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# Disentangling Pathways of Adolescent Sexual Risk from Problem Behavior Syndrome

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DISENTANGLING PATHWAYS OF ADOLESCENT SEXUAL RISK FROM PROBLEM  
BEHAVIOR SYNDROME

by

KATHRYN A. BROOKMEYER

Under the Direction of Christopher C. Henrich

ABSTRACT

Understanding the development of adolescent sexual risk behavior is complicated by the co-occurrence of sexual risk with substance use and delinquency, conceptualized as “problem behavior syndrome,” with common causes and influences underlying all three problem behaviors (Jessor & Jessor, 1977). Explaining the development of sexual risk becomes even more complex given the changing patterns of adaptation and maladaptation over the course of adolescence (Sroufe & Rutter, 1984). Research also suggests that multiple pathways may forecast adolescent engagement in sexual risk behavior, underscoring the ideas of equifinality and multifinality in developmental psychopathology (Cicchetti & Rogosh, 1996). To understand the diverse nature of sexual risk taking, researchers must identify these pathways and disentangle co-occurring problem behaviors from sexual risk. Revealing the course of sexual risk taking and the early risk and protective processes through which problem behavior develops allows researchers to identify the developmental periods that would be most amenable to intervention efforts (Rolf et al., 1990).

Using data from the National Longitudinal Survey of Youth (NLSY79), this study aimed to disentangle problem behavior syndrome by identifying the unique developmental pathways of adolescent sexual risk, alcohol use and delinquency. This study also investigated how early

adolescent processes of risk and protection were associated with the growth of these risk behaviors during adolescence. Using a developmental psychopathology and resilience framework, risk trajectories were measured with adolescents aged 15 to 24, and antecedents were measured with early adolescents ages 10 to 14 ( $N= 1778$ ). Using Latent Class Growth Analyses (LCGA), joint trajectory analyses revealed five distinct adolescent risk taking groups: high sex and alcohol, moderate problem behavior, problem behavior, alcohol-only, and alcohol and delinquency experimentation. Early adolescent externalizing problems were particularly important in understanding adolescent risk group membership. The co-occurrence between sexual risk and alcohol use, the diversity of problem behavior syndrome, and potential intervention and prevention efforts are discussed.

INDEX WORDS: Adolescence, Problem Behavior Syndrome, Sexual Risk, HIV/AIDS, Alcohol Use, Delinquency, Risk Behavior, Latent Class Growth Curve Analyses, Trajectories, Developmental Psychopathology, Resilience

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BEHAVIOR SYNDROME

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KATHRYN A. BROOKMEYER

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Doctor of Philosophy  
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Georgia State University

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## Chapter 1: Introduction

One of the chief developmental tasks confronting youth during adolescence is the transition to sexuality. This transition represents a critical juncture for youth because there is tremendous variation in how adolescents meet this task, and the degree to which adolescents encounter risk in the process. Increased attention has been given to sexual activity during the teenage years in light of recent national findings revealing that nearly half of high school students have engaged in sexual intercourse (Grunbaun, Kann, Kinchen, Williams, Ross, Lowry, et al., 2002). As well, substantial proportions of adolescents report being sexually active by early or middle adolescence (Resnick, Bearman, & Blum, 1997).

Considering this high rate of sexual activity, it is particularly alarming that many adolescents engage in high-risk sexual behavior, predisposing them to a host of detrimental outcomes, including sexually transmitted diseases, and HIV in particular. Among sexually active teens nationwide, over one-quarter reported using alcohol or drugs during their last sexual encounter (CDC, 2004), and 37% reported that neither they nor their partner had used a condom during their last sexual intercourse (CDC, 2003). The effects of youth sexual risk behavior have been particularly destructive in the United States. Each year, there are approximately 19 million new STD infections, and almost half of them are among youth aged 15 to 24 (Ventura, Abma, Mosher, & Henshaw, 2004).

Despite researchers' efforts to identify psychological and social contextual antecedents of adolescent sexual risk (Boyer, Tschann, & Shafer, 1999; Henrich, Brookmeyer, Shrier, & Shahar, 2006; Miller, Forehand, & Kotchick, 2000; Prinstein, Boegers, & Spirito, 2001) and the course of sexual risk taking (Duncan, Strycker, & Duncan, 1999), this body of research is in need of a stronger theoretical framework and rigorous methodology to better understand the nature of

adolescent sexual risk over time (Coley & Chase-Landsdale, 1998). In illuminating sexual risk taking among adolescents, the co-morbidity of problem behaviors, the complex course of youth adaptation and adjustment, and the larger, multifaceted context of the youth's environment must be considered (Armistead, Kotchick, & Forehand, 2004; Coley & Chase-Landsdale, 1998; Perrino, Gonzalez-Soldevilla, Pantin, & Szapocznik, 2000). These three central factors, and their relationship to sexual risk taking, will be reviewed in turn.

### *Co-morbidity of Problem Behaviors*

Understanding the development of sexual risk during adolescence is compounded by the complex link between sexual risk and other problem behaviors, most notably substance use and delinquency (Donovan & Jessor, 1985; Farrell, Danish, & Howard, 1992; Loeber, 1988). Both cross-sectionally and longitudinally, adolescent involvement in deviance and substance use have been shown to predict the timing of first sexual intercourse (Bingham & Crockett, 1996), such that those adolescents who engaged in high levels of substance use initiated sexual intercourse earlier (Duncan et al., 1999). Given this persistent pattern of co-occurrence, researchers have conceptualized sexual risk, substance use, and delinquent behaviors as comprising a "problem behavior syndrome," (Jessor & Jessor, 1977) with common causes and influences underlying all three problem behaviors (Donovan & Jessor, 1985).

Support for problem behavior syndrome emerged from Jessor and Jessor's (1977) longitudinal work, which found that (1) all three problem behaviors were positively correlated with one another, (2) a composite index of problem behaviors was negatively correlated with measures of conformity or conventional behaviors, and (3) the problem behaviors were negatively correlated with unconventionality in personality and social environment measures (Donovan & Jessor, 1985; Jessor & Jessor, 1977). Findings supporting such links between

multiple problem behaviors have also been shown by other risk behavior researchers (Farrell et al., 1992; Loeber, 1988). Specifically, Duncan and colleagues (1999) have found support for the idea that alcohol use, marijuana use, and sexual risk behavior all follow a similar developmental trajectory over time, such that when adolescents are high on one problem behavior, they are at higher risk for reporting elevated levels on the others.

Yet, recent work suggests that the structure of problem behavior may not be so straightforward, and that strong associations among problem behaviors do not occur in all youth (Benda & Corwyn, 1998; Bryan & Stallings, 2002; White & Labouvie, 1994). Such an overarching theory containing multiple diverse behaviors does raise questions about the exact relationship between these risk behaviors, as well as their distinct developmental pathways over time (Allen, Leadbeater, & Aber, 1994). However, recognizing the links between these risk behaviors does not explain how these behaviors come together developmentally over the course of adolescence (Kazdin, 1997).

Understanding the connections between these problem behaviors and the developmental antecedents leading to their co-occurrence would aid in elucidating the specific nature of their association (Kuperminc & Allen, 2001). Specifically, it is possible that the presence of one problem behavior can increase the risk for the development of others, or that one behavior can interact, or be influenced by, the presence of another (Kazdin, 1997). Disentangling the complexity of these co-occurring deviant behaviors can promote understanding of the developmental course of problem behaviors, the processes through which deviant behavior occurs, and the periods of development which may be especially amenable to intervention efforts (Rolf, Masten, Cicchetti, Nuechterlein, & Weintraub, 1990).

### *Patterns of Adaptation and Maladaptation*

Understanding the development of risk behavior in adolescence also necessitates consideration of the changing patterns of adaptation and maladaptation over time (Sroufe & Rutter, 1984). Although there are expectations of coherence and lawfulness in development, the course of development does not necessarily occur through a series of linear adaptations (Egeland, Carlson, & Sroufe, 1993; Sroufe, 1990). The developmental psychopathology perspective has theorized that patterns of maladaptive outcomes are diverse, but conceptually related, such that risk factors can manifest uniquely depending on the environment in which they operate as well as how the individual responds to increased risk (Cicchetti & Toth, 1997). This idea of multifinality, whereby similar pathways can lead to adaptive, and in other contexts, maladaptive outcomes, and the related concept of equifinality, whereby the same outcome can be reached from a variety of different pathways, underscores the complexity of the developmental process (Cicchetti & Rogosh, 1996).

Another challenge for understanding patterns of adaptation and maladaptation is that the nature of risk is changeable over the course of development. In developmental psychopathology, the idea of maladaptation and risk must be considered within the context of the changing cognitive, social, emotional, and biological landscape of development (Kuperminc & Brookmeyer, 2006). Behavior that was considered developmentally appropriate and normative in one developmental phase may be considered deviant if it persists over another developmental period (Kazdin, 1997; Kuperminc & Brookmeyer, 2006). Further, when a child's context is markedly different from the majority culture, defining behavioral norms becomes increasingly difficult (Masten & Coatsworth, 1998). For example, joining a gang has the potential to provide protection and status, which in the inner city is difficult to ensure otherwise (Tolan, Sherrod,

Gorman-Smith, & Henry, 2003). The definition of good parenting may also depend on context; controlling parenting which limits exposure to deviant peers and violence may be adaptive within the environment of the inner city (Tolan et al., 2003).

Such a developmental psychopathology approach emphasizes the need to implement a more complex perspective in understanding the development of adaptive and maladaptive outcomes (Cicchetti & Rogosh, 1996). The variable nature of adaptation must be taken into account by investigating the diverse developmental trajectories of problem behavior syndrome over multiple developmental transitions. Following adolescents over time allows researchers to investigate how patterns of adaptation and maladaptation vary over the course of development.

#### *Diverse Nature of Adolescent Risk*

When such approaches are applied to adolescent sexual risk taking, evidence suggests that there may be multiple pathways which forecast adolescent involvement in sexual risk behavior. Specifically, several lines of research have raised the question as to whether there may actually be multiple distinct groups of adolescents engaging in sexual risk apart from those adolescents who participate in sexual risk taking along with substance use and delinquency, providing evidence for problem behavior syndrome (e.g., Jessor & Jessor, 1977). For example, Ensminger (1990) has found that there may be a subset of adolescents who engage in sexual risk behavior only, without participating in substance use and delinquency. Research suggests that these two groups of adolescents may differ qualitatively from one another, and may display differing trajectories of risk (Ensminger, 1990; Mott & Haurin, 1988). Previous work has found that engaging in unprotected sex was not predicted by drug use or delinquency and that unprotected sex did not predict levels of drug use or delinquency over time (Allen et al., 1994).

Such findings suggest that sexual risk taking may have distinct precursors and a unique developmental trajectory from other problem behaviors (Allen et al., 1994).

In addition, investigating the link between substance use and sexual risk taking may be particularly important in understanding the process of sexual risk taking. Experimentation with alcohol is prevalent for adolescents in the United States, and national findings reveal that the majority of high-schoolers have tried alcohol (Johnston, Bachman, & O'Malley, 2002). Research has suggested that engaging in alcohol use is critical in forecasting sexual risk behavior among adolescents. Alcohol use has been found to be linked to an early onset of sexual activity and sexual risk taking in general (Biglan, Noell, Ochs, Smolkowski, Metzler, 1995; Duncan et al., 1999; French & Duncan, 2003). For many adolescents, sexual activity appears to occur after drinking alcohol, and has been shown to reduce the likelihood of engaging in safer sexual practices among adolescents (Hingson, Strunin, Berlin, & Heeren, 1990; Lowry, Holtzman, Truman, Kahn et al., 1994). In this way, understanding the association between alcohol use and sexual activity can contribute to understanding the diverse patterns of sexual risk taking over time for adolescents.

Moreover, it is important to understand the link between sexual risk and delinquency in illuminating the nature of sexual risk taking. Research suggests that those adolescents with externalizing problems, who engage in sexual risk taking as well as delinquency, may have a unique profile from the other sexual risk taking groups. Externalizing problems and delinquency in particular, have been shown to be associated with sexual risk taking during adolescence (Biglan et al., 1995). Antisocial behavior has been shown to predict the subsequent early initiation of sexual activity (Capalidi, Crosby, & Stoolmiller, 1996) and research suggests that sexual risk and antisocial behavior have similar antecedents (Bryan & Stallings, 2002).

Accordingly, although adolescents with these differing constellations of problem behaviors are at high risk for contracting STDs through their sexual activity, these groups may be distinct in terms of the duration and nature of their sexual risk taking, and consequently, their specific needs within intervention efforts (Perrino et al., 2000). Indeed, the same end state of sexual risk taking may be reached from a variety of different pathways, underscoring the idea of equifinality in developmental psychopathology (Cicchetti & Rogosh, 1996; Cicchetti & Toth, 1997). Understanding the different ways in which these three problem behaviors of sexual risk, alcohol use and delinquency come together developmentally and are expressed over time has important implications for illuminating the diverse pathways of adolescent risk taking.

#### *Importance of Environmental Antecedents*

Much previous work on youth sexual risk behavior has centered on identifying the psychological characteristics of adolescents that have been associated with sexual risk taking and problem behavior broadly defined (e.g., Biglan et al., 1995; Bingham & Crockett, 1996; Kazdin, 1997). However, it has increasingly been recognized as critical to move beyond identifying adolescent attributes and acknowledge the larger social context in which the development of sexual risk behavior occurs. Bronfenbrenner (1977; 1988) emphasized the need to take multiple domains of behavioral influence into account, reflecting the complexity of the environment in which adolescents develop. This ecological approach allows for the consideration of how multiple microsystems may impact adolescents' sexual risk behavior. In fact, numerous social influences influence adolescents' initiation of sexual activity as well as the decision to engage in unsafe sexual behaviors (Allen et al., 1994; Armistead et al., 2004). Despite the importance of the larger context impacting sexual risk, rarely have multiple microsystems been considered within the same investigation (for exception, see Henrich et al., 2006).

Additionally, although problem behaviors have been linked to sexual risk in adolescence (Jessor & Jessor, 1977), it is still largely unknown whether these factors represent correlates or causes of sexual risk taking (Coley & Chase-Landsdale, 1998). In order to determine how contextual factors forecast sexual risk in adolescence, it is important to examine antecedents over time from early adolescence. An ecological approach considers how contexts of risk and protection during early adolescence may be linked to risk taking during later adolescence and emerging adulthood.

### *Processes of Risk and Protection*

According to Cicchetti & Toth (1997), childhood risk and protective factors are indicative of a complex vulnerability or protective process, rather than directly predictive of adaptive or maladaptive outcomes. To understand how risk and protection contribute to behavioral outcomes in development, the process by which risk and protection operates must be considered. Understanding how risk and protection function becomes particularly important when children achieve especially resilient outcomes, in spite of risk exposure (Luthar, Cicchetti, & Becker, 2000). Indeed, despite the presence of environmental risk, some children defy expectation by evading risk outcomes in adolescence (Luthar, 1991; Masten, 1999). Examining the development of children characterized as resilient- those children exposed to risk, but who do not ultimately develop risk behavior- can clarify the role of risk and protection as well as successful means by which to buffer risk (Luthar et al., 2000; Rutter, 1987). A resilience framework emphasizes that successful coping with risk is just as important as understanding the deficits which result from risk (Sroufe & Rutter, 1984).

However, judging resilient outcomes among adolescents in particular becomes complicated given that risk taking behavior in the United States is so prevalent among

adolescents. For example, the majority of adolescents have tried alcohol by senior year of high-school (Johnston et al., 2002), between one-third and one-fourth of adolescents are sexually active by age 15 (Blum & Tinehart, 2000), and experimentation with delinquent activity is considered developmentally normative in the adolescent years (Moffitt, 2003). Given this high rate of adolescent risk taking, the relative nature of adaptation comes into question as well as the standards by which research judges resilient outcomes (Luthar et al., 2000; Masten, 2001).

Making this idea of adaptation more complex, behavioral risks are not always associated with compromised functioning for adolescents (Savin-Williams & Diamond, 2004; Moffitt, 1993). For example, in terms of alcohol use, those adolescents who drink moderately may even be better adjusted and socially skilled than their abstaining peers (Shedler & Block, 1990). In this way, it becomes increasingly unclear to what extent researchers' conceptualization of risk and statistical risk translates into actual adolescent risk (Luthar et al., 2000). The relative nature of risk, therefore, is a critical consideration for researchers. Such high rates of risk taking raises the question as to which subgroup of adolescents constitute the reference group in examining resilient outcomes, and whether the abstaining group or the experimenting group would be most appropriate (Masten, 2001). Such questions around the nature of resilience are particularly challenging when considering the nature of adolescent risk over time.

#### *Importance of Advanced Methodology*

Given the diverse nature of adolescent adaptation over time, increasingly complex methodological approaches are needed to capture the nature of the developmental process. Multifaceted designs become necessary to separate the effects of current environments from the continuity and accumulations of risk conditions (Sameroff, 1975) and to consider the pathways of equifinality and multifinality over the course of development (Cicchetti & Rogosh, 1996).

Indeed, main effect and cross-sectional models cannot reliably capture the complexity of child development and often leave much unexplained variance (Coley & Chase-Landsale, 1998; Sameroff, 1975).

Advancements in statistical models, specifically semi-parametric group-based modeling and Latent Class Growth Analyses (LCGA) (Nagin & Tremblay, 1999), allow researchers to identify distinctive latent classes, or groups, of individual-level trajectories of behaviors, recognize how these classes are related between behaviors, and identify unique predictors of group trajectories over time (Muthén & Muthén, 2000; Nagin & Tremblay, 1999; 2001). Such methodology has the potential to offer a greater understanding of the complexity of the developmental course of sexual risk behavior and to reveal how early adolescent risk and protective antecedents affect the unfolding of health-risk behaviors during adolescence.

These statistical tools also have the ability to disentangle the connections between sexual risk behavior and alcohol use and delinquency during adolescence and emerging adulthood, revealing more about the nature of problem behavior syndrome (Jessor & Jessor, 1977). Elucidating links between these co-occurring problem behaviors can serve to clarify their unique developmental pathways, and the processes through which problem behavior occurs (Allen et al., 1994; Kazdin, 1997). In examining these pathways, adolescents' changing patterns of adaptation and the diverse trajectories through which risk outcomes develop can be considered over time (Cicchetti & Rogosh, 1996; Cicchetti & Toth, 1997; Sroufe & Rutter, 1984). Further, researchers can recognize multiple domains of risk and protection, reflecting the complexity of the environment in which risk behavior develops (Armistead et al., 2004; Bronfenbrenner 1977; 1988; Cicchetti & Toth, 1997; Masten, 1999).

Such increased appreciation of adolescent developmental problem behavior trajectories can be used to inform specific intervention efforts, tailored to the specific developmental needs of adolescents with distinct problem-behavior profiles (Hawkins et al., 1992). It has been suggested that adolescents with differing patterns of sexual risk and risk antecedents may benefit from distinct intervention initiatives (Perrino et al., 2000). Consequently, these methods can further inform such intervention efforts by illuminating the multifaceted nature of sexual risk with the ultimate objective of promoting healthy behavior for adolescents.

## Chapter 2: Current Study

In 2005, the Centers for Disease Control and Prevention named adolescent sexual risk behavior a critical health risk behavior priority for public health (CDC, 2005), citing that sexual risk taking predisposes youth to a host of detrimental outcomes, including sexually transmitted diseases, and HIV in particular. Among sexually active adolescents, over one-quarter reported using alcohol or drugs during their last sexual encounter (CDC, 2004), and 37% reported that neither they nor their partner had used a condom during their last sexual intercourse (CDC, 2003). The effects of such sexual risk behavior among adolescents have been devastating in the United States; in 1999 at least half of all new HIV infections were among youth under the age of 25 (CDC, 2003).

Such statistics have prompted researchers to describe the course of adolescent sexual risk among adolescents (Duncan et al., 1999) and identify psychological and social contextual antecedents of adolescent sexual risk taking (Boyer et al., 1999; Henrich et al., 2006; Miller et al., 2000; Prinstein et al., 2001). However, understanding the nature of adolescent sexual risk taking is complicated by the co-morbidity of problem behaviors, the diverse nature of sexual risk

taking, and early processes of risk and protection (Armistead et al., 2004; Coley & Chase-Landsdale, 1998; Perrino et al., 2000).

### *Co-morbidity of Problem Behaviors*

The consistent link between sexual risk and other problem behaviors, most notably substance use and delinquency, confounds our understanding of sexual risk taking (Armistead et al., 2004; Bingham & Crockett, 1996; Donovan & Jessor, 1985; Farrell et al., 1992; Orr et al., 1991). From a theoretical framework, researchers have conceptualized sexual risk, substance use, and delinquency as comprising a “problem behavior syndrome,” (Jessor & Jessor, 1977) with common causes and influences underlying all three behaviors (Donovan & Jessor, 1985). Support for problem behavior syndrome emerged from Jessor and Jessor’s (1977) longitudinal work, which found that all three problem behaviors were (1) positively correlated with one another, (2) negatively correlated with measures of conformity, and (3) positively correlated with personality unconventionality (Donovan & Jessor, 1985; Jessor & Jessor, 1977). Recent research also supports such links; both cross-sectionally and longitudinally, adolescent involvement in deviance and substance use has been shown to predict the timing of first sexual intercourse (Bingham & Crockett, 1996). Reports also find that when youth report high levels of alcohol use, marijuana use, or sexual risk, they are at higher risk for elevated levels of the other problem behaviors as well (Duncan et al., 1999).

Despite such evidence supporting associations between multiple problem behaviors, recent work suggests that the structure of problem behavior may not be so straightforward, and that strong associations among all three problem behaviors do not occur in all youth (e.g., Benda & Corwyn, 1998; Bryan & Stallings, 2002; White & Labouvie, 1994). It has been argued that an overarching theory containing multiple diverse behaviors raises questions about the precise

nature of their relation, as well as their unique developmental pathways (Allen et al., 1994). According to Kazdin (1997), although we know that multiple deviant behaviors co-occur, the challenge is to explain *how* these behaviors come together developmentally.

A central goal of this study is to understand more about the distinct patterns through which sexual risk develops and co-occurs with substance use, namely alcohol use, and delinquency over the course of adolescence and emerging adulthood. Although the theory of problem behavior syndrome considers all three risk behaviors as co-occurring in high levels, understanding the differing pathways through which sexual risk, substance use, and delinquency develop is critical. Indeed, problem behavior syndrome may be expressed differently, such that adolescents may engage in all three risks, but with differing levels of severity. Given the complex relationship between these three problem behaviors, this study seeks to elucidate the developmental course of problem behaviors over adolescence and to identify the periods of development which may be especially amenable to intervention efforts (Kuperminc & Allen, 2001; Rolf et al., 1990).

#### *Diverse Nature of Adolescent Sexual Risk*

Using a developmental psychopathology perspective, this study seeks to examine the complex nature of problem behavior syndrome and to understand the development of adolescent adaptive and maladaptive outcomes (Cicchetti & Rogosh, 1996). In developmental psychopathology, patterns of maladaptive outcomes have been theorized as diverse, but conceptually related, such that risks can manifest uniquely depending on the environment in which they operate as well as how the individual responds to increased risk (Cicchetti & Rogosh, 1996; Cicchetti & Toth, 1997). In fact, evidence suggests that there may be multiple pathways forecasting adolescent involvement in sexual risk behavior and distinct ways in which sexual risk

can co-occur with other problem behaviors. This idea of equifinality, whereby the same outcome can be reached from a variety of different pathways, and the related concept of multifinality, whereby similar pathways can lead to adaptive, and in other contexts, maladaptive outcomes, underscores the complexity of the developmental process (Cicchetti & Rogosh, 1996). A developmental psychopathology approach emphasizes this variable nature of adaptation and maladaptation over time, and stresses the need to identify and explain these diverse risk outcomes among adolescents (Cicchetti & Rogosh, 1996).

Specifically, though it has been well studied that adolescents participate in sexual risk taking along with substance use and delinquency (e.g., Jessor & Jessor, 1977), research also indicates that there are other unique groups of adolescents engaging in sexual risk taking behavior. For example, Ensminger (1990) has found that there may be a subset of adolescents who engage in sexual risk behavior only, without participating in substance use and delinquency. These two groups of adolescents- those who engage in sexual risk behavior only and those engage in sexual risk as well as substance use and delinquency- may have very different profiles and display distinct trajectories of risk over time (Ensminger, 1990; Mott & Haurin, 1988; Perrino et al., 2000).

### *Substance Use and Sexual Risk*

Understanding the association between substance use and sexual risk taking may also be particularly important in appreciating the nature of adolescent risk taking. Research has suggested that engaging in substance use is critical in forecasting sexual risk behavior among adolescents. Findings indicate that substance use is associated with the early onset of sexual activity and sexual risk taking in general (Biglan et al., 1990; Duncan et al., 1999; French & Duncan, 2003). Indeed, using alcohol has specifically been shown to reduce the likelihood of

engaging in safer sexual practices (Hingson et al., 1990; Lowry et al., 1994). Alcohol use, above and beyond other substance use, is particularly prevalent during adolescence; national findings reveal that the majority of high-schoolers have tried alcohol, and that 17% of 8th graders and 47% of 12th graders drank in the past month (Johnston et al., 2002). Given this alarmingly high rate of alcohol use, those adolescents who engage in both alcohol use and sexual risk are examined in this study.

### *Delinquency and Sexual Risk*

Understanding the link between sexual risk and delinquency is also particularly key, and adolescents engaging in these risks may have a unique profile of risk. Indeed, externalizing problems and delinquency in particular, have been linked to sexual risk taking during adolescence (Biglan et al., 1990). Antisocial behavior has been shown to predict the subsequent early initiation of sexual activity (Capaldi, Crosby, & Stoolmiller, 1996). Moreover, adolescent juvenile offenders are more likely to initiate sexual activity earlier, less likely to use condoms, and more likely to engage in sexual activity with a larger number of partners (Barthlow, Horan, DiClemente, & Lanier, 1995; Elliot & Morse, 1989; Farrington, 1991). Those adolescents with externalizing problems, who engage in sexual risk taking as well as delinquency, may also be qualitatively different from the other sexual risk taking groups.

In addition, much evidence suggests that delinquency and aggression is associated with alcohol use during adolescence (e.g., Chassin, Pitts, & Prost, 2002; Disney, Elkins, McGue, & Iacono, 1999; Windle, 1993). However, it remains unclear to what extent these two behavioral risks of delinquency and alcohol use co-occur independently, outside the context of sexual risk taking. Therefore, this link between adolescent delinquency and alcohol use will also be explored in this study.

In sum, these distinct groups of adolescents may follow unique developmental trajectories in their engagement in sexual risk and have unique precursors to risk. Though all adolescents who engage in sexual risk are at high risk for contracting STDs through their sexual activity, these groups may be distinct in terms of the duration and nature of their sexual risk taking, and consequently, their specific needs within intervention efforts (e.g., Perrino et al., 2000). Understanding the different ways in which these three problem behaviors of sexual risk, alcohol use and delinquency are expressed over time has important implications for explaining pathways of risk taking. Moreover, investigating the mechanisms and processes by which these risks come together developmentally is critical in revealing the diversity of adolescent problem behavior syndrome (Cicchetti & Rogosh, 1996; Kuperminc & Brookmeyer, 2006).

#### *Early Adolescent Processes of Risk and Protection*

Multiple social factors influence adolescents' decision to engage in unsafe sexual behaviors (Armistead et al., 2004), and an ecological approach considers how these contexts work together to influence youth adjustment. Taking multiple domains of behavioral influence into account reflects the complexity of the environment in which youth develop (Bronfenbrenner, 1979; 1988). Social influences in the transition to adolescence in particular, when youth confront biological, cognitive, and social-emotional developmental changes, are especially notable (e.g., Arnett, 1999; Steinberg, 2005). In this transition, early adolescent environmental and behavioral factors have been shown to be particularly important in anticipating the nature and duration of risk taking over time (Loeber & Farrington, 2000; Shedler & Block, 1990). Appreciating how early adolescent factors increase or decrease the likelihood of later behavior problems can offer insight into developmental continuity over the course of adolescence. This study will therefore examine how environmental and behavioral antecedents

measured in early adolescence forecast pathways of risk behavior in adolescence and emerging adulthood.

Previous work has found that specific behavioral and environmental antecedents are especially important in forecasting engagement in sexual risk behavior. Externalizing and internalizing problems have been linked to elevated risk taking in general (Loeber & Farrington, 2000) and to sexual risk taking in particular (Armistead et al., 2004; Perrino et al., 2000). In terms of environmental antecedents, parent support and peer influence have been shown as fundamental in understanding variability in sexual risk taking among adolescents (Armistead et al., 2004; Crosby et al., 2001; Hutchinson et al., 2003). However, despite being widely studied, the link between sexual risk, parent support, and peer influence is not straightforward. For example, although greater parental monitoring was found to be linked to decreased levels of sexual risk behavior among youth (Romer et al., 1994), other research does not document such a clear association (Armistead et al., 2004). In addition, peers become important behavioral referents during adolescence (Henrich et al., 2000), but research finds that supportive friendships have differential influences within the contexts of sexual risk and alcohol use (Rotherbaum-Borus et al., 1994; Wills & Vaughan, 1989).

Further, sexual risk research has rarely considered adolescents' larger context of schools in contributing to sexual risk taking (Armistead et al., 2004), though schools have been found to play a key role in mitigating levels of risk in the context of other health-risk behaviors, such as aggressive behavior and committing acts of violence (e.g., Brookmeyer et al., 2006; Department of Health and Human Services, 2001). Despite the importance of the larger context affecting sexual risk, rarely have the multiple influences of parents, peers, and schools been considered within the same investigation (for exception, see Henrich et al., 2006).

Knowledge of how these environmental antecedents operate is crucial to understanding the diversity in adolescent sexual risk taking outcomes (Coley & Chase-Landsdale, 1998). Understanding the mechanisms through which risk and protection function becomes particularly important when youth achieve especially resilient outcomes, and avoid risk taking behavior in adolescence despite early risk exposure (Luthar et al., 2000). Identifying the early developmental patterns of adolescents who do not ultimately engage in risk behaviors can clarify the role of risk and protective antecedents as well as successful means by which to buffer risk taking (Luthar, 1991; Masten, 1999; Rutter, 1987).

Taking such a resilience and ecological approach, this study will consider how early adolescent processes of risk and protection, including behavior problems, parent and peer connectedness and school quality, may be associated with distinct patterns of risk taking over the course of adolescence and emerging adulthood. However, resilience does not arise from fixed attributes within an individual or environment, but rather from the dynamic interplay between the individual and environment (Masten, 1999) so that it may be more precise to examine resilience in terms of interaction effects. Therefore, in addition to main effects, this study will examine the ways in which the early adolescent's environment- through peer and parent relationships and school quality- interact with adolescent behavior problems to curb or accelerate risk taking during adolescence.

#### *Methodological Approach: Latent Class Growth Analysis*

Attempts to capture the growth of adolescent sexual risk and other problem behaviors have largely taken a main-effects and cross-sectional approach, relying mainly on summary statistics (Coley & Chase-Landsdale, 1998; Nagin & Tremblay, 2001). Yet, advancements in statistical models, and the semi-parametric group-based modeling technique of Latent Class

Growth Analysis (LCGA) specifically (Nagin & Tremblay, 1999), allow researchers to identify distinctive classes, or groups, of individual-level trajectories of behaviors, recognize how these classes are related between behaviors (Nagin & Tremblay, 1999), and identify unique predictors of class trajectories over time (Muthén & Muthén, 2000). Accordingly, LCGA methods are particularly well-suited for disentangling the trajectories of sexual risk from alcohol use and delinquency as well as clarifying the adaptive and maladaptive pathways influencing adolescent risk taking. From a developmental psychopathology perspective, LCGA methods allow researchers to approach risk behavior development with a complexity that matches the diverse nature problem behavior outcomes (Kuperminc & Brookmeyer, 2006; Sroufe & Rutter, 1984).

#### *The Present Study*

This study uses a developmental psychopathology framework in an effort to offer a greater understanding of the developmental course of co-occurring health risk behaviors and to reveal how processes of early adolescent risk and protection may be associated with their growth during adolescence. Such increased appreciation of youth problem behavior trajectories and their antecedents can be used to inform specific intervention efforts, tailored to the specific developmental needs of adolescents with distinct problem behavior profiles (Hawkins et al., 1992).

In exploring the diverse developmental pathways of adolescent sexual risk taking, this study aims to capture how sexual risk, alcohol use, and delinquency develop over the course of adolescence and emerging adulthood. Specifically, this study aims to describe the diverse patterns of risk *within* each problem behavior by identifying distinct latent classes, or groupings, of individual level adolescent trajectories. Building from studies that suggest distinct courses of risk behaviors (e.g., Allen et al., 1994; Ensminger, 1990; Muthén & Muthén, 2000; Nagin &

Tremblay, 1999), it is hypothesized that risk trajectories will include such classes as *early-increasing* and *early-decreasing* (beginning at high levels and accelerating or decreasing risk during adolescence) and *moderate-stable* and *moderate-decreasing* (beginning at average levels and stabilizing or decreasing over the course of adolescence) (Muthén, 2001; Nagin & Tremblay, 2001).

This study also aims to identify how the growth trajectory of sexual risk is linked to other problem behaviors, in terms of patterns of increasing and decreasing levels of risk over time. Identifying the probability of membership in sexual risk and other problem behavior trajectory groups across risk behaviors (e.g., early-increasing sexual risk/early-increasing substance use/moderate-decreasing delinquency) can elucidate how distinct adolescent profiles of risk behaviors are related (Nagin & Tremblay, 2001). Consistent with studies documenting considerable overlap between these multiple risk behaviors (e.g., Duncan et al., 1999; Jessor & Jessor, 1977), as well as research suggesting differing patterns of youth sexual risk (e.g., Allen et al., 1994; Ensminger, 1990), it is hypothesized that adolescents will form at least five distinct groups of risk behaviors: those who engage in sexual risk behaviors only (Perrino et al., 2000), those who engage in sexual risk and alcohol use (Boyer et al., 1999), those who engage in sexual risk and delinquency (French & Dishion, 2003), those who engage in alcohol use and delinquency (Chassin et al., 2002), and those who display high levels of sexual risk behaviors as well as substance use and delinquency, providing evidence for a problem behavior syndrome (Jessor & Jessor, 1977). It is also hypothesized that problem behavior syndrome is diverse so that sexual risk, alcohol use, and delinquency can co-occur with differing levels of severity. Understanding more about how these three risk behaviors come together developmentally can offer insight into the nature of problem behavior syndrome for adolescents.

Within a resilience framework (Luthar et al., 2000; Masten et al., 1999), this study also aims to investigate how early adolescent processes of risk and protection forecast adolescent membership in distinct groups of problem behaviors. It is hypothesized that high levels of early adolescent environmental and behavioral risk will increase the likelihood of a high-risk multiple-problem group trajectory. Also, high levels of protection are hypothesized to forecast decreased adolescent risk and increase the likelihood of engaging relatively less risky trajectories of behavior. The study also examines how early adolescent environmental processes of risk and protection interact with early adolescent behavior problems to influence risk taking over the course of adolescence. In addition, how processes of protection and risk may vary by age, gender, and ethnicity will be explored. Parent demographic variables, including level of education attainment and marital status, will be controlled for in these analyses.

An overarching aim of this study is to capture the complexity of the developmental course of sexual risk behavior with co-occurring risk behavior trajectories and to reveal how processes of risk and protection impact the unfolding of these health-risk behaviors. Such increased understanding of youth developmental problem behavior trajectories can inform specific intervention efforts designed to prevent and mitigate the development of distinct patterns of risk behaviors over the course of adolescence and emerging adulthood.

### Chapter 3: Methods

#### *Participants and Procedures*

Data for this study were taken from the National Longitudinal Survey of Youth (NLSY79). This study focuses the children of the mothers from the original 1979 sample, using data collected from 1992 through 2004. Sponsored by the U.S. Department of Labor, the NLSY79 was originally designed to assess labor force behavior; however, the NLSY79 also

contains extensive information about the individual attributes and family, peer, and school experiences, as well as the health-risk behaviors of the respondents. In 1992, peer relationships and school quality constructs were added, and therefore, 1992 was designated as the starting point of this study.

The NLSY79 survey includes over-samples of African-American and Hispanic youth, and the overall sample of children has remained relatively stable over time in terms of its racial, ethnic, and gender compositions. As well, the NLSY79 exhibits a high retention rate; from 1992 to 2002, the NLSY79 retained 81.2% of participants.

The NLSY79 contains two sets of assessments for youth. The first is given to children and their mothers from infancy to age 14, and is referred to as the “child dataset.” At age 15, adolescents begin the second battery of assessments, referred to as the “young adult dataset,” which contains more sensitive self-report questions on risk taking behaviors and attitudes. These two datasets are discussed in detail in the paragraphs that follow.

#### *Early Adolescent Antecedents*

The child dataset of the NLSY was used in measuring how risk and protection in early adolescence may forecast risk behavior over the course of adolescence. Specifically, this study considers how early adolescent processes of risk and protection, including behavior problems, parent and peer connectedness and school quality, may accelerate or curb distinct patterns of risk taking in adolescence and emerging adulthood.

Early adolescent antecedents are measured during ages 10 to 14 in the child dataset. In order to maximize sample size, the single oldest age of early adolescent data available was used to measure antecedents. The majority (97.4%) of participants were assessed at ages 12 to 14, with 28.0% assessed at age 12, 49.2% assessed at age 13, and 20.2% assessed at age 14.

Although early adolescents were assessed every two years in the child dataset, some may have missed the age 14 assessment, and were therefore captured at ages 12 or 13. In order to take this variability in early adolescent assessment ages into account, age was controlled for in the analyses and interactions of age with independent variables were explored. These interactions allow for the investigation of whether the relationship between early adolescent variables and risk group membership varies by age of assessment.

### *Adolescent and Emerging Adult Risk Trajectories*

In an effort to explore the diverse developmental pathways of risk taking, this study examines how sexual risk, alcohol use, and delinquency develop over the course of adolescence and emerging adulthood. Specifically, this study describes the diverse pattern of risk *within* each behavior by identifying distinct classes, or groupings, within each risk trajectory. This study will then identify how these risk classes are related to one another over time, and will capture how distinct patterns of sexual risk, alcohol use, and delinquency co-occur over the course of adolescence and emerging adulthood.

These patterns of risk and their co-occurrence were measured with the young adult dataset, which assesses adolescents ages 15 and older every two years. The young adult dataset contains adolescent self-report data on such topics as parent-child conflict, participation in delinquent or criminal activities, use of controlled and uncontrolled substances, and sexual activity. Interviews with the NLSY79 adolescents are conducted in respondents' homes by specially trained field staff. Interviews with participants through 1992 were conducted with paper and pencil assessments, and by 2000, all reports were completely computerized. From 1994 to 1998, adolescents were assessed with an in-person interview, and by 2000, the primary

interview mode for adolescents shifted to telephone interviews. (For more information on the ongoing sampling methodology, please refer to <http://www.bls.gov/nls/nlsy79.htm>.)

Participants were followed over the course of adolescence and emerging adulthood until 2004, which is the most updated data currently available to the public. Consequently, to construct the adolescent trajectories of risk behavior, participants were followed for nine years from ages 15 to 24 and through at least three out of a maximum of four waves of data assessment (1998, 2000, 2002, and 2004).

#### *Following Cohorts over Time*

The data for this study were selected to ensure that all adolescents were assessed in at least three waves of data collection, had at least some data at every assessment point, and had at least some data across assessment points on every measure. The resulting sample size was  $N = 1,778$ . However, participants did not necessarily fill out all questions at each of those waves. Specifically, although 98.9% of alcohol assessments and 96.0% of delinquency assessments were completed in at least three waves, 68.1% of sexual risk assessments were completed in at least three waves with the remaining majority completed at two waves. However, such differing patterns of missingness should not present a problem for data accuracy; Mplus makes complete use of available sample data in determining parameter estimates by using full information maximum likelihood (Muthén & Muthén, 2006). To check this assumption, stricter data parameters were used (i.e., more data at each wave were required for inclusion) and patterns of adolescent risk trajectory findings were comparable.

Table 1 depicts the four cohorts who were followed over the course of adolescence and emerging adulthood in order to construct risk trajectory classes and co-occurring patterns of risk behavior. The first row of Table 1 shows that adolescents were assessed beginning in 1998 at age

15 and then every two years through 2004 when these participants reached age 21. The second row follows adolescents aged 16 to 22 every two years, also from 1998 to 2004. The third row follows adolescents from 17 in 1998 to 23 years of age in 2004, and the fourth row from 18 in 1998 to 24 years of age in 2004. By following these four cohorts of adolescents, the majority of participants will have at least three waves of adolescent/emerging adulthood data to create risk trajectories over time.

Following participants by age, rather than by wave or assessment year, allows for greater measurement precision as it specifies the adolescent's age on the day each exam was administered (Singer & Willett, 2003). Following participants by age also results in "unbalanced data" with a substantial amount of missingness at each age. However, such unbalanced data do not present a problem, since it is planned missingness that can be considered missing completely at random (MCAR) (Singer & Willett, 2003).

*Table 1.* Following sample cohorts by age, rather than by year of assessment ( $N= 1,778$ )

1998	2000	2002	2004
Age 15	Age 17	Age 19	Age 21
Age 16	Age 18	Age 20	Age 22
Age 17	Age 19	Age 21	Age 23
Age 18	Age 20	Age 22	Age 24

Table 2 displays the descriptive statistics for race and sex as well as the parent demographic variables of maternal education and father presence in the household, which were controlled for in the analyses. The final sample used for this study was similar to the larger

overall sample in terms of race, sex, maternal education and paternal household presence distributions. Table 2 depicts a comparison between the basic descriptives of the sub-sample used in this study and the larger NLSY sample.

*Table 2.* Descriptive statistics comparison between the study sub-sample ( $N= 1,778$ ) and total NLSY sample ( $N= 5,634$ )

Descriptive Statistic	Study Sample	NLSY Sample
Sex		
Female	52.4%	48.8%
Race		
Hispanic	22.3%	22.8%
Black	38.2%	36.3%
White	39.5%	40.9%
Maternal education completed		
Eighth-grade	3.5%	2.3%
High-school	42.2%	35.5%
College 1-year	10.6%	10.3%
Biological father presence		
Present in household	50.1%	57.6%

## *Study Measures*

### *Early Adolescent Measures*

All early adolescent measures are assessed with participants varying in age from 10 to 14 and come from the child dataset of the NLSY79.

*Behavior problems.* Behavior problems were measured with the Behavior Problem Index (BPI) (Zill & Peterson, 1986), where mothers rated the occurrence of common youth behaviors in the past three months as “often true” (score of 2), “sometimes true” (score of 1), or “not true” (score of 0) and items were summed to create an index score, with higher scores indicating increased behaviors problems. Items were used to create two subscales measuring internalizing problems and externalizing problems. Internalizing problems were measured using the 5-item anxious/depressed subscale (e.g., child is unhappy, sad or depressed, child complains no one loves him/her, child feels worthless or inferior) and externalizing problems were measured using the 6-item antisocial subscale (e.g., child was disobedient at school, child does not feel sorry for misbehaving, child cheats or tells lies). Researchers have consistently demonstrated the construct validity of this measure, and using the BPI, McLoyd & Smith (2002) found higher levels of child behavior problems using the BPI to be linked to higher spanking by mothers. Reliability for the externalizing subscale ranged from  $\alpha = .71$  to  $.73$ , and reliability for the internalizing subscale ranged from  $\alpha = .70$  to  $.72$ .

*Parent emotional support.* Emotional support from parents and family was measured with the twelve-item Home Observation for Measurement of the Environment (HOME), Part D, a widely used and well-established HOME subscale measure (Caldwell & Bradley, 1980). Emotional support HOME items measure the amount of warmth and involvement as reported by the mother (e.g., how often does the family get together with relatives or friends, how often does

child spend time with his/her father, how does the mother respond to child's tantrum). Emotional support items were scored on a frequency scale and includes response categories from 1 (occurs once per day or more often) to 6 (never, does not occur) and 7 (father/father-figure/parent not present). These response categories were then recoded as 1(emotional support present) or 0 (no emotional support displayed) and summed to create an index score, with higher scores reflecting increased emotional support and involvement. The HOME has been widely adapted (Mott, 2004), and McLoyd & Smith (2002) found HOME maternal support to be negatively linked to child behavior problems. The reliability for the emotional support measure ranged from  $\alpha = .70$  to  $.73$ .

*Perceived school quality.* Perceived school quality was measured with an 8-item scale where mothers rated the quality of their early adolescent's school by assigning a grade to each item scored from 1 ("F") to 5 ("A") (e.g., school does its job on school safety, teachers care about students at this school, school maintains order and discipline). The mean of mothers' responses was calculated, and in this study, reliability ranged from  $\alpha = .91$  to  $\alpha = .92$ .

*Negative peer pressure.* Negative peer pressure to engage in delinquent activities was measured with a five-item dichotomous yes-no self-report scale where early adolescents reported on perceived peer influence (e.g., do you ever feel pressure from your friends to: skip school, smoke cigarettes, try marijuana and drugs, commit crime, drink alcohol, work hard in school (reverse coded)). In this study, scale reliability ranged from  $\alpha = .79$  to  $\alpha = .81$ .

### *Young Adult Measures*

All young adult measures are assessed with adolescents and emerging adults from ages 15 to 24 and come from the young adult of the NLSY79.

*Alcohol use.* Frequency of substance use focused on alcohol use in particular, building from previous studies assessing heavy drinking with the NLSY (e.g., Muthén & Muthén, 2000). The extent of alcohol use was measured through youth self-report of their number of drinks per week and per month. Alcohol use frequency was measured by an eight-point scale, assessing the frequency of drinking in the past year. Response categories were based on alcohol intake in the past year and included: 0 (no alcohol use), 1 (drank 1-2 days in the past year), 2 (drank 3-5 days in the past year), 3 (drank every other month in the past year), 4 (drank 1-2 times in the past month), 5 (drank several times in the past month), 6 (drank 1-2 days per week), 7 (drank 3-6 days per week) and 8 (drank daily). Windle (1990) found that a higher frequency of alcohol use as measured by the NLSY was linked to higher levels of antisocial behaviors among youth.

*Delinquency.* The delinquency construct, adapted from Hannon (2003), was measured using a 5-item adolescent self-report measure of acts committed in the past year, summed to comprise an index score. Items were summed to assess a wide range of adolescent deviance (e.g., skipped school or work, got into a fight at school or work, stole item worth over \$50, hit or seriously threatened to hit someone, convicted of charges). An item was coded as 1 if a delinquent act was reported one or more times and 0 otherwise, with a score of 0 denoting that no delinquency acts had been committed in the past year and a score of 5 denoting that all five delinquency items were endorsed. Using the NLSY, Hannon (2003) found that delinquency among adolescents was positively related to dropping out of high-school for non-poor youth (versus youth in poverty).

*Sexual risk.* Sexual risk behavior was measured using a four-item index score adapted from Raffelli and Crockett (2003), which sums risk behavior items with dichotomous yes-no responses. Those who had ever had sexual intercourse then responded to their number of sex

partners in the last 12-months, and condom use at last intercourse, and relationship with last sexual partner (casual versus non-casual). Following Raffelli and Crockett (2003), scores ranged from 0 (no risk; i.e., never had sex) to 4 (high risk; i.e., sexually active, two or more partners in the last 12 months, no condom use at last intercourse, casual partner at last intercourse). In addition, a score of 1 indicated that the adolescent was sexually active, but no risks were reported. Raffelli & Crockett (2003) found that autonomous decision making and negative peer pressure was positively related to sexual risk behavior four years later using the NLSY.

## Chapter 4: Results

### *Latent Class Growth Analysis*

The present study uses Latent Class Growth Analysis (LCGA) (Nagin & Tremblay, 1999), a type of Growth Mixture Modeling (Muthén & Muthén, 2000) to conduct latent class growth trajectories and joint class trajectory analyses. LCGA is a well-suited methodology for this study, as it allows researchers to investigate models that relate the entire longitudinal course of multiple behaviors of interest (Nagin & Tremblay, 2001), such as sexual risk, alcohol use and delinquency. LCGA has three central advantages over structural equation modeling and growth modeling. First, LCGA is able to capture developmental heterogeneity by allowing participants to cluster into distinct subgroups, each with a distinct mean trajectory (Muthén & Muthén, 2000). LCGA is therefore appropriate methodology to examine developmental trajectories suggested to be inherently categorical, such as sexual risk (Ensminger, 1990), alcohol use (Muthén & Muthén, 2000), and delinquency (Nagin & Tremblay, 2001).

Second, LCGA enables researchers to classify *how* these classes or groups are related between multiple risk behaviors. Groups of sexual risk trajectories can be linked to distinct trajectories of alcohol use and delinquency to evaluate how patterns of engaging in these three

risks are related over time. Third, LCGA provides the ability to determine unique predictors of trajectory classes over time (Muthén & Muthén, 2000; White, Pandina, & Chen, 2002), and this study uses LCGA to identify specific risk and protective factors that may be associated with joint trajectory groups.

### *Analyses Plan*

Analyses were conducted in three steps. First, to investigate how trajectories of problem behaviors develop, distinct latent class models for trajectories of sexual risk, alcohol use and delinquency over the course of adolescence and early adulthood (ages 15-24 years) were identified with the use of Mplus (Version 4.1; Muthén & Muthén, 2004). Growth trajectories were limited to linear patterns of development because the majority of the sample completed assessments at fewer than four waves of data (Singer and Willett, 2003).

Second, to investigate how these distinct adolescent profiles of risk behaviors are related and co-occur with one another, joint probabilities, which indicate the groups adolescents had the highest probability of concurrently belonging to, were derived using Mplus (Nagin & Tremblay, 2001). Specifically, growth parameters from the individual class memberships (e.g., intercepts and linear slopes from the high sexual risk, high alcohol use, and high delinquency classes) were used to predict the probability of multiple group membership (e.g., problem behavior group) (Nagin & Tremblay, 2001). In this way, adolescents' unique patterns of sexual risk taking, alcohol use and delinquency were used to identify distinct groups of problem behaviors over time.

Third, to determine how early adolescent processes of risk and protection forecast adolescent membership in joint trajectory groups, multinomial logistic regression in SPSS 12.0 was conducted. Participants' joint group membership was regressed on the early adolescent risk

and protective factors in multinomial logistic regressions (Nagin & Tremblay, 2001; Stanton, Flay, Colder & Mehta, 2004) to investigate which early adolescent antecedents forecasted group membership in adolescence and emerging adulthood. In addition, contextual interactions in multinomial logistic regressions were conducted in order to test resilience-based hypotheses. As well, gender, ethnicity and age interactions were conducted in order to better understand the diversity with which problem behaviors can be expressed.

### *Descriptive Statistics*

Descriptive statistics, including means, standard deviations and skewness indices for the three risk taking outcomes are displayed in Table 3. Overall, all three risk outcomes were highly skewed and displayed high kurtosis, with sexual risk becoming steadily less skewed on average over time, and delinquency increasingly more skewed on average over the course of adolescence and emerging adulthood. The data were skewed in that there were a large number of zeros, indicating that adolescents were not engaging in risks at each time point (e.g., no delinquent acts). In addition, all three risk constructs- sexual risk, alcohol use, and delinquency- were specified as count variables, such that each unit increase corresponded to an increasing number of risks (e.g., delinquent acts committed).

Researchers have demonstrated that a zero-inflated Poisson (ZIP) model is a suitable correction for these two data circumstances: data skewness with a large number of zeros and using count variables (Kreuter & Muthén, 2006; Nagin & Land, 1993). The zero-inflated Poisson distribution is a special case of the Poisson distribution, defined as a discrete probability distribution that can be derived as a limiting case of the binomial distribution. Zero-inflated Poisson models were developed for data in which the count outcome (e.g., sexual risk, alcohol use, delinquency) is equal to zero more than one would expect using a Poisson distribution (Hall,

2000; Kreuter & Muthén, 2006). In this way, the zero-inflated Poisson contains a zero-inflation factor to account for the possibility of a greater frequency of zero counts than can be predicted by the standard Poisson distribution (Jones, Nagin, & Roeder, 2001; Nagin & Tramblay, 2001).

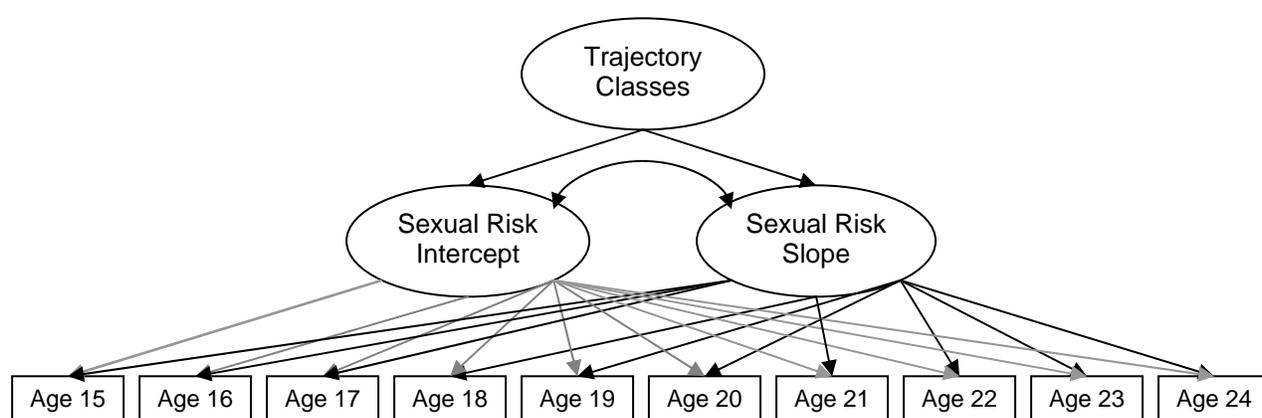
*Table 3.* Descriptive statistics for the risk outcome variables

	Mean	SD	Skewness	Kurtosis
Sex risk 1998	1.07	1.24	12.05	7.69
Sex risk 2000	1.39	1.30	5.86	12.44
Sex risk 2002	1.38	1.29	6.72	14.30
Sex risk 2004	1.49	1.32	4.85	15.73
Alcohol use 1998	1.84	2.27	15.12	4.35
Alcohol use 2000	1.84	2.27	20.89	5.29
Alcohol use 2002	2.13	2.34	18.24	11.87
Alcohol use 2004	2.46	2.42	13.34	16.96
Delinquency 1998	1.03	1.14	19.30	6.43
Delinquency 2000	.74	.94	29.55	18.43
Delinquency 2002	.62	.77	24.40	14.80
Delinquency 2004	.58	.81	37.80	31.85

### *Individual Trajectories*

LCGA allows researchers to capture diversity in developmental trajectories in sexual risk, alcohol use, and delinquency trajectories over time. Utilizing the intercept and linear slope, LCGA categorizes adolescents into distinct subgroups, or classes, each with a distinct trajectory

pattern over time (Muthén & Muthén, 2000; Nagin, 1999). Figure 1 depicts this LCGA process of identifying distinctive classes of individual level trajectories over adolescence and emerging adulthood for sexual risk specifically. In this study, age 16 was selected as the intercept for all three problem behaviors. This age was designated as the problem behavior intercept because it approximates the midpoint of adolescence and is an age when the participants had more data due to the NLSY sampling design.



*Figure 1.* Describing the developmental course of sexual risk behavior and trajectory classes using LCGA.

### *Model Building Process*

In deriving models of risk taking behaviors, LCGA utilizes a model building technique to determine the optimal number of classes. Starting with a one-class model, classes are subsequently added to evaluate improvement in model fit. In this way, models with differing number of classes can be compared to one another based on model fit statistics in order to select the model that best represents the data.

To determine the optimal number of classes for the models of sexual risk, alcohol use, and delinquency, the standards presented by Nagin (1999) and Muthén (2000) were followed. The Bayesian information criterion (BIC) (Schwarz, 1978) was the primary model selection tool used to evaluate the optimal number of classes in the model. Secondly, the Lo-Mendel Rubin (LMR) statistic was used to evaluate the number of classes which fit the data best. Third, the shape of the trajectory classes was evaluated to ensure that each class was conceptually unique and meaningful. Each of these standards for model selection is discussed in detail in the paragraphs that follow.

First, the BIC was the central tool to determine the optimal number of classes for each model. A goodness-of-fit model statistic based on a maximization of a log likelihood function, the BIC has been recommended as a well-validated tool to evaluate improvement in model fit when additional classes are added (D'Unger, Land, McCall, & Nagin, 1998). Much like the chi-square test in SEM, the BIC is used to select the optimal number of classes in the model. However, unlike the chi-square test, the BIC statistic has the ability to compare models in non-nested models to select the best-fitting number of classes in the model (Muthén & Muthén, 2000; Nagin & Tremblay, 2001). The BIC is based on the negative log likelihood of the model, with a penalty for the number of parameters (Schwarz, 1978). In this way, the BIC favors model parsimony and is scaled so that a small value corresponds to a better fitting model, with a large log-likelihood value and not too many parameters (Muthén, 2000; Raftery, 1995). Decreases in the BIC statistic therefore indicate improvements in model fit.

The Lo, Mendell, Rubin (LMR) statistic (Lo, Mendell & Rubin, 2001) was used secondarily to assess model fit (Muthén, 2000). The LMR is a log likelihood ratio test used to compare models with different number of classes to find the best fitting model for the data. The

LMR is based on an approximation of the likelihood ratio test distribution, which some researchers believe make the LMR statistic an important compliment to the BIC (Nylund, Asparouhov, & Muthén, 2006). Specifically, the LMR provides an adjusted likelihood ratio-based method for testing  $k - 1$  classes against  $k$  classes for nested class models (Muthén, 2000). A low  $p$ -value on the LMR test indicates that the  $k - 1$  class is less favorable than the  $k$  class model. Though the LMR test provides a useful additional tool for assessing model selection, it has been criticized for capitalizing on Type II error (Jeffries, 2003).

However, because the BIC favors class parsimony, and the LMR has been criticized for its capitalization on Type II error, the bootstrap Likelihood Ratio Test (BLRT) is favored by Muthén and Muthén (2006) for its balance between these two statistics. Instead of assuming the difference distribution follows a known distribution (e.g., the chi-square distribution), the bootstrap test empirically estimates the difference distribution (Nylund et al, 2006). Similar to the LMR test, the bootstrap test provides a  $p$ -value that can be used to compare the increase in model fit between the  $k - 1$  and  $k$  class models. The bootstrap test, however, is computationally rigorous for most computer operating systems, and does not always converge. When possible, the bootstrap test was used in these analyses as an additional statistic for model decision making.

Last, evaluating the shape of each growth trajectory is critical in determining the optimal number of classes for each model. In order for a model to be maximally informative, classes must represent unique patterns of development over time (Nagin & Tremblay, 2001). Guiding conceptualization of each risk behavior is also key (Muthén, 2000), and final decisions on the number of classes chosen were based on developmental theory and knowledge of the course of adolescent sexual risk, alcohol use, and delinquency over adolescence and emerging adulthood.

### *Modeling Pathways of Sexual Risk*

Using the model selection criteria presented, LCGA was used to determine the optimal number of distinct classes for growth in sexual risk over time, from ages 15 to 24. The model fit statistics are displayed in Table 4. The BIC decreased steadily for the one- through three-class solutions but increased for the four-class model, indicating that the 3-class model was optimal. Therefore, the BIC supported the decision for a 3-class model of sexual risk taking.

However, the LMR statistic fell out of statistical significance in the 3-class model, indicating that a 2-class model could be a better fit for the data. The bootstrap statistic was run to collect more information in the decision between the 2- and 3-class models, but it was truncated by the program in 13 iterations, or draws, and the model did not converge.

Evaluating the 3-class model based on trajectory shape indicated that the classes were unique and distinct, with the first class becoming sexually active in early adolescence and increasing risk over time, the second becoming sexually active in middle adolescence and increasing risk over time, and the third becoming sexually active in late adolescence and being much safer sexually than the other two early-initiating groups.

In contrast, the two-class model depicted one group of adolescents abstaining from sexual activity throughout the entire span of the study and the second group becoming sexually active beginning in middle-adolescence, but with no sexual risk activity. This 2-class characterization of sexual risk did not appear to accurately represent the sample data; according to the sample's descriptive statistics, an average of 60.3% of adolescents engaged in sexual risk taking. The 2-class model, which reflected safe sexual behavior, did not fit the true nature of the data.

Therefore, based on trajectory patterns and the BIC statistic, the *three-class model* was chosen as

best representing the diverse patterns of sexual risk taking over time. Table 4 displays the model statistics for each model conducted and highlights the final model, the 3-class sexual risk model.

*Table 4.* Model fit statistics for sexual risk trajectories

Classes	Sexual Risk	
	BIC Statistic	Lo-Mendel Rubin Statistic (LMR)
1	14617.33	--
2	14169.32	$p < .001$
3	14101.80	$p = .71$
4	14115.35	$p = .74$

The three-class sexual risk model trajectory groups are depicted in Figure 2, and the unstandardized intercepts and slopes in Table 5. Inspection of the figure shows that the majority of adolescents were categorized into an early-onset increasing class, comprising 68.9% of the sample ( $n = 1,222$ ). This group initiated sexual activity in early adolescence, increased in sexual risk taking through middle and late adolescence, and was still at high levels of sexual risk taking in emerging adulthood. The increase in sexual risk was steep throughout the course of adolescence, and because sexual activity began in early adolescence, these adolescents were at high risk over the entire course of adolescence.

The second largest group, constituting 22.6% of the sample ( $n = 400$ ), was a mid-onset increasing sexual risk class. In this class, adolescents were sexually active beginning in middle adolescence and increased in sexual risk taking throughout middle and late adolescence, and

were still at high levels of sexual risk taking in emerging adulthood. In fact, in emerging adulthood these adolescents were at the same levels of risk as the early-onset group. However, because these adolescents in the mid-onset increasing class were estimated to be sexually active, on average, two to three years after the early-onset group, they were at high-risk for a relatively shorter period during adolescence.

Last, the third sexual risk group constitutes the abstaining class, which included 8.5% of the sample ( $n= 151$ ). This group of adolescents appeared to abstain from engaging in sexual activity for most of adolescence, and became sexually active in late adolescence/emerging adulthood, on average at about 22 to 23 years of age. A score of 1 on sexual risk taking indicates that adolescents are sexually active, but engaging in safe sex (i.e., no risks reported). This late-onset class appeared to remain safe sexually through emerging adulthood.

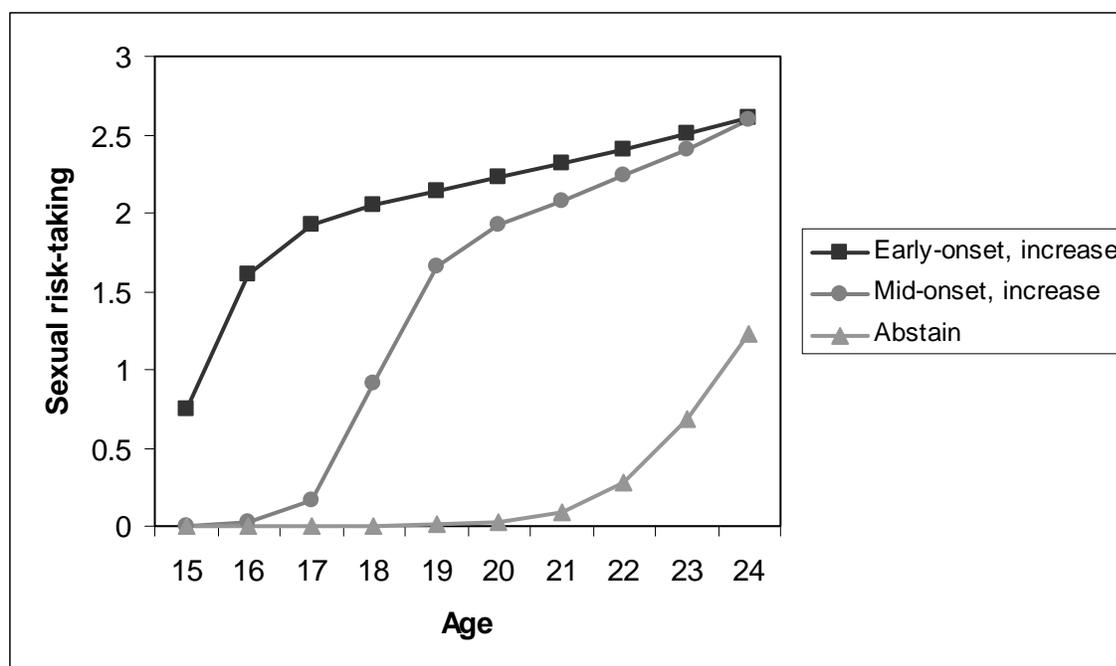


Figure 2. Model-based trajectories of sexual risk taking over the course of adolescence.

*Table 5.* Unstandardized growth factor parameter estimates and standard errors (SE) for sexual risk taking

Sexual Risk Classes	Intercept (SE)	Linear Slope (SE)
Abstain	-.39 (1.14)	.12 (.22)*
Mid-onset, increase	.37 (.07)**	.07 (.01)**
Early-onset, increase	.64 (.02)**	.04 (.01)**

*Note.* \* $p < .05$ , \*\* $p < .01$ .

### *Modeling Pathways of Alcohol Use*

LCGA was next used to determine the optimal number of classes for growth in alcohol use over time, from ages 15 to 24, following the model selection criteria presented. The model fit statistics are displayed in Table 6. The BIC decreased steadily for the one- through four-class models. However, the BIC showed the largest decrease between the 2-class and the 3-class models, indicating a large improvement in model fit for the 3-class model.

The LMR statistic did not distinguish between the classes, as it never fell out of significance, and was therefore of minimal assistance. Last, the bootstrap statistic was run in attempt to have more information in the decision between the 3- and 4-class models, but it was truncated by the program in 5 iterations, or draws, and the model did not converge.

Comparison of the 3- and 4-class model trajectory shapes revealed that the 4-class model split the lowest abstaining class into two abstaining groups, which is of little conceptual significance. In this way, the single abstaining group from the three-class model was divided into two parallel abstaining groups in the four-class model. According to Nagin and Tremblay (2001), in choosing the final model, each group should be distinct from one another and of conceptual

importance. The 3-class model therefore offers more information about the nature of alcohol use in adolescents with its single abstaining class. Indeed, the 3-class model depicted three distinct groups: the first began drinking prior to early adolescence and accelerated risk over time, the second began drinking in middle adolescence and accelerated risk over time, and the third began drinking in late adolescence/emerging adulthood and remained at low levels of alcohol use.

Because the 3-class model was more conceptually informative, the alcohol use trajectory shapes distinct, and the BIC had the greatest improvement, the *3-class model* was the best fitting for the data and was chosen as best representing the structure of alcohol use over time. The model fitting statistics are depicted in Table 6, and the final 3-class model is highlighted.

*Table 6.* Model fit statistics for alcohol use trajectories

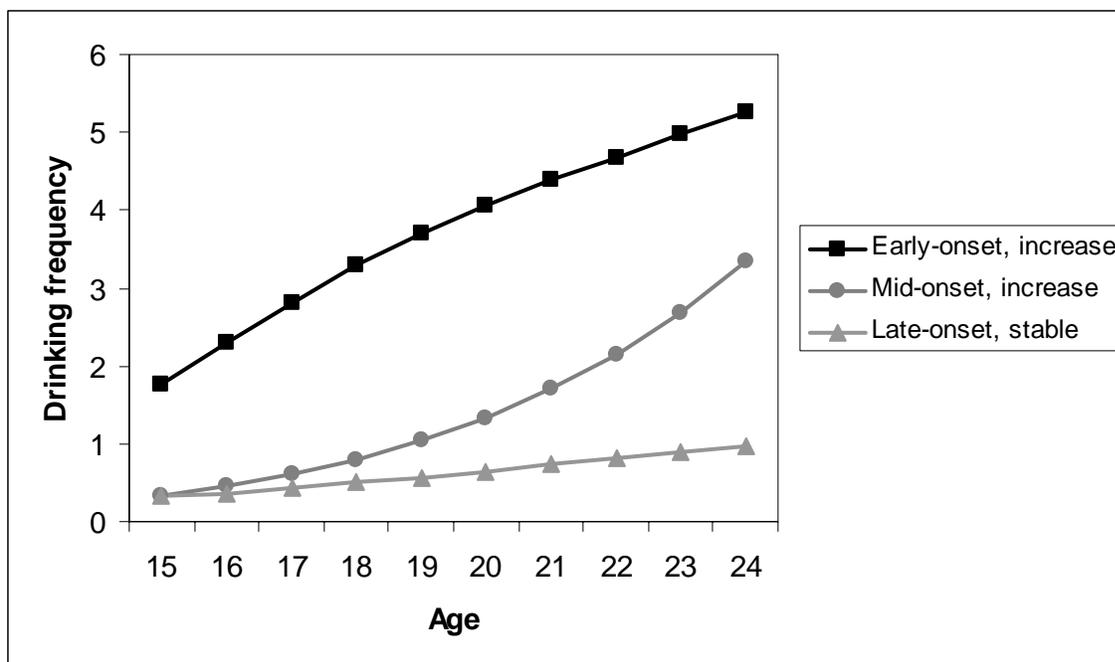
Classes	Alcohol Use	
	BIC Statistic	Lo-Mendel Rubin Statistic (LMR)
1	23355.36	--
2	22284.58	$p < .001$
3	22138.88	$p < .01$
4	22095.53	$p = .01$

The three-class alcohol use model trajectory classes are depicted in Figure 3, and the unstandardized intercepts and slopes in Table 7. Inspection of the figure shows that the majority of adolescents are categorized into an early-onset increasing class, comprising 55.1% of the sample ( $n = 980$ ). This group had already begun drinking alcohol at the start of the study, at age

15, and steadily increased their frequency of alcohol consumption throughout adolescence and emerging adulthood. By emerging adulthood, these adolescents were estimated to be drinking, on average, one to two days per week. This early-onset increasing class showed early use of alcohol, with a steady pattern of increased drinking over the course of adolescence.

The second class, which contains 21.5% of the sample ( $n= 382$ ), began drinking alcohol in middle-adolescence. This group too showed steady increases in the frequency of drinking alcohol over the course of adolescence, but by emerging adulthood was drinking at much lower rates than the early-initiating class.

The third alcohol class constitutes 23.4% of the sample ( $n= 416$  adolescents). This group, referred to as the late-onset, stable class, began drinking at very low frequency in late adolescence/emerging adulthood. This group was relatively stable over time, and drank alcohol infrequently, estimated to be only several times per year, in emerging adulthood.



*Figure 3.* Model-based trajectories of alcohol drinking frequency over the course of adolescence and emerging adulthood.

Table 7. Unstandardized growth factor parameter estimates and standard errors (SE) for alcohol

Alcohol Use Classes	Intercept (SE)	Linear Slope (SE)
Late-onset, stable	1.44 (.12)**	-.07 (.04)
Mid-onset, increase	-.34 (.25)	.20 (.03)**
Early-onset, increase	1.25 (.04)**	.05 (.01)**

Note. \* $p < .05$ , \*\* $p < .01$ .

### *Modeling Pathways of Delinquency*

LCGA was also used to determine the optimal number of unique classes for growth in delinquency over time, from ages 15 to 24. The model fit statistics are displayed in Table 8. The BIC decreased steadily for the one- through three-class solutions but increased for the four-class model, indicating that the 3-class model was optimal. Therefore, the BIC supports the decision for the 3-class model of delinquency.

However, because the LMR statistic fell out of statistical significance in the 3-class model, indicating that the 2-class model was a better fit for the data, the bootstrap test was computed. Testing a model with two versus three groups with the bootstrap test indicated that a 3-class model was preferred (Ho likelihood = -6675.33,  $p < .01$ ).

Evaluating the 3-class model based on trajectory shape indicated that the classes were unique and distinct, with one class beginning at high levels and decreasing over time, the second beginning at much lower levels and decreasing over time, and the third abstaining from delinquency over the course of adolescence and early adulthood. Therefore, because the BIC and

bootstrap test indicated that the 3-class model was optimal and the trajectory shapes were distinct, the *three-class model* was decided as the best fit for describing the course of delinquency over time. This class is highlighted in Table 8, and depicts the model fit statistics for each of the models tested.

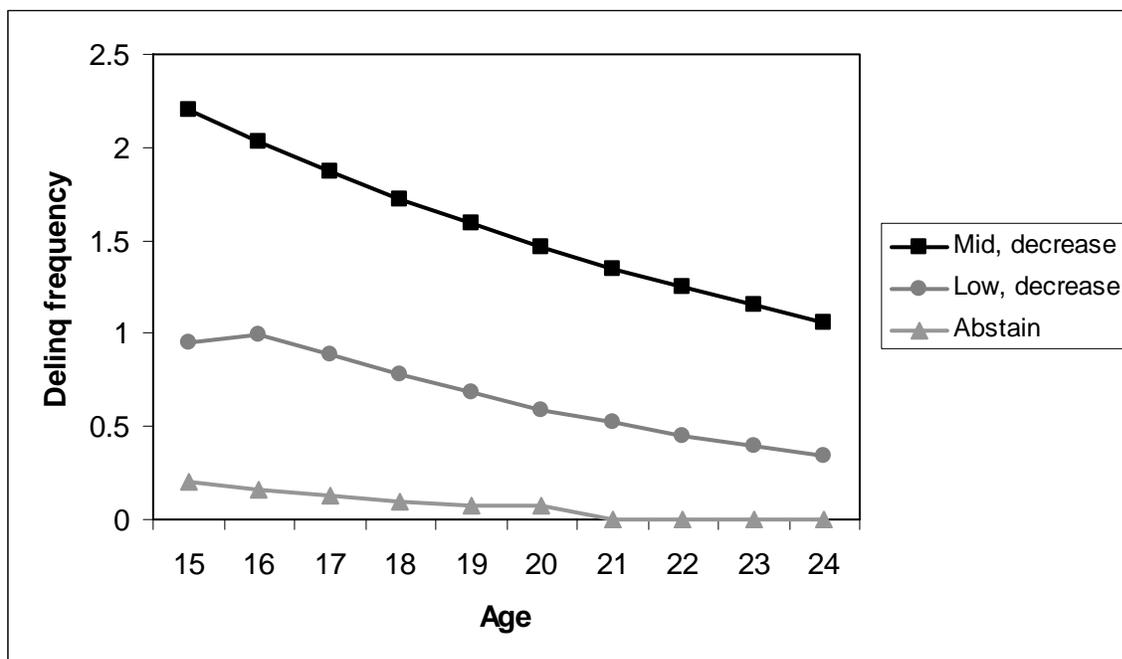
*Table 8.* Model fit statistics for delinquency trajectories

Classes	Delinquency	
	BIC	Lo-Mendel Rubin Statistic (LMR)
1	13743.96	--
2	13421.87	p < .001
3	13423.05	.54
4	13456.16	.65

The three-class model trajectory groups are depicted in Figure 4, and the unstandardized intercepts and slopes in Table 9. Inspection of the figure shows that the majority of adolescents were categorized into a low-decreasing group, making up 75.6% (n= 1,345). This class was characterized by beginning at low levels of delinquency in early adolescence, decreasing steadily and steeply in mid-adolescence through emerging adulthood. This low-decreasing class, representing the majority of adolescents, can be described as a group experimenting in delinquency in early to middle adolescence, but decreasing steadily with virtually no involvement in delinquent activities during late-adolescence and emerging adulthood.

The second largest class, constituting 10.9% of the sample (n= 194), was a moderate-decreasing group, and adolescents engaged in moderate levels of delinquency in early adolescence, but decreased steadily through middle-adolescence to participate in relatively low levels of delinquency by late adolescence and emerging adulthood. Although the sample overall did not engage in high levels of delinquency as measured in this study, this group of adolescents did engage in higher levels of delinquency, relative to the rest of the sample.

Last, the third delinquency class constitutes the abstaining group, with 13.4% of the sample (n= 239). This group of adolescents abstained from engaging in delinquent activities over the course of adolescence, with little change from early adolescence through emerging adulthood.



*Figure 4.* Model-based trajectories of delinquent acts committed over the course of adolescence and emerging adulthood.

*Table 9.* Unstandardized growth factor parameter estimates and standard errors (SE) for delinquency

Delinquency Classes	Intercept (SE)	Linear Slope (SE)
Abstain	-1.83 (.42)**	-.22 (.20)
Low, decrease	.03 (.05)	-.14 (.01)**
Mid, decrease	.71 (.08)**	-.08 (.01)**

Note. \* $p < .05$ , \*\* $p < .01$ .

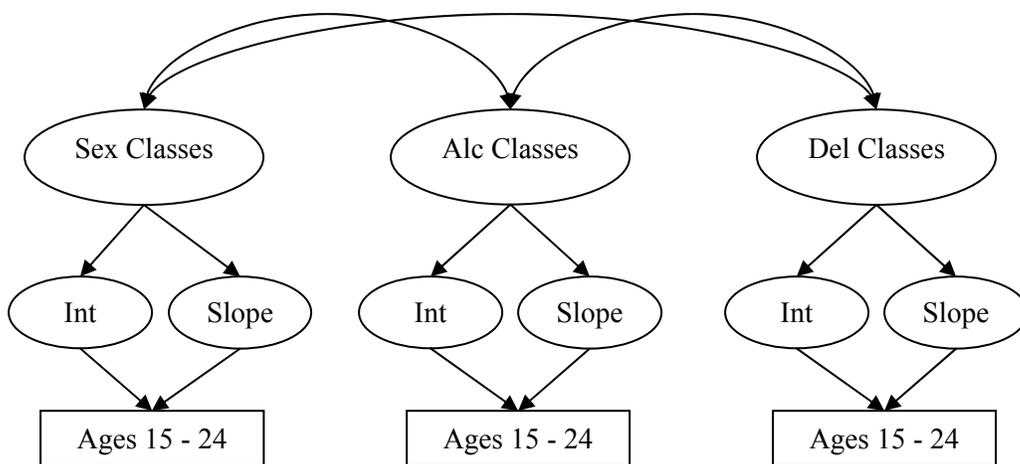
#### *Joint Trajectory Analyses: Measuring Risk Co-occurrence*

To understand how growth trajectories of sexual risk, alcohol use, and delinquency are linked over the course of adolescence, a concurrent model to investigate joint probabilities between the three risk constructs was conducted. The estimation process of LCGA provides joint probabilities, indicating the probability that risk sub-groups co-occur between multiple types of risks (Nagin & Tremblay, 2001). The Mplus program uses the intercept and slope of the final latent classes from sexual risk, alcohol use, and delinquency to specify joint classes. For example, to define the problem behavior group, the slope and intercept from the highest risk sexual risk, alcohol use, and delinquency groups would be used. In this way, LCGA uses the results from the individual trajectory classes to create the joint, co-occurring groups in order to determine how distinct, but conceptually related risks come together developmentally.

Identifying the probability of membership in trajectory groups across risk behaviors has the capacity to reveal how distinct adolescent profiles of risk behaviors are related (Nagin & Tremblay, 2001). These probabilities provide the ability to describe the linkage in the developmental course of sexual risk, alcohol use and delinquency and consequently allows for

the investigation of the diversity in problem behavior over time. Such a joint trajectory model measures comorbidity between these risk behaviors, and provides advancement over summary statistic approaches through its capacity to examine the course of risk behaviors over the entire measurement period, from ages 15 to 24 (Nagin & Tremblay, 2001).

A depiction of the joint trajectory analysis is shown in Figure 5. The risk groups, derived from the individual trajectories each have unique intercept and slope factors, corresponding to a pattern of linear growth (Muthén, 2001). In this joint trajectory analysis, the three risk groups, or classes of sexual risk, alcohol use, and delinquency are linked to one another (Muthén, 2001), and used to combine the groups from the individual trajectory analyses. In this way, the three groups for each risk as linked over the course of adolescence, and LCGA allows for the classification of how these groups are related to one another over time.



*Figure 5.* Model of LCGA joint trajectory analyses, co-occurrence between sexual risk, alcohol use, and delinquency classes.

### *Model Trimming Process*

To conduct the LCGA joint trajectory analysis using Mplus, a 27-group model, with all possible combinations of trajectory classes (3 sexual risk classes X 3 alcohol use classes X 3 delinquency classes) was first specified. To determine the optimal number of risk taking behavior joint groups, LCGA utilizes a model-trimming technique. The program begins with the full, 27-group model, and groups are removed to evaluate overall model fit. In this way, models with differing number of groups can be compared to one another based on model fit statistics, so that the model selected most parsimoniously represents the data.

To determine the optimal number of groups for the models of sexual risk, alcohol use, and delinquency, the standards presented by Nagin (1999) and Muthén (2000) were utilized. First, those joint trajectory groups containing empty cells, with no participants, were eliminated. Second, once adolescents were placed in groups, posterior probabilities were used to trim model groups. Posterior probabilities indicate the degree to which groups are distinct from one another, and that adolescents are well-classified in a particular group based on their growth parameters. Posterior probabilities range from 0 to 1, with a score of 1 indicating that groups are completely distinct. Groups with low probabilities, such as below .50, were systematically eliminated from the joint trajectory analyses.

After each group was trimmed from the overall model based on its posterior probability, the Bayesian information criterion (BIC) (Schwartz, 1978) was the primary model selection tool used to evaluate the optimal number of model classes. In addition, the entropy model statistic, a summary indicator of group posterior probabilities, was also considered in the model selection process. The entropy value is used to evaluate the accuracy of classification of adolescent joint group membership and the degree of separation between groups. Like posterior probabilities,

entropy values range from 0 to 1, with higher values indicating greater distinctness between groups and clearer classification.

### *Joint Group Results*

Table 10 depicts the model statistics from the model trimming process for the joint group analyses. Results from the 27-group model revealed that 14 of the possible groups contained empty cells, i.e., no adolescents were placed into these groups. These groups were therefore excluded from the LCGA analyses. The resulting 13-group model had improved fit indices according to the BIC, but also contained three groups with now empty cells. These three groups were also eliminated from the analyses. The resulting 10-group model had improved model fit, but contained one group with empty cells and consequently, this group was also deleted from subsequent analyses.

The resulting 9-group model contained no empty cells, and groups were therefore systematically eliminated one group at a time based on low posterior probabilities, which indicated that groups were not well-separated (Nagin & Tremblay, 1999; 2001). Groups with the lowest posterior probability were eliminated, and the BIC continued to decrease with each step until after the 9-group model. In the 6-group model the BIC increased, indicating that this model fit the data most optimally.

This *6-group model* contained the lowest BIC and was the most parsimonious. Therefore, the 6-group model fit the data optimally: the lowest posterior probability was .55, and the majority of the probabilities were .65 and above, indicating that the joint trajectories were well-separated and represented unique patterns of growth in sexual risk, alcohol use and delinquency. Table 11 displays probabilities, percentages, and final counts for each of the final joint trajectory

groups. Each of these final groups will be discussed in turn and are depicted pictorially by classification name in Table 12 for ease of reference.

*Table 10.* Model trimming of joint trajectory group analyses

Number of Groups	BIC (Parameters)	Entropy
27 (full model)	50476.86 (32)	0.65
13	50372.10 (18)	0.55
10	50351.82 (15)	0.52
9	50345.01 (14)	0.55
8	50340.35 (13)	0.55
7	50334.59 (12)	0.55
6	50334.15 (11)	0.55
5	50357.67 (10)	0.57

*Table 11.* Final 6-group joint trajectory model

Joint Trajectory Group	Probability	Percentage	No. Adol.
High sex and alcohol	.72	46.0%	818
Moderate problem behavior	.57	22.2%	395
Problem behavior	.74	13.6%	241
Alcohol & delinquency experiment	.55	3.6%	64
Moderate alcohol use	.66	14.1%	250
High alcohol use	.71	.5%	10

Table 12. Final joint trajectory group figures

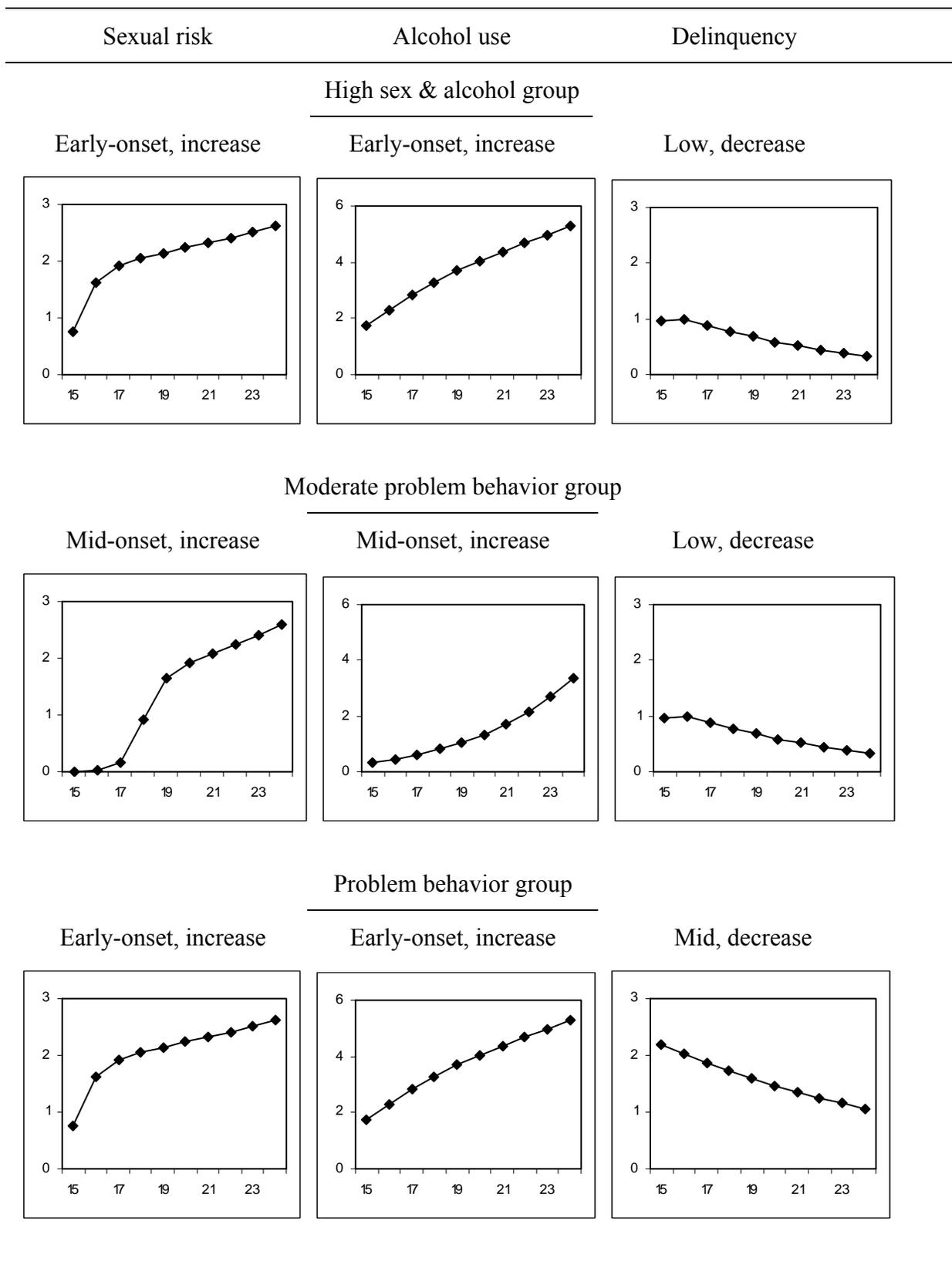
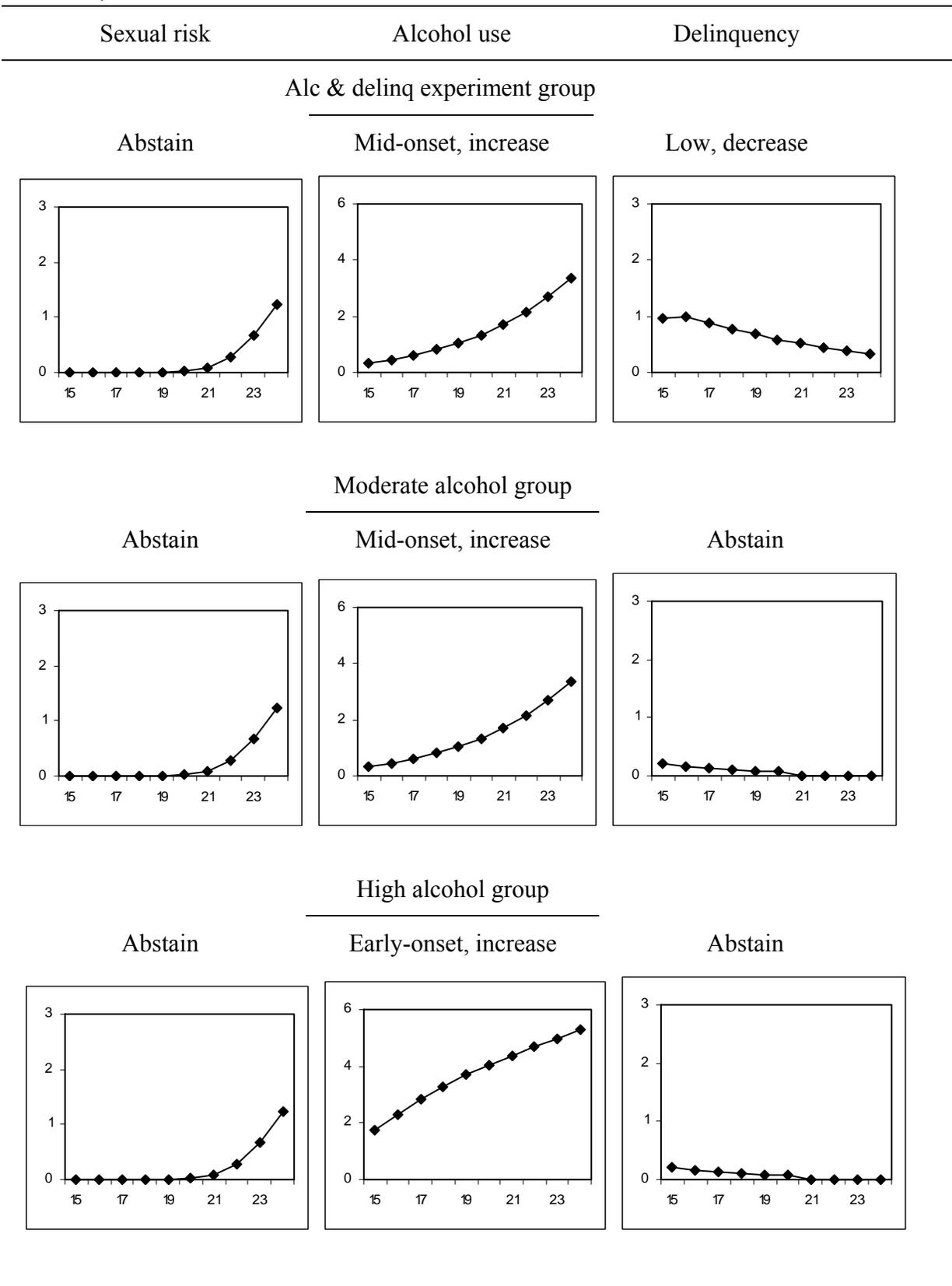


Table 12, continued



### *High Sex and Alcohol Group*

This *high sex and alcohol group* comprised the largest proportion of adolescents in the sample, 46.0% (n= 818). Characterized by high sexual risk taking beginning in early adolescence and the highest levels of alcohol use, also beginning in early adolescence, this group was at relatively high risk over the course of adolescence and early adulthood. This group abstained from delinquency, but engaged in sexual risk and alcohol use at the most elevated levels in the sample.

### *Moderate Problem Behavior Group*

This *moderate problem behavior group*, containing 22.2% of the sample (n= 395), was characterized by moderately high levels of sexual risk taking beginning in middle adolescence and accelerating over time as well as low levels of alcohol and delinquency, relative to the rest of the sample. In this way, all three risk behaviors were present in this group, but risks were not at the highest levels of severity, as represented by the problem behavior group. Labeled the moderate behavior problem group, this group represents a distinct, less severe form of problem behavior syndrome (Jessor & Jessor, 1977).

### *Problem Behavior Group*

This group, which contained 13.6% of the sample (n= 241), engaged in delinquency, sexual risk, and alcohol use at the highest levels of severity in the sample. This group is labeled the *problem behavior group* because this group most approximates Jessor and Jessor's (1977) theory of youth problem behavior. Sexual risk taking was present beginning in early adolescence and increased throughout adolescence and emerging adulthood, alcohol use frequency also began in early adolescence and steadily increased, and delinquency was present at relatively high levels in early adolescence, and steadily declined over time, but remained at moderate levels in

emerging adulthood. This group of adolescents was therefore at the highest level of risk throughout adolescence based on their levels of engagement of sexual risk taking, alcohol use, and delinquency.

#### *Alcohol and Delinquency Experimenting*

This group of adolescents, representing 3.6% of the sample (n= 64), is referred to as the *alcohol and delinquency experimenting group*, because their risk behavior was confined to alcohol and delinquency at relatively low levels. This group committed an estimated one delinquent act in early adolescence and decreased over time and overall is characterized by low levels of delinquency. In addition, this group of adolescents drank alcohol at moderate to low levels, such that these youth began drinking in middle-adolescence and increased over time. However, by early adulthood this group of adolescents still did not drink with high frequency. This group did not engage in sexual risk behavior, and on average was not sexually active until late adolescence or emerging adulthood. In this way, this group of adolescents experimented with alcohol and delinquency in early and middle adolescence, but their risk behavior decreased over time and never accelerated to high levels.

#### *Alcohol-only Group*

The results of the joint trajectory analysis revealed that *two groups* of adolescents who engaged in alcohol risk only and abstained from sexual risk and delinquent behaviors. The first group of adolescents was characterized by using alcohol beginning in early adolescence, and then steeply accelerated their frequency of use throughout late adolescence and emerging adulthood (.5% of sample, n= 10). The second group was characterized by drinking alcohol beginning in middle adolescence, and then steeply increasing their frequency of use throughout late adolescence and emerging adulthood (14.1% of sample, n= 250). Because both of these

groups comprise alcohol-only oriented risk taking, for the purposes of the study they were combined to form the *alcohol-only group*. This combined group contained 14.6% of the sample (n= 260).

#### *Early Adolescent Antecedents: Processes of Risk and Protection*

Last, multinomial logistic regressions in SPSS 12.0 were conducted in order to determine how antecedents differentiate between concurrent groups (Muthén, 2000; 2001). This approach allows for the identification of how patterns of risk and protection in early adolescence forecast the likelihood of engaging in different patterns of risk over the course of adolescence and emerging adulthood. Understanding the developmental patterns of youth exposed to risk who do not ultimately engage in risk behaviors can serve to clarify the role of risk and protective antecedents as well as successful means by which to buffer risk (Luthar et al., 1991; Masten, 1999; Rutter, 1987). This study considers how early adolescent processes of risk and protection in early adolescence, including behavior problems, parent and peer connectedness and school quality, forecast distinct patterns of risk taking over the course of adolescence.

Participants' group membership, such as problem behavior group, was regressed on the early adolescent contextual risk and protective factors in multinomial logistic regressions (Nagin & Tremblay, 2001; Stanton et al., 2004). The *high sex and alcohol group* was used as the reference group in these analyses because it constituted the largest proportion of adolescents and was most consistent with the study's conceptualization and hypotheses of comparisons to a high sexual risk taking group.

In addition, interactions by age, sex, and behavior problems and contextual variables were examined. Interactions by age were used to investigate how relationships between antecedents in early adolescence and risk behavior in adolescence and emerging adulthood may

differ by the age at which the antecedents were measured at the transition to adolescence. These interactions enable the study to examine whether the relationship between early adolescent variables and risk group membership varies by age of assessment. As well, interactions by sex were included to investigate how process of risk and protection might differ between males and females in the transition to adolescence and risk behavior in adolescence and emerging adulthood. Interactions with ethnicity were included in order to explore how patterns of risk and protection might differ for specific groups. Last, interactions between behavior problems (externalizing problems, internalizing problems) and contextual factors (parental emotional support, peer influence and school quality) were included in order to investigate how these factors might interact to buffer or exacerbate risk taking behavior over the course of adolescence and emerging adulthood.

#### *Early Adolescent Antecedent Results*

Table 13 lists the means and standard deviations for the control variables and antecedents under study in the transition to adolescence. In Table 14, correlations between these early adolescent antecedents are displayed.

*Table 13.* Descriptive statistics for antecedents in the transition to adolescence

	Mean (SD)	Max.	Min.
Externalizing	1.74 (1.69)	6	0
Internalizing	1.90 (1.47)	5	0
Support	108.30 (19.28)	143	20
Peer pressure	.10 (.22)	1	0
School quality	3.93 (.80)	5	1

Table 14. Correlations between antecedents in the transition to adolescence

	1.	2.	3.	4.	5.
1. Externalizing	--				
2. Internalizing	.45**	--			
3. Support	-.24**	-.17**	--		
4. Peer pressure	.19**	.08**	-.05*	--	
5. School quality	-.17**	-.14**	.08**	-.10**	--

Note. \*\* $p < .01$ , \* $p < .05$ .

The full multinomial logistic regression model included measures of gender, ethnicity, age, mother education, whether the father was present in the household, as well as adolescent externalizing problems, internalizing problems, and the contextual factors of parental emotional support, school quality, and peer pressure. As well, 2-way interactions of age, sex, and ethnicity by contextual factors and behavior problems were included as well as context by behavior problems interactions.

The multinomial logistic regression was first conducted with the full model, which included all of the control variables, antecedent main effects, sex by antecedents interactions, age by antecedents interactions, and contextual interactions (internalizing and externalizing X support, peer pressure and school quality). This significant chi-square test,  $\chi^2(108, N = 1596) = 297.18, p < .001$ , indicated that the full model fit the data better than an intercept-only null model. To trim the full model, all non-significant 2-way interactions were deleted, and the resulting final model fit just as well as the full model with all 2-way interactions as indicated by the non-significant chi-square difference test,  $\Delta\chi^2(48, N = 1596) = 45.95, p = .56$ , which

indicated no change in the log-likelihood value. Therefore, the final trimmed regression model included the control variables, antecedent main effects, and significant two-way interaction effects.

Table 15 depicts the independent variables and two-way interactions included in the final trimmed model. Significant chi-square tests for the independent variables indicate that if the variable was removed from the model, the model would fit significantly less well. For example, if sex was removed from the regression model, the log-likelihood value would change by 49.11 and the model would fit significantly less well.

Table 16 further probes how each variable contributes to the model through significant odds ratio comparisons between each final trajectory group and the high sex and alcohol reference group. Odds ratios greater than 1 reflected higher odds of belonging in a given trajectory group, compared to the high sex and alcohol reference group. Table 16 compares the odds of belonging in each group to the reference group of high sex and high alcohol. Only the significant parameter estimate results are displayed in Table 16 for ease of presentation, though all the variables displayed in Table 15 were included in the regression equations.

#### *Moderate Problem Behavior Group*

Females were more likely than males to be in the moderate problem behavior group than the high sex and alcohol group (odds ratio = 1.53,  $p < .01$ ), as were African-American adolescents as compared to white adolescents (odds ratio = 2.96,  $p < .01$ ).

#### *Problem Behavior Group*

Females were less likely than males to be in the problem behavior group than the high sex and alcohol group (odds ratio = .43,  $p < .01$ ). In addition, Hispanic adolescents were less

likely than white adolescents to be in the problem behavior group than the high sex and alcohol group (odds ratio = .62,  $p < .05$ ).

#### *Alcohol and Delinquency Experimenting Group*

Higher levels of externalizing problems in early adolescence forecasted a lower likelihood of belonging to the alcohol and delinquency experimenting group than the high sex and alcohol group (odds ratio = .74,  $p < .01$ ). On the other hand, higher levels of internalizing problems indicated a greater likelihood of belonging in the delinquency and alcohol experimenting group than the high sex and alcohol group (odds ratio = 1.43,  $p < .01$ ).

#### *Alcohol-only Group*

African-American adolescents were more likely than white adolescents to be in the alcohol-only group than the high sex and alcohol group (odds ratio = 1.72,  $p < .01$ ). In contrast, Hispanic adolescents were less likely than white adolescents to be in the alcohol-only group than the high sex and alcohol group (odds ratio = .65,  $p < .05$ ). There were also significant differences between this alcohol-only group and the reference group in terms of externalizing and internalizing problems, but these effects were embedded within contextual and behavior problem interactions, which will be discussed in turn.

The two-way interactions were further probed in accordance with the guidelines set forth by Aiken and West (1991). For the support X internalizing and support X externalizing interactions, the mean +/- 1 SD deviation of the moderating support variable was used to create groups of high and low support levels.

Probing the sex X internalizing interaction revealed that higher levels of internalizing problems was linked to a greater likelihood of belonging to the alcohol only group, rather than

the high sex and alcohol group for males (odds ratio = 1.36,  $p < .001$ ), but not for females (odds ratio = 1.05,  $p = .51$ ).

Results also suggested that emotional support moderated the relationship between externalizing problems and group membership. Probing the externalizing X support interaction indicated that in the context of high emotional support, externalizing problems were linked to a decreased likelihood of belonging to the alcohol only group, rather than the high sex and alcohol group (odds ratio = .71,  $p < .001$ ). In the context of low emotional support, externalizing problems had no effect (odds ratio = .90,  $p = .16$ ).

Last, results indicated that emotional support also moderated the relationship between internalizing problems and group membership. Probing this internalizing X support interaction revealed that at high levels of support, internalizing problems were associated with a higher likelihood of adolescents belonging to the alcohol only group, rather than the high sex and alcohol group (odds ratio = 1.59,  $p < .001$ ). In the context of low emotional support, internalizing problems had no effect (odds ratio = 1.16,  $p = .17$ ).

In summary, externalizing problems in early adolescence were linked to an increased likelihood of belonging to the high sex and alcohol group, rather than the alcohol and delinquency experimenting group during adolescence. Internalizing problems in early adolescence were associated with an increased likelihood of belonging to the alcohol and delinquency, rather than the high sex and alcohol group in adolescence. Further, higher levels of internalizing problems were linked to belonging to the alcohol-only group, rather than the high sex and alcohol group for males.

In the context of high emotional support, externalizing problems were linked to a decreased likelihood of belonging to the alcohol-only group, rather than the high sex and alcohol

group. At high levels of support, internalizing problems were linked to a greater likelihood of belonging to the alcohol-only group, rather than the high sex and alcohol group.

In terms of gender effects, females were more likely to be part of the moderate problem behavior group than the high sex and alcohol group. Males were more likely to be in the problem behavior group than the high sex and alcohol group. Further, African-American adolescents were more likely than white adolescents to belong to the moderate problem behavior group and the alcohol-only group than the high sex and alcohol group. Hispanic adolescents were more likely than white adolescents to belong to the high sex and alcohol group than either the alcohol-only group or the problem behavior group.

*Table 15.* Results of the multinomial logistic regression likelihood ratio test

Antecedent	Chi-square test
Sex (female)	49.11**
Race (black)	49.56**
Race (Hispanic)	9.91*
Age	4.57
Mother education	7.81
Father present	8.94
Externalizing	29.10**
Internalizing	17.45**
Peer pressure	7.38
Emotional support	4.29
School quality	4.48
Sex X internalizing	9.81*
Externalizing X support	10.56*
Internalizing X support	10.58*

*Note.* \* $p < .05$ , \*\* $p < .01$ .

Table 16. Multinomial regression parameter estimate results comparing the *high sex and alcohol group* to the other risk behavior groups (only significant results depicted) (n= 1596)

Risk group	B (SE)	Exp(B)
Moderate problem behavior		
Sex (female)	.43 (.14)	1.53**
Race (black)	1.09 (.17)	2.96**
Problem behavior		
Sex (female)	-.85 (.17)	.43**
Race (Hispanic)	-.49 (.23)	.62*
Alcohol & delinq experiment		
Externalizing	-.30 (.11)	.74**
Internalizing	.35 (.13)	1.43**
Alcohol-only		
Race (black)	.54 (.19)	1.72**
Race (Hispanic)	.44 (.22)	.65*
Externalizing	-.22 (.06)	.80**
Internalizing	.30 (.09)	1.35**
Sex X Internalizing	-.26 (.11)	.77*
Externalizing X Support	-.01 (.00)	.99*
Internalizing X Support	.01 (.00)	1.01*

Note. Reference group for the model is high sex and alcohol group.

\* $p < .05$ , \*\* $p < .01$ .

## Chapter 5: Discussion

Using an developmental psychopathology approach (Cicchetti & Toth, 1997; Cicchetti & Rogosh, 1996) and a resilience framework (Luthar et al., 2000; Masten et al., 1999), the central aim of this study was to offer a greater understanding of the development of the co-occurring problem behaviors of sexual risk, alcohol use, and delinquency and to reveal how early adolescent processes of risk and protection are linked to the growth of these problem behaviors during adolescence. Specifically, this study investigated how: (1) pathways of sexual risk, alcohol use, and delinquency develop in adolescence and emerging adulthood, (2) sexual risk co-occurs with alcohol use and delinquency to further elucidate the nature of problem behavior, and (3) early adolescent processes of risk and protection forecast adolescent membership in distinct groups of problem behaviors.

An overarching goal of this study was to use this increased understanding of adolescent problem behavior trajectories and their antecedents to inform intervention efforts, tailored to the specific developmental needs of adolescents (Hawkins et al., 1992). The potential intervention and prevention implications of this study are discussed, as well as the strengths, limitations and future directions building from this investigation.

### *Pathways of Risk Taking*

Overall, results of this study indicated that the adolescents sampled were at high risk, with the majority engaging in sexual risk taking and alcohol consumption at elevated levels. Specifically, in agreement with statistics describing alarmingly high rates of sexual risk taking among adolescents (CDC, 2003; 2004), this study found that the vast majority of adolescents were taking risks during intercourse (i.e., not using protection, having casual partners) beginning in early and middle adolescence. Especially concerning, this trend indicates that adolescents are

at high risk for exposure to sexually transmitted disease and the risks of pregnancy for a protracted period of time.

In addition, over half of the sample drank alcohol at high levels in adolescence and emerging adulthood, further confirming reports of adolescents' elevated rates of alcohol use and abuse (CDC, 2006; Johnston et al., 2002). The majority of adolescents reported drinking alcohol starting in early and middle adolescence, consistent with statistics illustrating overall escalating trends of alcohol use during high school (Johnston et al., 2002). It is particularly notable that when adolescents began drinking in early adolescence, they entered adulthood with the highest levels of alcohol use in the sample.

#### *Adolescent Risk Co-occurrence*

Examining co-occurrence between risk behaviors has the ability to reveal the ways in which health risks come together developmentally as well as how patterns of maladaptive outcomes are related over time (Cicchetti & Rogosh, 1996; Cicchetti & Toth, 1997). Understanding such distinctions in patterns of risk taking behavior has important implications for how interventions are tailored to an increasingly diverse population of adolescents.

#### *Link between Sexual Risk and Alcohol Use*

This study found that sexual risk taking only occurred in conjunction with other health risks, including moderate problem behavior, problem behavior and alcohol use. In this way, a group of adolescents engaging only in sexual risk did not emerge, which stands in contrast to study hypotheses and work suggesting that sexual risk develops independently of other problem behaviors (Ensminger, 1990). Therefore, because sexual risk only took place in the context of other risks, the effects of adolescent sexual risk taking could not be teased apart from other co-occurring problem behaviors.

In fact, consistent with study hypotheses, sexual risk taking was most likely to develop alongside alcohol use, and this high sex and alcohol group comprised nearly half of the sample. This was the largest adolescent group that emerged in the study, and these adolescents engaged in both sexual risk and alcohol use at the study's highest levels. Already involved in these two risks by early adolescence, both sexual risk and alcohol use sharply increased over time and remained at high levels in emerging adulthood. Such findings are consistent with research evincing the strong link between alcohol use and sexual risk (Biglan et al., 1990) and work that suggests that the development of alcohol use has similar patterns of growth as sexual risk taking (Duncan et al., 1999). Such findings highlight the predominance of drinking and sexual risk taking among adolescents, and suggest that the link between alcohol use and sexual risk is of particular cause for concern.

#### *Impact of Adolescent Alcohol Use*

Other risk findings further demonstrate the potency of alcohol use among adolescents. In contrast to hypotheses and previous work (Capaldi et al., 1996), sexual risk and delinquency did not occur exclusively with one another; instead, these risks developed alongside alcohol use in the problem behavior syndrome groups. Alcohol use and delinquency also developed concurrently, though this group of adolescents experimented with both risks. Another group emerged who drank alcohol at high and moderate levels only, exclusive of other problem behaviors. Such findings support alcohol use and abuse as a particularly pivotal risk among adolescents, which may be fundamental in understanding the growth of other problem behaviors.

#### *Diversity of Problem Behavior Syndrome*

Study hypotheses on the proposed presence of problem behavior syndrome (Jessor & Jessor, 1977; Jessor & Donovan, 1985) were supported. All three problem behaviors - sexual

risk, alcohol use, and delinquency - co-occurred with high levels of severity in the sample. Such corroboration of problem behavior syndrome is consistent with multiple studies that have found these risks to be linked and associated with one another (e.g., Bingham & Crockett, 1996, Donovan & Jessor, 1985, Farrell et al., 1992).

Further, hypotheses proposing *diversity* in problem behavior syndrome were also supported. Study findings indicated that adolescents engaged in all three problem behaviors, but with different constellations of severity. Specifically, the emergence of a moderate problem behavior group revealed that although adolescents were engaging in all three problem behaviors, sexual risk taking was occurring at relatively high levels beginning in middle adolescence, while delinquency and alcohol use were at low levels. In this way, although all three health risks were present, they developed with dissimilar levels of severity.

Results suggest that the nature of problem behavior syndrome may be multifaceted. Indeed, in an overarching theory like problem behavior syndrome, these findings offer additional insight into the precise nature of co-occurrence between problem behaviors as well as the ways in which these risks come together developmentally (Allen et al., 1994; Kazdin, 1997). In addition, results support the developmental psychopathology principle of equifinality, whereby all three problem behaviors co-occur as outcomes, but their pathways to reach the same end state are distinct (Cicchetti & Rogosh, 1996). Recognizing this complexity in process and outcomes offers a more diverse view of problem behavior syndrome, whereby the severity of each problem behavior is considered. Appreciation for the diversity of problem behavior syndrome allows for targeted intervention efforts, tailored to adolescents' specific risk taking behavior.

### *Early Adolescent Antecedents*

In building intervention and prevention programs to address the diversity of problem behavior syndrome and sexual risk, it is important to understand the mechanisms and processes through which adolescent risk taking develops. Identifying the antecedents prior to adolescence that forecast later risk pathways enables researchers to develop more precise initiatives for adolescents.

The study hypothesized that multiple contextual antecedents would emerge as key in distinguishing between adolescent risk taking groups. This hypothesis was only partially supported. Relatively few early adolescent contextual factors differentiated patterns of risk taking in adolescence. The presence of both externalizing problems and internalizing problems in early adolescence differentiated the alcohol and delinquency experimenting group and the alcohol only group from the high sex and alcohol reference group. As well, parental emotional support in early adolescence was a significant factor in differentiating the alcohol only group from the high sex and alcohol reference group.

In this study, buffering hypotheses were not supported. Early adolescent processes of protection, such as school quality, did not affect later adolescent risk taking. Such protective processes may not have influenced adolescent risk taking because the sample was at relatively high risk overall, and a group of adolescents who abstained from all three kinds of risk taking did not exist. That is, although groups represented distinct constellations of risk taking, all patterns of co-occurrence represented risky health behavior, and protective factors may not have been able to differentiate between such groups. It is also possible that certain key antecedents were not measured in early adolescence, and this possibility will be discussed.

### *Role of Externalizing and Internalizing Problems*

However, externalizing and internalizing problems did emerge as important in understanding risk group membership. Youth with externalizing problems in early adolescence were more likely to engage in high levels of sexual risk and frequent drinking than experiment with alcohol and delinquency during adolescence. Such results support the idea of developmental continuity (Sroufe, 1990; Sroufe & Rutter, 1994) and suggest that early externalizing problems may be particularly key in forecasting later high risk behavior (Loeber & Farrington, 2000). Targeting the development of externalizing problems prior to the transition to adolescence may be particularly important in buffering the development of high levels of risk taking around sex and alcohol in adolescence.

In addition, internalizing problems in early adolescence were associated with belonging to the alcohol and delinquency experimenting group, rather than the high sex and alcohol group during adolescence. Finding an increased prevalence of internalizing problems in this relatively low risk group stands in contrast to previous research indicating that infrequent risk taking is not necessarily linked to maladaptive behavior (Schier & Botvin, 1998; Shedler & Block, 1990). Understanding the patterns through which internalizing problems develop in adolescence can offer insight into the link between early adolescent internalizing problems and risk experimentation during adolescence.

Further, higher levels of internalizing problems were linked to belonging to the alcohol only group, rather than the high sex and alcohol group for males. Such findings indicate that males may be especially vulnerable to engaging in alcohol use when they have high internalizing problems in early adolescence.

### *Role of Parental Emotional Support*

Parental emotional support had a complex relationship differentiating the alcohol only group from the high sex and alcohol reference group. Main effects of emotional support did not exist, but the antecedent also interacted with internalizing and externalizing behavior. Contrary to buffering hypotheses, high levels of emotional support appeared to enhance risk behavior in adolescence. In the context of high emotional support, externalizing problems were linked to an increased likelihood of belonging to high sex and alcohol group, rather than the alcohol only group. Also, at high levels of support, internalizing problems were associated with a higher likelihood of belonging to the alcohol only group, rather than the high sex and alcohol group during adolescence. Though these findings appear counterintuitive, it may be that parents are reacting to adolescents' risk behavior with increased emotional support and involvement. Further longitudinal work examining parental support over the course of childhood and adolescence is needed to discern the direction of these effects.

### *Race and Gender Effects*

Results also indicated that risk taking in adolescence and emerging adulthood may operate differently for males and females. Specifically, females were found to be more likely to be part of the moderate problem behavior group than the high sex and alcohol group. As well, males were more likely to be in the problem behavior group than the high sex and alcohol group. Although both genders are engaging in high levels of risk, the ways in which these risks uniquely come together may be distinct. Understanding this diversity may be important for intervention efforts targeting differing severity of problem behaviors.

In addition, African-Americans adolescents were more likely to belong to the moderate problem behavior group and the alcohol-only group than the high sex and alcohol group.

Hispanic adolescents had an increased likelihood of belonging to the high sex and alcohol group than either the alcohol-only group or the problem behavior group. Again, appreciating the distinctions in ethnicity in understanding ways in which problem behaviors are expressed may lead to increased knowledge about the nature of problem behavior syndrome and more targeted initiatives.

### *Intervention and Prevention Implications*

The common link found in this study between alcohol use and sexual risk is of particular concern, and may hold critical prevention implications for adolescents. At present, our schools most often teach about the dangers of sexual risk taking and alcohol use separately and independently of one another. However, results of this study suggest that adolescent sexual risk taking may be inextricable from alcohol use. Much previous work has indicated that adolescents who drink before intercourse are less likely to use protection and more likely to have multiple sex partners (CDC, 2004; Hingston et al., 1990; Lowry et al., 1994). Therefore, it may be more effective for adolescents to understand how sexual risk and alcohol use mutually reinforce each other and coincide over the course of adolescence. Curricula that increase awareness of this link may have success in advancing adolescent consciousness of the dangerous association between sexual risk and alcohol use.

Further, because sexual risk and alcohol use begins in early adolescence and increases over time, prevention initiatives are more likely to be successful if they start before adolescents become sexually active and begin drinking alcohol and also if efforts continue over the course of high school (Armistead et al., 2004; Coley & Chase-Landsale, 1998; Perry, Williams, Veblen-Mortenson, Toomey, Komro, Anstein et al., 1996). If such early, comprehensive preventative education is unavailable, or untenable, prior research has found that the family is a powerful

socializing force in the lives of adolescents to reduce sexual risk taking (Armistead et al., 2004; Dittus, Miller, Kotchick, & Forehand, 2004), particularly through sexual risk communication (Hutchinson et al., 2003; O'Sullivan, Meyer-Bahlburg, & Watkins, 2001).

Results also suggest that interventions designed to target alcohol use in particular might be important in curbing the development of other risk taking behaviors. Indeed, sexual risk and delinquency could not be teased apart from alcohol use in this study. Alcohol use was present in all risk groups, co-occurring with sexual risk and delinquency in the problem behavior syndrome groups, high sex and alcohol group, and alcohol and delinquency experimenting group. Alcohol use and abuse may be a particularly pivotal risk among adolescents, and fundamental to understanding the growth of the course of delinquency and sexual risk. Interventions that target alcohol use along with sexual risk and delinquency may be more influential than those initiatives focusing exclusively on one problem behavior (Tolan, Gorman-Smith, & Henry, 2004; Yoshikawa, 1994).

In addition, appreciation of the diversity of problem behavior syndrome involves tailoring such interventions to the distinct needs of adolescents. In this study, both a problem behavior group and a moderate problem behavior group, with sexual risk at relatively high levels and alcohol use and delinquency at low levels, emerged. Such findings indicate that, in addition to comprehensive interventions for adolescents high on all three problem behaviors, initiatives created for those adolescents who are relatively less risky, but still involved in all three risk behaviors may also be key for curbing risk taking. Such efforts tailored to distinct patterns of risk taking may be more likely to be successful in ameliorating adolescent health risk behavior.

Last, although a dearth of early adolescent antecedent protective effects emerged, results do suggest certain factors may be important in informing intervention and prevention efforts. In

particular, directing resources towards the identification of early adolescents' externalizing problems may be critical in thwarting the development of high sexual risk taking and alcohol use during adolescence. As well, appreciating the diversity in gender and ethnicity in understanding ways in which problem behaviors are expressed can also offer more specialized initiatives, adapted for adolescents' distinct patterns of risk taking.

#### *Strengths, Limitations and Future Directions*

Strengths of this study included a large sample of adolescents followed over the course of adolescence and emerging adulthood, which included over-samples of racial minorities. As well, early adolescent antecedents were incorporated to capture key environmental factors which may distinguish between risk taking groups. As well, early adolescent antecedent data targeted multiple environmental contexts and used multiple informants, including early adolescent self-report and mother report.

This study also offers a number of methodological advances. Examining risk taking for nine years over the course of adolescence and emerging adulthood allows for the study of how distinct risks may develop independently and co-occur. Following these risk behaviors over such a protracted period of time enables the examination of change and growth over adolescence. Given the multiple transitions that youth confront during adolescence and upon entry to emerging adulthood, it is especially critical to observe these problem behaviors over time.

As well, the use of Latent Class Growth Analysis (LCGA) enables findings to relate the entire developmental course of sexual risk, alcohol use, and delinquency over the course of adolescence and emerging adulthood. This approach allowed for the examination of developmental heterogeneity over time, and the co-occurrence of problem behaviors. Exploring how these distinct behavioral trajectories are related allows for greater insights into the structure

of problem behavior syndrome than prior summary statistic approaches, or investigations using two time points allow (Nagin & Tremblay, 1999; 2001).

However, using probabilities to characterize the nature of the link between problem behaviors requires the formation of latent classes. As discussed in Nagin and Tremblay (1999; 2001), the assumption that the population is composed of distinct groups is unlikely to represent the true nature of behavior development. Instead, these constructed groups are intended to approximate an underlying continuous developmental process (Nagin & Tremblay, 2001). Despite this assumption inherent in LCGA, it has been shown that when behaviors have a precedent for forming multiple, distinct groups, this semiparametric group-based method is a valuable approach (Colder et al., 2001).

An additional limitation of the study is that the contextual early adolescent antecedents under study did not appear to fully capture the complex factors that forecast risk behavior in adolescence. The inclusion of additional risk and protective factors might serve to further distinguish between the co-occurring risk groups. Specifically, the inclusion of other factors which have been shown to be linked to sexual debut, such as peer perceptions of using protection and perceived rates of numbers of friends having sexual intercourse (Willis, Mariani, & Filer, 1996; Willis & Vaughan, 1998). As well, incorporation of community measures, such as neighborhood efficacy, neighborhood socioeconomic status as well as community violence may have ties to alcohol use and delinquency use in adolescence (Farrell & Bruce, 1997; Leventhal & Brooks-Gunn, 2000; Sampson, Morenoff, & Earls, 1999; Sampson, Raudenbush, & Earls, 1997).

Further, following such antecedents over the entire course of adolescence and emerging adulthood would offer greater clarity focusing on the ways in which processes of risk and protection impact the development of risk taking behavior. Creating latent class growth models

for key risk and protective factors would offer greater insight for how these processes may operate over time and the most amenable points for intervention and prevention efforts. In addition, future research utilizing transactional models would allow the direction of effects between processes of risk and protection and adolescent risk taking behavior to be further clarified.

Moreover, although the measure of alcohol use captures the frequency with which adolescents drank, it did not target how many drinks were consumed on each occasion. This additional information has implications for binge drinking, which is particularly prevalent among adolescents (Johnston et al., 2002) and has been shown to be linked to alcohol dependency in adulthood (Muthén, 2000). As such, future studies would benefit from including both frequency and amount of alcohol use in order to better capture adolescent substance use over time and inform intervention efforts tailored to the specific needs of adolescents.

Overall, this study represents a unique contribution to understanding the diverse nature of sexual risk taking and the development of problem behavior syndrome over the course of adolescence and emerging adulthood. Additional studies conducted can further investigate the diversity with which adolescents engage in risk taking and the resources they need in coming of age while confronting health risks during adolescence.

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