SEX DIFFERENCES IN THE MANIFESTATION OF ADOLESCENT PROBLEM BEHAVIORS

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ABSTRACT
Sex Differences in the Manifestation of Adolescent Problem Behaviors
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Relatively little is known about the manifestation of conduct disorder among girls versus boys, despite increasing rates among girls. Moreover, it has been well-established that adolescent conduct disorder is correlated with other problem behaviors (e.g., substance use, status offenses, and risky sexual behaviors), and there is evidence that there are differences by sex and ethnicity in the likelihood of exhibiting specific patterns of these problem behaviors. It has been suggested that a dimensional approach may provide a more accurate conceptualization of adolescent externalizing behaviors, particularly among girls. To address these issues, this study used a nationally representative sample to examine patterns of adolescent problem behaviors across sex and ethnicity. Latent class analysis was used to determine classes of problem behaviors and to model differences in class membership by sex and ethnicity. Behaviors examined included violent and non-violent criminal behavior, drug and alcohol use, risky sexual activity, and status offenses.

A model with five latent classes of problem behaviors provided the best representation of the data. One class represented high levels of problem behaviors, one represented low levels of problem behaviors, and three classes represented high levels of specific problem behaviors. These classes were characterized respectively by (a) high levels of criminal activity, (b) high levels of substance use, and (c) high levels of risky sexual activity. Differences existed in the likelihood of belonging to each class, such that boys were more likely to belong to the "high problem behavior," "criminal activity," and

"risky sexual activity" classes. Girls were more likely to belong to the "substance use" and "low problem behavior" classes. These results suggest that a broader definition of externalizing behavior may more accurately capture adolescent behavior patterns, particularly among girls. Implications of findings and direction for future research are discussed.

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CHAPTER 1
INTRODUCTION

Recently, increasing attention has been paid to delinquency and externalizing behaviors among girls, despite a historical tendency to examine these behaviors among boys only (Keenan, Loeber, & Green, 1999). The category of externalizing behaviors includes violent, aggressive, oppositional, and/or disruptive behaviors with potential sequelae that can substantially impair quality of life. However, there is still a dearth of understanding of the development and manifestation of these behaviors among girls (Keenan et al., 1999; Rutter, Caspi, & Moffitt, 2003). Some literature indicates that externalizing processes are similar across sex (Deater-Deckard, Dodge, Bates, & Pettit, 1998; Fergusson & Horwood, 2002; Gorman-Smith & Loeber, 2005), whereas other findings indicate that there are sex differences in the way that externalizing behaviors develop and manifest (Broidy et al., 2003; Crick & Zahn-Waxler, 2003; Greenberg, Lengua, Coie, Pinderhughes, & The Conduct Problems Prevention Research Group, 1999; Schaeffer et al., 2006; Silverthorn & Frick, 1999; Simons, Johnson, Beaman, Conger, & Whitbeck, 1996). In addition, evidence suggests that there are racial/ethnic differences in the manifestation of problem behaviors. It is important that we understand these processes to ensure that prevention and intervention efforts will be effective for both boys and girls, and among individuals from different ethnic groups. In the present study, I used nationally representative data from the National Longitudinal Study of Adolescent Health (Add Health) to examine potential sex and ethnic differences in the manifestation of externalizing behaviors.

In terms of sex differences, the symptoms used to operationalize externalizing behaviors may contribute to different prevalence rates among boys and girls. Most epidemiological studies indicate that boys are more likely to meet the criteria for conduct disorder (CD) than girls (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003). There has been some debate, however, as to whether the CD criteria are appropriate for girls. Some authors have argued that more non-aggressive behaviors should be included, pointing to evidence that *DSM-III* criteria were more effective in identifying girls with early-onset, persistent, antisocial behavior (Robins, 1991; Zoccolillo, 1993; Zoccolillo, Tremblay, & Vitaro, 1996), whereas others have argued that differential criteria for boys versus girls may no longer identify the same disorder regardless of sex (Zahn-Waxler, 1993). Hartung and Widiger (1998) have pointed out that some of the sex differences in prevalence of psychopathology may be due to biases in sampling and diagnostic criteria. They suggest that the use of primarily male participants in studies focused on understanding CD may contribute to a male-biased description of the disorder. It has been suggested that non-aggressive symptoms such as rule violations, prostitution, early substance use, or running away from home overnight might better characterize CD among girls. The *DSM-IV-TR* acknowledges that CD is likely to manifest differently among boys versus girls, with boys' being more likely to exhibit behaviors such as fighting, stealing, or vandalism, and girls' being more likely to exhibit behaviors such as lying, truancy, or running away (APA, 2000). Although we currently apply the same criteria to boys and girls, it remains to be seen whether these criteria adequately identify both boys and girls who engage in significant levels of externalizing behaviors.

Although much of the debate related to externalizing symptoms has focused on the diagnosis of CD, we know that once a diagnosis is made, these types of problems are fairly intractable to treatment (Hill, Coie, Lochman, Greenberg, & The Conduct Problems Prevention Research Group, 2004). As such, it is important to study the development of externalizing behaviors dimensionally to better understand the process by which these disorders develop among both boys and girls, before a diagnosis is made and treatment becomes more difficult. Among studies that examine externalizing behaviors dimensionally, these behaviors are often operationalized in terms of physical aggression or violence (e.g., Gorman-Smith & Loeber, 2005; McDermott, 1996; Moffitt, Caspi, Rutter, & Silva, 2001; Stanger, Achenbach, & Verhulst, 1997). Although girls engage in these behaviors, their prevalence rates are generally lower than boys' rates (Loeber, Burke, Lahey, Winters, & Zera, 2000; Tiet, Wasserman, Loeber, McReynolds, & Miller, 2001), and a dimensional approach may allow for the identification of girls who exhibit sub-diagnostic levels of significant externalizing behaviors. Moreover, research that separates externalizing behaviors into overt and covert behaviors indicates that overt, aggressive behaviors are more prevalent among boys than girls (Loeber & Schmaling, 1985; Loeber et al., 2000). Additionally, girls frequently engage in nonaggressive, covert forms of delinquency (Loeber et al, 2000), and consideration of behaviors that are more commonly seen among girls (e.g., substance abuse, lying, stealing, truancy) also may help in the identification of girls who exhibit significant externalizing symptoms. Therefore, it is likely that a broader dimensional conceptualization of externalizing problems would be more useful in understanding the development and manifestation of externalizing problems among girls, as well as boys.

It has been well-established that adolescent problem behaviors such as juvenile offending and CD are highly correlated with other problem behaviors, including substance use and risky sexual behaviors (Fergusson, Horwood, & Lynskey, 1994; Fisher, Kramer, Hoven, King, Bird, Davies, et al., 2000; Loeber et al., 2000). Jessor and colleagues (Donovan & Jessor, 1985; Donovan, Jessor, & Costa, 1988) hypothesized that multiple problem behaviors (e.g., alcohol and marijuana use, delinquent behaviors, adolescent sexual contact) are indicators of a single, underlying problem behavior syndrome. They used confirmatory factor analysis to demonstrate that a single common underlying factor accounted for the relations among these variables in two different adolescent samples. These findings underline the importance of considering a problem behavior syndrome that jointly takes all of these behaviors into account, rather than conceptualizing or examining them separately.

Similarly, several authors have concluded that various problem behaviors may be indicators of one underlying syndrome. For instance, Patterson and colleagues (2000) have demonstrated that multiple problem behaviors (e.g., delinquency, substance use, risky sexual behavior) show inter-related growth during adolescence, and their results suggest that these diverse problem behaviors may be indicators of a single fundamental phenomenon. Moreover, Wei et al. (2004) found that the relation between violence and substance abuse among a sample of boys from the Pittsburgh Youth Study was accounted for by the influence of shared risk factors, suggesting that violence and substance abuse may be different indicators of a unified, underlying syndrome.

Consistent with this perspective, Krueger and colleagues (2005) recommended that for *DSM-V*, externalizing behaviors should be conceptualized dimensionally and

include behaviors associated with CD, antisocial personality disorder (ASPD), and substance dependence. These findings suggest that our current conceptualization of CD does not completely describe the syndrome of problem behaviors that are often exhibited concurrently, and therefore highlight the need for further research examining clusters of problem behaviors that typically occur together. Drabick (2009) has suggested that a mixed categorical-dimensional classification system might allow for a more conceptually meaningful approach to categorizing CD and ODD. She recommends further research directed at identifying processes and dimensions for use in such a diagnostic system. The current examination of adolescent patterns of problem behavior can inform such research.

A few studies have examined sex differences in the likelihood of exhibiting specific patterns of problem behaviors. Fergusson and colleagues (1994) used latent class modeling to examine the patterns of problem behaviors among adolescents participating in the Christchurch Health and Development Study. They found that both boys and girls fit into a four-class model, but boys were more likely to fit into a class that exhibited antisocial or law-breaking behaviors (e.g., conduct problems, police contact), whereas girls were more likely to be members of a class with problematic early transitions to adult hedonic behaviors (e.g., early sexual activity, alcohol problems).

Noting that the *DSM-IV* diagnoses of attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and CD are closely related, and that the current diagnostic system may not adequately describe the overlap among these diagnoses and the heterogeneity of symptoms associated with these disorders, Storr and colleagues (2007) used latent class modeling to examine patterns of symptoms of ADHD, ODD, and CD among boys and girls. In addition, these authors examined the relation

between class membership and substance use. They identified three classes of disruptive behaviors: one engaging in very few disruptive behaviors, one engaging primarily in behaviors consistent with ADHD and ODD, and one engaging in behaviors consistent with all three diagnoses. In terms of sex differences, more girls than boys were members of the second class. Symptoms with the highest probability of occurring among this class were temper tantrums, arguing, disobeying adult requests at home, and lying or cheating. More boys than girls were members of the third class. This group exhibited a high probability of endorsing most symptoms of ADHD, ODD, and CD. Among younger adolescents, girls who fit into this more severe class with ADHD, ODD, and CD symptoms were more likely than their male counterparts to have used illicit drugs during the past month. This could indicate that girls with disruptive behavior disorder symptoms are more likely to exhibit co-occurring problem behaviors than their male peers.

Silverthorn and Frick (1999) posited sex differences in the timing and manifestation of CD, suggesting that boys are more likely to exhibit childhood-onset CD whereas girls are more likely to exhibit adolescent-onset CD. Existing research is mixed on this point, with some researchers indicating that it is rare for girls to exhibit childhood-onset CD (Moffitt & Caspi, 2001; Silverthorn, Frick, & Reynolds, 2001) and others finding that boys and girls exhibit both childhood and adolescent onset, but that childhood-onset CD is relatively more common among boys (Connor, Ford, Albert, & Doerfler, 2007; McCabe, Rodgers, Yeh, & Hough, 2004).

In addition to these potential sex differences in age of onset, there is evidence that these different types of CD may be differentially associated with other problem behaviors. For example, Connor et al. (2007) found that childhood-onset CD was

associated with higher rates of ADHD and anxiety, whereas adolescent-onset CD was associated with higher rates of alcohol and substance abuse. Following from the conclusion that boys are more likely to present with childhood-onset CD than girls, it is possible that boys would be more likely to present with a cluster of symptoms including ADHD and anxiety, which have relatively younger ages of onset and thus may be more likely to overlap with childhood-onset CD, whereas girls would be more likely to present with a cluster of symptoms including substance abuse, which may be more likely to develop in adolescence.

Some evidence exists to suggest that patterns of problem behavior also differ by racial or ethnic background, though findings differ depending on the type of problem behavior examined. Studies examining substance abuse have found that Caucasian adolescents are consistently more likely to abuse alcohol than are African-American adolescents, with Latino adolescents' levels of alcohol use falling somewhere in the middle (Barnes, Welte, Hoffman, & Dintcheff, 2005; Blum et al., 2000; Eaton et al., 2005; Grunbaum, Basen-Engquist, & Pandey, 1998; Vanderschmidt, Lang, Knight-Williams, & Vanderschmidt, 1993). When an aggregate measure of overall drug use is used, Caucasian adolescents report higher levels of drug use than African-American adolescents (Barnes et al., 2005) and Latino adolescents' levels of drug use do not differ from that of Caucasian adolescents (Grunbaum et al., 1998). When use of specific drugs was examined in the National Household Study on Drug Abuse, the results indicated that Caucasian adolescents and young adults were more likely to use most of the illicit drugs examined, compared to African-American participants, with the exception of crack-cocaine and heroin, which were more heavily used by African-American youth (Ma &

Shive, 2000). In the CDC's Youth Risk Behavior Surveillance study (Eaton et al., 2005), Latino youth reported the highest lifetime usage of several illegal drugs (i.e., marijuana, cocaine, injection drugs, heroin), followed by Caucasian and African-American participants. For other illegal drugs (i.e., inhalants, steroids, hallucinogens, methamphetamines), Latino and Caucasian youth's use did not differ but their use was reportedly higher than African-American youth's use.

In the areas of delinquency and criminal behaviors, African-American and Latino youth tend to report more involvement in these behaviors than Caucasian youth (Blum et al., 2000; Cota-Robles, Neiss, & Rowe, 2002; Eaton et al., 2005; Grunbaum et al, 1998). In addition, African-American youth report initiation of sexual activity at younger ages than Caucasian or Latino youth (Blum et al., 2000; Eaton et al., 2005; Ku, Sonenstein, & Pleck, 1993; Vanderschmidt et al., 1993). Although the primary purpose of the present study was to examine sex differences in patterns of problem behaviors, these studies strongly indicate that patterns of problem behaviors may differ among youth from different racial and ethnic backgrounds. Rather than trying to statistically “control” for the effects of racial and ethnic factors, I consider these differences to be meaningful and important in understanding the manifestation of problem behaviors. Therefore, additional analyses were conducted to explicitly examine racial and ethnic differences in patterns of problem behaviors.

This study is the first to examine potential sex and racial/ethnic differences in classes of co-occurring problem behaviors (such as substance abuse, risky sexual behavior, and truancy) in a large, American adolescent sample. Thus, the primary objective of this investigation was to determine potential classes of problem behaviors

among adolescents, using a broader conceptualization of adolescent problem behaviors than is typically considered using the *DSM* framework. Given that this broader framework may be more appropriate for understanding externalizing behaviors among girls (Hartung & Widiger, 1998; Robins, 1991; Zoccolillo, 1993; Zoccolillo et al., 1996) and documented differences in prevalence rates of these problem behaviors among youth of different ethnic backgrounds, this research will yield further information as to whether there are systematic, underlying sex or ethnic differences in patterns of problem behaviors. This information thus has the potential to inform conceptualizations of externalizing problems and the nosological system, as well as assessment and treatment of adolescents exhibiting problem behaviors.

Based on previous literature (e.g., Fergusson et al., 1994), I hypothesized that at least four latent classes of co-occurring problem behaviors would emerge from this sample: one group that engages in few problem behaviors (hereafter referred to as Class 1); one group that engages in behaviors consistent with a precocious transition to adult roles and behaviors (i.e., risky sexual behaviors, substance abuse, status offenses; hereafter referred to as Class 2); one group that engages in primarily covert, non-violent problem behaviors (i.e., property offenses; hereafter referred to as Class 3); and one group that engages in both overt, aggressive problem behaviors (i.e., violence and delinquency) and covert, non-aggressive problem behaviors (hereafter referred to as Class 4).

Second, I hypothesized that the proportion of boys vs. girls who fall into particular classes of problem behaviors would differ. Specifically, I hypothesized (a) a higher proportion of girls compared to boys would be classified into a class characterized

by overall low levels of problem behaviors (Class 1); (b) a higher proportion of girls compared to boys would be classified into a class of problem behaviors characterized by a precocious transition into problematic adult behaviors (Class 2); (c) similar proportions of boys and girls would be classified into a class of problem behaviors characterized by engaging in primarily covert, non-violent problem behaviors (Class 3); and (d) a higher proportion of boys compared to girls would be classified into a class of problem behaviors characterized by engaging in both covert and overt, violent problem behaviors (Class 4).

Third, I predicted that membership in these classes would differ based on racial/ethnic background. Specifically, I hypothesized (a) Asian and Caucasian participants would be classified into a class characterized by overall low levels of problem behaviors; (b) Asian and Caucasian participants would be classified into a class of problem behaviors characterized by a precocious transition into problematic adult behaviors (Class 2) in higher proportions than other groups; (c) Caucasian and Latino participants would be classified into a class of problem behaviors characterized by engaging in primarily covert, non-violent problem behaviors (Class 3) in higher proportions than other groups; and (d) African-American and Latino participants would be classified into a class of problem behaviors characterized by engaging in both covert and overt, violent problem behaviors (Class 4) in higher proportions than other groups.

CHAPTER 2
METHOD

Participants

The present study involved a secondary analysis of data from Add Health, a school-based, longitudinal study of the health-related behaviors among a nationally representative sample of adolescents. The participants were individuals who completed Waves I and II of Add Health. A sample of 80 high schools and 52 middle schools from the US was selected between 1994 and 1996 from a list of all high schools in the US and weighted to match population norms by region, location (urban or rural), type of school, and racial/ethnic mix of students (Udry, 1998). An initial wave of in-home interviews was conducted with 20,427 adolescents in grades 7 to 12 between September 1994 and December 1995. Participants were eligible to participate in the second wave of data collection between April and August of 1996. Therefore, data from Wave II were collected an average of one year after data collected from Wave I, though the period between waves of data collection ranged from eight to eighteen months. In addition, parents were asked to complete a questionnaire about family and relationships. More information regarding the sampling procedure can be obtained at http://www.cpc.unc.edu/projects/addhealth/design (Harris et al., 2003).

Data were collected longitudinally from 14,738 (48.7% male) participants. Racial/ethnic breakdown was as follows: 54.2% White, 21.0% African-American, 16.9% Latino, 6.1% Asian, and 1.8% of participants identified themselves as members of another racial/ethnic group. Five dummy coded variables were created to represent membership in each well-represented ethnic group (i.e., White/Non-White, African-

American/Non-African-American, Latino/Non-Latino, Asian/Non-Asian, Other Ethnic Group/Non-Other Ethnic Group). At Wave II, participants ranged in age from 11 to 23, with a median age of 16. The adolescent's primary caregiver (88.3% participant's biological mother; also included stepmothers, other female caretakers, fathers, other male caretakers) reported on their highest level of education (14.6% did not complete high school) and family income (median income = $43,000). Other indicators of sample SES included number of caretakers receiving public assistance (9.1%) and number of caretakers who reported not having enough money to pay their bills (18.2%). According to the primary caregiver, 79.2% of adolescents lived with their biological mothers and 59.9% of adolescents lived with their biological fathers. As stated above, there is a dearth of literature examining patterns of co-occurring problem behaviors in a large, American adolescent sample. This large, nationally representative sample was used for the current analyses to contribute a better understanding of the manifestations of problem behaviors among American adolescents and to test for sex and ethnic/racial differences in the patterns of behaviors demonstrated.

Measures

The specific constructs drawn from Add Health that were used in the present study included measures of violent and non-violent criminal behavior, truancy, risky sexual behavior, prostitution, substance abuse, and running away from home. Relational aggression, which has been extensively studied among girls, does not generally tend to be associated with the same negative sequelae as the other problem behaviors examined here. Therefore, relationally aggressive behaviors were not included in the present

analyses. All variables used were drawn from Wave II of the data collection. Measures used to index each of these constructs are presented next.

Violent and property crimes. Based on Felson and Haynie's analyses using the current sample (2002), items from the delinquency module and the fighting/violence module were used to create measures of property crimes and violent crimes. Adolescents responded to 14 items that asked them to report whether they had engaged in various violent or property crimes in the past 12 months, with 0 = *no* and 1 = *yes.* The property crimes scale consisted of the sum of eight items (sample item: "In the past 12 months did you deliberately damage property that didn't belong to you?"; Cronbach's $\alpha = .75$). The violent crimes scale consisted of the sum of responses to six items (sample item: "In the past 12 months did you hurt someone badly enough to need bandages or care from a doctor or nurse?"; Cronbach's $\alpha = .52$). Responses on both scales ranged from 0 to 1, with higher scales indicating higher levels of criminal behavior. Participants' self-reports of gang involvement were also used as a measure of violence ("Have you been initiated into a named gang?"). Responses ranged from 0 ("no") to 1 ("yes"). Separating violent crimes from property crimes provided indexes of physically aggressive vs. non-aggressive delinquency.

Substance abuse. Adolescent's alcohol abuse was represented by 3 variables contributing to a latent alcohol abuse factor. The first composite represents the frequency with which adolescents viewed themselves as having gotten in trouble based on their alcohol use and was made by averaging the responses to five items (sample item: "Over the past 12 months how many times did you get in trouble with your parents because you had been drinking?"). The mean of these items was used as a measure of alcohol-related

problems in day-to-day life (Cronbach's α = .76). In addition to this composite, two items were used as indicators of a latent construct referring to alcohol abuse, namely, "Over the past 12 months, on how many days did you drink five or more drinks in a row?", and "Over the past 12 months, on how many days have you gotten drunk or 'very, very high' on alcohol?" with responses ranging from 0 (*never)* to 6 (*every day or almost every day*). Results of a principal components factor analysis indicated that these three items represent one factor, with each item yielding factor loadings of .43 or above, representing moderate to high factor loadings (Hair, Anderson, Tatham, & Black, 1998).

Five items served as indicators of the latent construct of adolescent drug abuse. First, adolescents were asked to report the number of times that they had used marijuana, cocaine, inhalants, and other illegal drugs. As these variables were positively skewed, an additional variable was calculated to represent the total number of illicit drugs with which the adolescent had experimented. Specifically, the answers to four questions about whether the participant had ever used marijuana, cocaine, inhalants, or other illegal drugs, with responses 1 (*yes)* and 0 (*no),* were summed. These variables were used as indicators of a latent variable measuring drug use. Results of a principal components factor analysis indicated that these five items represent one factor, with each item yielding a factor loading of .51 or greater.

Risky sexual behavior. A latent variable representing engaging in sexual activity with multiple partners was created based on three items that adolescents rated based on their experiences since the Wave I assessment: adolescents' total number of sexual partners, number of sexual partners outside of a "romantic relationship," and number of times that the adolescent reported giving someone sex in return for drugs or money.

Results of a principal components factor analysis with Varimax rotation indicated that these three items represent one factor, with each item yielding a factor loading of .68 or higher. These items were used as indicators of a single latent variable representing the construct of engaging in sexual activity with multiple partners.

A latent variable representing use of safe sexual practices was created based on three indicators. The first indicator was a variable representing adolescents' use of a contraceptive that was likely to prevent pregnancy. This indicator was created from adolescents' reports of the type of contraceptive that they used most recently during sexual intercourse. Adolescents who were not having sex or who used a reasonably safe protection against pregnancy (e.g., condoms, birth control pills) were coded as 0 (*low risk),* whereas adolescents who reported using no protection or an ineffective method (e.g., withdrawal, rhythm method) were coded as 1 (*high risk).* The second indicator of this latent variable was a variable representing the number of sexually transmitted diseases with which the adolescent has been diagnosed. Adolescents answered eight questions that used the format, "Have you been told by a doctor or nurse that you had [STD]?" (e.g., chlamydia, syphilis) with the possible responses of 0 (*no*) or 1 (*yes*). These items were summed to create a variable representing the total number of STDs. This variable was highly skewed, so a logarithmic transformation was used in these analyses, followed by Shapiro-Wilks test to confirm that the sample distribution approximated the normal distribution sufficiently to meet assumptions of statistical tests. The third indicator was a variable representing the frequency of adolescents' condom use during intercourse. Adolescents were asked, "Thinking about all of the times that you have had sexual intercourse, about what proportion of the time have you used a

condom?" This was coded on a three point scale, with respondents who denied sexual activity or who reported using a condom every time were coded 0, those who reported using a condom "most of the time" or "half of the time" coded 1, and respondents who reported using a condom "some of the time" or "never" coded 2. Results of a principal components factor analysis with Varimax rotation indicated that these three items represent one factor, with each item yielding a factor loading of .48 or higher. As stated above, these three constructs were used as indicators of a single latent variable representing the construct of risky sexual practices.

Status offenses. Two items were used as indicators of status offenses. The question, "How many times have you skipped school for a full day without an excuse?" was used as a measure of frequency of days truant from school. The question, "During the past 12 months, have you ever spent the night away from home without permission?" with possible responses of 1 (*yes)* and 0 (*no*) was used as an index of running away from home. As described below, LCA was used to create an aggregate status offenses variable based on these two items.

Data Analyses

Latent Class Analysis (LCA) was used to identify the smallest number of clusters that adequately describe the relations among the observed symptoms of problem behaviors (violent crime, non-violent crime, substance abuse, status offenses, and risky sexual behavior). LCA is a person-centered analysis, designed to help classify individuals into categories representing subpopulations within the greater population (in this case, subpopulations that engage in specific clusters of problem behaviors). It does so by taking into account how the probability of a set of indicators varies across a group

of individuals. LCA has been used in previous diagnostic studies with goals of identifying subtypes of a given disorder (Muthén & Muthén, 2000). All of the models presented in this paper were estimated using Mplus, Version 5. Although other statistical approaches, such as structural equation modeling (SEM) or factor analysis (FA) could have been used to examine sex differences in the data, these approaches are variable-centered, not person-centered. Use of SEM would have required creation of *a priori* groups for examination here, and use of FA would have yielded results grouping items together rather than people. Therefore, LCA was considered to be the most effective tool for answering the questions that I have posed here.

Three phases of analyses were undertaken for the current study. The first was the class enumeration phase. During this phase, I fit a series of models with an increasing number of latent classes and compared the relative fit of these models to determine the number of classes that best fit the data. Consistent with previous research, the class enumeration model that yields the highest log likelihood value and the lowest BIC or sample-size adjusted BIC is the preferred model. The sample was split by sex to determine whether boys' and girls' problem behaviors yielded the same number of classes of behaviors and whether the conceptual meaning of these classes varied across sex. The series of models ranged from a one-class to a six-class model. I entered the five aggregated variables representing different types of problem behaviors (described above) into the analysis as latent class indicators. Following separate class enumeration analyses among boys and girls, the best-fitting models for each sex were examined to determine whether the best-fitting models yielded the same number of classes among boys and girls, and whether the classes were conceptually similar across sex.

During the second phase of analysis, I considered all of the participants concurrently and used a multiple groups analysis to examine potential sex differences in the final, best-fitting model. First, I determined whether there were sex differences in the probability of belonging to each class. Because latent class analysis uses a probabilistic approach to class membership, posterior class probabilities for each sex can be used to this end. These probabilities are the estimated probability of membership in each of the latent classes for boys versus girls in this sample. Each participant was assigned to the class for which s/he has the highest posterior probability, and then the likelihood of belonging to each class was compared across sex.

Second, I examined whether sex predicted differential endorsement of each type of problem behavior. Currently, there is no established methodology in LCA for conducting this type of analysis. My approach was adapted from the strategy used in Factor Analysis. Once the ideal number of classes was determined during the first phase of analyses when the sample was split by sex, this model was replicated with the entire sample. In this model, hereafter referred to as Model 1, all parameters were allowed to vary freely across sex.

In a second model, referred to as Model 2, sex was treated as a second latent class variable, a "known class" variable. Membership in the other latent class, in this case pattern of problem behaviors, was allowed to vary across levels of the known class (sex). These two models were then compared to determine whether a third "compromise" model would best fit the data. Specifically, I evaluated whether allowing sex to predict class membership but not level of problem behavior caused a "misfit" anywhere in the model. This was determined by examining the threshold values for each variable. A

standardized difference variable was calculated for each threshold to determine whether thresholds for a given problem behavior had been altered in Model 2 compared with Model 1. When this was the case, a path directly from sex to the type of problem behavior was drawn, allowing for sex differences in levels of that problem behavior (Model 3).

The strength of this approach is that it allowed me to examine potential sex differences in particular problem behaviors without depending on a completely unrestricted model, which was likely to be unstable in this situation. The final model determined through this phase allowed me to examine sex differences in the proportion of participants engaging in behaviors consistent with each latent class, as well as to determine whether the predictive relation between latent class membership and each of the problem behaviors (for example, drug abuse) differed by sex.

In the third phase of analyses, ethnicity was added to the model as a third "known class" latent class variable. The process from phase 2 was repeated. I first determined whether there were differences in probable class membership based on race/ethnicity. I then created a model in which membership in class of problem behavior was allowed to vary across levels of race (treated as a "known class" latent variable). Guided by the data, some parameters were allowed to vary by race, and others were constrained, yielding information as to which types of problem behaviors were related to race/ethnicity.

CHAPTER 3
RESULTS

Aggregate Variables

Preliminary analyses indicated that the latent class model was affected by the number of indicators included from each problem category. Therefore, I decided to include one aggregate variable to represent each distinct type of problem behaviors, with the exception of property crimes, which was represented by a single indicator. I created these aggregates through a class enumeration method. Specifically, a model was created for each type of problem behavior (e.g., drug use), in which each individual variable that was used to index that problem behavior (e.g., marijuana use, cocaine use; described above in the Measures section) was used as an indicator of an overall latent variable representing that problem behavior more broadly. These models yielded ordered latent classes, each level of which represented a higher level of participation in that problem behavior (e.g., low, low-medium, medium-high, and high levels of drug use). The class enumeration method allowed me to determine the ideal number of levels for each aggregate variable based on the data (see Table 1). Indices used to determine model fit included log likelihood value, BIC, sample-size adjusted BIC, and entropy Higher values for log likelihood and lower values for BIC are indicative of better model fit. For entropy, values closer to 1 are desirable. During the class enumeration process, these values were used to determine relative fit of models as classes were added. The smallest class count for each model also was examined to ensure that a sufficient number of participants would be represented at each level of the variable, and consequently, that differences found in the final model would describe meaningful differences in problem

Table 1
Fit Indices Used to Create Aggregate Variables

	Log likelihood	BIC	Sample-size adjusted BIC	Entropy	Class count for smallest class in model
VIOLENCE					
2-class model	-16599.41	33246.79	33230.90	0.69	2414
3-class model	-16465.23	33007.21	32981.79	0.72	585
4-class model	**-16464.32**	**33034.16**	**32999.20**	**0.78**	**119**
5-class model	-16464.32	33062.94	33018.45	0.75	0
ALCOHOL USE					
2-class model	-33455.41	67227.56	67122.69	0.94	4166
3-class model	-32238.79	64957.49	64798.59	0.92	1658
4-class model	**-31774.34**	**64191.76**	**63978.84**	**0.91**	**1200**
DRUG USE					
2-class model	-26357.47	53185.24	53029.53	1.00	4024
3-class model	**-24106.31**	**48922.88**	**48687.72**	**0.99**	**1154**
4-class model	-23631.09	48212.40	47897.78	1.00	181
SEX WITH MULTIPLE PARTNERS					
2-class model	-20463.34	41243.42	41138.549	1	2972
3-class model	**-19541.7**	**39563.28**	**39404.38**	**0.98**	**1137**
UNSAFE SEXUAL PRACTICES					
2-class model	-14633.94	29392.65	29351.338	0.60	557
3-class model	**-14603.76**	**29399.48**	**29335.92**	**0.85**	**184**
STATUS OFFENSES					
2-class model	-28585.57	57219.12	57203.23	0.92	1707
3-class model	**-24059.13**	**48195.02**	**48169.60**	**0.88**	**372**

Note. Models in **bold** were used to create aggregate variables.
Higher log likelihood, lower BIC, and entropy closer to 1 all indicate better model fit.

behaviors. Finally, based on posterior probabilities, an aggregate variable was created such that each level of the variable represented one class from the model. Each participant's posterior probability was used as an indicator of their level of overall involvement in that type of problem behavior. For example, the best-fitting model for drug use included three levels, representing low, medium, and high levels of overall drug use. Participants whose posterior probabilities indicated the highest probability of belonging to the low drug class were coded as "1," those who had the highest posterior probability of belonging to the medium drug class were coded as "2," and those who had the highest posterior probability of belonging to the high drug class were coded as "3." Descriptive statistics for the final aggregate variables are presented in Table 2.

In terms of the specific aggregate variables, an aggregate violence variable was created by combining participants' reports that they had participated in a violent crime and their reports of gang membership. Examination of fit indices indicated very small differences in model fit across the four models estimated. The selection of the final model was based on the entropy value for each model. This value indicates how well the model predicts class membership, which was the primary goal for this analysis. The final model chosen to represent overall violence included four levels, and had the highest entropy level of the models estimated (see Table 1).

An aggregate alcohol use variable was created by combining three variables: participants' self-reported alcohol-related problems in day-to-day life, binge drinking (five or more drinks in a row), and number of days that they had "gotten drunk". Model fit was increasingly good as more classes were added to the model. The final model chosen to represent overall alcohol abuse included four levels, and had the best model fit

Table 2
Bivariate Correlations, Means, and Standard Deviations for Study Variables

Variable	1	2	3	4	5	6	7
1. Violence	-	**.67****	**-.01**	**-.02**	**.02**	**-.01**	**.41****
2. Property Crime	.69**	-	**-.01**	**-.01**	**.02***	**-.02**	**.28****
3. Alcohol	-.02	-.02	-	**.50****	**.25****	**.19****	**-.01**
4. Drugs	-.03*	-.003	.47**	-	**.26****	**.18****	**-.01**
5. Sexual activity	.02*	.06**	.22**	.21**	-	**.21****	**.01**
6. Unsafe sexual practices	.15**	-.002	.001	<.001	.004	-	.002
7. Status	.34**	.29**	-.02	-.01	-.002	-.001	-
Boys: *M*	1.50	.79	1.63	1.36	1.38	1.24	1.26
SD	.78	1.12	1.04	.62	.67	.44	.50
Girls: *M*	1.27	.54	1.48	1.34	1.19	1.26	1.21
SD	.59	.96	.87	.62	.49	.48	.46

Note. Correlations for boys are below the diagonal. Correlations for girls are in bold and above the diagonal.
*$p < .05$; ** $p < .01$.

of the models estimated with minimal loss of entropy (see Table 1).

An aggregate drug abuse model was created by combining five variables: the number of different drugs that participants' reported having used and the number of times that participants' reported using marijuana, cocaine, inhalants, and other illegal drugs. Model fit was increasingly good as more classes were added to the model; however, the number of participants included in the smallest class dropped precipitously between the three-group model and the four-group model (from 1154 to 181). This small *n* represented a problem because one goal in this process is to create aggregate variables

that have a meaningful number of participants at each level. Therefore, the final model chosen to represent drug use included three levels.

An aggregate variable representing engaging in sexual activity with multiple partners was created by combining three variables: participants' reports of their total lifetime number of sexual partners, the number of sexual partners outside of a "romantic relationship," and the number of times participants reported giving someone sex in return for drugs or money. Model fit was increasingly good as more classes were added to the model. However, in a four-class model, the lowest log likelihood value was not replicated, indicating difficulty fitting a model with four classes. Therefore, the final model chosen to represent sexual activity with multiple partners included three levels.

An aggregate variable representing failure to use safe sexual practices was created by combining three variables: use of a contraceptive likely to prevent pregnancy, number of sexually transmitted diseases with which the participant had been diagnosed, and frequency of condom use during intercourse. Examination of fit indices indicated very small differences in model fit across the two models estimated. The final decision was based on the entropy value for each model, and included three levels of unsafe sexual practices.

An aggregate variable representing status offenses was created by combining two variables: number of days of school skipped and whether participants had run away from home within the past twelve months. Model fit was increasingly good as classes were added to the model, and the final model chosen to represent status offenses included three levels.

As noted above, a single indicator was used to represent property crimes. The original property crimes variable was a categorical variable with seven levels. To be more consistent with the aggregate variables described thus far, which all had three or four levels, the original property crimes variable was recoded as a categorical variable with four levels. Thus, participants retained their original categorical scores for levels 1-4. Participants reporting engaging in 4 or more acts of property crime in the last year were recoded into a single "high property crime" group.

Class Enumeration

The class enumeration process was conducted separately among boys and girls. Initially, the BIC and sample-size adjusted BIC were examined for each model (with models ranging from 1-class to 6-class). Among both boys and girls, the fit indices for the 4-class and 5-class models were relatively similar and these models provided a slightly better fit than the 6-class model (see Table 3, Figures 1 and 2). Among boys, fit indices reached a minimum value at the five-class model and the Likelihood Ratio Test (LRT) indicated that there was a significant difference in fit with each subsequent model until the six-class model, which did not differ significantly from the five-class model in terms of fit. Among girls, fit indices were almost identical for the four-class and five-class models. The LRT indicated a significant improvement in fit between the four-class and the five-class model, with no significant improvement in fit for the six-class model.

To further investigate which model would best represent the data, the conceptual meanings of the models were examined. Two methods were used. First, thresholds for each problem behavior were graphed across classes, yielding a graphic representation of the distribution of each problem behavior for each class (see Figure 3 for graphic

Table 3
Fit Indices for Class Enumeration

	Log likelihood	BIC	Sample-size adjusted BIC	p-value of Likelihood Ratio Test	Entropy	Class count for smallest class in model
BOYS						
1-class	-40473.00	81096.94	81042.92	N/A	N/A	7182
2-class	-37966.40	76243.58	76132.36	< .001	.72	2482
3-class	-37715.10	75900.81	75732.38	.32	.60	1232
4-class	-37550.93	75732.29	75506.66	< .001	.62	1052
5-class	-37436.54	75663.34	75380.52	.001	.64	804
6-class	-37400.15	75750.40	75410.37	.37	.68	371
GIRLS						
1-class	-36431.31	73014.42	72960.40	N/A	N/A	7556
2-class	-33924.42	68161.39	68050.17	< .001	.75	2282
3-class	-33711.21	67895.72	67727.30	< .001	.70	908
4-class	-33574.57	67783.18	67557.56	< .001	.65	691
5-class	-33495.38	67785.54	67502.72	< .001	.66	483
6-class	-33464.88	67885.29	67545.26	0.15	.66	389

Note. Higher log likelihood, lower BIC, and entropy closer to 1 all indicate better model fit.

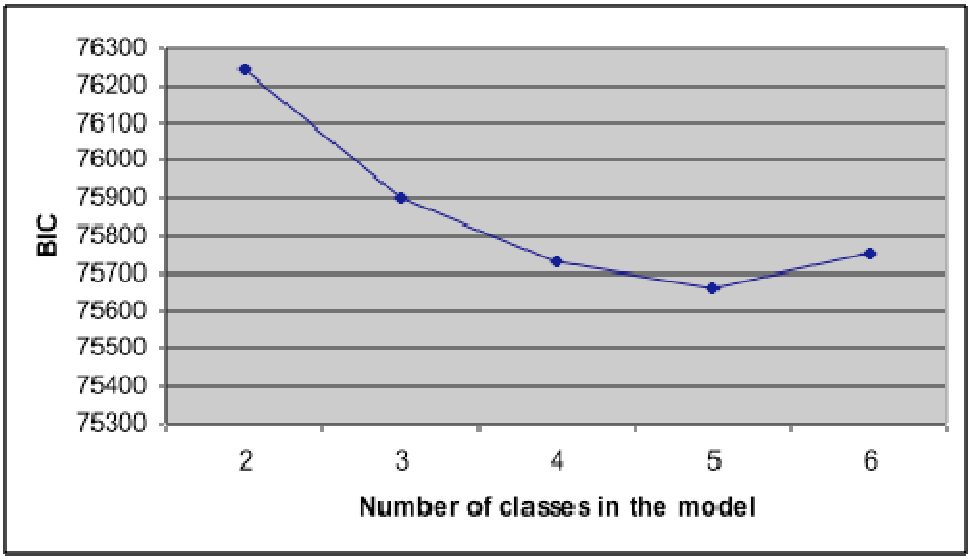

Figure 1. Comparison of Bayes Information Criterion (fit index) during class enumeration phase of analyses. Analyses conducted among boys only.

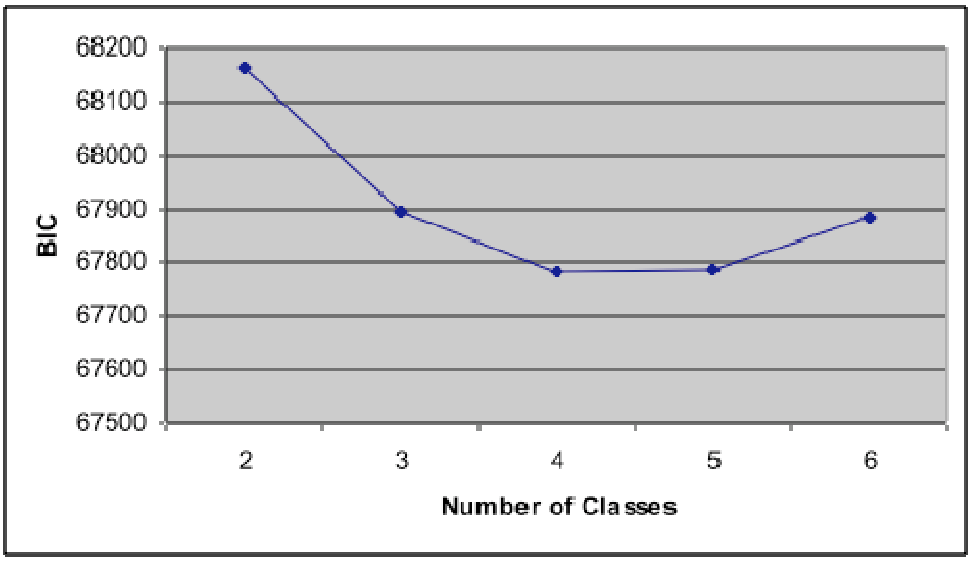

Figure 2. Comparison of Bayes Information Criterion (fit index) during class enumeration phase of analyses. Analyses conducted among girls only.

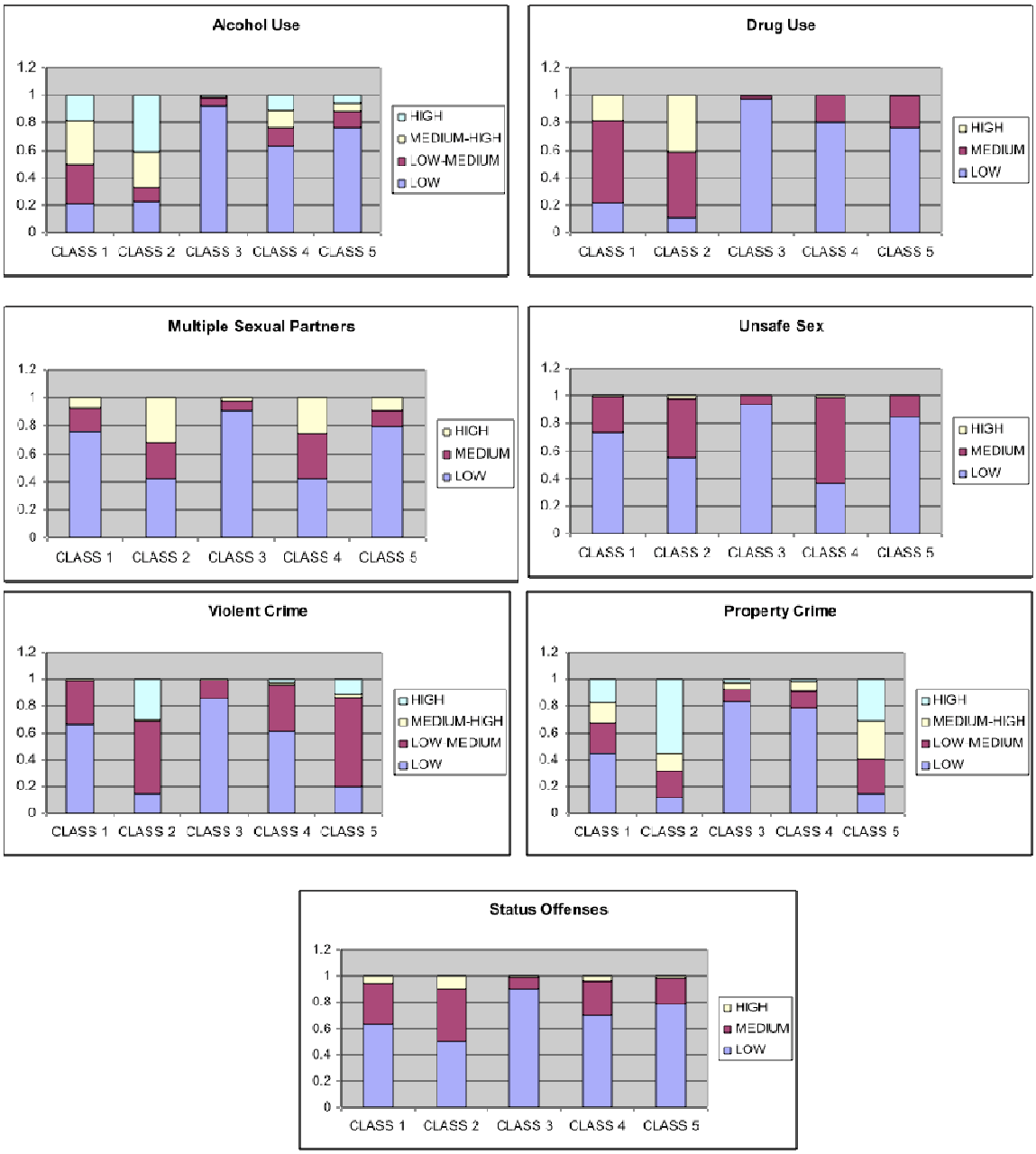

Figure 3. Distribution of latent class indicators of problem behaviors across levels of latent problem behavior variable. Class 1 = high substance abuse, Class 2 = high overall problem behaviors, Class 3 = low overall problem behaviors, Class 4 = high risky sexual behaviors, Class 5 = high criminal activity.

representation of distributions of problem behaviors in the final model). Second, the response patterns for each class were examined to determine the modal response pattern for each class. Among both boys and girls, the three-class model yielded ordered classes, representing low, medium, and high levels of problem behaviors. The four-class model yielded a "low problem behaviors" class that reported participating in low levels of all problem behaviors measured, a "high problem behaviors" class that reported participating in high levels of all behaviors measured (and particularly drinking, drug use, property and violent crime), and two classes participating in moderate levels of problem behaviors. One of these two moderate level classes was characterized by high levels of property crime and moderate levels of violent crime, combined with low to moderate levels of substance use and risky sexual behaviors. The other moderate level class was characterized by levels of risky sexual behavior that were as high as the "high" overall problem behaviors group from this analysis, moderate levels of substance use, and relatively low levels of criminal behaviors. The five-class model also yielded one "low" and one "high" problem behaviors group (Class 1 and Class 5). Each of the other three groups represented one of the areas of problem behaviors; specifically, a class emerged that was high in criminal activity and moderate in other problem behaviors (Class 2), one that was high in substance use and moderate in other problem behaviors (Class 3), and a third that was high in risky sexual activity and moderate in other problem behaviors (Class 4; see Figure 3). Given model fit data and the fact that this model yielded five distinct classes that could be interpreted as meaningfully different from each other, the five-class model was chosen as the best representation of the data.

Multiple Groups Modeling

Sex differences. As described in the Method section, a series of models were fitted to examine the relation between participant's sex and likelihood of engaging in a given pattern of problem behaviors. The first model that I fitted replicated the final model that was reached during the class enumeration phase using the entire sample (Model 1). In this model, all parameters were allowed to vary freely across sex. In Model 2, a path was added directly from participant sex to class membership, allowing for sex differences in proportion of participants belonging to each class. Model 2 yielded a slightly better model fit than Model 1 (see Table 4).

Table 4
Fit Indices for Multiple Groups Analysis

	Log likelihood	BIC	Sample-size adjusted BIC	Entropy	Class count for smallest class in model
Model 1	-71540.47	143935.19	143652.35	.64	1435
Model 2	-71191.53	143275.70	142980.15	.65	1519
Model 3	-71344.8	143639.70	143325.10	.64	1426
Model 4	-71131.33	143174.49	142872.59	.65	1444
Model 5	-70666.47	142398.32	142045.57	.67	1380

Note. Higher log likelihood, lower BIC, and entropy closer to 1 all indicate better model fit.

Examination of class thresholds indicated that in some classes, thresholds for sexual activity were significantly different in Model 2 than in the reference model (Model 1; see Table 5). This difference was an indication of a misfit in the model, due to an underlying relation between participants' biological sex and their level of participation in risky sexual activity. Therefore, paths were added from biological sex to each variable

Table 5
Threshold Differences Used in Determining a Final Multiple Groups Model

	Model 1 (reference model)	Model 2 (biological sex predicts class proportions)	Std. Difference Model 1 vs. Model 2	Model 3 (biological sex predicts risky sexual behavior)	Std. Difference Model 1 vs. Model 3
CLASS 1 (low problem behaviors)					
Alcohol 1	2.62	2.68	-0.61	2.58	0.43
Alcohol 2	4.01	4.16	-0.81	4.03	-0.13
Alcohol 3	4.84	4.97	-0.54	4.90	-0.22
Drug Abuse 1	3.38	3.56	-1.36	3.45	-0.51
Drug Abuse 2	4.74	5.01	-1.28	4.88	-0.68
Sexual Activity 1	2.89	3.17	-2.30	2.91	-0.16
Sexual Activity 2	4.79	6.03	-4.16	4.98	-0.65
Unsafe Sexual Practices 1	2.38	2.10	2.05	2.30	0.53
Unsafe 2	5.39	5.13	0.93	5.23	0.57
Status Crime 1	2.33	2.27	0.83	2.29	0.51
Status Crime 2	5.34	5.27	0.36	5.33	0.14
Violent Crime 1	2.12	2.18	-0.79	2.22	-1.20
Violent Crime 2	5.54	5.40	0.37	5.48	0.17
Violent Crime 3	6.20	5.91	0.50	6.03	0.29
Property Crime 1	1.89	1.95	-0.53	1.94	-0.39
Property Crime 2	2.97	3.09	-0.66	3.06	-0.51
Property Crime 3	4.21	4.49	-0.93	4.44	-0.76

Table 5 (continued)
Threshold Differences Used in Determining a Final Multiple Groups Model

	Model 1 (reference model)	Model 2 (biological sex predicts class proportions)	Std. Difference Model 1 vs. Model 2	Model 3 (biological sex predicts risky sexual behavior)	Std. Difference Model 1 vs. Model 3
CLASS 2 (criminal activity)					
Alcohol 1	1.00	1.09	-0.63	1.09	-0.63
Alcohol 2	2.11	2.10	0.07	2.10	0.05
Alcohol 3	2.96	2.97	-0.05	2.96	-0.02
Drug Abuse 1	-.98	1.21	-1.43	1.28	-1.89
Drug Abuse 2	3.41	4.19	-1.86	4.46	-2.50
Sexual Activity 1	1.65	1.85	-0.99	1.83	-0.90
Sexual Activity 2	2.76	3.01	-0.88	2.96	-0.69
Unsafe Sexual Practices 1	2.11	2.15	-0.15	2.01	0.44
Unsafe 2	15 or above	15 or above	0	15 or above	0
Status Crime 1	1.24	1.34	-0.90	1.33	-0.77
Status Crime 2	3.94	4.08	-0.41	4.08	-0.41
Violent Crime 1	-0.79	-0.73	-0.10	-0.72	-0.19
Violent Crime 2	2.10	2.24	-0.63	2.25	-0.68
Violent Crime 3	2.31	2.47	-0.64	2.48	-0.75
Property Crime 1	-1.37	-1.11	-0.93	-1.05	-1.14
Property Crime 2	-0.12	0	-0.73	0.05	-1.02
Property Crime 3	0.95	1.04	-0.59	1.09	-0.89

Table 5 (continued)
Threshold Differences Used in Determining a Final Multiple Groups Model

	Model 1 (reference model)	Model 2 (biological sex predicts class proportions)	Std. Difference Model 1 vs. Model 2	Model 3 (biological sex predicts risky sexual behavior)	Std. Difference Model 1 vs. Model 3
CLASS 3 (substance use)					
Alcohol 1	-1.52	-0.99	-1.46	-1.21	-0.85
Alcohol 2	0.21	0.61	-1.63	0.43	-0.92
Alcohol 3	1.78	2.10	-1.17	1.93	-0.56
Drug Abuse 1	-1.58	-1.01	-0.68	-1.69	0.13
Drug Abuse 2	1.30	1.52	-0.71	1.20	0.30
Sexual Activity 1	1.21	1.34	-0.50	1.03	0.67
Sexual Activity 2	2.44	2.67	-0.69	2.25	0.56
Unsafe Sexual Practices 1	0.56	0.38	1.40	0.71	-1.23
Unsafe 2	3.39	3.20	0.85	3.38	0.02
Status Crime 1	0.75	0.76	-0.10	0.72	0.26
Status Crime 2	3.26	3.28	-0.08	3.18	0.28
Violent Crime 1	1.12	1.28	-0.81	1.16	-0.20
Violent Crime 2	4.56	4.36	0.38	4.09	0.87
Violent Crime 3	15 or above	5.37	15 or above	5.05	15 or above
Property Crime 1	0.11	0.27	-0.90	0.02	0.49
Property Crime 2	0.94	1.07	-0.65	0.82	0.65
Property Crime 3	1.95	2.13	-0.58	1.78	0.55

Table 5 (continued)
Threshold Differences Used in Determining a Final Multiple Groups Model

	Model 1 (reference model)	Model 2 (biological sex predicts class proportions)	Std. Difference Model 1 vs. Model 2	Model 3 (biological sex predicts risky sexual behavior)	Std. Difference Model 1 vs. Model 3
CLASS 4 (risky sexual activity)					
Alcohol 1	0.67	0.74	-0.57	0.58	0.71
Alcohol 2	1.44	1.33	0.80	1.26	1.34
Alcohol 3	2.25	2.06	1.11	2.09	0.91
Drug Abuse 1	1.31	1.50	-0.97	1.36	-0.27
Drug Abuse 2	6.75	15 or above	-1.25	15 or above	-15 or below
Sexual Activity 1	0.10	-0.53	2.85	0.01	0.42
Sexual Activity 2	1.50	1.06	2.42	1.46	0.20
Unsafe Sexual Practices 1	-0.51	-0.17	-1.89	-0.61	0.58
Unsafe 2	3.72	4.52	-3.30	3.94	-0.90
Status Crime 1	0.81	0.88	-0.89	0.81	0.04
Status Crime 2	3.26	3.32	-0.30	3.25	0.08
Violent Crime 1	0.78	0.58	1.36	0.71	0.45
Violent Crime 2	3.30	3.14	0.69	3.34	-0.13
Violent Crime 3	3.74	3.61	0.48	3.83	-0.32
Property Crime 1	1.36	1.30	0.34	1.36	-0.02
Property Crime 2	2.38	2.31	0.30	2.39	-0.08
Property Crime 3	4.04	3.78	0.48	4.10	-0.11

Table 5 (continued)
Threshold Differences Used in Determining a Final Multiple Groups Model

	Model 1 (reference model)	Model 2 (biological sex predicts class proportions)	Std. Difference Model 1 vs. Model 2	Model 3 (biological sex predicts risky sexual behavior)	Std. Difference Model 1 vs. Model 3
CLASS 5 (high problem behaviors)					
Alcohol 1	-1.45	-1.42	-0.19	-1.38	-0.47
Alcohol 2	-0.70	-0.68	-0.25	-0.70	0.00
Alcohol 3	0.45	0.49	-0.48	0.44	0.06
Drug Abuse 1	-2.25	-2.28	0.11	-2.18	-0.28
Drug Abuse 2	0.26	0.33	-0.73	0.32	-0.63
Sexual Activity 1	-0.20	-0.11	-0.98	-0.02	-1.86
Sexual Activity 2	0.94	1.00	-0.60	1.10	-1.61
Unsafe Sexual Practices 1	0.32	0.39	-0.89	0.21	1.31
Unsafe 2	3.61	3.76	-0.74	3.65	-0.20
Status Crime 1	-0.05	0.00	-0.63	-0.02	-0.37
Status Crime 2	2.15	2.20	-0.43	2.18	-0.20
Violent Crime 1	-1.26	-1.20	-0.25	-1.44	0.74
Violent Crime 2	1.06	1.13	-0.46	1.02	0.22
Violent Crime 3	1.15	1.24	-0.52	1.12	0.20
Property Crime 1	-2.04	-1.87	-0.70	-2.00	-0.19
Property Crime 2	-0.82	-0.68	-0.90	-0.76	-0.35
Property Crime 3	-0.20	-0.10	-0.78	-0.18	-0.20

Note. Std. Difference = (Threshold of Reference Model (1) – Threshold of Test Model)/Standard Error of Reference Model. Similar to a *z*-score, values above 2 can be considered significant

representing risky sexual activity (Model 3). Following the addition of these paths, model fit remained essentially the same; moreover, threshold levels in Model 3 were comparable to those in Model 1 (see Table 5).

The next step was to interpret the final model. First, I examined coefficients when class membership was regressed on biological sex. Each of these regressions was significant, indicating that sex differences exist in the likelihood of being identified as a member of each problem behavior class as compared to the normative (low problems) class (see Table 6).

Table 6
Logistic Regressions of Latent Class Membership on Biological Sex

	b	Standard Error	Odds Ratio	95% Confidence Interval
High Problem Behaviors Class	-1.33	0.17	0.26	0.19 - 0.37
Substance Abuse Class	0.55	0.13	1.73	1.34 - 2.24
Criminal Activity Class	-1.25	0.14	0.29	0.22 - 0.38
Risky Sexual Activity Class	-1.02	0.25	0.36	0.22 - 0.59

The latent class regression formula (see Appendix) was used to calculate relative odds of being in each class among boys vs. girls. Results indicated that boys had a higher probability of being in the “high problem behaviors” class, the “risky sexual activity” class, and the “criminal activity” class, whereas girls had a higher probability of being in the “substance use” class and the “low problem behaviors” class (see Table 7).

Table 7
Relative Probability of Belonging to each Class among Boys and Girls

Class	Boys	Girls
High Problem Behaviors	0.15	0.06
Substance Abuse	0.07	0.18
Criminal Activity	0.18	0.08
Risky Sexual Activity	0.18	0.09
Low Problem Behaviors	0.41	0.59

Finally, the logistic regression odds ratio results for the path from biological sex to the risky sexual activity variables were examined. These paths were held constant across classes, and results indicated that boys were more likely to report engaging in sexual activity with multiple partners (Odds ratio = 0.63; 95% Confidence Interval = 0.52 - 0.76), whereas girls were more likely to report engaging in unsafe sexual practices (i.e., failing to protect themselves from sexually transmitted infections; Odds ratio = 1.56; 95% Confidence Interval = 1.33 – 1.84).

Ethnicity/racial differences. As described in the Method section, ethnicity next was added as a third “known class” variable to Model 3, which included five classes of problem behavior, biological sex as a "known class" latent variable, and paths directly from biological sex to adolescents' sexual behavior. Model 4 included post-hoc ethnicity analyses added on to Model 3, rather than immediately including a path from ethnicity to problem behavior. This strategy was chosen to allow me to examine the effect of ethnicity without affecting model specifications or fit. Multiple imputation from posterior probabilities was used to estimate racial/ethnic differences in the proportion of participants belonging to each class in the previously estimated best-fitting 5-class model. In further modeling (described below), the model fit indices from Model 4 were used as a

"check" to make sure that models were properly specified. If the relation between class and ethnicity changed substantially in future models, this would be an important indicator of misspecification in the model.

In Model 5, a path was added directly from participant ethnicity to class membership, fully integrating ethnicity into the final model. When ethnicity was integrated in Model 5, model fit was marginally better than in Model 3 (see Table 4). Examination of class thresholds indicated that in some classes, thresholds for alcohol use, drug use, violent crime, and property crime were significantly different in Model 5 than in the reference model (see Table 8). Given these differences in class thresholds, paths were drawn from ethnicity to each of these areas of problem behavior. The lowest log likelihood value was not replicated, even when the number of starting values was increased to 5000 starts, indicating that this was not a stable model. In addition, examination of the model results that were yielded indicated that the basic nature of the latent class variable was not comparable to the model data for previous models (i.e., the model yielded a conceptually different set of latent classes), further suggesting that this model was not a good fit to the data. A second and third model, respectively, were run with paths only from (a) ethnicity to the substance use variables and (b) ethnicity to the violent and property crime variables. For both of these models, the lowest log likelihood value did not replicate and the conceptual nature of the latent classes was dramatically different than it had been in the reference model. Because the threshold changes that occurred when ethnicity was fully integrated into the model could not be addressed by adding additional paths, I concluded that it was not feasible to examine ethnicity differences within the context of this model. An alternative approach to addressing the

role of ethnicity could be to repeat the class enumeration phase separately by ethnicity to accurately represent classes of problem behaviors across ethnic groups. However, these additional analyses were beyond the scope of this investigation, which primarily focused on identifying classes of problem behaviors among adolescents.

Table 8
Threshold Differences Used in Determining a Final Model including Race/Ethnicity

	Model 3 (reference model)	Model 5 (race/ethnicity predicts class proportions)	Std. Difference Model 1 vs. Model 5
CLASS 1 (low problem behaviors)			
Alcohol 1	2.58	3.06	-5.63
Alcohol 2	4.03	5.09	-6.27
Alcohol 3	4.90	5.34	-1.91
Drug Abuse 1	3.45	3.38	0.44
Drug Abuse 2	4.88	4.78	0.45
Sexual Activity 1	2.91	2.96	-0.40
Sexual Activity 2	4.98	5.12	-0.41
Unsafe Sexual Practices 1	2.30	2.26	0.43
Unsafe 2	5.23	5.25	-0.08
Status Crime 1	2.29	2.30	-0.06
Status Crime 2	5.33	5.32	0.02
Violent Crime 1	2.22	2.26	-0.44
Violent Crime 2	5.48	5.70	-0.69
Violent Crime 3	6.03	6.24	-0.47
Property Crime 1	1.94	1.96	-0.24
Property Crime 2	3.06	3.08	-0.10
Property Crime 3	4.44	4.45	-0.50

Table 8 (continued)
Threshold Differences Used in Determining a Final Model including Race/Ethnicity

	Model 3 (reference model)	Model 5 (race/ethnicity predicts class proportions)	Std. Difference Model 1 vs. Model 5
CLASS 2 (criminal activity)			
Alcohol 1	1.09	1.03	0.44
Alcohol 2	2.10	2.23	-0.59
Alcohol 3	2.96	2.92	0.14
Drug Abuse 1	1.28	0.96	1.51
Drug Abuse 2	4.46	3.45	1.03
Sexual Activity 1	1.83	2.43	-3.06
Sexual Activity 2	2.96	3.71	-2.71
Unsafe Sexual Practices 1	2.01	2.80	-2.67
Unsafe 2	15 or above	15 or above	15 or above
Status Crime 1	1.33	1.20	1.07
Status Crime 2	4.08	3.78	0.86
Violent Crime 1	-0.72	-0.72	0.01
Violent Crime 2	2.25	2.23	0.10
Violent Crime 3	2.48	2.46	0.13
Property Crime 1	-1.05	-1.07	0.08
Property Crime 2	0.05	-0.03	0.45
Property Crime 3	1.09	1.00	0.50

Table 8 (continued)
Threshold Differences Used in Determining a Final Model including Race/Ethnicity

	Model 3 (reference model)	Model 5 (race/ethnicity predicts class proportions)	Std. Difference Model 1 vs. Model 5
CLASS 3 (substance use)			
Alcohol 1	-1.21	1.63	-15 or below
Alcohol 2	0.43	1.56	-7.42
Alcohol 3	1.93	1.73	1.08
Drug Abuse 1	-1.69	-0.43	-2.71
Drug Abuse 2	1.20	1.56	-1.93
Sexual Activity 1	1.03	1.06	-0.16
Sexual Activity 2	2.25	2.40	-0.80
Unsafe Sexual Practices 1	0.71	0.40	3.13
Unsafe 2	3.38	3.55	-1.04
Status Crime 1	0.72	0.91	-2.29
Status Crime 2	3.18	3.34	-0.82
Violent Crime 1	1.16	1.41	-1.51
Violent Crime 2	4.09	5.96	-3.79
Violent Crime 3	5.05	15 or above	-15 or below
Property Crime 1	0.02	0.41	-2.52
Property Crime 2	0.82	1.19	-2.31
Property Crime 3	1.78	2.17	-1.71

Table 8 (continued)
Threshold Differences Used in Determining a Final Model including Race/Ethnicity

	Model 3 (reference model)	Model 5 (race/ethnicity predicts class proportions)	Std. Difference Model 1 vs. Model 5
CLASS 4 (risky sexual activity)			
Alcohol 1	0.58	1.31	-6.94
Alcohol 2	1.26	2.03	-6.21
Alcohol 3	2.09	2.57	-3.33
Drug Abuse 1	1.36	0.99	2.41
Drug Abuse 2	15 or above	6.85	15 or above
Sexual Activity 1	0.01	-0.10	0.69
Sexual Activity 2	1.46	1.32	0.99
Unsafe Sexual Practices 1	-0.61	-0.28	-2.13
Unsafe 2	3.94	3.94	-0.02
Status Crime 1	0.81	0.90	-1.16
Status Crime 2	3.25	3.40	-0.87
Violent Crime 1	0.71	0.27	2.29
Violent Crime 2	3.34	2.72	2.26
Violent Crime 3	3.83	3.16	1.98
Property Crime 1	1.36	0.80	2.57
Property Crime 2	2.39	1.80	2.05
Property Crime 3	4.10	2.99	1.42

Table 8 (continued)
Threshold Differences Used in Determining a Final Model including Race/Ethnicity

	Model 3 (reference model)	Model 5 (race/ethnicity predicts class proportions)	Std. Difference Model 1 vs. Model 5
CLASS 5 (high problem behaviors)			
Alcohol 1	-1.38	-1.53	1.09
Alcohol 2	-0.70	-0.73	0.26
Alcohol 3	0.44	0.45	-0.09
Drug Abuse 1	-2.18	-2.20	0.09
Drug Abuse 2	0.32	0.31	0.07
Sexual Activity 1	-0.02	0.001	-0.30
Sexual Activity 2	1.10	1.11	-0.20
Unsafe Sexual Practices 1	0.21	0.33	-1.29
Unsafe 2	3.65	3.57	0.36
Status Crime 1	-0.02	-0.09	0.96
Status Crime 2	2.18	2.16	0.17
Violent Crime 1	-1.44	-1.46	0.06
Violent Crime 2	1.02	1.02	0.04
Violent Crime 3	1.12	1.14	-0.13
Property Crime 1	-2.00	-2.06	0.35
Property Crime 2	-0.76	-0.84	-.69
Property Crime 3	-0.18	-0.22	0.40

Note. Std. Difference = (Threshold of Reference Model (1) – Threshold of Test Model)/Standard Error of Reference Model. Similar to a *z*-score, values above 2 can be considered significant.

CHAPTER 4
DISCUSSION

The present study addressed several gaps in the literature concerning the nosology and conceptualization of problem behaviors. First, this study used a dimensional approach, examining multiple areas of problem behavior concurrently. This strategy allowed examination of the theory that a broader underlying externalizing "syndrome" may describe adolescent externalizing symptoms more accurately than current diagnostic criteria or more limited conceptualizations that have been used in the previous literature. Second, this study examined sex differences in patterns of problem behaviors. Relatively less is known about girls' patterns of problem behaviors compared to boys' patterns; thus, this study addressed an important gap in the literature by allowing explicit comparisons of these behaviors across sex. Third, patterns of problem behaviors across ethnicity were examined. This approach is in contrast to a strategy of attempting to statistically "control" for differences in problem behaviors between adolescents of various ethnicities, which can mask patterns of differences that provide important information relevant to clinical assessment and intervention. These analyses were conducted using a large, nationally representative sample and using person-centered modeling techniques, allowing for a more sophisticated examination of these questions than has previously been conducted.

As predicted, a conceptualization of externalizing behaviors that extended the *DSM* framework and included multiple types of problem behaviors (e.g., criminal behaviors, substance abuse, risky sexual behavior) yielded multiple problem behavior classes that supported previous research indicating that adolescents were engaging in

multiple types of problem behaviors (Donovan & Jessor, 1985; Donovan, Jessor, & Costa, 1988; Fergusson et al., 1994; Fisher et al, 2000; Loeber et al., 2000; Patterson et al., 2000). Five classes of problem behaviors emerged, including one class exhibiting high levels of all problem behaviors, one class with low levels of all problem behaviors, and three classes each characterized by higher levels of participation in one problem behavior area (i.e., substance use, criminal activity, and risky sexual activity). Even those adolescents who "specialized" in one type of problem behavior were also typically engaged in lower levels of other types of problem behaviors (see Figure 3).

Consistent with previous research (Fergusson et al., 1994; Storr et al., 2007), the same 5-class model described both boys' and girls' patterns of problem behaviors. Although this model held across sex, sex differences were evident in the rates of participation in different types of problem behavior. As predicted, boys demonstrated a higher probability of belonging to the "high problem behavior" class and the "criminal activity" class, whereas girls demonstrated a higher probability of belonging to the "low problem behaviors" class. Contrary to predictions and the findings of Fergusson et al. (1994), one class characterized by participation in both risky sexual behavior and high levels of substance abuse did not emerge. Rather, the data were better described by two separate classes, a "risky sexual activity" class and a "high substance use" class. Boys were more likely to belong to the "risky sexual activity" class, whereas girls were more likely to belong to the "high substance use" class. In contrast to the findings of Storr et al. (2007), I did not find that girls with disruptive behaviors were more likely than boys to exhibit co-occurring problem behaviors. Rather, the results of the present study suggest that both boys and girls exhibit similar patterns of comorbidity with regard to the

externalizing behaviors under consideration. One implication of this discrepancy in findings between Storr et al. and the present study is that when broader conceptualizations of externalizing problems are used, boys and girls exhibit similar levels of comorbid symptoms, whereas use of *DSM* diagnostic criteria for externalizing disorders may lead to artificially elevated levels of comorbidity among girls. This possibility lends further support for the inclusion of a dimensional element into diagnostic conceptualizations of externalizing behaviors.

In addition, this study supports previous research indicating that a broader conceptualization of externalizing behaviors, including substance use and sexual activity, likely provides the most accurate description of adolescents' actual patterns of problem behaviors (Donovan & Jessor, 1985; Donovan et al., 1988; Krueger, Markon, & Patrick, 2005; Patterson, Dishion, & Yoerger, 2000). My findings indicated that those adolescents who engaged in the highest levels of more typical externalizing behaviors also engaged in the highest levels of substance use and risky sexual activity. Further, adolescents belonging to the three "specialty" classes engaged in relatively high levels of one problem behavior, but also engaged in elevated levels of other problem behaviors (e.g., participants in the "substance use" class also engaged in elevated levels of property crime and risky sexual behavior; see Figure 3). These results indicated that even adolescents who "specialize" in one type of problem behavior are likely to engage in other types of problem behaviors as well. Theoretically, these results do not fit neatly with previously operationalized subsets of externalizing behaviors. Systematic differences between overt and covert types of behaviors did not emerge (e.g., violent vs. property crime). Instead, latent classes were defined by dimensions of problem behaviors

(e.g., overall criminal activity). Also, it is important to note that although a "low problem behaviors" class emerged, this class is not synonymous with "no problem behavior." Of the adolescents categorized into this class, approximately half were engaged in low levels of at least one of the behaviors included in the model.

Clinically and nosologically, these results have several important implications. These finding support arguments that our current conceptualization of CD does not adequately describe the range of problem behaviors that are typically seen among adolescents who engage in externalizing behaviors (Drabick, 2009; Hartung & Widiger, 1998; Krueger et al., 2005). The results indicate that a broader conceptualization of externalizing problems may more accurately describe these behaviors among boys and girls alike. Consistent with the arguments made by Zahn-Waxler (1993), this similarity across sex in a community-based sample implies that a separate set of diagnostic criteria for girls vs. boys is not necessary; instead, a broader set of diagnostic criteria overall might better describe these patterns of behaviors among both girls and boys. These findings suggest that problem behaviors such as criminal activity, rule-violations, risky sexual activity, and substance use should all be considered as potential dimensions for inclusion in a categorical-dimensional framework for defining externalizing problems. Maser et al. (2009) have argued convincingly that use of such a diagnostic framework would create a nosological system that more accurately reflects the way that psychopathology manifests. These findings support the argument that the addition of a dimensional approach to our typical categorical framework for conceptualizing psychological disorders could more accurately reflect the patterns of problem behaviors seen in this population.

One interesting finding that emerged was a direct relation between participants' biological sex and their pattern of engaging in risky sexual behavior. Results indicated that boys were more likely to engage in sexual activity with multiple partners, whereas girls were more likely to engage in sexual activity without using appropriate "safer sex" protection against STDs and pregnancy. These findings imply that both boys and girls may have similar likelihood of putting themselves at risk during sexual encounters, but there are sex differences in the risky choices that they make. Although I was unable to empirically examine potential explanations for these sex differences, there are several possible reasons that could be examined in future research. It is possible that social factors contribute to these sex differences. For example, boys' tendency to engage in sexual activity with multiple partners may be related to differential attitudes towards promiscuity. Girls may feel more pressure to avoid being labeled as a promiscuous, whereas promiscuity among boys may be more accepted. Moreover, girls' failure to protect themselves from pregnancy and STDs may be because of differences in expectations about sexual contact. Perhaps boys have higher expectation or desire for sexual activity, and thus are more likely to regularly have protection with them. In addition, it is possible that boys have easier access to birth control, or experience less embarrassment about purchasing protection. Further research that distinguishes between these types of risky sexual behavior will be necessary to validate and further explore these findings.

One strength of the current study was the use of latent class analysis to examine clusters of problem behaviors. Use of a person-centered approach allowed a more clear understanding of the classes and subgroups that exist within the broad category of

externalizing behaviors. This is particularly important when examining these symptoms, given the heterogeneity of externalizing problems (Drabick, 2009). An additional strength of the current study was the use of a large, nationally representative sample of American adolescents. A large sample size, along with the use of sophisticated modeling techniques, allowed me to concurrently examine multiple different types of problem behaviors, rather than examining different types of problem behaviors separately in different models. This concurrent examination allowed me to determine that even among adolescents who "specialize" in one type of problem behavior, it is common to see elevated levels of other types of problem behaviors as well. Moreover, the size of the sample allowed examination of differences in the results based on adolescents' biological sex. Many studies are underpowered to include these analyses, and the significant differences were detected between these groups speak to the importance of their inclusion in current and future research.

Despite these strengths, there are several limitations that must be noted. Because this was an archival data analysis, I was not able to choose variables for inclusion in the study or how these constructs were operationalized. Therefore, I was not able to use variables that mapped directly onto diagnostic criteria for CD, and although these results can speak to problem behaviors more broadly, cannot speak directly to the way that CD is currently conceptualized within the *DSM* framework. Future research that includes the specific *DSM-IV* diagnostic criteria for CD can provide further information as to whether these criteria are equally relevant across biological sex and ethnic groups.

A second weakness is the use of adolescents' self-report, which suggests some likelihood that adolescents may have under-reported or misremembered the information

that they provided. Nevertheless, there is some evidence that adolescents can be reasonably truthful in reporting their own rates of problem behaviors when guaranteed privacy and confidentiality as they were during the collection of these data. Further, adolescents are probably the most knowledgeable sources for reporting on their own problem behaviors, as it is natural for them to keep knowledge of these behaviors from adults in their lives.

Further, the use of a non-disordered community sample means that the base rates of problem behaviors were likely lower than they would be in a clinic-referred or disadvantaged sample. However, descriptive statistics indicated that although mean levels of problem behaviors in this sample were relatively low, a full range of problem behaviors were present in these data. Additionally, my emphasis on a dimensional approach to understanding problem behaviors mandated an examination of adolescents across the spectrum of severity of problem behaviors in order to consider different levels of these behaviors.

Another limitation of this study was the use of a relatively broad age range in the current sample. Although the median age of participants included in the present analyses was 16, the sample included a great deal of heterogeneity in this respect, with participant ages ranging from 11 to 23. At data collection, participants ranged from grade 8 to their first year post-high school, representing a wide range of developmental levels. Given that the base rates of some of these behaviors vary by developmental period (e.g., some behaviors are more normative in later adolescence than late childhood), it is possible that restricting analyses to participants at a single developmental level (e.g., ages 14-18) would have yielded different results. Future analyses that take into account

developmental periods and evaluate more homogeneous subgroups could address this possibility.

Finally, although the results suggest that there may be differences between adolescents of different ethnicities in patterns of problem behaviors, I was unable to successfully integrate ethnicity into the model presented here. Future research examining subgroups of problem behavior across adolescents of different ethnicities is necessary to further examine the role of adolescents' race or ethnicity in the patterns of problem behaviors that they display.

Further research is also necessary to validate the clusters of problem behaviors identified in the present study. For example, longitudinal studies examining development of problem behaviors will be necessary to determine whether membership in one of these groups remains stable over time, or whether adolescents progress from one area of problem behavior to another. In addition to examining course, evaluation of other criteria that may be useful for identifying syndromes (e.g., treatment response, correlates, etiological processes, family history) could provide further validation of these clusters of problem behaviors. Given the continuity evident in many of these behaviors, research examining correlates of membership in these clusters will be important in generating guidelines for discerning normative vs. clinically significant levels of problem behaviors. Examination of different samples during distinct developmental periods (e.g., youth at different ages, clinical samples) will help to determine whether these patterns of co-occurrence are similar in other populations and during different developmental periods. Finally, environmental factors such as family functioning, peer processes, and school performance each have been linked to the development of externalizing problems

(Crosnoe, Erickson, & Dornbusch, 2002; Duncan, Duncan, Biglan, & Ary, 1998; Lammers, Ireland, Resnick, & Blum, 2000; Moffit, Rutter, & Silva, 2001; Rothbaum & Weisz, 1994). Research examining the relation between these factors and subgroups of problem behavior could provide a more sophisticated understanding of these dimensions and their development.

In conclusion, the results of the present analyses suggest that a broader, dimensional understanding of externalizing problems including substance abuse and risky sexual behavior is necessary to provide a full understanding of the manifestation of these behaviors among adolescents. Further, such an approach is likely to better capture these behaviors across sex than current *DSM-IV* diagnostic criteria for CD. In particular, this type of conceptualization is not only consistent with previous research examining typical adolescent development, but also likely to improve our ability to describe these behaviors among girls, whose likelihood of participating in aggressive types of problem behaviors was lower than that of boys. These results should inform assessment and clinical interventions, as well as research aimed at understanding typical and atypical development of externalizing behaviors that can ultimately inform etiological and nosological models.

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Appendix

Latent class regression formula used to calculate relative odds of belonging to a given latent class.

$$\hat{\pi}(c = k \mid sex) = \frac{\exp\left(c\#k + [c\#k\_on\_sex](sex)\right)}{\sum_{h=1}^{K} \exp\left(c\#h + [c\#h\_on\_sex](sex)\right)}$$

$$c\#K = 0, [c\#K\_on\_sex] = 0$$

$$\hat{\pi}(c = 1 \mid sex) = \frac{\exp\left(c\#1 + [c\#1\_on\_sex](sex)\right)}{\sum_{h=1}^{K} \exp\left(c\#h + [c\#h\_on\_sex](sex)\right)}$$

$$= \frac{\exp\left(c\#1 + [c\#1\_on\_sex](sex)\right)}{\left(\begin{array}{l}\exp\left(c\#1 + [c\#1\_on\_sex](sex)\right) + \exp\left(c\#2 + [c\#2\_on\_sex](sex)\right) + \\ \exp\left(c\#3 + [c\#3\_on\_sex](sex)\right) + \exp\left(c\#4 + [c\#4\_on\_sex](sex)\right) + 1\end{array}\right)}$$

$$= \frac{\exp\left(-1.664 + -1.263(sex)\right)}{\begin{array}{l}\exp\left(-1.664 + -1.263(sex)\right) + \exp\left(-1.484 + 0.655(sex)\right) + \\ \exp\left(-1.400 + -1.015(sex)\right) + \exp\left(-1.485 + -1.356(sex)\right) + 1\end{array}}$$