al., 1978). The gateway drug model operates under the axiom that the best predictor of future behavior is past behavior. This model states that progression to more frequent substance use, substance abuse, and use of more serious substances (e.g. cocaine, heroin, etc.) is almost always preceded by experimentation with less serious substances (e.g. coffee, tea, alcohol, etc.). As

such, experimentation with the less serious substances serves as a gateway to more serious use but does not necessarily result in more serious use. The gateway drug model applies to substance use specifically and emphasizes the role of the individual in the progression of substance use above the role of context.

Mayes and Suchman (2006) have recently proposed models illustrating pathways to the initiation of substance use as well as the transition from substance initiation to substance dependence and abuse. In both models, an emphasis is placed on the role of genetic factors. Regarding substance initiation, the genetic basis for emotion regulation and self-control contributes to later attitudes toward social conventions and choice of peers. Those individuals with poor emotion regulation and self-control are at greater risk for substance initiation. This model also acknowledges the role of parental influence. The second model proposed by Mayes and Suchman (2006) illustrates the role of genetic vulnerability in the transition from substance initiation to substance dependence and abuse. Genetic vulnerability towards dependence and mood disorders, in combination with substance initiation and engagement in antisocial behaviors, can lead to continued drug use, school failure and isolation, depression, and ultimately substance dependence and abuse. While these models do include engagement in antisocial behavior as a factor that is important in the transition from substance initiation to substance dependence, the main emphasis of these models is in illustrating the role of genetics on subsequent substance use.

Models Applicable to Several Antisocial Behaviors

Several models have been proposed to explain the development of multiple antisocial behaviors including aggression, delinquency, and substance use. As indicated, whereas these models are often applied to aggression, delinquency, and substance use, they do not posit direct associations among these behaviors. Again, these models utilize aspects of more general

developmental theories like Bronfenbrenner's ecological model (1979) or social learning theory (Bandura, 1977). Similar to social learning theory, the social development model (Catalano & Hawkins, 1996) asserts that antisocial behavior is learned through interpersonal interactions. Antisocial behavior encompasses both delinquency and substance use in this model. The social development model differs from social learning theory in that it emphasizes bonding to antisocial others as an influence on antisocial behavior independent of social learning processes. Direct influences on future antisocial behavior include perceived rewards for antisocial behavior, belief in antisocial values, interaction with antisocial others, and attachment to antisocial others. The influence of past engagement in antisocial behavior on future engagement in antisocial behavior is mediated via the aforementioned direct influences (Catalano & Hawkins, 1996).

The social interactionist perspective emphasizes the role of the parent-child interaction in the development of antisocial behavior from childhood through adolescence (Patterson, DeBaryshe, & Ramsey, 1989). In this model, antisocial behavior encompasses a number of different behaviors including aggression, delinquency, and substance use. This perspective follows a developmental progression towards more serious antisocial behavior which begins with maladaptive parenting practices. This leads to conduct problems and aggressive behavior in childhood which results in poor social skills, academic failure, and association with deviant peers. This in turn reinforces antisocial behavior, leading to more serious aggression, delinquency, and substance use.

Botvin and Sheier (1997) present a model which combines elements of the social interactionist perspective and a social cognitive perspective to illustrate the developmental processes underlying the emergence of violent and drug using behaviors. Emphasis is placed on deficits in familial social interactions and social information processing. These deficits increase

the probability of associating with deviant peers, aggression, delinquency, and substance use. While connections between substance use and aggressive or delinquent behaviors are discussed, emphasis is placed on deficient social skills and lack of personal competence in the development of all three antisocial behaviors.

The importance of intraindividual psychological characteristics such as sensation seeking and egocentrism are highlighted by the reckless behavior perspective (Arnett, 1992). Reckless behavior encompasses reckless automobile driving, sex without contraception, illegal drug use, and minor criminal activity. This perspective states that developmental changes in sensation seeking and egocentrism underlie the rapid increase in reckless behavior seen during the middle school years (ages 11 – 14), the relatively high levels of reckless behavior maintained throughout adolescence, and the eventual decline observed in the 20s and early 30s. This perspective also emphasizes the importance of the interaction between psychological characteristics such as sensation seeking and the social environment in the expression of reckless behavior.

The role of individual characteristics is important because it allows prevention scientists to develop targeted interventions for individuals at a particularly high risk for antisocial behavior including initiation and escalation of substance use, aggression, and delinquency. The utility of targeting a personality characteristic such as sensation seeking directly as a method of intervention is a topic of debate. Most researchers conceptualize sensation seeking as a stable trait which is unlikely to be reduced via intervention (Zuckerman, 2007). However, it may be possible to change how sensation seeking is expressed, minimizing unhealthy expressions. It has been suggested that the expression of sensation seeking is influenced via socialization and hence, is a potential target of intervention (Arnett, 1995). Despite the emphasis on person factors,

Arnett does acknowledge the importance of social contexts in the development of reckless behaviors such as substance use, aggression, and delinquency.

Perspectives that focus on multiple domains of influence on antisocial behaviors are inherently complex, resulting in a large number of risk factors. Due to the large number of factors that influence initiation of substance use, as well as other antisocial behaviors, some researchers have evaluated sheer exposure to multiple risk factors as a predictor of future antisocial behavior (Newcomb & Bentler, 1989). This includes an aggregate of behavioral, psychological, and social/contextual factors. As risk factors increase, the likelihood of initiation of substance use and engagement in other antisocial behaviors also increases.

The previous models provide an excellent framework for understanding risk factors associated with substance use, aggression, and delinquency individually. This is particularly important during later childhood and early adolescence as this is the developmental time period during which onset of these behaviors are associated with the greatest risk of health compromising outcomes in later adolescence and adulthood. Just as it is beneficial to evaluate risk factors from multiple domains, it is also beneficial to evaluate multiple antisocial behaviors as opposed to studying a single behavior in isolation. By evaluating the co-occurrence of antisocial behaviors it is possible to determine common correlates among a variety of outcomes. This is useful in the development of broad interventions aimed at reducing multiple antisocial behaviors as opposed to specific outcomes. In addition, studies of multiple antisocial behaviors allows for the evaluation of the impact that engagement in one type of antisocial behavior may have on participation in other antisocial behaviors. A great deal of information has been obtained about aggression, delinquency, and substance use from studies that focus on only one of

these outcomes; however, interrelationships between antisocial behaviors can only be established via studies that evaluate multiple antisocial behaviors.

Models of Associations between Outcomes

To date, only two theories directly address the importance of evaluating multiple antisocial behaviors as opposed to individual outcome models. These are the self-control theory adaptation of a general theory of crime (Gottfredson & Hirschi, 1990) and problem behavior theory (Jessor, 1992).

A general theory of crime conceptualizes all antisocial behaviors (e.g., delinquency, aggression, substance use, etc.) as arising from a common underlying disposition towards general deviance. This would result in common correlates among all antisocial behaviors. Interventions aimed at addressing one such behavior should also impact other antisocial behaviors as well. This theory proposes that not only are all antisocial behaviors manifestations of the same underlying general deviance but that because of this it is unnecessary to distinguish between different types of behaviors in the study of prevention and intervention. It is more important to identify the underlying common correlates of these behaviors and focus intervention efforts on those correlates as this will result in the reduction of all antisocial behaviors. It is unnecessary, and in fact erroneous, to try and develop interventions for aggression or delinquent behavior that are separate from interventions for substance use.

The general theory of crime proposes that all antisocial behavior is a manifestation of a lack or loss of self-control or an inability to inhibit one's actions (Gottfredson & Hirschi, 1990). Self-control is believed to be the underlying commonality associated with all forms of antisocial behavior. According to the general theory of crime, self-control is learned via parental training and socialization. Parental socialization strengthens bonds to conventional social institutions and this training is virtually complete by age 10. Hence, according to this theory, interventions

aimed at reducing antisocial behavior should focus primarily on parental training to promote the development of socialization and self-control during early childhood.

Jessor's problem behavior theory (1987) identifies psychological, social, and behavioral influences on antisocial behaviors. Problem behavior refers to all behaviors that depart from both the social and legal norms of society. This includes but is not limited to aggression, delinquency, and substance use, as well as precocious sexual intercourse. According to this perspective, problem behavior is similar to all other learned behaviors in that it is a functional and purposeful method of attaining one's goals. Hence, it generally increases upon entry into adolescence in response to many of the challenges that face adolescents. This includes but is not limited to attaining independence from parental authority, expressing opposition to the norms of conventional society, or strengthening bonds with peers or youth culture.

There is some evidence of ethnic differences in the applicability of Jessor's problem behavior theory. Stanton and colleagues (1993) found that sexual activity belonged in a separate domain from other problem behaviors such as substance use and truancy among African American adolescents from resource depleted, urban environments. One explanation for this finding is that sexual behavior among this youth culture is not recognized as a problem behavior and hence, does not cluster predictably with other problem behaviors. Given that problem behaviors are defined as departures from cultural and societal norms, it is important to be cautious when conducting research on specific behaviors across cultures and subcultures.

Problem behavior theory is similar to the general theory of crime in that it postulates associations between various antisocial behaviors. However, problem behavior theory is distinct from the general theory of crime in that it does not assert that it is unnecessary to evaluate specific antisocial behaviors. Rather, problem behavior theory emphasizes the importance of

identifying risk and protective factors for co-occurring antisocial behaviors. Jessor (1992) describes a person-situation interactionist perspective that emphasizes the role of both person and context in the development of antisocial behaviors and points out limitations of focusing solely on one domain. Hence, problem behavior theory encourages evaluating multiple antisocial behaviors as well as interconnections between them and risk factors to evaluate empirically the degree to which antisocial behaviors are related to one another and stem from common causes.

A strength of problem behavior theory and the general theory of crime is that both highlight the importance of commonalities between a variety of antisocial behaviors. However, these theories still have their limitations. By combining multiple antisocial behaviors into a construct of general deviance, information regarding potential influences of one antisocial behavior on another are lost. Identifying common correlates of multiple antisocial behaviors is indeed informative; however, predictive pathways among antisocial behaviors are not specified by these frameworks.

The Developmental Model of Reciprocal Influence

The direction of effect regarding interconnections among antisocial behaviors has been evaluated differently across various studies. In general, studies of late childhood and early adolescence evaluate the predictive influence of aggressive or delinquent behaviors on later initiation and escalation of substance use and abuse (Farrell et al., 2005; Scheier & Botvin, 1996). In part, this is due to the fact that children rarely engage in substance use while aggressive behavior is not unusual in childhood. In contrast, studies of late adolescence through adulthood often evaluate the predictive influence of substance use on later delinquent or criminal behavior (Stacy & Newcomb, 1995). The question of the directionality or reciprocity of effects is an important issue to try and disentangle to further understand the development of these antisocial behaviors and establish age appropriate intervention techniques.

The Developmental Model of Reciprocal Influence (DMRI) is meant to serve as a heuristic device regarding the development of substance use and abuse and other antisocial behaviors (See Figure 1-1).

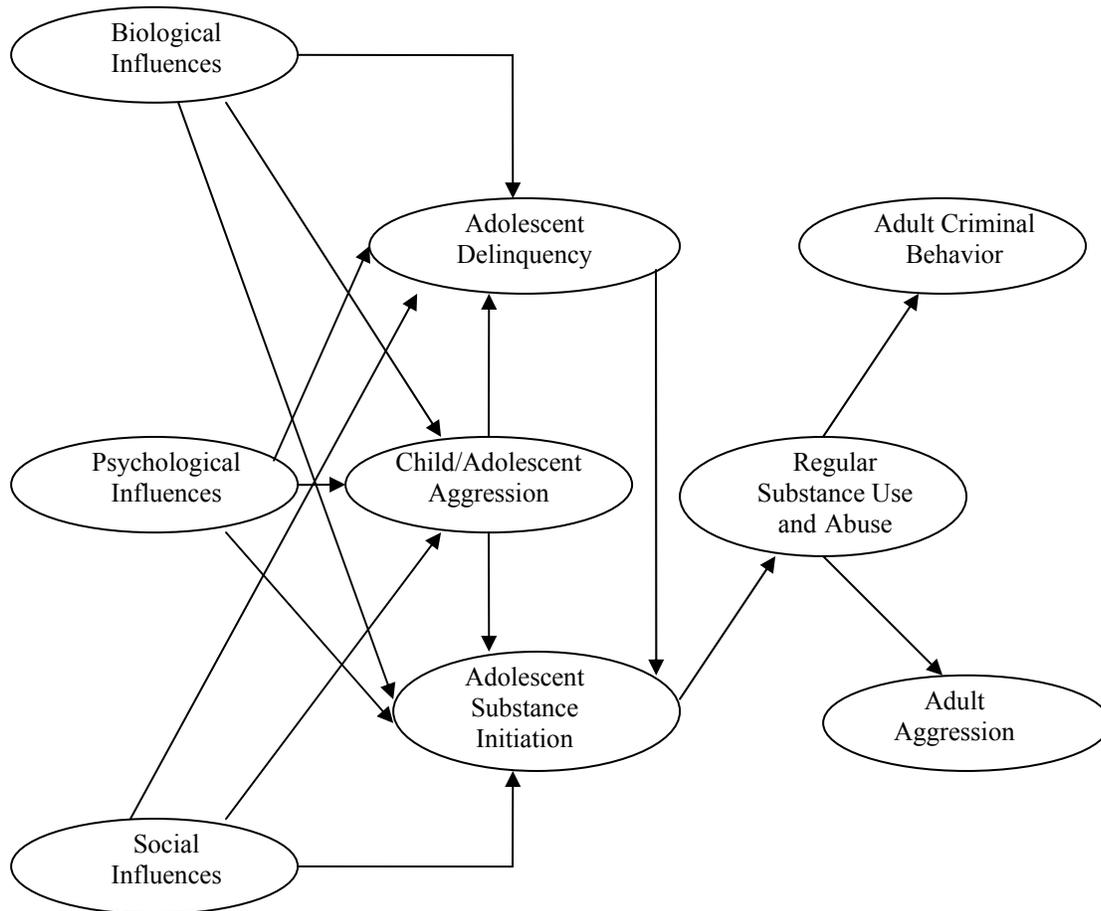


Figure 1-1. The developmental model of reciprocal influence

This model was informed by and is complementary to the aforementioned theories with the main distinction being an emphasis on understanding the interconnections between multiple antisocial behaviors. The basic framework of the DMRI states that the interconnections between substance use and other antisocial behaviors, such as aggression or delinquency, are reciprocal when viewed broadly across the transition from childhood to adulthood. For instance, there is

evidence of aggression and delinquency predicting substance use and as well as evidence of substance use predicting aggression and delinquency (Farrell et al., 2005; Mason & Windle, 2002; Scheier & Botvin, 1996; Stacy & Newcomb, 1995; Vitaro, Brendgen, Ladouceur, & Tremblay, 2001). However, we propose that the specific direction of influence changes across the adolescent time period. Given that aggressive behavior is often the first antisocial behavior to develop beginning in childhood (Dodge et al., 2006), aggressive behavior should predict the onset of delinquent behavior and substance use in early adolescence. In addition, given the higher levels of engagement in delinquent behavior in early adolescence, delinquency should be predictive of initiation and escalation of substance use in early adolescence. However, if substance use, in general, transitions to more frequent use or abuse, the direction of association changes such that substance use is predictive of aggressive and delinquent behavior. This transition in the direction of effects will generally occur in mid to late adolescence with adolescent substance use becoming the strongest predictor of antisocial behavior in adulthood.

According to this model, risk factors associated with the development of aggression, delinquency, and substance use will have the strongest influence during early adolescence. When evaluating adolescent predictors of antisocial behavior in adulthood, adolescent substance use will have the strongest predictive value of adult antisocial behavior. The effects of other risk factors on adult antisocial behavior, such as adolescent peer deviance or sensation seeking, will be mediated by adolescent substance use. Hence, according to the DMRI, interventions aimed at reducing antisocial behaviors in general should focus on reducing risk factors associated with the development of aggressive and delinquent behaviors during childhood and early adolescence. This in turn will reduce the number of adolescents that initiate substance use and become regular substance users or abusers. Of course, there are some individuals who engage in

experimentation with substance use in mid to late adolescence that do not have a history of aggressive or delinquent behavior (Dishion & Loeber, 1985; Loeber, 1988). While these individuals are at a lower risk of transitioning to substance dependence and abuse, they will still benefit from substance use interventions. Hence, by mid to late adolescence and early adulthood, interventions should more aggressively target reducing regular substance use or substance abuse. This strategy would reduce adult rates of other antisocial behaviors.

The DMRI is in line with other theories of antisocial behavior in emphasizing the importance of biological, psychological, and social factors in the development of aggression, delinquency, and the initiation of substance use during childhood and early adolescence. However, it differs from the prominent theories reviewed previously in two important respects. First, the DMRI asserts direct reciprocal influences between specific antisocial behaviors rather than assuming that the co-occurrence of these behaviors is simply due to common antecedent risk factors. Second, the DMRI is not intended to be a general model of all aggressive or delinquent behavior. Rather, it focuses specifically on the association between substance use and aggressive or delinquent behavior and how this association develops from adolescence into adulthood.

While only a handful of studies have evaluated reciprocal effects between antisocial behaviors, evidence to date lends support to the Developmental Model of Reciprocal Influence. This review summarizes results from studies which directly evaluate a predictive association between substance use and aggression or delinquency. Studies were excluded if (a) only a single antisocial behavior was evaluated, (b) multiple antisocial behaviors were combined into a construct of general deviance, or (c) co-occurrence of multiple antisocial behaviors were

evaluated but predictive associations of one antisocial behavior on another were not. See Table 1-1 for methodological descriptions of the following studies.

Table 1-1. Summary of studies that examined reciprocal effects among antisocial behaviors

Authors	Design	Sample	Measures
<i>Early Adolescence</i>			
Margulies, Kessler, & Kandel, 1977	Longitudinal study of 18 public high school students (grades 9 – 12) in New York state (6 urban, 6 suburban, and 6 rural). Data were collected in 2 waves: beginning of academic school year (fall) and 5-6 months later.	1936 (62% female). 29% 9 th graders, 31% 10 th graders, 21% 11 th graders, and 19% 12 th graders. Race/ethnicity distribution was not provided.	Self reported intrapsychic states (depression, self-image), academic orientation (classes cut, grade average, days absent, educational expectations), lifestyle values (conformity, political attitudes, church attendance), drug attitudes, delinquent involvement, prior drug use (beer, wine, and cigarettes), demographics (religion, race/ethnicity, family income, father’s education, gender). Parent reported substance use behaviors, attitudes towards substance use, parent/child relationship quality. Peer reported substance use, attitudes towards substance use, peer/adolescent relationship quality.
Brook, Whiteman, Gordon, & Cohen, 1986	Longitudinal study of youth from one low SES county and one middle/high SES county in upstate New York. Data were collected over 2 waves: T1 ages 5-10, T2 ages 13-18.	356 youth (52% female), 94% Caucasian from diverse socioeconomic backgrounds. 51% were age 5-7 at T1 (age 13-15 at T2)	Mother report of childhood personality and behavior (conventionality/unconventionality, control of emotions, intrapsychic functioning, and interpersonal relatedness). Mother and adolescent report of adolescent personality and behavior (conventionality/unconventionality, control of emotions, intrapsychic functioning, and interpersonal relatedness). Adolescent self report of substance use.

Table 1-1. Continued.

Authors	Design	Sample	Measures
Simcha-Fagan, Gersten, & Langner, 1986	Longitudinal study of Manhattan, New York children. Data is from a subsample followed up 5.5 years after baseline. Baseline ages ranged from 8.5-18 years. Follow-up ages ranged from 14-23.5 years.	200 youth, 69.6% White, 12.9% Black, 17.5% Spanish speaking. Participants were a probability sample of Manhattan children. Gender distribution and SES were not provided. Mean age at Follow-up assessment 18.3 years.	Mother reported social demographic characteristics (mother's education, monthly rent), familial dimensions (parent relationship quality, relationship quality with child, parenting behaviors, mother's physical and mental health), and child behavior (parent-child conflict, fighting, delinquency, non-compulsive antisocial tendencies, isolation from peers, anxiety, self-destructive tendencies, dependence). Adolescent/young adult self reported legal and illicit substance use (alcohol, cigarettes, marijuana, lsd, methedrine, amphetamines, barbiturates, heroin)
Scheier & Botvin, 1996	Cross-sectional study of 8th graders from a low SES, urban area in New York	418 African American 8th graders (51% female) from low SES	Self reported measures made up 4 latent constructs; general deviance (unconventional behavior, sensation seeking, aggressive behavior, risk taking behaviors), polydrug use (frequency of cigarette smoking, alcohol use, marijuana use, and inhalant use as well as intensity of alcohol and marijuana use), personal anomie (loneliness, future hope and life purpose, hopelessness, existential purpose in life and meaning, and suicidal ideation), and cognitive efficacy (personal competence and cognitive mastery, self-reinforcement, applied decision-making skills, and self-esteem).
Farrell, Sullivan, Esposito, Meyer, & Valois, 2005	Longitudinal study of youth from 3 urban middle schools and 4 rural middle schools in a low SES area in south eastern United States. Data were collected over 5 waves: the beginning and end of 6th and 7th grade and the beginning of 8th grade.	667 urban adolescents (51% female), 96% African American, 3% Caucasian, mean age at first assessment 11.7 years; 950 rural adolescents (47% female), 58% Caucasian, 24% Latino, 14% African American.	Self reported aggression, non-violent delinquency, drug use (average of cigarette use, alcohol use, and marijuana use)

Table 1-1. Continued.

Authors	Design	Sample	Measures
Lillehoj, Trudeau, Spoth, & Madon, 2005	Longitudinal study of 7th grade students drawn from 36 rural schools in the mid western United States. Data were collected over 5 waves: baseline, 6, 18, 30, and 42 months after baseline.	198 youth (49% female), 96% Caucasian from middle class background, mean age at baseline assessment 12.3 years	Self reported antisocial behaviors (CBCL-YSR, disobedience, misconduct, aggression), number of substances initiated (cigarettes, alcohol, marijuana)
<i>Late Adolescence and the Transition to Adulthood</i>			
Stacy & Newcomb, 1995	Longitudinal study of individuals from the Southern California area. Data were collected in 2 waves: late adolescence and early adulthood.	536 predominately Caucasian, middle class individuals (72% female), mean age 18.9 years at first assessment and 26.9 years at follow-up	Self reported general drug use (cigarettes, alcohol, marijuana, hard drugs, and cocaine), peer deviance, social-emotional security, social support, academic orientation and family disruption, social conformity, and criminal deviance
Ensminger & Juon, 1998	Longitudinal study of youth drawn from the urban, low SES Woodlawn neighborhood located in the south side of Chicago. Data were collected in 4 waves: 2 early childhood, 1 adolescence, and 1 adult.	953 predominantly African American youth (52% female) from an urban, low SES background. Assessed at 1st grade, 3rd grade, 10th grade, and at age 32-33	Teacher reported school behavior and grades in 1st grade. Self reported adolescent antisocial behaviors (physical assault, marijuana and hard liquor use), adolescent social bonds (parental supervision, attachment to school, attachment to mother), transitions to adulthood (marriage, childbearing), adult antisocial behaviors (alcohol, marijuana, cocaine use, interpersonal aggression), adult SES, and anxiety

Table 1-1. Continued.

Authors	Design	Sample	Measures
<i>Reciprocal Influences</i>			
Vitaro, Brendgen, Ladouceur, & Tremblay, 2001	Longitudinal study of males from disadvantaged neighborhoods in Montreal, Quebec, Canada. Data were collected in 2 waves: early adolescence and late adolescence.	717 French-speaking Caucasian males, age 13 - 14 at first assessment and age 16 - 17 at follow-up	Self reported impulsivity, friends' deviancy (illegal activity), parental supervision, and sociodemographic info (family configuration, parental occupation) at age 13 - 14. Self reported gambling frequency, gambling problems, delinquency, and drug/alcohol problems at age 16 - 17.
Mason & Windle, 2002	Longitudinal study of youth drawn from 3 suburban highschools in western New York State. Data were collected in 4 waves at 6 month intervals.	1218 predominantly Caucasian middle class youth (51% female), mean age at first assessment 15.51 years	Self reported aggression, property damage, theft, cigarette use, marijuana use, and alcohol use in the past 6 months

Early Adolescence

Looking at the first part of the model, a few studies have specifically examined the predictive role of aggression or delinquency on substance use initiation in early adolescence. Margulies, Kessler, and Kandel (1977) evaluated factors associated with the transition to hard liquor consumption among high school students (grades 9 – 12). This study only evaluated students from the original sample who had previously never consumed hard liquor which constituted only 35% of the original sample. Hence, these results may not generalize to the majority of adolescents who initiated hard liquor use earlier. Nevertheless, overall results indicated that engagement in minor delinquent activity was one of the best predictors of the transition to hard liquor consumption. When evaluated separately by gender, minor delinquent activity was predictive of hard liquor consumption among males only. However, peer and

parental alcohol use exert nearly three times the influence on female use of hard liquor compared to males. Hence, among youth who tend to be more resistant to substance use, minor delinquency predicts hard liquor use for males while females may be more influenced by interpersonal role models.

Brook, Whiteman, Gordon, and Cohen (1986) longitudinally assessed both childhood and adolescent personality and behavioral factors associated with adolescent substance use in a predominantly White sample of males and females. Results indicated that mother report of childhood delinquency was associated with adolescent delinquency which in turn predicted stage of substance use in adolescence. The effect of childhood delinquency on stage of adolescent drug use was mediated by adolescent delinquency. This study did not evaluate gender differences or differences between older and younger adolescents. These variables were controlled for along with socioeconomic status.

In a similar study, Simcha-Fagan, Gerston, and Langner (1986) longitudinally evaluated the association between mother report of child/adolescent behavior and adolescent/young adult self report of illicit substance use five and a half years later. Participants were divided into four groups of illicit substance use: no use, marijuana only, substances other than marijuana (excluding heroin), and heroin use. When controlling for social demographic characteristics and familial dimensions, early childhood/adolescent delinquency surfaced as a unique predictor of the transition to marijuana use as well as the transition to heroin use in adolescence/young adulthood. Similarly, early childhood/adolescent aggressive behavior, such as fighting, was predictive of the transition to substance use other than marijuana (excluding heroin) controlling for familial dimensions. While gender and race/ethnicity differences were not evaluated for pathways between antisocial behaviors, differences in stage of illicit substance use were

evaluated. White adolescents/young adults were more likely to have transitioned to marijuana use as well as use of illicit substances other than marijuana. This is congruent with current national trends as discussed previously (CDC, 2006). Males were significantly more likely to have used heroin. No other gender or race/ethnicity differences were observed.

In a cross-sectional sample of Black middle school students, a latent construct of general deviance mediated the relationship between both personal anomie and cognitive efficacy on polydrug use. In this study, general deviance included both behaviors, such as aggression and risk taking, as well as personality factors, such as sensation seeking and unconventionality (Scheier & Botvin, 1996). There were no gender differences on any of the drug use items; however, males reported higher rates of physical aggression, sensation seeking, and risk taking behaviors while females reported higher grades, conventionality, self-reinforcement, self-esteem, and decision making skills. Levels of drug use were somewhat lower than in national and regional samples. This is consistent with current trends indicating that Black youth in general have lower rates of drug use than White or Hispanic youth as discussed previously.

A longitudinal study of the same early adolescent time period evaluated quadratic growth curves of aggression, delinquency, and substance use (Farrell et al., 2005). Overall, initial levels of aggression predicted change in drug use and delinquency. While females had lower initial rates of drug use, aggression, and delinquency in this sample, there were no differences by gender in pattern or rates of change for any of the antisocial behaviors across middle school. This study did not evaluate ethnic differences but did evaluate differences between urban and rural environments. This was largely confounded with ethnicity such that 96% of adolescents described themselves as Black in the urban sample while the rural sample was 58% White, 24% Hispanic/Latino, and 14% Black. Urban adolescents had higher initial levels of aggression and

delinquency and greater increases in aggression, delinquency, and drug use compared to rural adolescents. Importantly, a general antisocial behavior factor did not account for the data as well as the models evaluating direct effects between separate antisocial behaviors.

Gender differences in associations between substance initiation and antisocial behaviors (aggression, disobedience, and misconduct) were evaluated longitudinally among a sample of rural White adolescents (Lillehoj, Trudeau, Spoth, & Madon, 2005). There were no gender differences in antisocial behaviors in the 7th grade; however, males did report higher levels of substance initiation in the 7th grade compared to females. Among both genders, 7th grade antisocial behaviors predicted initiation of substance use but not change in substance use over time. This provides evidence in support of a link between aggression and initiation of substance use.

Notably, longitudinal studies of childhood aggression and subsequent adolescent behavior are nearly absent from the literature. Due to costs and time constraints, most studies of adolescent substance initiation have focused on concurrent behaviors or longitudinal associations within the adolescent decade or period of adolescence (e.g., middle school). Interestingly, there are projects currently collecting and analyzing data that will be able to address this gap in the literature. For example, the Conduct Problems Research Prevention Group (e.g., 1992, 2004) is conducting a multi-site evaluation of a long-term intervention program that presently has complete cohort data available for kindergarten through 5th grade. In addition, the Oregon Youth Substance Use Project (OYSUP; Andrews, Tildesley, Hops, Duncan, & Severson, 2003; Andrews, Hampson, Barckley, Gerrard, & Gibbons, in press; Hampson, Andrews, Barckley, & Severson, 2006) is a cohort-sequential evaluation of individual and contextual influences on the acquisition and development of substance use from early childhood (kindergarten) through

adolescence (12th grade). On-going research from these projects is well positioned to examine pathways to substance use from childhood through adolescence.

Late Adolescence and the Transition to Adulthood

Turning to the later part of the model, again, only a few studies have examined prediction from adolescence into adulthood. In a predominantly White sample, Stacy and Newcomb (1995) evaluated the influence of late adolescent drug use on adult criminal deviance, controlling for the possible predictive effects of other adolescent factors including peer deviance. Adolescent drug use was found to be the only significant path predicting criminal deviance in adulthood. However, evaluations of specific drugs did not predict criminal deviance in adulthood. Unfortunately, gender effects were not evaluated due to a highly skewed gender distribution (72% female). Hence, gender was controlled for in relevant analyses. Despite this limitation, these findings lend some support to the DMRI in that a general factor of polydrug use in late adolescence predicted criminal deviance in adulthood, unmediated by differential association with deviant peers, specific drug effects, or attitude.

Ensminger and Juon (1998) evaluated patterns of antisocial behaviors in adulthood among the participants of the Woodlawn longitudinal study of children. This study evaluated a sample of African American children from an impoverished community on the South Side of Chicago. For both males and females, heavy use of liquor and marijuana during mid adolescence (approximately 10th grade, ages 15 – 16) predicted membership in clusters of adulthood antisocial behaviors characterized by high substance use and interpersonal aggression or violent behavior assessed at ages 32 - 33. While these high risk individuals only made up 20.2% of the males and 21.7% of the females in the sample, they represent the group with the most risk for whom a targeted intervention program is most necessary. Among individuals who did not engage in high rates of substance use in adolescence, there were markedly lower rates of

problems in adulthood. Other factors from early childhood and adolescence also differentiated the clusters. Unfortunately, the influences of the childhood and adolescent factors on adulthood cluster group membership were evaluated independently of one another. Hence, the relative influence of any one factor compared to the others was not determined.

Reciprocal Influences

In contrast to these uni-directional studies of influence, Vitaro, Brendgen, Ladouceur, and Tremblay (2001) utilized structural equation modeling (SEM) to test predictive relationships between gambling, delinquency, and a general drug and alcohol use construct in a sample of White males in Canada. Only drug and alcohol use at age 16 was predictive of the other antisocial behaviors at age 17. Impulsivity, friend deviancy, and parental supervision in early adolescence (ages 13 and 14) explained a significant, although small, amount of the residual covariance between the outcomes illustrating that covariance between drug and alcohol use, delinquency, and gambling in mid adolescence are partially accounted for by early adolescent predictors. Unfortunately, this study could not evaluate the moderating effects of gender due to the absence of females in the sample. However, these findings highlight the importance of understanding adolescents who engage in multiple antisocial behaviors rather than just one antisocial behavior as the etiology and prognosis may differ between these groups. This study provides important information regarding reciprocal influences between antisocial behaviors given that substance use in mid adolescence was predictive of other antisocial behaviors but the reverse association was not substantiated.

Only one other study has examined directional associations between antisocial behaviors and substance use. Mason and Windle (2002) longitudinally evaluated reciprocal influences between substance use and delinquency in a sample of White males (49%) and females. Participants were 15.5 years of age at first assessment and were reassessed at 6th month intervals

for 2 years. Results indicate consistent but small associations between delinquency at an earlier time point and substance use at the subsequent time point among males only. Substance use at first assessment was also positively associated with delinquency at second assessment among males. Evidence of reciprocal influences was not found for females. These results also lend support to the DMRI; however, this study is limited in that it encompasses a very small window of time in adolescent development and it does not address the early adolescent time period, during which the initiation of these antisocial behaviors actually occurs.

Salient Issues for Understanding Reciprocal Influences

Most research that evaluates antisocial behaviors either examines each behavior separately as individual outcomes or antisocial behaviors are combined into a construct of general deviance a priori. Results of these studies do provide meaningful information regarding common risk factors for antisocial behaviors but ignore the possibility that engagement in one antisocial behavior may serve as a risk for engagement in other forms of antisocial behaviors. At the same time, as can be seen from the brief list of published studies reviewed, examination of reciprocal influences has been lacking. In addition, studies to date have not fully examined issues of diversity in these developmental processes. It should be noted that one drawback to the examination of reciprocal influences has been an absence, until recently, of appropriate analytic methods for testing the DMRI and other developmental models.

Gender. Few studies have examined the role of gender in regards to reciprocal influences between substance use, aggression, and delinquency. Of these, reports of engagement in aggression, delinquency, and substance use either show no differences by gender or males report higher levels of engagement. As noted, Mason and Windle (2002) found reciprocal influences between delinquency and substance use only for males. However, evaluations across a longer range of development (from early adolescence to early adulthood) may result in different

patterns of associations between antisocial behaviors. This encourages further exploration of gender differences when evaluating reciprocal influences.

Ethnicity. Moreover, ethnic diversity is woefully underrepresented in evaluations of reciprocal influences among antisocial behaviors. As discussed previously, there is some evidence that certain behaviors which are generally seen as problematic (i.e., precocious sexual activity) do not necessarily cluster with other antisocial behaviors among African American adolescents (Stanton et al., 1993). Whereas, Ensminger and Juon (1998) found that heavy substance use in late adolescence was associated with adulthood aggression and delinquency in a sample African American males and females. Of course, the Woodlawn study was conducted with only urban, low-income children. Given ethnic differences in prevalence of substance use, indicating lower use during early to mid adolescence among African American youth, and aggression and delinquency, indicating higher rates for this group in comparison to White youth, it would be informative for future research of reciprocal influences to evaluate ethnically diverse samples within a variety of regional and socio-economic contexts. At present, it is not clear whether ethnicity is particularly informative in understanding pathways for antisocial behaviors or whether confounding contextual factors (e.g., urban versus suburban environments) or socio-economic factors (e.g., poverty, parental education, employment) are more salient for prediction. Clearly, these distinctions are important for prevention programming and accurately identifying not only who may be at heightened risk but also who may be protected from risk, and most importantly, why risk or protection is conferred (Newcomb, 1995).

Analytical approaches. As discussed previously, numerous studies have examined individual differences in behaviors and changes in behaviors across time via comparisons of time-specific mean levels of a particular outcome (e.g., aggression) for a particular group (e.g.,

males). While these studies do provide information that can be quite useful, they are limited when attempting to understand outcomes which are inherently developing over time (Curran & Muthen, 1999). Frequently, it is of interest to understand how specific factors alter the normative developmental trajectory of a particular outcome across multiple time points rather than simply evaluating change in that outcome between two discrete time points. This section addresses three different analytic techniques used to evaluate longitudinal data: Hierarchical Linear Modeling, Structural Equation Modeling, and Group-based trajectory analysis.

Hierarchical Linear Modeling (HLM) allows researchers to evaluate changes that occur over time within an individual as well as differences between individuals (Tabachnick & Fidell, 2007). This allows researchers to account for the nested nature of assessing the same individuals across multiple time points by allowing them to model intraindividual change as well as interindividual variability over time. This has been useful in the study of substance use and other antisocial behaviors because researchers are able to statistically evaluate changes in individual substance use over time as well as potential differences in changes between genders or ethnicities. This method is very similar to regression and hence, has the same advantages and limitations. Moderating effects are frequently evaluated using this technique; however, structural equation modeling is often recommended to evaluate mediating influences.

Structural Equation Modeling (SEM) allows researchers to statistically evaluate associations among both observed (measured) variables and latent variables (Tabachnick & Fidell, 2007). This analytic technique provides the clearest assessment of both direct and indirect (mediated) effects. In fact, four of the studies described in Table 1-1 utilize this approach in evaluating associations among antisocial behaviors (Mason & Windle, 2002; Scheier & Botvin, 1996; Stacy & Newcomb 1995; Vitaro et al., 2001). One application of SEM, latent

growth curve modeling (LGC), is conceptually very similar to HLM. LGC allows researchers to evaluate individual change in one or more domains over time (Tabachnick & Fidell, 2007). It is similar to HLM in that one can assess intraindividual change over time as well as interindividual variability. Of the studies reported in Table 1-1, Farrell et al. (2005) and Lillehoj et al. (2005) both employ linear growth curve modeling to evaluate longitudinal associations between antisocial behaviors. LGC does have a few advantages over HLM under certain circumstances. Both HLM and LGC can be used to calculate parallel growth curves of more than one outcome; however, LGC is generally easier to interpret and is more frequently used for this type of analysis. In addition, LGC is capable of estimating time intervals as well as using growth to predict future outcomes, neither of which is possible with HLM.

Group-based trajectory analysis assesses developmental trajectories for group-based rather than individual growth curves (Nagin, 1999; Nagin & Tremblay, 2001). This method is used to identify distinctive groups of individual trajectories within samples with multi-wave data. This method includes the capability to: (a) relate group membership probability to individual characteristics and circumstances; (b) use the group membership probabilities to create profiles of group members; (c) add time-varying covariates to trajectory models; and (d) estimate joint trajectory models of distinct but related behaviors. The advantage of group-based trajectory modeling is the ability to identify distinct groups of trajectories within the population. This is in contrast to HLM and LGC modeling, both of which assume a continuous distribution of trajectories within the population. Assuming a continuous distribution of trajectories within the population is in direct opposition to the idea of distinct clusters or categories of development and therefore it is awkward to use these methods when evaluating research questions that address developmental trajectories that are inherently categorical.

Notably, a debate regarding the application and interpretation of group-based trajectory modeling, as well as other complex longitudinal statistical methods, has arisen in response to the recent increase in the use of these analytic techniques. Numerous articles have centered around this debate¹ (Nagin & Tremblay, 2005a; Nagin & Tremblay, 2005b; Sampson & Laub, 2005). In brief, caution must be used when applying these complex methodologies so as not to misinterpret the results obtained. For example, regarding group-based trajectory analysis, it is important to emphasize that individuals do not actually belong to trajectory groups, the number of groups is not immutable, and even individuals with a high probability of belonging to a particular group do not follow that group trajectory exactly (Nagin & Tremblay, 2005a). Given these features of group-based trajectory modeling, it has been argued that results provided by this type of technique are potentially flawed due to ambiguity in groups and group membership, an inability to accurately predict individual outcomes based on group membership, and a tendency to rely on results of statistical analyses to draw conclusions and inform future analyses as opposed to relying strictly on theory (Sampson & Laub, 2005). Despite these criticisms, utilizing new statistical methodologies can provide important new information that can then be useful in the revision and refinement of existing theories as well as the development of new theories, provided the analyses are applied and interpreted appropriately.

Conclusions

The empirical evaluation of the development and prevention of antisocial behaviors is a challenging endeavor. Our current state of knowledge has benefited immensely from numerous, large, nationally representative longitudinal studies of antisocial behaviors. Longitudinal research designs are essential in disentangling the reciprocal influences between antisocial behaviors from childhood to adulthood. In addition, advances in statistical methodology, including trajectory analysis and structural equation modeling, allow researchers to evaluate

more accurately the associations among constructs over time. Finally, continued development and evaluation of developmentally appropriate intervention techniques, that includes interconnections between antisocial behaviors across the lifespan, are critical in making the translation from empirical research to real world applications.

Measurement issues associated with accurately assessing initiation of and continued engagement in antisocial behaviors will always be a challenge. Self report remains an informative method of assessing antisocial behaviors. Analyzing saliva samples for carbon monoxide and thiocyanate levels has not been established as a valid alternative to self-reported tobacco use among adolescent populations (Snow, Gilchrist, & Schinke, 1985). However, collecting saliva and breath samples can enhance the validity of self report responses (e.g., bogus pipeline procedure), as does emphasizing confidentiality of responses (Evans, Hansen, & Mittelmark, 1977).

Co-occurrence of antisocial behaviors is quite common throughout adolescence and adulthood. Unfortunately, literature on the development of antisocial behaviors is currently limited by evaluating each antisocial behavior separately or by combining them into general deviance constructs without thoroughly evaluating reciprocal influences among antisocial behaviors. Clearly there are some individuals who engage in only one form of antisocial behavior (e.g., delinquent or criminal behavior); however, the association between substance use and delinquent or aggressive behavior is highlighted by one study of youth with pervasive antisocial behavior. This study found that 51% of youth with pervasive antisocial behavior reported high levels of substance use compared to 11% of youth without pervasive antisocial behavior (Tiet, Wasserman, Loeber, McReynolds, & Miller, 2001). Adolescents who are engaging in multiple antisocial behaviors represent a significant subgroup of individuals at

higher risk for continued problems in adulthood. Having an accurate understanding of the reciprocal effects of one antisocial behavior on another across adolescence will be invaluable in the development and implementation of appropriate intervention strategies for these high risk youth.

The Developmental Model of Reciprocal Influence (DMRI) attempts to highlight developmental differences across adolescence regarding interconnections between substance use and other antisocial behaviors. It emphasizes the multifaceted pathways to the development of individual antisocial behaviors in early adolescence while recognizing the interconnections between antisocial behaviors in late adolescence and adulthood. As recommended by Newcomb and Bentler (1989), DMRI distinguishes between substance initiation and experimentation as opposed to regular substance use and abuse. Regular substance use and abuse is associated with problematic adult outcomes and criminal behavior. Importantly, DMRI also recognizes the importance of reducing the initiation of antisocial behaviors in early adolescence, as escalation of antisocial behaviors begins with initiation.

The DMRI has strong implications for interventions involving substance abusers who also engage in other antisocial behaviors. Preventing the onset and escalation of antisocial behaviors in adolescence has long been a priority of policy makers, prevention scientists, and the public in general. Initial strategies focusing on substance use prevention, utilized dissemination of information about the harms of substance use as well as the “Just Say No” campaign (Lynam et al., 1999). These first forays into substance prevention proved to be largely unsuccessful. Hence, more rigorous scientific approaches to the development and evaluation of substance use prevention interventions have burgeoned (e.g., Life Skills Training Program, Botvin & Griffin, 2004).

Clearly, current interventions/programs aimed at reducing risk factors and enhancing protective factors during childhood and early adolescence are imperative. However, programs aimed at early identification of regular substance users or abusers who engage in other antisocial behaviors should strongly emphasize substance use rehabilitation as a mechanism through which future adult criminal activity and aggressive behavior will be reduced.

The DMRI supports the evaluation of biological, psychological, and social risk factors on the onset of antisocial behaviors in early adolescence. However, further research is needed to evaluate if these risk factors operate directly or indirectly through regular substance use and abuse during late adolescence to predict future adult criminal behavior and aggression.

Importantly, the DMRI should be evaluated among both males and females from a variety of ethnic backgrounds, regional contexts, and socio-economic strata given that there is evidence of gender and ethnic differences in prevalence of antisocial behaviors, as well as differential effects of risk and protective factors (Andrews, 2005; Eide, Acuda, Khan, Aaroe, & Loeb, 1997; Mason & Windle, 2002; Newcomb, 1997; Svensson, 2003). Information regarding gender and ethnic differences in reciprocal influences between antisocial behaviors is sparse and inconsistent thus far, requiring further examination. Longitudinal evaluations beginning in early adolescence, before many antisocial behaviors are initiated, and continuing through the transition to adulthood will provide the most complete picture of associations between antisocial behaviors as well as the influence of risk and protective factors.

The Proposed Study

The DMRI is meant to serve as a heuristic device to guide future research. Given the breadth of the model, it would be unrealistic to attempt to evaluate the model in its entirety. As such, the proposed study begins to address some of the gaps in the literature regarding the DMRI by focusing on one particular part of the model. Specifically, associations delineated in the first

part of the DMRI, relating trajectories of aggressive behavior to trajectories of delinquent behavior as well as both of these with initiation of substance use during early adolescence. These pathways will be evaluated in a longitudinal sample of ethnically diverse males and females.

CHAPTER 2 THE ROLE OF SENSATION SEEKING AND DEVIANT PEER ASSOCIATION ON ANTISOCIAL BEHAVIOR

The middle school years (ages 11-14) are when behaviors such as substance use (tobacco, alcohol, marijuana, and other drugs), aggression, and delinquency increase more dramatically. While a great deal of information has been gained by evaluating these constructs independently of one another, it is important to investigate the interconnections between the development of aggressive and delinquent behaviors and the development of substance use and abuse in adolescence and adulthood (Jessor, 1992). Research has shown that rates of all three of these behaviors increase during this time frame and that they share common correlates, yet it is still unknown whether aggression and delinquency develop temporally along with drug use or whether one naturally precedes or leads to the other. Equally importantly, does this association vary by gender? Previous research has investigated both sensation seeking, and association with delinquent or drug using peers with the development of aggressive, delinquent, and drug using behaviors in adolescence. However, the association between these factors and the temporal relationship between aggression, delinquency, and drug use in middle school has yet to be established.

Pathways to Drug Use and Aggression and Delinquency: Conceptual Framework

A wide range of individual and contextual factors have been determined to influence initiation of drug use during the middle school years with some factors proving to be drug specific while others have comparable effects across drugs. Current literature provides several existing models for initiation of drug use (Botvin & Sheier, 1997; Catalano & Hawkins, 1996; Chassin & Ritter, 2001; Newcomb & Bentler, 1989; Sher, 1991) as well as pathways for aggression and delinquency (Bandura, 1977; Broidy et al., 2003; Crick & Dodge, 1994; Jessor, 1992; Moffitt et al., 2001). This project draws specifically from Jessor's problem behavior

theory (Jessor, 1992). An advantage of Jessor's theory (1992) is the broad conceptualization of problem behaviors rather than a focus on specific outcomes. Jessor's theory (1992) also emphasizes the importance of identifying risk and protective factors for co-occurring problem behaviors. I am extending this model by incorporating new and innovative methods for examining co-occurrence of problem behaviors that allows for examining temporal associations and pathways, with attention to individual and peer factors that set youth on different pathways/trajectories.

My framework for studying adolescent drug use draws heavily from Bronfenbrenner's (1979) ecological model of human development. This model emphasizes the concept of an individual as embedded within, interacting with, influencing, and being influenced by a social context. For example, not only do contextual factors influence individual development, but individual characteristics also influence or form the social contexts in which individuals interact. It is clear that the ecological model as well as other models drawn upon for the proposed study include multiple factors from several contexts (cultural/societal environment, interpersonal forces, psychobehavioral factors, and biogenetic influences). Rather than attempting to evaluate this complex model in its entirety, my goal is to provide a better delineation of pieces of the model that may be particularly salient to the interconnection of pathways to drug use, aggression, and delinquency.

For this project, the primary focus is on the hypothetical model shown in Figure 3-1. Specifically, I am interested in evaluating gender-specific and common pathways for aggression and delinquency and the interconnection to pathways to drug use. As discussed in the previous chapter, it is important to evaluate the role of individual characteristics to aid in the development of targeted interventions for individuals at risk for the development of antisocial behaviors.

While most researchers conceptualize sensation seeking as a stable trait, unlikely to be reduced via intervention (Zuckerman, 2007), Arnett (1995) argues that it may be possible to change how sensation seeking is expressed, minimizing unhealthy expressions. In addition, Arnett acknowledges the importance of social contexts in the development of substance use, aggression, and delinquency. The formation of healthy peer relationships continues to be a key element of current drug use and violence prevention programming (e.g., Dishion & Loeber, 1985; Kandel & Andrews, 1987). As such, it is important to understand the role of sensation seeking and deviant peer association regarding changes in antisocial behavior from childhood through adulthood to better inform the aforementioned intervention strategies.

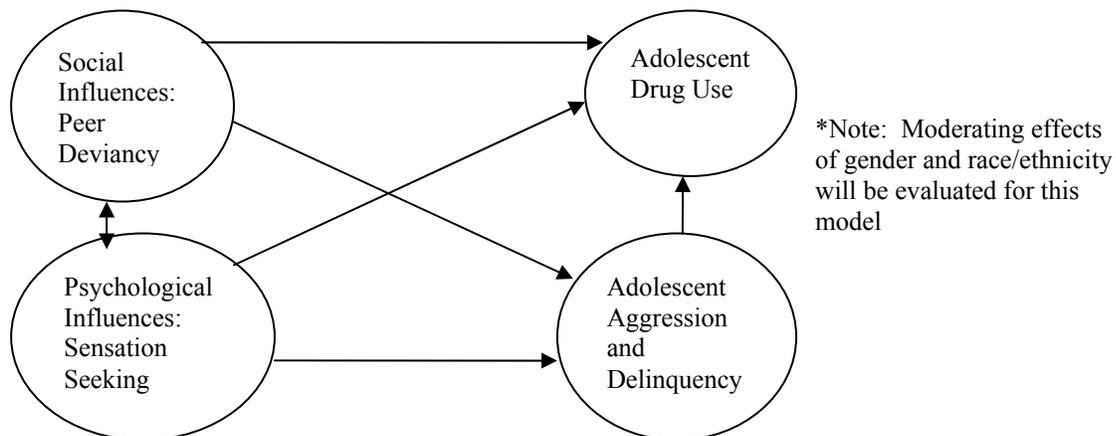


Figure 3-1. Hypothetical model of individual and contextual pathways to drug use

Individual sensation seeking as well as peer contexts will be investigated as predictors of pathways for aggression and delinquency and the interconnection to pathways to drug use. The evaluation of sensation seeking and peer context in connection to studying pathways is unique in that previous studies have evaluated these constructs separately for each outcome, rather than as predictors of pathways between drug use, aggression, and delinquency. It is likely that the interrelationship among these factors varies by gender; hence, gender is evaluated as a moderator. The proposed study draws from and elaborates upon models that have served as the

basis of previously developed violence and substance use prevention programming (Botvin & Sheier, 1997; Catalano & Hawkins, 1996). Therefore, the results of the present project will directly inform future prevention programming efforts.

Core Domains

Individual Sensation Seeking

Measurement considerations. Sensation seeking is the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences (Zuckerman, 1979). Studies that have evaluated the construct of sensation seeking have found it to be a fairly stable biologically based personality trait (Bardo & Mueller, 1991; Clayton, Leukefeld, Donohew, Bardo, & Harrington, 1995; Bardo, Donohew, & Harrington, 1996). Sensation seeking is traditionally conceptualized as being composed of four subscales: experience seeking, thrill and adventure seeking, disinhibition, and boredom susceptibility (Zuckerman, 1986). Zuckerman (1986) developed the original self report questionnaire used to evaluate this construct. Reduced forms of the original questionnaire have been developed and widely used, including a four item version where each item represents one of the four subscales.

Research that has evaluated the effects of specific sensation seeking subscales on antisocial behaviors have found stronger associations between antisocial behaviors and the thrill and adventure seeking and disinhibition subscales (Alexander, Allen, Brooks, Cole, & Campbell, 2004; Andrucci, Archer, Pancoast, & Gordon, 1989; Bardo et al., 1996; Donohew, Lorch, & Palmgreen, 1991; Donohew et al., 1999; Kopstein, Crum, Celentano, & Martin, 2001; Newcomb & McGee, 1991; Zuckerman, et al., 1990). Thrill and adventure seeking refers to a person's desire to engage in physically risky activities such as risky sports and the enjoyment of frightening experiences (Zuckerman, 1986). Disinhibition represents a form of sensation seeking

more related to impulsivity or a lack of self-control. Unfortunately to date, disinhibition, impulsivity, and self-control are often evaluated and discussed separately. The minor differences between these concepts have arisen due to differences in theoretical orientation. For instance, the hierarchical model of personality defines impulsivity as a biologically based personality trait characterized by acting on impulse, nonplanning, liveliness, and risk-taking (Acton, 2003; Eysenck & Eysenck, 1985). As discussed previously, sensation seeking also represents a biologically based personality trait characterized by a tendency to seek exciting experiences with the disinhibition subscale representing a tendency to act without regard for consequences (Acton, 2003). Self-control is considered a behavioral style which is learned early in life and is highly resistant to change. High self-control is characterized by an ability to make decisions about current behavior based on considering the long-term consequences of that behavior. Individuals with low self-control act without consideration of future consequences (Gottfredson & Hirschi, 1990).

While there are some relatively minor theoretical distinctions in the origins and definitions of disinhibition, impulsivity, and self-control, they are all clearly related by a tendency to act on impulse, without planning for or taking into account the future consequences of one's actions. There is little debate among researchers regarding the conceptual similarity among these constructs. In part, the distinction between these constructs may be resolved via developmental approaches to temperament and personality. An individual may be born with a biological disposition towards impulsivity; however, during early childhood, parenting behaviors will either encourage or discourage the development of self-control.

Background research. In studies evaluating the association between sensation seeking and substance use, thrill and adventure seeking and disinhibition are continually identified as the

subscales most strongly related to drug use (Andrucci, Archer, Pancoast, & Gordon, 1989; Bardo et al., 1996; Donohew, Lorch, & Palmgreen, 1991; Donohew et al., 1999; Kopstein, Crum, Celentano, & Martin, 2001; Zuckerman, et al., 1990). Individuals with higher levels of thrill and adventure seeking and disinhibition have been identified by numerous studies to be more likely to initiate substance use, as well as have higher levels of use for both specific substances and combined measures of substance use (Ball, 1995; Newcomb & McGee, 1989; Zuckerman, 2007). A separate literature has elaborated on a similar connection between the thrill and adventure seeking and disinhibition sensation seeking subscales and the development of aggressive and delinquent behaviors (Newcomb & McGee, 1991). More recent studies have evaluated drug use, aggression, and delinquency combined representing general deviance in multiple domains. These studies also find high levels of thrill and adventure seeking and disinhibition to be associated with general deviance (Newcomb & McGee, 1991). Other studies have found positive correlations between sensation seeking and drug use, aggression and delinquency but are limited in that they utilized cross sectional samples of college students (Huba, Newcomb, & Bentler, 1981; White, Labouvie, & Bates 1985). Hence, generalizability to the development of these behaviors over time in middle school is limited.

There is some evidence that the effects of the thrill/adventure seeking and the disinhibition constructs may differ by gender depending on outcome (Newcomb & McGee, 1991). In addition, males are more likely than females to be high sensation seekers. There is also some evidence to suggest that the association of sensation seeking and drug use may differ when race (comparing Black and White adolescents) is evaluated. Brown, Miller, & Clayton (2004) found sensation seeking to be predictive of drug use among White adolescents but for Black adolescents findings were either non-significant or in the opposite direction than hypothesized.

Aside from the findings of Brown, Miller, & Clayton (2004), evidence indicates that sensation seeking, in particular the thrill/adventure seeking and disinhibition subscales, are associated with substance use, aggression, and delinquency when evaluated as independent constructs or combined to form a general deviance construct. However, to date, the role of these subscales in a longitudinal analysis of gender specific and common pathways between substance use and aggression and delinquency during the middle school years has yet to be determined. It is also clear that race/ethnicity should be evaluated to clarify its role in these pathways.

Peer Factors

The formation of healthy peer relationships is a key element of current drug use and violence prevention programming (e.g., Dishion & Loeber, 1985; Kandel & Andrews, 1987). Many of the more effective programs incorporate tasks aimed at developing healthy peer relationships and effectively avoiding developing friendships with peers who use drugs or engage in delinquent behaviors. Given higher rates of delinquency and aggression overall compared to overall drug use during the middle school years, it follows that more middle school students will develop delinquent peer relationships, than will develop drug using peer relationships.

Measurement considerations. Evaluating peer influences on problem behaviors is subject to many challenges. Initial research on the influence of peers focused on the gender composition of one's peer group, with male peer groups being more conducive to problem behaviors than groups largely composed of females (Moffitt et al., 2001). Another way peer groups have been conceptualized is by age of peers. During adolescence, associating with older peers increases the risk of an individual engaging in problem behaviors (Moffitt et al., 2001). Despite the fact that in both of these situations peer deviancy was not directly assessed, it is assumed that peer groups composed of mostly males engage in or at least encourage deviant

behavior to a greater degree than peer groups largely composed of females. Similarly, since overall rates of deviant behavior increase with age, older peer groups will be more likely to engage in or encourage deviant behavior compared to peer groups of a comparable age to the adolescent.

There are other definitional issues to consider when evaluating the deviancy of an individual's peer group. Social learning theory (Bandura & Walters, 1959) postulates modeling of peer behavior as a mechanism that drives the increase in problem behaviors. Based on this premise, researchers generally operationally define peer deviancy by assessing peer drug use or by assessing peer engagement in delinquent behaviors depending upon the outcome of interest in their study. However, given the co-occurrence of substance use, aggression, and delinquency during adolescence it is important to evaluate both the substance use and delinquent behavior of an individual's peers within the same study. This will provide a more complete picture of the role of peer influences on adolescent problem behavior.

Beyond definitional issues, measurement issues also arise in the evaluation of peer deviancy. As was discussed previously, the most common method of assessment used in the evaluation of problem behaviors is adolescent self report. Along with the problems associated with self reporting one's own deviant behaviors, additional considerations must be taken into account when adolescents report on the behavior of their peers. For instance, adolescents tend to report that their friends' behavior is more similar to their own behavior than it actually is in reality (Wilcox & Udry, 1986). One method recommended by Aseltine (1995) to address this bias involves obtaining information about peer behaviors from actual peer reports. This can be achieved by obtaining adolescent self report on their own deviant behaviors and then asking them to list the names of their closest friends. With this information it is possible to match

adolescent surveys with the surveys completed by their friends. Peer deviant behavior is then determined based on the adolescent's friend's reports of their own deviant behavior rather than the adolescent's perception of their friend's behavior. However, this does require high participation rates within schools as well as friend networks within schools. The National Longitudinal Study of Adolescent Health (Add Health) dataset is one example of a large longitudinal dataset with the capacity for this type of measurement technique.

Background research. There is substantial evidence of a strong influence of deviant peer association on adolescent antisocial behavior (Dishion & Patterson, 2006; Elliot, Huizinga, & Ageton, 1985; Haviland, Nagin, & Rosenbaum, 2007). In a longitudinal analysis of a nationally representative sample, Elliot and colleagues (1985) found that deviant peer association predicted subsequent delinquent behavior, even after controlling for previous delinquency. This finding held for both males and females. Similarly, research on the impact of gang affiliation consistently shows increases in delinquent and criminal behavior upon joining a gang even after accounting for an individual's history of delinquent behavior (Haviland et al., 2007). The impact of deviant peer affiliation on adolescent substance use is highlighted by numerous studies revealing deviant peer affiliation to be one of the strongest predictors of adolescent substance use as well as relapse after substance abuse treatment (Brown, 1993; Dishion & Patterson, 2006; Friedman & Glassman, 2000; Mayes & Suchman, 2006).

While previous research has found a positive association between delinquent friends and adolescent delinquent behaviors (Elliot, Huizinga, & Ageton, 1985; Lynne, Graber, Nichols, Brooks-Gunn, & Botvin, 2007; Moffitt et al., 2001), less work has been done examining the role of friend delinquency on the development of substance use, or on the association between friend drug use and the development of aggression, delinquency, and drug use. In a prior collaborative

study, rates of friend delinquency were much higher than friend drug use among urban minority adolescents (Graber, Lynne, Nichols, Brooks-Gunn, & Botvin, in preparation). Yet, the differential impact on the development of aggression, delinquency and drug use of associating with delinquent peers, as opposed to drug using peers, has yet to be thoroughly evaluated. Hence, the examination of interconnections between the development of aggressive and delinquent behaviors with drug using behaviors while evaluating friend delinquency and friend drug use separately as predictors of these pathways will further inform prevention programming.

Consistent with research indicating that males tend to engage in higher rates of delinquency and aggression than females, previous research has found that, among middle school students, male peer groups are more conducive to aggressive and delinquent behaviors (Moffitt et al., 2001). In addition, there is some evidence that adolescent males are influenced by association with delinquent or drug using friends more so than females (Erickson, Crosnoe, & Dornbusch, 2000). However, differential association or susceptibility to delinquent peers does not completely explain the gender difference in aggressive and delinquent behaviors. As such, it is of value to examine gender differences in pathways to drug use that incorporate interconnections with aggression and delinquency.

Unfortunately, there is very little empirical information regarding the influence of deviant peers among ethnically diverse samples. Only one study that we know of has evaluated differences in the influence of deviant peers among different ethnicities. This study provided some evidence that friend's substance use operates differently when comparing White and Black adolescents. Black adolescents with friends who smoked cigarettes in the 6th grade were less likely to smoke themselves in 10th grade suggesting that friend's use is not directly related to Black youths' own use of drugs (Brown, Miller, & Clayton, 2004). Clearly, further research is

needed evaluating the influence of deviant peers on multiple antisocial behaviors among ethnically diverse samples.

Referring to Bronfenbrenner's (1979) ecological model, it is important to evaluate person-context interactions regarding the pathways to problem behaviors. Initiation of substance use often occurs with friends who are using drugs; however, it is clear that exposure to drug using friends does not operate independent of the individual who chose those friends (Newcomb & Bentler, 1989). Adolescents often select friends with common interests based on their own psychological characteristics. Yet, no studies have examined interactions between sensation seeking and deviant peer association. The proposed study plans to examine this interaction and evaluate it in regards to pathways to problem behaviors.

CHAPTER 3 SPECIFIC AIMS

While numerous studies have evaluated initiation and use of drugs and alcohol as well as increases in rates of aggression and delinquency during the middle school years, interconnections between these factors have not systematically been evaluated longitudinally in a large sample of urban, minority adolescents. Studies have shown that rates of aggression and delinquency begin to increase earlier than rates of drug use, and co-occurrence of these behaviors is often reported. However, the temporal associations among these factors and individual differences in these pathways have yet to be fully evaluated.

It is also important to examine the role of individual and contextual factors as predictors of these negative adjustment outcomes. Sensation seeking, specifically thrill and adventure seeking and disinhibition (i.e., impulsivity, lack of self-control), represents an individual characteristic that has been identified as salient to engagement in drug use and some delinquent behaviors. Similarly, contextual factors such as friend delinquency and friend drug use have been shown to be related to aggression, delinquency, and drug use when evaluated separately for each outcome but have yet to be studied as predictors of interconnections between these outcomes. Moreover, pathways between these factors and substance use may be mediated by engagement in aggressive or delinquent behaviors.

In addition, there is substantial evidence indicating that rates of engagement in aggression, delinquency, and drug use differ by gender and race/ethnicity. However, more recent research seems to indicate that the gender gap is narrowing, especially in regards to aggression and some types of substance use. It is therefore imperative to examine commonalities as well as differences between genders and races/ethnicities regarding pathways to aggression, delinquency, and drug use in middle school. Likewise, sensation seeking and the impact of

deviant peers may vary by gender. Hence, these constructs may be particularly informative to understanding factors associated with gender specific pathways to drug use. Prevention efforts (and interventions) largely focus on reducing the rates of all three of these negative outcomes among adolescents. These efforts would greatly benefit from a clearer understanding of both gender specific and common pathways to drug use, incorporating interconnections with pathways to aggression and delinquency. Based on previous research, it was hypothesized that significant increases in antisocial behaviors would be observed as well as gender and racial/ethnic differences in average levels of antisocial behaviors. However, the primary aims of the current study were not necessarily hypothesis driven but rather, were more exploratory, stemming from previous theoretical work outlined above. The specific aims of this study were as follows:

1. The first aim examined differences in patterns of change for aggression, delinquency, and substance use for girls, boys, or both genders. Bi-directional or temporal associations between these patterns of change in substance use, aggression, and delinquency were evaluated over three assessments in early adolescence.
2. The second aim evaluated the mediating role of individual changes in aggression and delinquency on associations between substance use, sensation seeking, and peer deviancy for girls, boys, or both genders. Two components of general sensation seeking, thrill/adventure seeking and disinhibition, were evaluated along with the general sensation seeking construct. Two aspects of peer deviancy were also evaluated (peer delinquency and peer drug use).
3. The third aim evaluated the moderating role of gender on associations between antisocial behaviors (aggression, delinquency, and substance use), sensation seeking, and peer deviancy. Two components of general sensation seeking, thrill/adventure seeking and disinhibition, were evaluated along with the general sensation seeking construct. Two aspects of peer deviancy were also evaluated (peer delinquency and peer drug use) for gender differences in associations with aggression, delinquency, and substance use.
4. The fourth aim evaluated the moderating role of race/ethnicity on associations between antisocial behaviors (aggression, delinquency, and substance use), sensation seeking, and peer deviancy. Two components of general sensation seeking, thrill/adventure seeking and disinhibition, were evaluated along with the general sensation seeking construct. Two aspects of peer deviancy were also evaluated (peer delinquency and peer drug use)

for race/ethnic differences in associations with aggression, delinquency, and substance use.

These research questions were addressed via secondary data analysis of data collected as part of a large, school-based violence prevention program evaluation, based on the LST Program for alcohol, tobacco, and drug prevention. Other data sets might be used to examine these issues. In particular the ADD Health public domain data set includes many of the constructs of interest in the present project; in addition, ADD Health is a nationally representative sample. However, the violence prevention data set to be used in this project focuses intensively on the middle school years with an urban minority sample. The dearth of information on pathways to drug use and delinquency among this group of adolescents validates the choice of this particular dataset and results of the proposed study will contribute greatly to the field.

CHAPTER 4 RESEARCH DESIGN AND METHODS

Design

A total of 42 public and parochial middle schools in New York City participated in the evaluation study. All schools participated in baseline data collection activities with their 6th grade classes, prior to the intervention, and annual surveys in 7th and 8th grades; half the schools received prevention programming for three years. Only participants assigned to the control condition at baseline will be used in the proposed study in order to avoid contamination with potential intervention effects.

Participants

Participants were 2,931 young adolescents drawn from the control condition of the LST program evaluation study. In the 6th grade, participants of the study reported a mean age of 11.72 years (SD = 0.54) with a range from 9.64 to 14 years. Fifty percent of the sample is female and the sample is largely minority with 48% Black, 30% Latino, 7% White, 5% Asian, and 9% Other (1% didn't report race). Just under half of the students came from an intact family (43%), 32% lived with a single parent, 14% lived in blended families (with stepparents or split time between mother and father's home) and 6% lived in households without any parent present (with other relatives, or with foster parents or guardians). Although a measure of family SES was not available, archival public school records of participating schools showed that the majority (88%) of schools had greater than 65% student eligibility for free or reduced lunch. Youth were enrolled in public (90%) and parochial (10%) schools.

Procedure

A passive consent procedure approved by Weill Cornell Medical College's IRB was used to inform parents about the nature of the study and to provide them with an opportunity to disallow their child's participation. A consent form describing the study and the self-report survey was distributed in the schools, as well as mailed directly to students' homes. Students whose parents indicated they did not want them to participate in the self-report survey did not complete any of the data collection activities.

Data collectors for survey data collection were recruited, trained, and supervised by the Project Manager at Teachers College, Columbia University under the supervision of the PI and Co-PIs. Equal numbers of males and females, as well as Black and Latino college students were recruited from City and Community colleges and trained for the school based study. A standardized and effective system for training data collectors was developed under the NIDA center grant. Data collectors were organized into teams of 5 and were supervised by a field leader. Each team was able to complete the data collection for students in a single day per school. The primary collection of survey data took about 2 weeks at each school. Smaller teams of two data collectors returned to schools on at least three occasions after each scheduled data collection to collect data on absentees.

Quality control in the collection of the data was assured by careful training of all data collection staff, use of carefully written protocols, and by regular observation of field procedures by the investigators. Data collectors observed a training video of data collection protocols in addition to signing a Confidentiality Pledge regarding the handling of sensitive participant information.

The survey was divided into two booklets and data collection was conducted on two days during regular 40-minute class periods. A multi-ethnic team of three to five data collectors

administered the questionnaire following a standardized protocol used in previous research (e.g., Botvin, Schinke, Epstein, & Diaz, 1994). To ensure the quality of self-report data, identification codes rather than names were used to emphasize the confidential nature of the questionnaire and students were assured about the confidentiality of their responses. Carbon monoxide (CO) breath samples were also collected at 6th, 7th, and 8th grade to enhance the validity of self-report data utilizing a variant of the bogus pipeline procedure developed by Evans and his colleagues (Evans, Hansen, & Mittlemark, 1977). While this measure was used to increase the validity of questions pertaining to cigarette smoking, studies have shown bogus pipeline procedures can also increase the validity of reporting on other problem behaviors (Tourangeau, Smith, & Rasinski, 1997).

Measures

Surveys were used to assess aggressive and delinquent behaviors as well as drug, alcohol, and tobacco use in each year of data collection. In addition, surveys assessed numerous factors that have been identified in prior studies as correlates of these behaviors. The measures used in this investigation have been developed from in depth pilot testing and use of measures in large school-based drug prevention studies with urban multi-ethnic youth (See Appendix A). All measures were collected annually in the spring of 6th, 7th, and 8th grades.

Demographics

Data concerning the demographic characteristics of the participants were collected using standard survey items concerning gender, age, family structure, race/ethnicity, socioeconomic status (i.e., receive free or reduced-price school lunch). For purposes of analyses, a single dichotomous variable was created to capture the type of household structure where 1 indicates living in a two-parent household. Students from single and no-parent households were coded as 0. Two dichotomous variables were created to capture participants' race or ethnic affiliation.

The first represented participants who were Latino (coded one) versus all other participants (coded zero). The second represented participants who were Black/African American (coded one) versus all other participants (coded zero). Values of zero on both of these variables represented individuals from all other ethnic groups (White/Caucasian, Asian, American Indian, and Other). A single dichotomous variable was created to indicate if the adolescent was attending a public or a parochial school (where 1 represents participants who attended public school and 0 for parochial school students).

Drug Use

Survey items assessed frequency of cigarette smoking, drinking alcohol, drinking until drunk, smoking marijuana, smoking marijuana until high or stoned, and using inhalants. Frequency of each item was measured on a nine-point scale with the following choices: never, a few times but not in the past year, a few times a year, once a month, a few times a month, once a week, once a day, or more than once a day. Due to the fact that reports of individual substance use is quite low at the initial assessment but increases, the proposed study plans to create a composite sum score of drug use, such that higher values represent more overall drug use at each grade. Cronbach's alpha is somewhat low in the 6th grade ($\alpha = .61$) due to the low reported rates of substance use at this age, but increases to appropriate levels in the 7th ($\alpha = .78$) and 8th ($\alpha = .86$) grades. Previous studies have found composites to be useful, although there are limitations such as an inability to test gateway models (Chen & Kandel, 1995; Kandel & Logan, 1984). The present study will not test this model.

Aggression

Aggression was assessed via the aggression scale of the Youth Self-Report (YSR, Achenback & Edelbrock, 1986). Students were asked how many times in the past month they had engaged in ten incidents of overtly aggressive behavior in the 6th grade ($\alpha = .93$), 7th grade (α

= .94), and 8th grade ($\alpha = .94$). Items included “Yelled at someone (you were mad at),” “Told someone off,” “Pushed or shoved someone on purpose,” and “Hit someone.” Response categories were on a 5-point scale. Response options included 1 (*Never*), 2 (*Once*), 3 (*2-3 times*), 4 (*4-5 times*), and 5 (*More than 5 times*). Items were rescored onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate greater aggression. The response options were changed from the 3-point scale in the YSR to the 5-point scale in this study to be consistent with the other measures in the survey.

Delinquency

Students were also asked how many times in the past year they had engaged in ten incidents of delinquent behavior (adapted from Elliott, Huizinga, & Menard, 1989). The same ten items were used in the 6th grade ($\alpha = .86$), 7th grade ($\alpha = .88$), and 8th grade ($\alpha = .90$). Two separate subscales were created to distinguish violent delinquency (6 items; 6th grade $\alpha = .81$, 7th grade $\alpha = .83$, and 8th grade $\alpha = .85$) and non-violent delinquency (4 items; 6th grade $\alpha = .69$, 7th grade $\alpha = .77$, and 8th grade $\alpha = .80$). Items for violent delinquency included “Thrown objects such as rocks or bottles at cars or people,” “Picked a fight with someone,” “Hit someone with the idea of seriously hurting them,” “Taken something from a person by force (other than just playing around),” “Beat up on someone or fought someone physically if they provoked you (other than just playing around),” and “Taken part in a fight where a group of your friends were against another group.” Items for non-violent delinquency included “Purposefully damaged or destroyed property or things that did not belong to you,” “Taken something from a store when the clerk wasn’t looking,” “Intentionally damaged or messed up something in a school or some other building,” and “Taken something worth less than \$50 that did not belong to you.” Response categories were on a 5-point scale. Response options included 1 (*Never*), 2 (*Once*), 3 (*2-3 times*), 4 (*4-5 times*), and 5 (*More than 5 times*). Within each subscale, items were rescored

onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate greater violent or non-violent delinquency.

Friend Delinquency

Students were asked to indicate how many of their friends had engaged in seven incidents of delinquent behavior in the past year. The same seven items were used to assess friend delinquency in the 6th grade ($\alpha = .88$), 7th grade ($\alpha = .91$), and 8th grade ($\alpha = .92$). These were taken from a violence/delinquency scale developed by Elliot et al. (1989). Items for friend delinquency included “Hit or threatened to hit someone without any real reason,” “Beat someone or fought someone physically if they were provoked (other than just playing around),” “Ruined or damaged something on purpose that wasn’t theirs,” and “Stolen something worth less than \$50.” Response options included 1 (*None*), 2 (*Less than half*), 3 (*About half*), 4 (*More than half*), and 5 (*All or almost all*). Items were rescored onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate associating with more friends who engage in a higher number of delinquent behaviors for each time point.

Friend Drug Use

Adolescents reported how many of their friends had tried tobacco, alcohol, marijuana, inhalants, or other drugs. The same five items were used to assess friend drug use in the 6th grade ($\alpha = .79$), 7th grade ($\alpha = .80$), and 8th grade ($\alpha = .83$). Response options included 1 (*None*), 2 (*Less than half*), 3 (*About half*), 4 (*More than half*), and 5 (*All or almost all*). Items were rescored onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate associating with a greater number of substance using friends for each time point.

Perceived reports of friend delinquency and drug use have been used extensively in the past. Previous studies have also attempted to validate adolescent perceptions of peer delinquency and drug use by assessing rates of these behaviors directly from the adolescent’s

friends, rather than having the adolescent report on their perception of their friend's behaviors only. However, it is not possible in the present investigation to match adolescent reports to peer reports of delinquent and drug using behavior due to the nature of the dataset.

Sensation Seeking

Thrill and adventure seeking. Students were asked to indicate how much they agree with four statements regarding enjoyment of risky activities in the 6th grade ($\alpha = .79$), 7th grade ($\alpha = .82$), and 8th grade ($\alpha = .82$). Items for thrill and adventure seeking included "I enjoy taking risks," "I would enjoy fast driving," "I would do almost anything on a dare," and "I think life with no danger in it would be dull for me." Responses were measured on five-point scales ranging from "strongly disagree" to "strongly agree". The validity of this four item measure of thrill and adventure seeking was confirmed in a study conducted by Eysenck & Eysenck (1975). Items were rescored onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate greater enjoyment of risky activities.

Disinhibition. Students were asked to indicate how much they agree with 13 statements regarding the ability to focus and inhibit certain behaviors in the 6th grade ($\alpha = .79$), 7th grade ($\alpha = .80$), and 8th grade ($\alpha = .80$). This measure was modeled after a scale developed by Rosenbaum (1980). Items for disinhibition included "I am easily distracted from my work," "It doesn't really take much to calm me down when I am excited or all wound up (reverse coded)," and "I have been told that I interrupt people in conversations." Responses were measured on five-point scales ranging from "strongly disagree" to "strongly agree". Items were rescored onto a scale of 0-4 and then summed to create a continuous measure where higher scores indicate less ability to focus and inhibit behaviors.

A composite measure of sensation seeking was formed by combining the thrill and adventure seeking subscale and the disinhibition subscale. This composite measure was formed

by summing the two subscales to create a continuous measure where higher scores indicated a greater enjoyment of risky activities and less ability to inhibit behaviors while lower scores indicated a dislike of risky activities and a greater ability to focus and inhibit behaviors.

Tracking and Attrition

Participants were maintained over the three years of data collection by using a combination of existing tracking information from the investigators' own files or provided to them by middle school administrators and (for New York City schools) information obtained from the New York City Board of Education Office of Systems Development Support (OSIS) database (a computerized biofile on every student ever enrolled in the system).

Several sources of information were used to track students throughout the course of the study including: (1) ID information obtained at the beginning of the study (name, ID code, school, home room, grade); (2) parent information collected annually on "tracking cards" and (3) school records (e.g., name of parent(s) or guardian, home address, phone number). Unique student identification numbers were linked to student's name, current address, phone number, current school, and enrollment status. Those numbers were used to track students throughout their academic careers and provided an excellent method of locating students.

At the first assessment in 6th grade, 2931 students participated in the control condition of the larger study. From 6th to 7th grade, 5% of the sample was lost to attrition with an additional 31% lost between 7th and 8th grades resulting in a longitudinal sample of 1922 students. Analyses of attrition bias were conducted to test for differences in 6th grade between students in the current study and those who were dropped from any of the planned analyses (t-tests for continuous variables, χ^2 tests on background variables).

Analysis Plan

Data analysis encompasses two main phases in the proposed study: psychometric analysis followed by analysis of specific research questions. Initial data cleaning and file construction were conducted at the Institute for Prevention Research at Weill Medical College of Cornell University which was responsible for all data management

Power Analysis

For Ordinary Least Squares Regression (OLS) models, Cohen and Cohen (1983) recommend a power level of .7 to .9 for determining necessary sample sizes for research. Given conservative estimated effect sizes of .25 to .35 (Cohen & Cohen, 1983), an alpha level of .05, a power level of .9 (90% chance an effect will be found if it is there), and an N of 175, as many as 20 independent variables can be used in hierarchical regressions and path analyses (including control and mediator/moderator variables). In this study, the sample size was 2,931 in the first assessment (50% female). As reported previously, a longitudinal sample of approximately 1,922 participants were maintained (53% female). In addition, mean levels of behaviors may differ by race/ethnicity, but such differences would not influence the extent that underlying processes accounting for behavioral outcomes would be similar. All analyses controlled for ethnic/racial group with the exception of those for Aim 4, which specifically examined the possible moderating effects of race/ethnic group. Results of this power analysis reveal that the sample size is more than adequate to test the research questions of interest in the proposed study.

Nagin (1999) has conducted group-based trajectory analyses with samples of 411 and 1,037. Thus, it is likely that power was sufficient in this study for these analyses. Across the aims, the initial sample size of 2,931 affords testing many complex models; however, attention will be paid to violation of norms when choosing specific estimation methods and test statistics.

Additionally, some of the methods used in this study are particularly useful because of their robustness against missing data.

Longitudinal Analyses

Because constructs assessed in the surveys were measured at 3 points in time, it was expected that change over time, or trajectories of constructs were more important than specific levels at any given time of assessment. As such, major research objectives outlined in *Aim 1* were pursued via innovative methods developed to assess developmental trajectories for group-based rather than individual growth curves (Nagin, 1999; Nagin & Tremblay, 2001). This method was used to identify distinctive groups of individual trajectories within samples with multi-wave data. This method includes the capability to: (1) relate group membership probability to individual characteristics and circumstances; (2) use the group membership probabilities to create profiles of group members; (3) add time-varying covariates to trajectory models; and (4) estimate joint trajectory models of distinct but related behaviors. The advantage of group-based trajectory modeling is the ability to identify distinct groups of trajectories within the population. This is in contrast to hierarchical and latent growth curve modeling, both of which assume a continuous distribution of trajectories within a population. This is in direct opposition to the idea of distinct clusters or categories of development and therefore it is awkward to use these methods when evaluating research questions that address developmental trajectories that are inherently categorical.

Testing Mediating and Moderating Effects

Mediating effects outlined in *Aim 2* were evaluated through a series of HLM equations where both the predictors and the mediators were person-mean centered to assess the impact of individual changes in aggression, delinquency, sensation seeking, and peer deviancy on substance use. Each of the aforementioned variables was person-mean centered by first

estimating each participant's personal average on a particular variable across time. For example, an individual's self-reported aggression in the 6th, 7th, and 8th grades was averaged resulting in an average level of aggression specific to that individual during middle school. Next, each participant's personal average on a particular variable was subtracted from the time specific assessments for that variable. In other words, an individual's average level of aggression was subtracted from their self-reported aggression in 6th, 7th, and 8th grades. The resulting values provided information about engagement in a specific behavior at higher or lower rates than typical for a particular individual.

Examination of gender as a moderator of associations was tested under *Aim 3* while the moderating effect of race/ethnicity was tested under *Aim 4*. HLM was used for testing cross-level interactions involving gender (level 2 predictor) and sensation seeking or deviant peer association (level 1 predictors) on the dependent variable of interest. The level 1 predictors were person-mean centered to assess the effect of changes in sensation seeking or deviant peer association within an individual on the dependent variable of interest rather than average associations between these variables across the sample.

Analysis of Specific Aims

This study addresses 4 primary aims. *Aim 1* examined differences in patterns of change for aggression, delinquency, and substance use for girls, boys, or both genders. Bi-directional or temporal associations between these patterns of change in substance use, aggression, and delinquency were evaluated over three assessments in early adolescence. This aim was addressed by initial examinations of group-based trajectories for each outcome individually followed by dual trajectory analyses. The initial group-based trajectory analysis determined if there were different patterns of change within each construct. The dual trajectory analysis evaluated patterns of change within two outcomes of interest simultaneously as well as estimated

the probability that an individual following a particular trajectory for outcome “A” (e.g., aggression) also followed a particular trajectory on outcome “B” (e.g., delinquency). Gender differences in trajectory group membership were analyzed.

Aim 2 evaluated the mediating role of individual changes in aggression and delinquency on associations between substance use, sensation seeking, and peer deviancy for girls, boys, or both genders. Two components of general sensation seeking, thrill/adventure seeking and disinhibition, were evaluated along with the general sensation seeking construct. Two aspects of peer deviancy were also evaluated (peer delinquency and peer drug use). The first step in the mediation analysis was to determine if there was a significant association between the predictor (e.g., sensation seeking) and substance use. Next, the association between the predictor and the mediator (e.g., aggression or delinquency) was evaluated for significance. Finally, both the predictor and the mediator were simultaneously evaluated for significant associations with substance use. Aggression or delinquency served as a mediator if the previously significant association between the predictor and substance use was either rendered non-significant or was significantly reduced. These series of analyses were conducted using HLM with both the predictor variables and the mediator variables person-mean centered to assess changes within an individual. An analysis of the interaction between sensation seeking and peer deviancy was first evaluated as the predictor. In the event of a non-significant interaction, analyses proceeded by evaluating the main effects of general sensation seeking, the two sub-dimensions of sensation seeking, and the peer deviancy variables as the predictors.

Aim 3 evaluated the moderating role of gender on associations between antisocial behaviors (aggression, delinquency, and substance use), sensation seeking, and peer deviancy. Two components of general sensation seeking, thrill/adventure seeking and disinhibition, were

evaluated along with the general sensation seeking construct. Two aspects of peer deviancy were also evaluated (peer delinquency and peer drug use) for gender differences in associations with aggression, delinquency, and substance use. As discussed previously, HLM was used to test cross-level interactions involving gender (level 2 predictor) and sensation seeking or deviant peer association (level 1 predictors) on aggression, delinquency, and substance use. The level 1 predictors were person-mean centered to assess the effect of changes in the variables within an individual on the outcomes of interest. First, the moderating role of gender on the interaction between sensation seeking and peer deviancy was evaluated. In the event of a non-significant three-way interaction, gender was evaluated as a moderator of the association between the outcomes of interest and the main effects of general sensation seeking, the two sub-dimensions of sensation seeking, and the peer deviancy variables.

Aim 4 evaluated the moderating role of race/ethnicity on associations between antisocial behaviors (aggression, delinquency, and substance use), sensation seeking, and peer deviancy. Both components of general sensation seeking, thrill/adventure seeking and disinhibition, were evaluated along with the general sensation seeking construct and two aspects of peer deviancy (peer delinquency and peer drug use) for race/ethnic differences in associations with aggression, delinquency, and substance use. Similar to the moderation analyses of the previous aim, HLM was used to test cross-level interactions involving race/ethnicity (level 2 predictor) and sensation seeking or deviant peer association (level 1 predictors) on aggression, delinquency, and substance use. The level 1 predictors were person-mean centered to assess the effect of changes in the variables within an individual on the outcomes of interest. First, the moderating role of race/ethnicity on the interaction between sensation seeking and peer deviancy was evaluated. If this three way interaction was not significant, race/ethnicity was evaluated as a moderator of the

association between the outcomes of interest and the main effects of general sensation seeking, the two sub-dimensions of sensation seeking, and the peer deviancy variables.

CHAPTER 5
RESULTS

Descriptive Analysis

Gender and racial/ethnic differences in demographic, outcome, and predictor variables as well as overall sample statistics for variables used in this study are presented in Table 5-1. There were no significant differences in the percentage of males compared to females among the demographic variables (e.g., race/ethnicity, household structure, and school type). However, there were significant racial/ethnic differences regarding household structure and school type. Black adolescents were less like to live with two parents in the 6th grade compared to Latinos and White/Other adolescents, $\chi^2(2, N = 2,879) = 112.50, p < .001$. Black and Latino adolescents were also more likely to attend public school as opposed to private school compared with White/Other adolescents, $\chi^2(2, N = 2,912) = 22.12, p < .001$.

Table 5-1. Descriptive statistics

	Gender		Race / Ethnicity			Total sample
	Males	Females	Black	Latino	White/Other	
Demographic Variables						
Gender (% female)	-	-	53%	50%	47%	50%
% African American	46%	50%	-	-	-	48%
% Latino	31%	30%	-	-	-	30%
% White/Other	23%	20%	-	-	-	22%
% Living with Two Parents	57%	56%	47%	62%	71%	57%
School Type (% public)	90%	90%	92%	90%	86%	90%

Table 5-1. Continued.

	Gender		Race / Ethnicity			Total sample
	Males	Females	Black	Latino	White/Other	
Outcome Variables	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Aggression 6th	13.48 (11.02)	11.62 (9.95)	14.06 (10.78)	10.49 (9.87)	12.05 (10.40)	12.54 (10.54)
Aggression 7th	18.76 (12.44)	19.17 (11.75)	20.35 (12.22)	17.62 (11.75)	17.34 (11.74)	18.98 (12.08)
Aggression 8th	19.10 (12.80)	19.64 (12.09)	21.05 (12.54)	17.22 (12.07)	18.80 (12.16)	19.39 (12.42)
Delinquency 6th	4.82 (6.40)	2.84 (4.32)	4.39 (5.89)	3.21 (4.94)	3.43 (5.44)	3.83 (5.55)
Delinquency 7th	6.99 (8.10)	5.43 (6.58)	6.76 (7.77)	5.82 (6.93)	5.11 (6.75)	6.16 (7.37)
Delinquency 8th	7.54 (8.87)	5.86 (7.42)	7.38 (8.75)	5.71 (7.27)	6.34 (7.94)	6.64 (8.17)
Substance Use 6th	0.62 (1.78)	0.38 (1.21)	0.49 (1.47)	0.47 (1.39)	0.58 (1.81)	0.50 (1.52)
Substance Use 7th	0.90 (2.00)	0.95 (2.18)	0.86 (1.99)	1.06 (2.24)	0.91 (2.19)	0.93 (2.10)
Substance Use 8th	1.21 (2.63)	1.37 (2.83)	1.25 (2.58)	1.33 (2.66)	1.33 (3.14)	1.30 (2.74)
Predictor Variables	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Friend Delinquency 6th	4.49 (5.63)	3.88 (4.99)	4.58 (5.56)	3.77 (5.00)	3.87 (5.19)	4.18 (5.33)
Friend Delinquency 7th	6.36 (6.78)	5.97 (6.36)	6.59 (6.90)	5.89 (6.11)	5.39 (6.19)	6.15 (6.56)
Friend Delinquency 8th	6.59 (6.79)	6.02 (6.63)	6.78 (7.04)	5.73 (6.22)	5.99 (6.57)	6.29 (6.71)
Friend Drug Use 6th	1.36 (2.66)	1.26 (2.47)	1.39 (2.70)	1.37 (2.55)	1.06 (2.31)	1.31 (2.58)
Friend Drug Use 7th	2.20 (3.13)	2.46 (3.27)	2.29 (3.27)	2.59 (3.27)	2.12 (2.96)	2.34 (3.21)
Friend Drug Use 8th	2.76 (3.58)	3.32 (3.87)	3.21 (3.86)	3.12 (3.74)	2.64 (3.48)	3.06 (3.75)
Sensation Seeking 6th	3.41 (1.44)	3.13 (1.31)	3.27 (1.39)	3.27 (1.32)	3.26 (1.42)	3.27 (1.38)
Sensation Seeking 7th	3.64 (1.37)	3.48 (1.31)	3.47 (1.34)	3.72 (1.29)	3.54 (1.39)	3.55 (1.34)
Sensation Seeking 8th	3.70 (1.32)	3.46 (1.27)	3.53 (1.29)	3.63 (1.30)	3.58 (1.32)	3.57 (1.30)

Table 5-1. Continued.

	Gender		Race / Ethnicity			Total sample
	Males	Females	Black	Latino	White/Other	
Predictor Variables	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Adventure Seeking 6th	2.86 (1.15)	2.57 (1.02)	2.72 (1.11)	2.67 (1.07)	2.73 (1.08)	2.71 (1.09)
Adventure Seeking 7th	2.98 (1.12)	2.79 (1.04)	2.80 (1.11)	3.00 (1.04)	2.91 (1.05)	2.88 (1.08)
Adventure Seeking 8th	3.06 (1.07)	2.80 (1.01)	2.87 (1.04)	2.98 (1.04)	2.96 (1.07)	2.93 (1.05)
Disinhibition 6th	3.44 (0.59)	3.43 (0.57)	3.44 (0.57)	3.40 (0.56)	3.46 (0.61)	3.43 (0.58)
Disinhibition 7th	3.35 (0.56)	3.31 (0.57)	3.33 (0.55)	3.30 (0.53)	3.38 (0.63)	3.33 (0.56)
Disinhibition 8th	3.36 (0.55)	3.35 (0.55)	3.34 (0.56)	3.35 (0.53)	3.39 (0.56)	3.35 (0.55)

Significant increases in aggression $F(2, 3254) = 396.82, p < .001, \eta^2 = .196$, delinquency $F(2, 3266) = 178.98, p < .001, \eta^2 = .099$, and substance use $F(2, 3168) = 115.35, p < .001, \eta^2 = .068$, were observed across middle school for the sample overall. There were a few differences in average rates of these outcomes between genders and race/ethnicities. There was a significant interaction between grade and gender for aggression, $F(2, 3254) = 5.36, p = .005, \eta^2 = .003$; however, bonferroni corrected follow-up tests were not significant. The difference between males and females on sixth grade aggression approached significance ($p = .061$) with males reporting slightly higher rates. Males did report significantly higher rates of delinquency compared to females across middle school, $F(1, 1633) = 28.59, p < .001, \eta^2 = .017$. There were no gender differences in reports of substance use. Black adolescents reported significantly higher levels of aggression $F(2, 1626) = 17.95, p < .001, \eta^2 = .022$ and delinquency $F(2, 1632) = 9.81, p < .001, \eta^2 = .012$ compared to Latino and White/Other adolescents. There were no significant racial/ethnic differences in reported rates of substance use.

Significant increases across middle school were observed in both of the deviant peer predictor variables, delinquent friends $F(2, 3218) = 106.78, p < .001, \eta^2 = .062$ and drug using friends $F(2, 3230) = 214.40, p < .001, \eta^2 = .117$. Gender and racial/ethnic difference were also observed. Males reported higher rates of delinquent friends than females, $F(1, 1609) = 3.95, p = .047, \eta^2 = .002$. Additionally, there was a significant interaction between grade and gender regarding friend drug use, $F(2, 3230) = 5.11, p = .006, \eta^2 = .003$. Bonferroni corrected follow-up tests revealed that in 8th grade, females reported significantly more drug using friends compared to males. White/Other adolescents reported significantly fewer delinquent friends $F(2, 1608) = 4.98, p = .007, \eta^2 = .006$ compared to Black adolescents as well as significantly fewer drug using friends $F(2, 1614) = 5.43, p = .004, \eta^2 = .007$ compared to both Black and Latino adolescents.

Significant increases across middle school were also observed for general sensation seeking $F(2, 3218) = 106.78, p < .001, \eta^2 = .062$. Both subscales showed significant changes as well; thrill/adventure seeking increased over time $F(2, 1766) = 37.42, p < .001, \eta^2 = .041$ and disinhibition decreased over time $F(2, 1984) = 24.42, p < .001, \eta^2 = .024$. Males reported significantly higher levels on the measure of general sensation seeking $F(1, 866) = 8.23, p = .004, \eta^2 = .009$ as well as the thrill/adventure seeking subscale $F(1, 883) = 16.45, p < .001, \eta^2 = .018$. There were no gender differences in levels of disinhibition. Latinos reported significantly higher levels of general sensation seeking compared to White/Other adolescents $F(1, 865) = 3.33, p = .036, \eta^2 = .008$; and there was a significant interaction between grade and race/ethnicity regarding thrill/adventure seeking $F(4, 1764) = 2.72, p = .028, \eta^2 = .006$. Bonferroni corrected follow-up tests revealed that Latinos reported significantly higher levels of thrill/adventure seeking compared to both Black and White/Other adolescents in the 7th grade and compared to

Black adolescents only in the 8th grade. There were no race/ethnic differences in 6th grade thrill/adventure seeking or disinhibition at any grade.

An evaluation of the correlations among the predictor variables revealed very strong associations between the overall sensation seeking variable and the 2 dimensions of sensation seeking (thrill/adventure seeking and disinhibition). There were also very strong correlations between friend delinquency and friend drug use (See Table 5-2). Intermediate analyses determined that the two dimensions of sensation seeking did not provide any new information beyond what was obtained through evaluations of overall sensation seeking. Nor did friend drug use provide any additional information above what was obtained through evaluations of friend delinquency. Given the high correlations between these variables and the redundancy in their associations with the outcomes of interest, further analyses are reported for overall sensation seeking and friend delinquency only.

Table 5-2. Correlations among the predictor variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Sensation Seeking 6th	-													
2 Sensation Seeking 7th	0.49	-												
3 Sensation Seeking 8th	0.43	0.54	-											
4 Thrill/Adventure Seeking 6th	0.91	0.45	0.40	-										
5 Thrill/Adventure Seeking 7th	0.44	0.91	0.49	0.46	-									
6 Thrill/Adventure Seeking 8th	0.38	0.48	0.91	0.40	0.50	-								
7 Disinhibition 6th	-0.65	-0.33	-0.25	-0.29	-0.19	-0.13	-							
8 Disinhibition 7th	-0.34	-0.63	-0.36	-0.20	-0.26	-0.19	0.42	-						
9 Disinhibition 8th	-0.29	-0.37	-0.63	-0.17	-0.20	-0.25	0.34	0.50	-					

Table 5-2. Continued.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10 Delinquent Friends 6th	0.29	0.20	0.19	0.26	0.18	0.15	-0.19	-0.14	-0.16	-				
11 Delinquent Friends 7th	0.28	0.32	0.24	0.26	0.26	0.18	-0.19	-0.26	-0.23	0.37	-			
12 Delinquent Friends 8th	0.29	0.30	0.37	0.25	0.23	0.32	-0.21	-0.26	-0.27	0.31	0.47	-		
13 Drug Using Friends 6th	0.22	0.17	0.14	0.19	0.14	0.11	-0.17	-0.13	-0.11	0.51	0.21	0.19	-	
14 Drug Using Friends 7th	0.23	0.27	0.20	0.20	0.21	0.13	-0.18	-0.25	-0.22	0.31	0.57	0.35	0.26	-
15 Drug Using Friends 8th	0.26	0.24	0.28	0.22	0.16	0.23	-0.18	-0.26	-0.22	0.18	0.37	0.61	0.19	0.45

Note: All correlations were significant at the $p < .001$ level

An evaluation of the correlations between the outcomes of interest revealed high positive correlations between aggression and delinquency (See Table 5-3). Both aggression and delinquency showed moderate positive correlations with substance use.

Table 5-3. Correlations among outcome variables

	1	2	3	4	5	6	7	8
1 Aggression 6th	-							
2 Aggression 7th	0.49	-						
3 Aggression 8th	0.42	0.57	-					
4 Delinquency 6th	0.71	0.35	0.31	-				
5 Delinquency 7th	0.46	0.67	0.44	0.49	-			
6 Delinquency 8th	0.41	0.47	0.66	0.42	0.57	-		
7 Substance Use 6th	0.25	0.11	0.10	0.37	0.20	0.15	-	
8 Substance Use 7th	0.25	0.30	0.18	0.23	0.41	0.27	0.24	-
9 Substance Use 8th	0.21	0.22	0.26	0.19	0.31	0.37	0.19	0.47

Note: All correlations were significant at the $p < .001$ level

In sum, significant increases in aggression, delinquency, substance use, peer deviancy, and sensation seeking were observed across middle school with some notable gender and racial/ethnic differences in average rates of these variables. Males reported higher levels of delinquency and more delinquent friends than females as well as higher levels of general sensation seeking and thrill/adventure seeking. There were no differences in average rates of aggression or substance use between males and females in this sample and females reported more drug using friends than males in 8th grade. Consistent with previous research, Black adolescents reported higher levels of both aggression and delinquency compared to the other racial/ethnic groups in this sample. There were no significant differences between racial/ethnic groups in reported rates of substance use. Black adolescents reported significantly more delinquent and drug using friends while Latinos reported significantly more drug using friends and higher levels of general sensation seeking compared to White/Other adolescents.

Group-Based Trajectory Analyses

Group-based trajectory analysis was used to determine the number and shape of trajectories of aggression, delinquency, and substance use as indicated in the first aim of this study. The number of groups identified as most parsimonious and descriptive of the developmental patterns in the data for each outcome were based on maximizing the Bayesian Information Criterion (BIC) score for the outcome of interest. The probability that a particular model was the correct model was based on an estimate developed by Kass and Wasserman (1995). This estimate is calculated by:

$$\frac{e^{BIC_j - BIC_{max}}}{\sum_j e^{BIC_j - BIC_{max}}}$$

where BIC_{max} is the maximum BIC score of the J different models and BIC_j is the BIC score of a particular model. In cases where the BIC score did not cleanly identify a preferred

number of groups, model selection was based on domain knowledge and the objectives of the analysis as recommended by Nagin (2005).

It is important to reiterate that the number of groups selected for each outcome is not immutable and even individuals who are assigned to a particular trajectory group do not necessarily follow that group's trajectory in lock step. These trajectory groups are meant to serve as a useful heuristic device in describing developmental patterns in the data. Each model was estimated for the entire sample and then evaluated via cross-tabulation to determine if there were gender differences in trajectory group membership.

Aggression

Examinations of the BIC scores resulted in strong evidence in support of a 5 group model for aggression (See Table 5-4). The final trajectory model of aggression across the middle school years is presented in Figure 5-1. Of those with complete data, 85.6% were assigned to a trajectory group based on a posterior probability greater than 0.60. The assessment of aggression used in this study is a sum score of self-reported engagement in aggressive behaviors over the past month. As such, the numeric value represented on the y-axis refers to discrete numbers of aggressive acts over the past month. See Table 5-5 for average levels of aggressive behavior within each trajectory group. There was a consistently low group (n = 441, 27% of the sample). This group displayed very low levels of aggression across the middle school years. There were two groups with increasing levels of aggression across middle school, a slowly increasing group (n = 599, 37% of the sample) and a rapidly increasing group (n = 344, 21% of the sample). Both of these groups began with similar levels of aggression which were only slightly higher than the consistently low group in the 6th grade. However, over 7th and 8th grades the slowly increasing group roughly doubled their reports of engagement in aggressive behaviors while the rapidly increasing group roughly tripled their engagement in aggressive behaviors. For the rapidly

increasing group, most of the increase in aggressive behavior occurred between the 6th and 7th grades. Another group showed an interesting pattern of high initial levels of aggression in the 6th grade which increased between 6th and 7th grades followed by a decrease in reported rates of aggression to levels comparable to the consistently low group in the 8th grade. This group was labeled increasing/decreasing (n = 62, 4% of the sample). Finally, a chronic highly aggressive group of individuals was identified (n = 183, 11% of the sample). These individuals reported chronically high levels of aggression upon entry into the 6th grade and these reports remained high throughout middle school.

Table 5-4. Using BIC to select the number of groups to include in the aggression model

No. of groups	BIC (N = 1629)	BIC (N = 4887)	Probability correct model
1	-18221.79	-18222.88	0.00
2	-17576.25	-17579.55	0.00
3	-17453.42	-17458.92	0.00
4	-17428.50	-17436.19	0.00
5	-17354.71	-17364.60	1.00
6	-17369.50	-17381.59	0.00

Note: N = 1629 refers to the number of participants; N = 4887 refers to the total number of assessments across the three years of the study

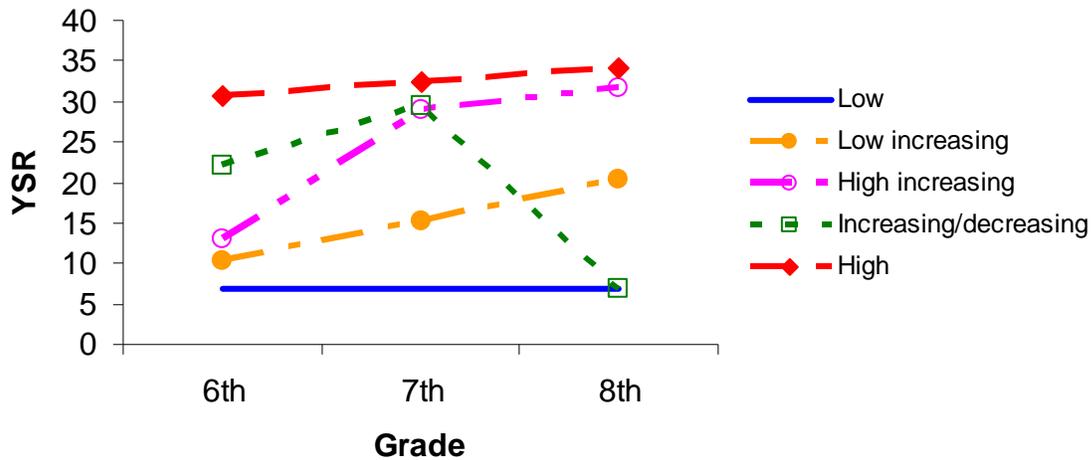


Figure 5-1. Five group aggression trajectory model

Table 5-5. Descriptive statistics within aggression trajectory group

	Aggression Trajectory Group					Total sample
	Low	Slow Increasing	Rapid Increasing	Increasing / Decreasing	High	
Demographic Variables						
Gender (% female)**	55%	54%	59%	34%	56%	50%
% African American***	44%	49%	54%	61%	66%	48%
% Latino**	32%	29%	24%	16%	21%	30%
% Living with Two Parents**	64%	57%	62%	58%	48%	57%
School Type (% public)	87%	86%	87%	86%	93%	90%
	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>
Aggression Variables	<i>(SD)</i>	<i>(SD)</i>	<i>(SD)</i>	<i>(SD)</i>	<i>(SD)</i>	<i>(SD)</i>
6th Grade	5.24 (5.33)	9.98 (6.88)	12.98 (6.60)	23.60 (9.60)	32.30 (5.41)	12.54 (10.54)
7th Grade	6.29 (5.15)	15.42 (7.24)	29.83 (6.33)	30.00 (7.43)	32.64 (7.30)	18.98 (12.08)
8th Grade	6.23 (4.53)	20.58 (7.11)	32.27 (6.25)	6.16 (6.11)	33.99 (6.60)	19.39 (12.42)

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

An analysis of the numbers of males and females in each trajectory group found significant gender differences in only one group, $\chi^2(4, N = 1,629) = 13.67, p = .008$. The increasing/decreasing aggression group was comprised of significantly more males ($n = 41$) than females ($n = 21$). The number of males and females were not significantly different within the other four trajectory groups (See Table 5-5). In addition, there were significant differences found for race/ethnicity and household structure among individuals following different trajectories of aggressive behavior during middle school. As shown in Table 5-5, there were significantly more African American adolescents, $\chi^2(4, N = 1,629) = 29.65, p < .001$, who followed a trajectory of increasing/decreasing or high aggression and significantly fewer Latinos, $\chi^2(4, N = 1,629) = 15.46, p = .004$, following those same trajectories. Furthermore, adolescents in the increasing/decreasing and high trajectory groups were less likely to live in a two parent household in the 6th grade, $\chi^2(4, N = 1,625) = 15.86, p = .003$.

Delinquency

Examination of the BIC scores did not produce conclusive results regarding the optimal number of delinquency trajectory groups. As discussed previously, for some constructs the BIC score cannot be used to determine the best fitting model because the score continues to rise with the addition of more groups. As such, a 6 group model for the delinquency construct was selected as the best fitting model based on maximizing parsimony without sacrificing meaningful variation in developmental trajectories. Models with fewer groups did not fully capture the rich trends in the data while models with more groups did not continue to add any new meaningful developmental patterns of delinquency across middle school.

The final trajectory model of delinquency across the middle school years is presented in Figure 5-2. Of those with complete data, 90.2% were assigned to a trajectory group based on a posterior probability greater than 0.60. Self-reported delinquent acts over the past year were

summed for each adolescent and as such, the numeric values represented on the y-axis refer to individual acts of delinquency over the past year. Table 5-6 presents average levels of delinquent behavior within each trajectory group and for the sample overall.

The trajectories observed for delinquency across middle school were similar to those observed for middle school aggression. There were two consistently low groups, one reported virtually no delinquency across middle school (n = 714, 44% of the sample) while the other reported consistently low levels of delinquency (n = 227, 14% of the sample). Notably, these 2 groups comprise 58% of the sample, indicating that most youth engage in no or very few delinquent acts during early adolescence. There were also two groups with increasing levels of delinquency across middle school. One increased more slowly (n = 302, 19% of the sample) while the other evinced rapid increases in delinquency (n = 140, 9% of the sample). The slowly increasing delinquency group began with initial levels of delinquency near zero in the 6th grade which subsequently increased across middle school to moderate levels. The rapidly increasing group began with slightly higher levels of delinquency than the slowly increasing group in the 6th grade which increased to levels comparable to the chronically high delinquent group by 8th grade. A group similar to the increasing/decreasing aggression group was also identified for delinquency. However, this group reported more stable to slightly increasing delinquency between 6th and 7th grades followed by a decrease to levels slightly higher than the low group in 8th grade. This group was labeled stable/decreasing (n = 179, 11% of the sample). Finally, a chronic highly delinquent group of individuals were identified (n = 73, 5% of the sample). These individuals reported chronically high levels of delinquency upon entry into the 6th grade which remained high with slight increases throughout middle school.

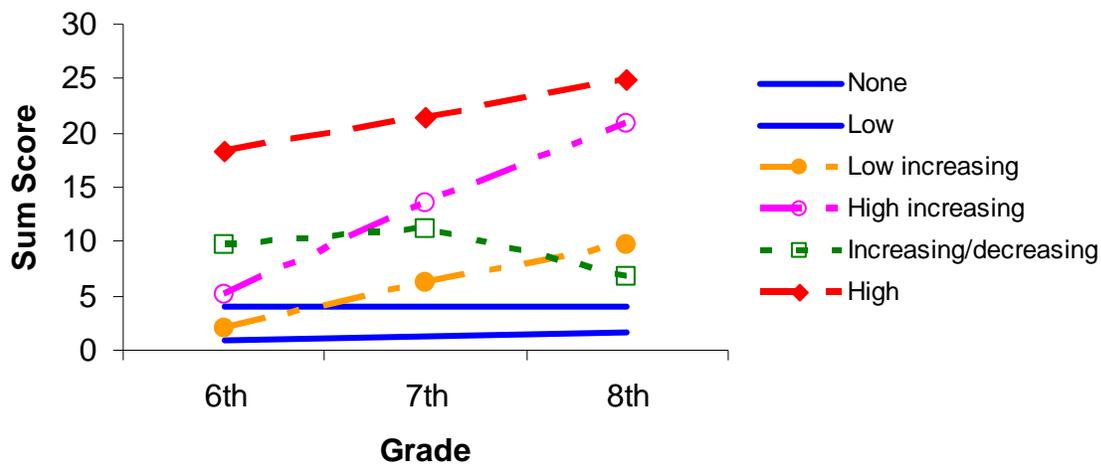


Figure 5-2. Six group delinquency trajectory model

Table 5-6. Descriptive statistics within delinquency trajectory group

	Delinquency Trajectory Group						Total sample
	None	Low	Slow Increasing	Rapid Increasing	Stable / Decreasing	High	
Demographic Variables							
Gender (% female)***	60%	53%	55%	48%	46%	37%	50%
% African American***	46%	51%	48%	61%	63%	62%	48%
% Latino*	29%	33%	27%	24%	19%	19%	30%
% Living with Two Parents	61%	58%	64%	54%	56%	52%	57%
School Type (% public)	87%	84%	87%	90%	89%	95%	90%
	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>
Delinquency Variables	(<i>SD</i>)	(<i>SD</i>)	(<i>SD</i>)	(<i>SD</i>)	(<i>SD</i>)	(<i>SD</i>)	(<i>SD</i>)
6th Grade	0.82 (1.20)	4.33 (2.29)	1.92 (1.62)	4.86 (3.28)	9.72 (6.65)	17.95 (8.60)	3.83 (5.55)
7th Grade	1.20 (1.46)	4.28 (2.22)	6.50 (3.70)	14.15 (6.25)	12.05 (6.65)	22.09 (9.63)	6.16 (7.37)
8th Grade	1.72 (2.05)	3.91 (2.23)	9.80 (4.78)	21.50 (7.77)	6.58 (4.49)	25.39 (10.12)	6.64 (8.17)

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

There were significant gender and racial/ethnic differences found for delinquency trajectory group membership. As can be seen in Table 5-6, there was a slightly higher percentage of females in the 3 lower delinquency trajectory groups. However, the high delinquency group showed significantly fewer females than all of the other groups, $\chi^2(5, N = 1,635) = 27.07, p < .001$. In addition, there were significantly more African American adolescents who followed a trajectory of rapidly increasing, stable/decreasing, or high delinquency, $\chi^2(5, N = 1,635) = 27.42, p < .001$. There were significantly fewer Latinos following trajectories of stable/decreasing and high delinquency, $\chi^2(5, N = 1,635) = 13.74, p = .017$.

Substance Use

Examination of the BIC scores resulted in strong evidence in support of a 5 group model of substance use across middle school (See Table 5-7). The five group model of substance use during middle school is presented in Figure 5-3. Of those with complete data, 94.6% were assigned to a trajectory group based on a posterior probability greater than 0.60. Adolescents self-reported use of tobacco, alcohol, marijuana, inhalants, and other hard drugs. Higher values on this sum score of substance use represent more frequent use of multiple substances (See methods section for more detailed description). Values higher than four on the y-axis can only be obtained via use of multiple substances. See Table 5-8 for average levels of substance use within each trajectory group.

Table 5-7. Using BIC to select the number of groups to include in the substance use model

No. of groups	BIC (<i>N</i> = 1586)	BIC (<i>N</i> = 4758)	Probability correct model
1	-8041.25	-8041.80	0.00
2	-5403.66	-5406.96	0.00
3	-5081.37	-5087.42	0.00
4	-5045.54	-5054.33	0.00
5	-5020.91	-5032.45	1.00
6	-5039.33	-5053.62	0.00

Note: *N* = 1586 refers to the number of participants; *N* = 4758 refers to the total number of assessments across the three years of the study

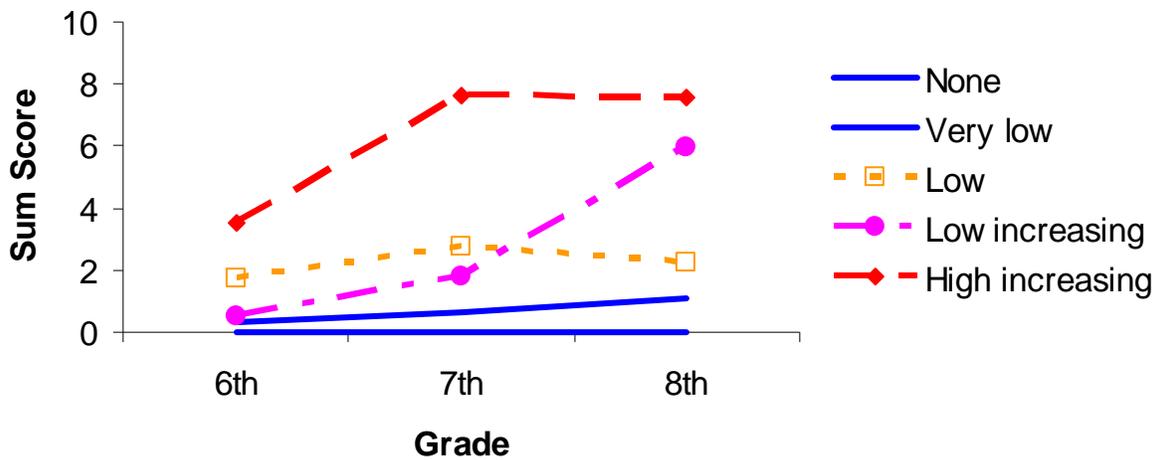


Figure 5-3. Five group substance use trajectory model

Most notably, the majority of adolescents report no use of substances during the middle school years (*n* = 798, 50% of the sample) or very little use (*n* = 552, 35% of the sample). This leaves 15% of individuals who do become more involved with substance use during middle school which places them at great risk for future negative developmental outcomes in late

adolescence and throughout adulthood. Of these remaining individuals, one group reported relatively stable low levels of substance use (n = 117, 7% of the sample). Finally, there are two groups which report increasing levels of substance use across middle school, a slowly increasing group (n = 99, 6% of the sample) and a rapidly increasing group (n = 20, 1% of the sample). The slowly increasing trajectory group began with initial levels of substance use near zero in the 6th grade. By 7th grade, substance use in this group has increased to levels comparable to the low level substance use trajectory group. Subsequently, levels of substance use continued to escalate such that by 8th grade, levels of substance use were similar to those of the rapidly increasing trajectory group. Most of the increase in substance use occurred between 7th and 8th grade for the slowly increasing group. On the contrary, most of the increase in substance use occurred between the 6th and 7th grades for the rapidly increasing substance use trajectory group. This group began with the highest levels of substance use in the 6th grade and quickly tripled in their reports of substance use by 7th grade with maintenance of high level usage in the 8th grade. While this is a small subgroup of individuals, they represent those adolescents at most risk for more serious problems. Interestingly, there were no demographic differences in substance use trajectory group membership; however, there were small sample sizes in 3 of the groups.

Table 5-8. Descriptive Statistics within Substance Use Trajectory Group

	Substance Use Trajectory Group					Total Sample
	None	Very Low	Low	Slow Increasing	Rapid Increasing	
Demographic Variables						
Gender (% female)	55%	55%	48%	60%	50%	50%
% African American	51%	53%	48%	48%	55%	48%
% Latino	26%	28%	31%	25%	30%	30%
% Living with Two Parents	59%	57%	58%	69%	60%	57%
School Type (% public)	88%	86%	85%	90%	90%	90%
Substance Use Variables						
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
6th Grade	0 (0)	0.43 (0.69)	2.06 (1.85)	0.39 (0.78)	3.44 (3.97)	0.50 (1.52)
7th Grade	0 (0)	0.76 (0.87)	3.62 (2.32)	2.14 (2.04)	10.30 (4.92)	0.93 (2.10)
8th Grade	0 (0)	1.31 (1.30)	2.48 (1.73)	8.39 (4.06)	9.21 (5.63)	1.30 (2.74)

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

Dual Trajectory Analysis

Dual trajectory analysis is an advanced form of group-based trajectory modeling where trajectory models are simultaneously estimated for two separate outcomes of interest (e.g., aggression and substance use) along with the probability that individuals who follow a particular trajectory on one of the outcomes (e.g., aggression) also follows a particular trajectory on the other outcome (e.g., substance use). These analyses provide information on the temporal associations between drug use and aggression and delinquency as indicated in the first aim of the study.

As discussed previously, it is well established that increases in aggressive behavior precede increases in delinquent behavior during middle school, both of which precede the onset of substance use. As such the current study evaluated the probability of membership in a particular delinquency or substance use trajectory given previous assignment to a particular aggression trajectory. The probability of membership in a particular substance use trajectory given assignment to a particular delinquency trajectory group was also evaluated.

Aggression and Delinquency

Based on the models established in the single outcome group-based trajectory analyses, a dual trajectory analysis was estimated for a five group aggression model and a 6 group delinquency model. The probabilities of following a particular trajectory of delinquency given membership in a particular aggression trajectory group are presented in Table 5-9.

Table 5-9. Probability of delinquency trajectory group membership given aggression trajectory group membership

		Delinquency Trajectory Group					
		None	Low	Slow Increasing	Rapid Increasing	Stable / Decreasing	High
Aggression Trajectory Group	Low	[88%	11%]	0%	0%	0%	0%
	Slow Increasing	6%	[68%	24%]	0%	2%	0%
	Rapid Increasing	1%	11%	[54%	30%]	3%	0%
	Increasing / Decreasing	2%	17%	0%	0%	[72%	9%
	High	0%	0%	0%	[26%	19%	55%]

A noticeable pattern between trajectories of aggression and delinquency emerged such that individuals following a particular trajectory of aggression tended to follow a similar pattern of delinquency during middle school. For example, individuals in the low aggression trajectory

group have a very high probability of also following a trajectory of no delinquency to low levels of delinquency. The high aggression trajectory group was most strongly associated with rapidly increasing or high trajectories of delinquency.

In addition, a couple of interesting patterns emerged. The slowly increasing aggression group had the highest probability of following a low trajectory of delinquency. Similarly, the rapidly increasing aggression group had the highest probability of following a slowly increasing delinquency trajectory. This illustrates the developmental trend of aggressive behavior preceding delinquent behavior while emphasizing the association between increases in both.

Another interesting trend involves the pattern of probabilities of delinquency trajectory group membership associated with the increasing/decreasing aggression trajectory group. The vast majority of individuals who follow a trajectory of increasing/decreasing aggression (72%) are likely to follow a similar trajectory of stable/decreasing delinquency across middle school. However, there is an interesting split among the remaining individuals in the increasing/decreasing aggression group illustrated by a 19% probability of following a trajectory of low to no delinquency and a 9% probability of following a trajectory of high delinquency. These findings raise many questions regarding why there is such diversity in the probability of belonging to a particular delinquency trajectory group given a pattern of increasing/decreasing aggression during middle school. Of note, is the finding that the increasing/decreasing trajectory is the only aggression trajectory group which has significantly more males than females.

Aggression and Substance Use

Dual trajectory analysis was used to estimate the probability that individuals following a particular trajectory of aggression would also follow a particular trajectory of substance use for a five group aggression model and a 5 group substance use model. These probabilities are presented in Table 5-10.

Table 5-10. Probability of substance use trajectory group membership given aggression trajectory group membership

		Substance Use Trajectory Group				
		None	Very Low	Low	Slow Increasing	Rapid Increasing
Aggression Trajectory Group	Low	[91%]	0%	8%	1%	0%
	Slow Increasing	[58%	30%]	6%	5%	1%
	Rapid Increasing	[35%	37%]	13%	10%	4%
	Increasing / Decreasing	[25%	14%	61%]	0%	0%
	High	[28%	10%	36%	11%	15%]

A similar pattern emerged between trajectories of aggression and substance use as was observed between trajectories of aggression and delinquency, although somewhat muted given the lower levels of reported substance use during the middle school years. Individuals following a trajectory of low aggression had a high probability of abstaining from substance use during middle school. Among the other trajectories of aggression, more problematic trajectories had a high probability of also following more severe substance use trajectories. The high aggression trajectory group was at most risk for following a trajectory of stable low or increasing substance use, both slow and rapid.

The increasing/decreasing aggression trajectory group had a 61% probability of also following a trajectory of stable low substance use. This is noteworthy because the increasing/decreasing aggression trajectory group has more males than females, a high probability of following a trajectory of stable/decreasing delinquency, and has a high probability of stable low substance use. These individuals seem to represent a group of adolescents who

have a short period of increased problem behavior around 7th grade accompanied by low level substance use experimentation. Further evaluation of the developmental history, personality characteristics, and social environment of these students will provide a more complete picture of the antecedents of this pattern of behavior. In addition, continued evaluations of engagement in problem behaviors throughout high school and young adulthood will determine the developmental outcomes associated with these particular middle school trajectories.

Delinquency and Substance Use

A dual trajectory analysis estimated the probability of membership in a particular substance use trajectory group given a particular trajectory of delinquency across middle school based on the previously established 6 group delinquency model and 5 group substance use model (See Table 5-11).

Table 5-11. Probability of substance use trajectory group membership given delinquency trajectory group membership

		Substance Use Trajectory Group				
		None	Very Low	Low	Slow Increasing	Rapid Increasing
Delinquency Trajectory Group	None	[86%	14%]	0%	0%	0%
	Low	[60%	33%]	4%	2%	1%
	Slow Increasing	[40%	41%]	6%	11%	2%
	Rapid Increasing	[34%	29%	35%]	0%	3%
	Stable / Decreasing	[19%	47%]	1%	[24%	9%]
	High	[18%	9%	42%	15%	16%]

Similar to both of the previous dual trajectory analyses, more problematic trajectories of delinquency are associated with more severe trajectories of substance use during middle school. Trajectories of low and no delinquency were most strongly associated with no to very low substance use. The slowly increasing delinquency trajectory had slightly higher probabilities of following a low or increasing substance use trajectory. The rapidly increasing delinquency trajectory had a higher probability of following a trajectory of stable low substance use but a lower probability of following a trajectory of slow increasing substance use compared to the slow increasing delinquency group. The high delinquency trajectory group was at most risk for following a trajectory of stable low or increasing substance use, both slow and rapid.

Similar to aggression, the stable/decreasing delinquency trajectory had an unusual pattern of association with the substance use trajectories. The stable/decreasing delinquency trajectory had a high probability of either following a trajectory of no to very low substance use or a trajectory of increasing substance use, both slow and rapid. This suggests two different explanations for the association between these two trajectories. It may be possible that there is one group of adolescents who are desisting from problem behavior in general while another group of adolescents may be transitioning from engagement in delinquent behavior to increased substance use.

As indicated, gender differences in group membership only appear in the high delinquency trajectory group. This group has more males than females in addition to a high probability of following a stable low or increasing substance use trajectory. Furthermore, gender differences are observed for the increasing/decreasing aggression trajectory group as well which is also strongly associated with the stable low substance use trajectory. Yet, there are no observed

gender differences in any of the substance use trajectories. This may be due, in part, to the low reports of substance use overall among this middle school sample.

Mediation Analyses

The mediating role of aggression and delinquency (Aim 2) on the association between sensation seeking, delinquent peers, and the interaction of sensation seeking with deviant peers on substance use was evaluated via HLM. An intercepts as outcomes model was estimated for the mediation analyses. As such, only level one (within person) predictors were included in the model. All level one predictors were person-centered to test the influence of changes within an individual on their subsequent behavior. Gender, race/ethnicity, household structure, and school type were controlled for in all mediation analyses.

The role of aggression and delinquency as mediators of the interaction between sensation seeking and delinquent peers on substance use was evaluated (See Figure 5-6). Follow up evaluations of the main effects of sensation seeking and delinquent peers were evaluated only if the two-way interaction between sensation seeking and deviant peers was not statistically associated with substance use.

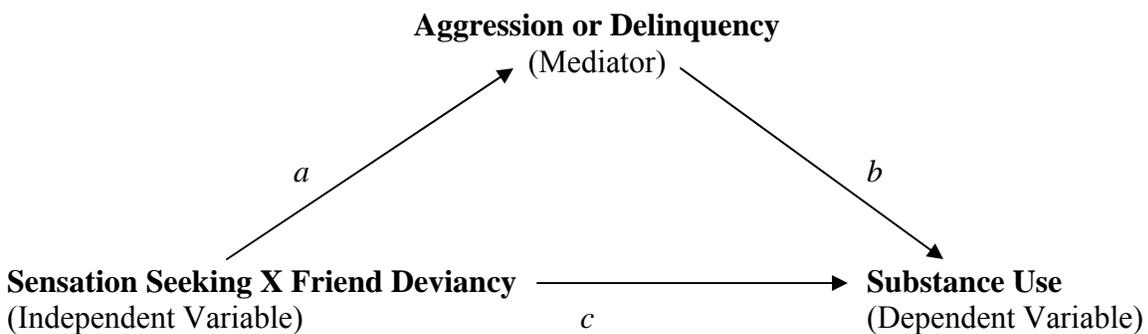


Figure 5-6. Mediation model evaluating aggression as the mediator

Figure 5-6 illustrates both the direct association between the independent variable and the dependent variable (path *c*) and the indirect association between the independent variable and the

dependent variable through the mediator (paths *a* and *b*). The indirect effect was estimated by multiplying the coefficients for path *a* and path *b* and the significance of the indirect effect was approximated through the use of Sobel tests.

An evaluation of path *c* revealed that there was not a significant direct association of a two-way sensation seeking by friend delinquency interaction on substance use. Due to the lack of association between the interaction and substance use, follow-up analyses of associations between the main effects of person-centered sensation seeking and person-centered delinquent peer association on substance use were evaluated.

Aggression and Delinquency as Mediators of Sensation Seeking

An initial evaluation of the association between person-centered sensation seeking and substance use was statistically significant (path *c*), $\beta = 0.23$, $SE = 0.04$, $t(5039) = 6.04$, $p < .001$. Experiencing levels of sensation seeking that were higher than average was associated with greater reported substance use. Separate evaluations of the main effect of person-centered sensation seeking on both aggression $\beta = 2.89$, $SE = 0.19$, $t(5095) = 15.49$, $p < .001$ and delinquency $\beta = 1.16$, $SE = 0.11$, $t(5098) = 10.64$, $p < .001$ (path *a*) were also significant. The direction of effect was similar to substance use, such that increases in sensation seeking within an individual were associated with increases in both aggression and delinquency.

The final evaluation of aggression and delinquency as mediators of the association between sensation seeking and substance use were evaluated separately for each potential mediator. First, both person-centered aggression and person-centered sensation seeking were simultaneously regressed onto substance use. The previously significant association between sensation seeking and substance use remained statistically significant; however, this effect was partially mediated by individual changes in aggression. Sobel tests evaluated the strength of the indirect effect and found it to be statistically significant (z statistic = 8.36, $p < .001$).

Second, the mediating influence of delinquency on the association between sensation seeking and substance use was evaluated. Person-centered delinquency and person-centered sensation seeking were both simultaneously regressed onto substance use. The previously significant association between sensation seeking and substance use remained statistically significant; however, this effect was partially mediated by individual changes in delinquency (z statistic = 8.19, $p < .001$). As such, increases in substance use that are associated with increases in sensation seeking are partially accounted for by individual increases in both aggression and delinquency.

Aggression and Delinquency as Mediators of Friend Delinquency

The main effect of person-centered friend delinquency on substance use was also found to be statistically significant (path c), $\beta = 0.09$, $SE = 0.01$, $t(6722) = 10.64$, $p < .001$. Associating with more delinquent friends than typical was associated with greater reported substance use. Person-centered friend delinquency was also significantly associated with both aggression $\beta = 0.94$, $SE = 0.03$, $t(6805) = 31.03$, $p < .001$ and delinquency $\beta = 0.58$, $SE = 0.02$, $t(6808) = 25.28$, $p < .001$ (path a). Increases in association with delinquent friends were associated with increases in aggression as well as delinquency.

First, aggression was evaluated as a mediator of the association between friend delinquency and substance use. Both person-centered aggression and person-centered friend delinquency were simultaneously regressed onto substance use. The previously significant association between friend delinquency and substance use remained statistically significant; however, this effect was partially mediated by individual changes in aggression. The strength of the indirect effect was determined to be statistically significant via a Sobel test (z statistic = 7.29, $p < .001$).

Second, delinquency was evaluated as a mediator of the association between friend delinquency and substance use. Person-centered delinquency and person-centered friend delinquency were both simultaneously regressed onto substance use. Individual changes in delinquency were found to partially mediate the association between friend delinquency and substance use. Sobel tests revealed that the indirect effect was statistically significant (z statistic = 9.45, $p < .001$). These results indicate that individual changes in aggression and delinquency both partially account for the association between substance use and delinquent peer association.

In sum, increases in both sensation seeking and delinquent peers were significantly associated with greater substance use, aggression, and delinquency. In addition, increases in aggressive behavior partially mediated the association of both sensation seeking and delinquent peers with substance use. Increases in delinquent behavior partially mediated the association of both sensation seeking and delinquent peers with substance use.

The Moderating Role of Gender

The moderating role of gender on the association between sensation seeking, delinquent peers, and the interaction of sensation seeking with delinquent peers (Aim 3) on aggression, delinquency, and substance use were evaluated via HLM. Evaluations of gender as a moderator of the interaction between sensation seeking and deviant peers on the outcomes of interest were evaluated. If the three-way cross-level interaction between gender, sensation seeking, and delinquent peers was not statistically significant, follow up evaluations of the two-way cross level interaction between gender and sensation seeking as well as between gender and delinquent friends were evaluated. As discussed previously, all predictors were person-mean centered to provide information about how individual changes in these predictors influenced the associations of interest. Household structure, race/ethnicity, and school type were controlled for in all analyses.

The evaluation of a three way interaction between person-mean centered sensation seeking, person-mean centered friend delinquency, and gender was not significant for aggression, delinquency or substance use. Two-way cross level interactions were evaluated between gender and person-mean centered sensation seeking as well as gender and person-mean centered friend delinquency for all three outcomes of interest.

Sensation Seeking by Gender

A significant interaction between gender and person-mean centered sensation seeking was found for substance use (See Table 5-12). The association between individual changes in sensation seeking and aggressive or delinquent behavior was not moderated by gender.

Table 5-12. Hierarchical linear models examining the association between gender, sensation seeking, and substance use

	Parameter	Model 1	Model 2	Model 3	Model 4
Fixed Effects					
Intercept	β_{00}	0.85*** (0.03)	0.91*** (0.13)	0.93*** (0.14)	0.93*** (0.14)
Latino	β_{01}		-0.02 (0.09)	0.02 (0.11)	0.02 (0.11)
Black	β_{02}		-0.10 (0.08)	-0.16 (0.10)	-0.16 (0.10)
Gender	β_{03}		0.04 (0.06)	0.05 (0.07)	0.05 (0.07)
School Type	β_{04}		-0.01 (0.09)	0.02 (0.10)	0.02 (0.10)
Household Structure	β_{10}		-0.03 (0.07)	-0.06 (0.08)	-0.06 (0.08)
Sensation Seeking	β_{20}			0.23*** (0.04)	0.32*** (0.06)
Gender X Sensation Seeking	β_{21}				-0.18* (0.08)
Variance Components					
Level 1					
Within-person residual	e_{ij}	3.37*** (1.83)	3.37*** (1.83)	3.25*** (1.80)	3.25*** (1.80)
Level 2					
Intercept	μ_{0i}	1.10 (1.05)	1.11 (1.05)	1.30 (1.14)	1.30 (1.14)
Pseudo R2 and Goodness of Fit					
R2 ϵ (within person variance)			0.00	0.04	0.04
R20 (intercept variance)			0.00	0.00	0.00
Deviance (-2LL)		29,219.99	29,232.20	21,723.70	21,722.87
Δ Deviance (-2LL)			-12.21	7508.50	0.83

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

A follow-up evaluation of how individual changes in sensation seeking impacted substance use by gender revealed a more pronounced effect for females. Both males and females reported lower rates of substance use when their own individual levels of sensation seeking were lower than average and higher rates of substance use when their individual levels of sensation seeking were higher than average. However, higher levels of sensation seeking showed a more pronounced influence on females substance use compared with males (See Figure 5-4).

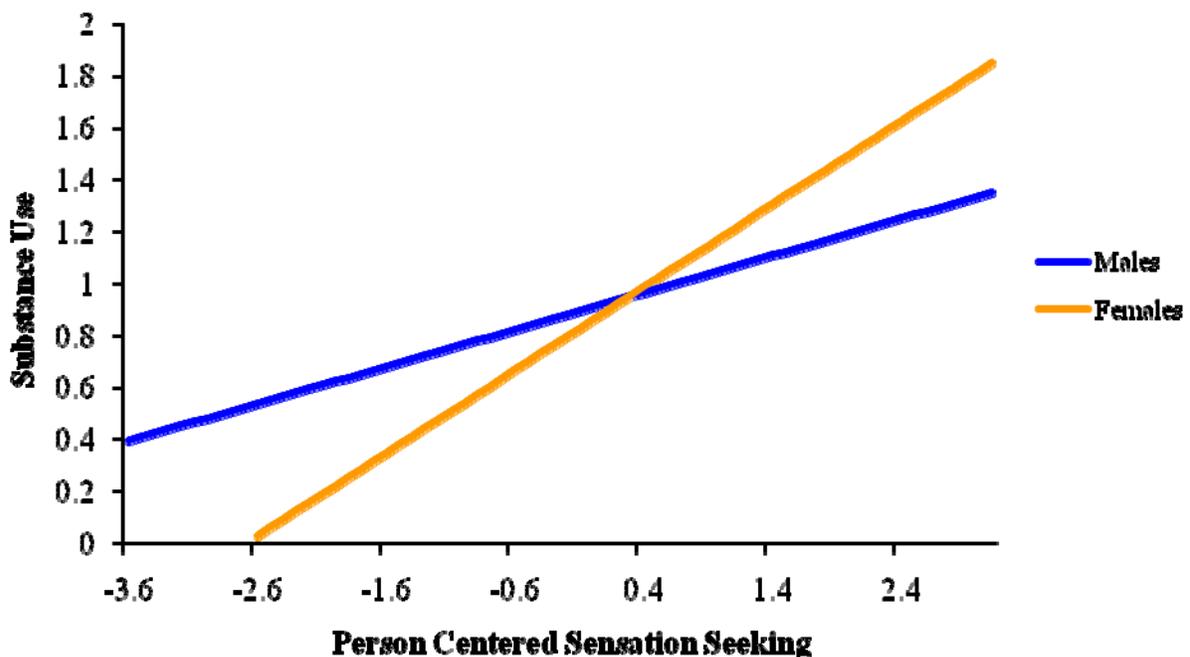


Figure 5-4. Gender moderating the association between person-centered sensation seeking and substance use

Friend Delinquency by Gender

A significant interaction between gender and person-mean centered friend delinquency was found for delinquent behavior only (See Table 5-13). The association between individual changes in friend delinquency and aggressive behavior or substance use was not moderated by gender.

Table 5-13. Hierarchical linear models examining the association between gender, friend delinquency, and delinquency

	Parameter	Model 1	Model 2	Model 3	Model 4
Fixed Effects					
Intercept	β_{00}	5.27*** (0.11)	3.44*** (0.38)	3.42*** (0.38)	3.42*** (0.38)
Latino	β_{01}		-0.18 (0.29) 1.17***	-0.19 (0.29) 1.17***	-0.19 (0.29) 1.17***
Black	β_{02}		(0.28) 1.88***	(0.28) 1.92***	(0.28) 1.92***
Gender	β_{03}		(0.21)	(0.21)	(0.21)
School Type	β_{04}		0.51 (0.29)	0.51 (0.29)	0.51 (0.29)
Household Structure	β_{10}		-0.23 (0.24)	-0.22 (0.24) 0.58***	-0.22 (0.24) 0.52***
Friend Delinquency	β_{20}			(0.02)	(0.03)
Gender X Friend Delinquency	β_{21}				0.11* (0.05)
Variance Components					
Level 1					
Within-person residual	e_{ij}	28.26*** (5.32)	28.21*** (5.31)	20.06*** (4.48)	19.99*** (4.47)
Level 2					
Intercept	μ_{0j}	20.89 (4.57)	19.73 (4.44)	23.03 (4.80)	23.06 (4.80)
Pseudo R2 and Goodness of Fit					
R2 ϵ (within person variance)			0.00	0.29	0.29
R20 (intercept variance)			0.06	0.00	0.00
Deviance (-2LL)		45,435.97	45,328.08	43,457.16	43,445.70
Δ Deviance (-2LL)			107.89	1870.92	11.46

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

A follow-up evaluation of how individual changes in association with delinquent friends impacted delinquent behavior by gender revealed a stronger influence of delinquent friends on females compared to males. Both males and females reported lower rates of delinquent behavior when associating with fewer delinquent peers than they do on average. Both genders also reported increases in reports of delinquent behavior when associating with a greater number of delinquent peers than their individual average (See Figure 5-5). Figure 5-5 illustrates the difference between the genders is not in the direction of the effect but rather in the strength of the effect. Females show a much more pronounced influence of changes in their delinquent peer association on their delinquent behavior.

To summarize, females reported a more pronounced negative impact associated with increases in sensation seeking and delinquent peer association compared with males. Specifically, females reported greater increases in delinquent behavior associated with individual increases in delinquent peer association and greater increases in substance use associated with individual increases in sensation seeking compared with males. There were no gender differences in the association between individual increases in sensation seeking and delinquent peers on aggressive behavior.

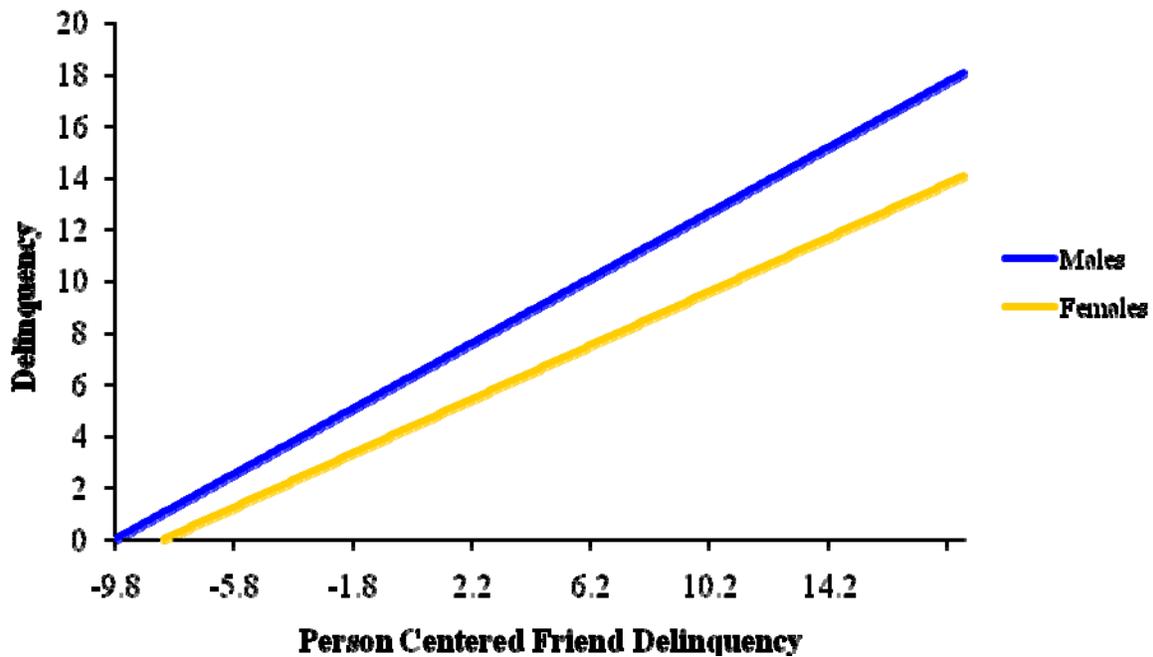


Figure 5-5. Gender moderating the association between person-centered friend delinquency and delinquency

The Moderating Role of Race / Ethnicity

The moderating role of race/ethnicity (Aim 4) on associations between antisocial behaviors (aggression, delinquency, and substance use), sensation seeking, and peer delinquency was evaluated via HLM. These analyses determined if there were differences in associations between the predictors and the outcomes of interest among Black, Latino, and White/Other adolescents.

Evaluations of race/ethnicity as a moderator of the interaction between sensation seeking and deviant peers on the outcomes of interest were evaluated. If the three-way cross-level interaction between race/ethnicity, sensation seeking, and deviant peers was not statistically significant, follow up evaluations of the two-way cross level interaction between race/ethnicity and sensation seeking as well as between race/ethnicity and deviant peers were evaluated. As discussed previously, all predictors were group-mean centered to provide information about how individual changes in these predictors influenced the associations of interest. Gender, household structure, and school type were controlled for in all analyses.

Evaluations of a three way interaction between race/ethnicity, person-centered sensation seeking, and person-centered friend delinquency were evaluated for aggression, delinquency, and substance use. A significant Latino X sensation seeking X friend delinquency interaction was found for aggression (See Table 5-14).

Table 5-14. Hierarchical linear models examining the association between Latino race/ethnicity, sensation seeking, friend delinquency, and aggression

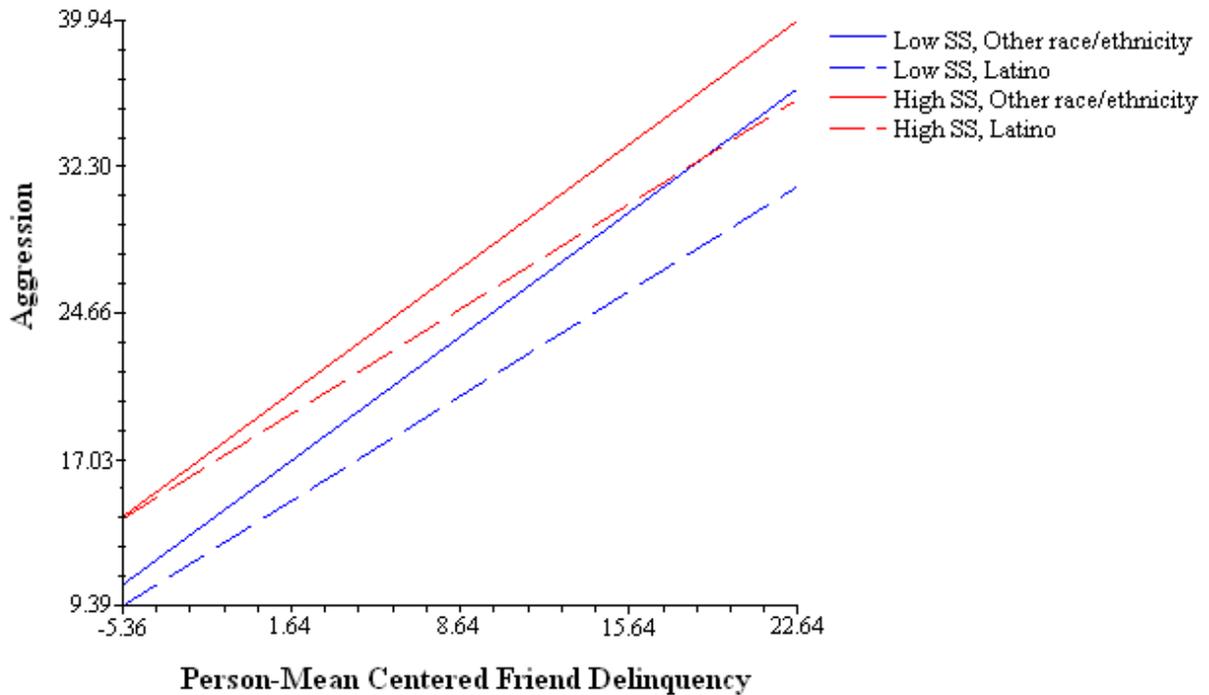
	Parameter	Model 1	Model 2	Model 3	Model 4
Fixed Effects					
Intercept	β_{00}	16.20*** (0.18)	15.21*** (0.68)	15.62*** (0.71)	15.62*** (0.71)
Latino	β_{01}		-1.33** (0.51)	-1.36* (0.56)	-1.36* (0.56)
Black	β_{02}		2.41*** (0.48)	2.09*** (0.52)	2.09*** (0.52)
Gender	β_{03}		0.72* (0.36)	0.48 (0.41)	0.48 (0.41)
School Type	β_{04}		-0.18 (0.57)	0.61 (0.58)	0.61 (0.58)
Household Structure	β_{10}		0.09 (0.41)	-0.40 (0.44)	-0.40 (0.44)
Friend Delinquency	β_{20}			0.87*** (0.04)	1.00*** (0.09)
Latino Friend Delinquency X	β_{21}				-0.14 (0.12)
Black Friend Delinquency X	β_{22}				-0.16 (0.11)

Table 5-14. Continued.

	Parameter	Model 1	Model 2	Model 3	Model 4
Fixed Effects					
Sensation Seeking	β_{30}			2.11*** (0.17)	1.91*** (0.34)
Sensation Seeking X Latino	β_{31}				0.54 (0.44)
Sensation Seeking X Black	β_{32}				0.03 (0.43)
Friend Delinquency X Sensation Seeking	β_{40}			-0.05* (0.02)	-0.13*** (0.05)
Friend Delinquency X Sensation Seeking X Latino	β_{41}				0.16* (0.07)
Friend Delinquency X Sensation Seeking X Black	β_{42}				0.08 (0.06)
Variance Components					
Level 1					
Within-person residual	e_{ij}	85.65*** (9.25)	85.49*** (9.25)	60.93*** (7.81)	60.81*** (7.80)
Level 2					
Intercept	μ_{0i}	58.49 (7.65)	56.17 (7.49)	68.96 (8.30)	69.03 (8.31)
Pseudo R2 and Goodness of Fit					
R2 ϵ (within person variance)			0.00	0.29	0.29
R20 (intercept variance)			0.04	0.00	0.00
Deviance (-2LL)		52,823.44	52,736.02	38,277.89	38,282.19
Δ Deviance (-2LL)			87.42	14458.13	-4.30

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Follow-up analyses revealed that increases in both sensation seeking and delinquent peers were associated with increases in aggression regardless of race/ethnicity. However, Latino's aggressive behavior was more strongly influenced by individual changes in sensation seeking compared to other race/ethnicities. In addition, other race/ethnicities reported a greater influence of individual changes in delinquent peer association on aggressive behavior compared to Latinos (See Figure 5-7). There were no significant three way interactions between race/ethnicity, sensation seeking, and friend delinquency on either delinquency or substance use.



Note: Low SS refers to individuals who report lower sensation seeking; High SS refers to individuals who report higher sensation seeking.

Figure 5-7. A three-way interaction between Latino race/ethnicity, sensation seeking, and delinquent peer association on aggressive behavior

Given the lack of significant three way interactions between race/ethnicity, sensation seeking, and friend delinquency on either delinquency or substance use, follow-up evaluations of two way interactions were conducted. Evaluations of the interaction between race/ethnicity and person-centered sensation seeking were evaluated for both delinquency and substance use. None of these two way interactions were statistically significant. Evaluations of the moderating effect of race/ethnicity on the association between person-centered friend delinquency and both substance use and delinquency also did not reveal significant results. As such, race/ethnicity did not moderate the associations between individual changes in sensation seeking or delinquent peer association on delinquency or substance use.

To summarize, race/ethnicity moderated the interaction between sensation seeking and delinquent peers on aggression such that Latinos were somewhat more influenced by increases in sensation seeking while other race/ethnicities were somewhat more influenced by increases in delinquent peer association. However, despite statistical significance, this effect was quite small in size. Given the overall lack of moderation by race/ethnicity in this study, the aforementioned finding for Latinos should be interpreted with caution.

CHAPTER 6 DISCUSSION

The purpose of this study was to evaluate changes in aggression, delinquency, and substance use across the middle school years and begin to elucidate interconnections between these negative adjustment outcomes as well as their antecedents. Deviant peer association and sensation seeking were evaluated in this study as they each represent constructs, one social and the other personality, which are strongly associated with increases in a variety of problem behaviors during the middle school years including aggression, delinquency, and substance use. A key element of this study was an emphasis on evaluating gender differences regarding interconnections between these antisocial behaviors and their antecedents.

The first aim was to evaluate trajectories of change across middle school for aggression, delinquency, and substance use. Group-based trajectory analyses revealed distinct patterns of change for each outcome of interest. The trajectory groups which best modeled aggression and delinquency revealed similar patterns of change across middle school. Both outcomes had stable low groups which reported little if any engagement in the antisocial behavior. Both aggression and delinquency also reported groups of increasing antisocial behavior as well as groups with stable high antisocial behavior. These groups map well onto Moffitt's theory of adolescent limited vs. life-course persistent antisocial behavior (Moffitt et al., 2001). The increasing groups are most similar to Moffitt's adolescent limited offenders. Rates of antisocial behavior are near zero in the 6th grade with steady increases to levels comparable to the stable high group by the 8th grade. The stable high groups begin 6th grade with high levels of both aggression and delinquency and maintain these levels across middle school which is similar to what would be expected from a chronic offender. Likewise, the dual trajectory analysis between aggression and delinquency supports the association between these groups. This analysis revealed a high

probability that individuals following increasing aggression trajectories will also follow trajectories of increasing delinquency. In addition individuals in the stable high aggression trajectory had the highest probability of following a trajectory of stable high delinquency. Broidy and colleagues (2003) evaluated multiple samples from within and outside of the United States for gender differences in associations between trajectories of childhood overt aggression and adolescent delinquency. Similar to the results of this study, they found significant associations between overt aggression in childhood and adolescent delinquency across samples for males. However, they found less support for this association among females with the one exception being a sample of females from within the United States. As such, the findings of this study do not contradict those of Broidy and colleagues (2003) but they do highlight the need for more comprehensive evaluations of gender differences in associations between antisocial behaviors from childhood through young adulthood among individuals from diverse backgrounds and across a wide age range spanning childhood through adolescence.

The identification of an increasing/decreasing aggression trajectory group and a stable/decreasing delinquency group was unexpected based on previous research. However, the ability to identify trends in the data which would not necessarily have been predicted a priori is one of the key advantages of group-based trajectory analysis. As such, evaluating the increasing/decreasing aggression trajectory group has the potential to provide new insights regarding developmental changes in aggressive behavior and associations with other problem behaviors in middle school. As shown in the dual trajectory analysis between aggression and delinquency, there was a very high (72%) probability of individuals following a trajectory of increasing/decreasing aggression to also follow a trajectory of stable/decreasing delinquency. Of course, results of this evaluation are more exploratory and could either represent a real

developmental trend or a statistical anomaly. Hence, these results should be considered stepping stones which future studies can use to gain a richer perspective on patterns of change in the development of aggression and delinquency over time.

Trajectories of substance use revealed small but significant groups of individuals who began to increase in substance use markedly during middle school. These individuals represent adolescents at the highest risk of developing substance use problems and other negative adjustment outcomes. Dual trajectory analyses revealed that patterns of high stable aggression and delinquency were strongly associated with increases in substance use as well. These individuals do appear to be at highest risk for continuing to follow a pattern of life-course persistent offending.

The increasing/decreasing aggression trajectory group had a high probability of consistent but low levels of substance use during middle school while the stable/decreasing delinquency group had a fairly high probability of showing increases in substance use during middle school. This particular pattern is interesting because it suggests that there may be a subgroup of adolescents for which initiation of substance use is accompanied by decreases in aggressive or delinquent behavior. It is possible that there is a small but significant subgroup of adolescents who desist in aggressive and delinquent behavior after transitioning to substance use. Again, given that both the increasing/decreasing aggression trajectory group and the stable/decreasing delinquency trajectory group are more exploratory, further research is needed to determine if these patterns of behavior hold across high school and adulthood. Future research should evaluate the possibility that for some individuals low levels of substance use may curb aggressive or delinquent tendencies. Understanding why this transition would take place and how this association may change across later adolescence and adulthood would provide

important insights for understanding the etiology of substance use problems and associations with other antisocial behaviors.

Notably, there were very few gender differences in trajectory group membership. Only two groups, the increasing/decreasing aggression group and the stable high delinquency group, consisted of significantly more males compared to females and there were no gender differences found regarding substance use trajectory group membership. The lack of gender differences in trajectories of aggression, delinquency, and substance use implies that the developmental progression of engagement in these behaviors during middle school is roughly equivalent for both males and females. This finding is in line with previous research on gender differences in patterns of change for childhood aggressive behavior (Broidy et al., 2003). Broidy and colleagues evaluated trajectories of childhood overt aggressive behavior in samples of children from the United States as well as internationally. There were very few differences between males and females in patterns of change in overt aggression across childhood and into early adolescence. However, a lack of gender differences in patterns of change does not necessarily imply that average rates of these behaviors are the same for both males and females. In fact, this study found that males reported somewhat higher average rates of aggression in the 6th grade and significantly higher average rates of delinquency throughout middle school. These results support the idea that males and females follow similar patterns of change during middle school regarding aggression, delinquency, and substance use. The greater number of males who follow a trajectory of stable high delinquency may account for the gender difference in average rates of this behavior.

The general lack of gender differences in trajectories of aggression, delinquency, and substance use during middle school has strong implications for prevention programming. It is

important to emphasize that prevention of aggressive, delinquent, and substance using behaviors at this early age is not just limited to males. Future research should continue to evaluate underlying mechanisms associated with patterns of change in these behaviors separate for males and females. This will help determine which individual and contextual antecedents of aggression, delinquency, and substance use are salient to the developmental progression of these behaviors for males and females.

Racial/ethnic differences were found in trajectory group membership in this sample of urban middle school adolescents for both aggression and delinquency. Black adolescents were more likely to follow trajectories of increasing/decreasing, high increasing, or chronically high aggression and delinquency compared to Latino and White/other adolescents. This finding is in line with previous research which has found higher prevalence rates of aggression and delinquency among minority adolescents compared to White adolescents (CDC, 2005). There were no race/ethnic differences in substance use trajectory membership despite previous research which has found higher prevalence rates of substance use among White adolescents and increases among Latinos (CDC, 2005). This may be due, in part, to the young age range of this sample. More distinct patterns of racial/ethnic differences in substance use may appear in late adolescence and early adulthood. In addition, this study evaluated an urban sample. It may be that previously reported racial/ethnic differences in substance use are more pronounced among suburban adolescents. These findings have important implications for prevention research and reduction of problem behaviors among urban minority adolescents. Elucidating the underlying risk and protective factors associated with initial trajectories of problem behaviors during the middle school years among ethnic minorities will aid in the development of ethnically sensitive

and appropriate intervention strategies. The ultimate goal is to reduce ethnic and racial disparities in adjustment outcomes in later adolescence and during the transition to adulthood.

Two risk factors for problem behavior, sensation seeking and deviant peer association, were evaluated in this study. Increases or decreases in sensation seeking and deviant peer association relative to an individual's average level on those constructs were evaluated to gain a better understanding of how individual change affects behavior rather than simply looking at trends for the overall sample.

The potential mediating influences of individual aggression and delinquency on associations between sensation seeking, deviant peer association and substance use were examined. Aggression and delinquency were evaluated as mediators of associations with substance use given the well documented developmental sequence of the emergence of these behaviors during the middle school years. These analyses found that individual changes in both sensation seeking and delinquent peer association were predictive of increases in substance use as well as both potential mediators (aggression and delinquency). The association between changes in delinquent peer association on substance use was partially mediated by individual changes in both aggression and delinquency. Likewise, the association between individual changes in sensation seeking on substance use was partially mediated by individual changes in both aggression and delinquency. These findings highlight the potential predictive influences of engagement in one type of problem behavior on subsequent engagement in other problem behaviors. Hence, part of the influence of more traditional risk factors for substance use (sensation seeking and deviant peer association) was accounted for by individual engagement in aggressive and delinquent behavior. As such, interventions aimed at reducing engagement in

aggressive behavior in late childhood and minimizing engagement in delinquent behavior in early adolescence may reduce substance use initiation in early and mid adolescence.

The conclusion that interventions aimed at reducing one problem behavior should also result in decreases in other problem behaviors is in line with Problem Behavior Theory (Jessor, 1987; Jessor, 1992) as well as the General Theory of Crime (Gottfredson & Hirschi, 1990). However, problem behavior theory asserts that this generalization of intervention effects from one problem behavior to another is due to overlap in common correlates, not direct influences of one problem behavior on the onset of another problem behavior. The general theory of crime asserts that the generalization of intervention effects is due to the fact that all forms of problem behavior emerge as part of an individual tendency towards deviance in general. Without contradicting these two theories, the results of this investigation suggest that there may be direct associations among problem behaviors. These direct associations among aggression, delinquency, and substance use, at the least, partially account for associations between common correlates of these behaviors.

This investigation also evaluated the moderating influences of gender and race/ethnicity on associations between sensation seeking, deviant peer association, aggression, delinquency, and substance use. The influence of individual changes in deviant peer association and sensation seeking was similar for both males and females with two exceptions. First, increases in associating with delinquent friends had a significantly stronger influence on increases in delinquent behavior among females compared with males. Second, increases in individual sensation seeking had a significantly stronger influence on increases in substance use among females compared with males. These findings clearly identify changes in sensation seeking and deviant peer association as risks for antisocial behavior for both males and females. However,

the results of the moderation analyses suggest that deviant peer association and sensation seeking may have a more pronounced influence on females compared to males regarding engagement in antisocial behaviors during middle school. As such, these constructs may convey a specific vulnerability to females in addition to a general risk for both genders.

Interestingly, this study found that individual changes in sensation seeking had a stronger influence on Latinos engagement in aggressive behavior while individual changes in delinquent peer association influenced aggression more strongly for other race/ethnicities. This finding highlights an important cultural difference in risks associated with engagement in problem behavior by suggesting that Latinos may be less influenced by social factors and more influenced by individual factors compared to other race/ethnicities. Importantly, increases in both sensation seeking and delinquent peer association conferred risk regardless of race/ethnicity and the interaction of race/ethnicity, sensation seeking, and friend delinquency did not account for a notable amount of within person variance in aggression. However, this finding does indicate that there may be cultural differences in risk factors for aggression in early adolescence among urban minority adolescents.

Importantly, the aforementioned racial/ethnic difference was the only significant difference found in associations between the outcomes of interest in this study (aggression, delinquency, and substance use) and the risk factors evaluated in this study (sensation seeking and deviant peer association). As such, most of the effects of sensation seeking and deviant peer association were common across both gender and race/ethnicity. The implication of this is that individual changes in sensation seeking and deviant peer association do not fully explain ethnic and racial differences or gender differences observed in trajectory group membership. This finding is important because it begins to rule out potential mechanisms which underlie observed disparities

in aggression and delinquency. Further research on other correlates of aggression and delinquency (i.e., family factors) are needed to identify which risk or protective factors are most influential in contributing to group disparities in aggression, delinquency, and substance use. Once identified, interventions can be modified to be more ethnically or gender appropriate.

Strengths and Implications of Study Design

This study was able to evaluate separate longitudinal trajectories of aggression, delinquency, and substance initiation across the middle school years and associations between these trajectories through the use of novel statistical methodology. Group-based trajectory analysis has the capability to go beyond theory by allowing the data to determine if there are different subgroups of individuals within the population who differ in terms of their initial levels of a behavior as well as changes in that behavior across time. The ability to confirm the existence of theorized subgroups of individuals (adolescence limited vs. life-course persistent offenders; Moffitt et al., 2001) as well as identify subgroups within the population that are not necessarily anticipated by theory is a useful tool for moving the field forward.

Another strength of the study is the longitudinal nature of the data across the middle school years, as this is when increases in antisocial behaviors often begin to emerge. However, future research would benefit from evaluations of changes in antisocial behaviors from childhood, through adolescence, and into adulthood to provide the most complete picture of interconnections in the development of these behaviors over time.

Perhaps most importantly, this study evaluated gender and racial/ethnic differences in trajectories of antisocial behaviors and associations between antisocial behaviors among a group of urban adolescents as they transition through middle school. These results contribute to a growing knowledge base regarding pathways to drug use and delinquency among this group of adolescents.

Limitations

Despite the aforementioned methodological strengths, the present study has some limitations. While the sample characteristics are considered a strength of the study, the results of this study are limited in that they are not generalizable to the general population.

Measurement issues associated with accurately assessing antisocial behaviors as well as correlates of antisocial behaviors will always be a challenge. The current study utilized self-report only; however, future studies would benefit from including multiple informants (e.g., parents, teachers) to provide additional perspectives on the participant's behavior (Achenback, McConaughy, & Howell, 1987; Phares, Compas, & Howell, 1989). Validity of self-report in the current study was promoted through the use of the bogus pipeline procedure which has been shown to increase the accuracy of reports of tobacco use (Evans, Hansen, and Mittelmark, 1977) as well as other antisocial behaviors (Tourangeau, Smith, & Rasinski, 1997). While this study was completed with paper and pencil, future research would benefit from use of computer based survey formats, a methodological technique which has been shown to increase the validity of self reported antisocial behaviors (Booth-Kewley, Larson, & Miyoshi, 2007; Turner et al., 1998). The impersonal context of the computer is thought to result in more accurate responses due to participants increased comfort answering sensitive questions.

To enhance the validity of reports of peer deviancy, rather than relying on participant report of peer deviancy, future research would benefit from survey designs that allow participants to report the names of their closest friends with matching of peer and self report data (Aseltine, 1995). Peer deviancy would then be assessed by peer report of engagement in problem behaviors, reducing bias of reports. Additionally, this study evaluated a general measure of sensation seeking based on two of the four dimensions outlined by Zuckerman (2007), disinhibition and thrill/adventure seeking. Future investigations of the association

between sensation seeking and problem behaviors would benefit from the inclusion of a more comprehensive evaluation of all four dimensions of sensation seeking. The construct of disinhibition would benefit in particular from consideration of closely conceptually related concepts such as lack of self control or impulsivity as well as studies of neurological functioning or biological bases of impulsive behavior.

Another measurement issue is the conceptual distinction between aggression and delinquency as evaluated in the current study. The items used to assess these constructs do have some conceptual overlap which is highlighted by the observed correlation between them. Likewise, the trajectory models for both aggression and delinquency were very similar in terms of the number of groups identified and the shapes of the trajectories. Despite these similarities, the distinction between these two behaviors is quite important and emphasizes the need to evaluate them separately. The most important distinction between aggression and delinquency is that delinquent behavior refers to illegal behavior. This includes theft, assault, and vandalism. These delinquent behaviors are more extreme and emerge later in adolescence than aggressive behaviors such as cursing, teasing, or saying mean things to someone. As such, it remains important to evaluate aggression and delinquency separately to more fully understand what factors are related to transitions from less serious forms of aggressive behavior to more serious delinquent acts. In addition, altering the items used to assess aggression and delinquency to try and minimize overlap will result in scales that have not been empirically validated and which may not capture the constructs of interest. Hence, it is important to be aware of the similarity between these constructs as well as the conceptual distinctions when interpreting the results of the current study.

Finally, previous research using dual trajectory analysis has only evaluated dual trajectory models among behaviors that occur over the same span of time (For review see Piquero, in press). The antisocial behaviors evaluated in the current study encompassed different time frames based on well established and validated measures of each behavior. Participants were asked to retrospectively report engagement in aggressive behavior over the past month while engagement in both delinquency and substance use were reported for the past year. It is unclear if the dual trajectory results presented in this study would remain the same or differ if all of the behaviors were assessed over the same span of time.

Implications

This investigation provided some insight into the underlying mechanisms contributing to the sequential emergence of aggression, delinquency, and substance use during early adolescence addressing a debate within the field regarding the co-occurrence of these behaviors during adolescence and adulthood. Despite the fact that the co-occurrence of these antisocial behaviors is well documented in the literature, most research to date has evaluated each antisocial behavior separately or has combined them into a single construct of general deviance. However, this study took advantage of a longitudinal research design to begin to disentangle the reciprocal influences between aggression, delinquency, and substance use in early adolescence.

Identifying interconnections among problem behaviors in adolescents is key to establishing effective prevention programming. The results of this study bring to light the need to take a holistic approach to preventive interventions. As shown in this study, patterns of change in aggression, delinquency, and substance use are associated with one another during middle school. Whether these behaviors are linked to one another causally or if they are simply different developmental manifestations of an underlying tendency toward general deviance is still a matter of debate. It is possible that the engagement in aggressive behavior affords the

opportunity to develop deviant peer associations which in turn leads to a social environment conducive to continued aggressive behavior, escalation into delinquency, and initiation of substance use.

Adolescents who are engaging in multiple antisocial behaviors represent a significant subgroup of individuals at higher risk for continued problems in adulthood. As such, it is particularly important to investigate individual and contextual factors that place adolescents at risk for multiple problem behaviors. This study evaluated both sensation seeking and deviant peer association as mechanisms underlying changes in aggression, delinquency, and substance use in early adolescence. This investigation shed light on the role of sensation seeking and deviant peer association on interconnections between antisocial behaviors rather than simply evaluating a general construct of deviance or individual outcomes alone. By doing so, the results of this study provide a richer picture of adolescent development during the middle school years which will assist in the development of more effective and appropriate intervention strategies for the prevention of substance use and violence. For example, regarding peer deviancy and sensation seeking, universal programming may be useful given minimal gender and race/ethnic differences in associations with antisocial behaviors and substance use. However, it would be informative for future research to evaluate other adjustment outcomes (i.e., precocious sexual activity, depression) given findings of unique processes among gender and race/ethnic groups found in other studies (Stanton et al., 1993).

In addition, information regarding gender and racial/ethnic differences on associations between antisocial behaviors in early adolescence is sparse and inconsistent thus far, requiring further examination. Given evidence of gender and race/ethnic differences in prevalence of antisocial behaviors, as well as differential effects of risk and protective factors, this study

investigated both males and females from a variety of racial and ethnic backgrounds with the goal of providing the most complete picture of the developmental progression of, and interconnections between, antisocial behaviors across early adolescence. Gaining a better understanding of commonalities and differences between genders and racial/ethnic groups in the etiology of antisocial behaviors is informative for the development and refinement of intervention strategies. Successful intervention techniques which promote positive youth development and minimize negative adjustment have important implications not only for individual lives but for society as a whole.

APPENDIX A
LIFE SKILLS TRAINING HEALTH SURVEY ITEMS

Substance use

About how often if ever do you:

1. Smoke cigarettes
2. Drink beer, wine, wine coolers or hard liquor (excluding use during religious ceremonies)
3. Drink until you get drunk
4. Smoke marijuana (pot, reefer, weed, blunts) or hashish (hash)
5. Smoke marijuana or hashish until you get high or stoned (nice)
6. Sniff glue, paint, gas or other things you inhale to get high

Delinquency

How many times in the past year have you:

1. Purposely damaged or destroyed property or things that did not belong to you?
2. Thrown objects such as rocks or bottles at cars or people?
3. Picked a fight with someone?
4. Hit someone with the idea of seriously hurting them?
5. Taken something worth less than \$50 that didn't belong to you?
6. Taken something from a person by force (other than just playing around)?
7. Beat up on someone or fought someone physically if they provoked you (other than just playing around)?
8. Taken something from a store when a clerk wasn't looking?
9. Intentionally damaged or messed up something in a school or some other building?
10. Taken part in a fight where a group of your friends were against another group?

Aggression

How many times in the past month have you:

1. Said mean things to someone?
2. Threatened to hurt someone?
3. Yelled at someone (you were mad at)?
4. Pushed or shoved someone on purpose?
5. Tripped someone on purpose?
6. Cursed at someone?
7. Teased someone or called someone names?
8. Argued with other people?
9. Told someone off?
10. Hit someone?

Friend Drug Use

How many of your friends do you think:

1. Smoke cigarettes
2. Drink beer, wine or liquor
3. Smoke marijuana (pot, reefer, weed, blunts)
4. Use cocaine or other hard drugs
5. Sniff glue, paint, gas or other things you inhale to get high

Friend Delinquency

During the past year how many of your friends have:

1. Ruined or damaged something on purpose that wasn't theirs.
2. Stolen something worth less than \$50.
3. Hit or threatened to hit someone without any real reason.
4. Broken into some place to steal something.
5. Carried weapons.
6. Picked a fight with someone.
7. Beat someone or fought someone physically if they were provoked (other than just playing around)?

Disinhibition

How much do you agree or disagree with the following statements.

1. I stick to what I'm doing until I'm finished with it. (reverse coded)
2. I have to be reminded several times to do something
3. I am easily distracted from my work.
4. I find that I like to switch from one thing to another.
5. If I find that something is really difficult, I get frustrated and quit.
6. If I promise to do something, I can be counted on to deliver. (reverse coded)
7. It doesn't really take much to calm me down when I am excited or all wound up. (reverse coded)
8. If I ask a question, I wait for the answer rather than jumping to the next idea. (reverse coded)
9. I have been told that I interrupt people in conversations.
10. In situations where I have to wait in line, I can do this patiently. (reverse coded)
11. If I am part of a group project, I can follow suggestions of other people. (reverse coded)
12. When someone asks me a question I usually respond with a thoughtful answer. (reverse coded)
13. I often do too many things at once, instead of concentration on one task.

Thrill/Adventure Seeking

How much do you agree or disagree with the following statements.

1. I enjoy taking risks.
2. I would enjoy fast driving.
3. I would do almost anything on a dare.
4. I think life with no danger in it would be dull for me.

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BIOGRAPHICAL SKETCH

Sarah Delphia Lynne was born on September 8, 1979, in Fairfax, Virginia, to Karen Barrett-Perry. She has two younger siblings, her brother Jonathan and her sister Elyse. While her father was never a parental figure in her life, Sarah's mother was a diligent and driven woman who always provided her children with not only the basic material needs but also a very warm and supportive home. Sarah learned the values of independence, patience, and persistence during childhood and adolescence by watching her mother successfully overcome adversity. She also learned the value and importance of family. She was married to Matthew David Russ Landsman on October 20th, 2007. Her husband is an honest and supportive man whose willingness to compromise and pervasive good nature have contributed tremendously to Sarah's happiness and success.

After graduating high school, Sarah went on to Lord Fairfax Community College where she earned an Associate of Arts and Science degree. She then transferred to Virginia Polytechnic Institute and State University where she earned a Bachelor of Science in Psychology. While at Virginia Tech, Sarah worked with elementary age students enhancing literacy and math skills, which contributed, in part, to her desire to study human development. She applied and was accepted into the developmental psychology graduate program at the University of Florida, where she is currently developing her skills as an academician and researcher. Her research interests include examining the psychological, biological, and social factors that impact the development of healthy/adaptive behaviors in adolescence and minimize maladaptive/pathological outcomes. She received her Master of Science degree in May 2005 and her Ph.D. in Developmental Psychology in May 2008.