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The Number of Sexual Partners and Health-Risking Sexual Behavior: Prediction from High School Entry to High School Exit

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Abstract

Precursors to adolescent health-risking sexual behavior (HRSB) were examined in a normative sample of 373 adolescents (48.0% female, $n = 178$). Using a variable-oriented approach, we regressed the number of sexual partners at high school exit (age 17) on parental monitoring, association with delinquent peers, romantic relationship status, problem behavior, physical maturity, and tobacco and alcohol use at high school entry (age 14); all emerged as significant predictors except alcohol use and physical maturity (we found sex differences in physical maturity and romantic relationship status, with females being more advanced in both areas). Sexual experimentation at high school entry served to partially or fully mediate the impact of these factors. A person-oriented approach, using a broader measure of HRSB, found three subgroups of adolescents: abstainers, low-risk-takers, and high-risk-takers. Results predicting membership in these groups generally followed those from the variable-oriented analysis. Implications for the prevention of HRSB and future research directions are discussed.

Keywords

adolescence; health-risking sexual behavior; coercion theory; problem behavior theory; biosocial model

INTRODUCTION

Although dating and sexual experimentation (i.e., kissing, sexual touching) become normative during adolescence, a subset of individuals engage in health-risking sexual behavior (HRSB), such as unprotected sex in non-monogamous relationships. HRSB can lead to a host of negative outcomes, including the contraction of sexually transmitted infections (STIs), teenage pregnancy, and early parenthood (Capaldi, Stoolmiller, Clark, & Owen, 2002; Kershaw et al., 2005).

Recent work has examined the longitudinal development of specific behaviors that might serve as risk factors for the development of HRSB in adolescence. Using a coercion theory framework, Ary et al. (1999a; 1999b) developed a model for problem behavior in adolescence that included a consideration of both parental monitoring and association with delinquent peers. In general, coercion theory suggests that a primary cause of adolescent antisocial behavior is a lack of parental monitoring, which can result in the adolescent spending unsupervised time with his/her peers (e.g., time in which the parent is not with the

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adolescent and is not aware of what the adolescent is doing or who they are with; Dishion, French, & Patterson, 1995; Patterson, 1982; Patterson, Reid, & Dishion, 1992). In early childhood, a coercive (i.e., harsh, reactive, or aggressive) parental response to child misbehavior can be reinforced by child acquiescence, creating a feedback loop in which both parental coercion and child acquiescence reinforce each other. As children get older, they may respond more negatively to parental coercion, and thus relatively minor disagreements may escalate into highly negative parent-child interactions. To avoid these aversive interactions, parents sometimes reduce their behavioral monitoring, which provides an opportunity for adolescents to associate with more delinquent peers and, in turn, more antisocial behavior. Research exists linking both lack of parental monitoring and association with delinquent peers to engagement in risky sexual behavior (Allen, Porter, & McFarland, 2006; Biglan et al., 1990; Miller, Forehand, & Kotchick, 1999; Rodgers, 1999; Stanton et al., 2000; Whitbeck, Yoder, Hoyt, & Conger, 1999). Ary et al. (1999a, 1999b) found evidence for a mediated model, by which the association with delinquent peers partially mediated the link between poor parental monitoring and more general problem behavior.

The work by Ary et al. also incorporated problem behavior theory (Jessor & Jessor, 1977), which suggests that adolescent health-risking behaviors comprise a single behavioral syndrome such that problems in one area may also manifest in other areas. Thus, the existence of one or more maladaptive behavior might predict or foreshadow other maladaptive behaviors. There is extant research to support covariation among HRSB, internalizing/externalizing behavior, and substance use (Achenbach, 1991; Biglan et al., 1990; Capaldi, Crosby, & Stoolmiller, 1996; Crowley, Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006; Henggeler et al., 2006; Jessor, Van Den Bos, Vanderryn, Costa, & Turbin, 1995; Tildesley, Hops, Ary, & Andrews, 1995). Ary et al. (1999a, 1999b) found that HRSB, antisocial behavior, academic problems, and substance use could be incorporated into a general problem behavior construct.

More recently, Siebenbruner, Zimmer-Gembeck, and Egeland (2007) found evidence supporting both problem behavior theory and a biosocial model (Udry, 1988) when examining sexually abstaining, low-risk-taking, and high-risk-taking adolescents in a high-risk sample. A biosocial model emphasizes individual differences in biological maturity, which can lead to differences in the onset of sexual activity. Research has found that more physically mature individuals are more likely to engage in sexual behavior, such as dating and sexual intercourse (Costa, Jessor, Donovan, & Fortenberry, 1995; Meschke, Zweig, Barber, & Eccles, 2000; Phinney, Jensen, Olsen, & Cundick, 1990). Siebenbruner et al. (2007) found that early physical maturation and involvement in long-term romantic relationships differentiated sexually abstaining from low-risk-taking adolescents, and romantic relationship status also differentiated abstainers from high-risk-taking adolescents. In support of problem behavior theory, Siebenbruner et al. found that alcohol use differentiated abstaining from low-risk-taking adolescents, while drug use differentiated abstaining from high-risk-taking adolescents.

The primary goal of the current study was to integrate these diverse theoretical frameworks in an investigation of the precursors to HRSB during adolescence. By incorporating multiple theoretically relevant predictors, we can provide a more complete picture of the risk factors for HRSB and contribute to more effective intervention efforts. In pursuit of this goal, we used two distinct approaches: (1) a variable-oriented approach, in which we considered the relationships between HRSB (i.e., number of sexual partners) and a set of predictors (i.e., parental monitoring, association with delinquent peers, behavior problems, substance use, physical development, and romantic relationship status) across the entire sample, and (2) a person-oriented approach, in which we empirically evaluated whether our sample was composed of distinct sub-populations, defined in terms of a broader measure of HRSB (i.e.,

number of partners, contraceptive use, sex with unfamiliar people, and pregnancy) and then examined predictors of group membership to determine whether any group possessed unique precursors. In general, a variable-oriented approach assumes that the relationships between variables are consistent across an entire population (i.e., a *homogeneous* population) while a person-oriented approach acknowledges that the relationships between variables may vary across distinct subgroups within a population (i.e., a *heterogeneous* population; see von Eye & Bogat, 2006). By conducting both variable- and person-oriented analyses, we can determine whether the precursors to HRSB are common across our entire sample or whether certain precursors are more relevant for certain sub-groups, if any exist. Such information would enable more direct, targeted intervention efforts.

With regards to the variable-oriented analysis, we hypothesized that we would find evidence to support coercion theory, problem behavior theory, and a biosocial model. Specifically, we expected to find links between HRSB and parental monitoring, association with delinquent peers, behavior problems (i.e., internalizing/externalizing behavior), substance use, physical maturity, and romantic relationship status. With regards to the person-oriented analysis, previous person-oriented and typological research (e.g., K. S. Miller et al., 1997; Siebenbruner et al., 2007; Whitaker, Miller, & Clark, 2000) identified at least three distinct groups of adolescents (i.e., delayed/abstaining, one-time/steady/low-risk, and multiple/high-risk) and we expected to find these three groups in our sample. Regarding the prediction of group membership, we were guided by Whitaker et al. (2000), who found a fairly linear trend across their groups (i.e., the same set of variables predicted membership across all groups). Although Siebenbruner et al. found that different variables were predictive of membership in different groups in some cases, we were less inclined to be guided by their findings given the high-risk nature of their sample (i.e., they used a low-SES sample with predominantly young and/or single parents while we used a normative community sample comprised mainly of middle-income, two-parent families).

We also sought to further understand the processes surrounding HRSB by investigating potential mediating factors. In pursuit of this goal, we were guided by the gateway hypothesis (Kandel, 2002). Stemming from the literature on substance use, the gateway hypothesis describes the likely progression of early substance use from tobacco or alcohol to later marijuana to other illicit drugs. Evidence supports this hypothesis for substance use, indicating that individuals are more likely to escalate to using more serious types of drugs once they have initiated earlier use of a lower intensity drug (Fergusson, Boden, & Horwood, 2006). When applied to sexual behaviors, the principles of the gateway hypothesis suggest that youth experimenting at an earlier age with more benign forms of sexual behavior (i.e., sexual touching) are more likely to progress into more advanced and potentially dangerous forms of sexual behavior (i.e., HRSB) during adolescence when compared to youth not experimenting with these behaviors. In other words, it is unlikely that an adolescent will begin to engage in HRSB if s/he has not already participated in normative sexual behaviors (Lanza & Collins, 2008). A specific health-risking sexual behavior that is conceptually linked to early sexual experimentation is early sexual intercourse, which has been found to lead to greater overall numbers of sexual partners when compared to individuals who initiated sexual intercourse at a later age (Seidman, Mosher, & Aral, 1994). Many of the factors discussed above have been linked to early sexual intercourse, including poor parental monitoring, association with delinquent peers, physical development, problem behavior, and substance use (Biglan et al., 1990; Capaldi et al., 1996; French & Dishion, 2003; Miller et al., 1997). We hypothesized that links between these variables and HRSB would be mediated by sexual experimentation. We also included tests of mediation for romantic relationship status in an exploratory fashion.

METHOD

Participants

Participants were part of an ongoing longitudinal study using a community-based sample (N = 373). The purpose of the longitudinal study was to examine normative family processes across development from early childhood to adolescence with a specific focus on processes related to parent and peer influences on children's social, emotional, and cognitive development. No interventions were involved.

Two cohorts of participants were recruited from a medium-sized city in the Pacific Northwest. Cohort 1 was recruited via advertisements in local newspapers, mailed newsletters, and flyers posted in public areas throughout the local community. All families with 18-month-old children were invited to participate. The resulting sample (n = 166) matched the family size, income, and occupational status statistics of the local area. When the children in Cohort 1 reached age 5, a second cohort of 5-year-old children (n = 207) was recruited using the same recruitment procedures as with Cohort 1. Sample retention rates remained high throughout the study. For example, data were collected on 97% of the original sample (n = 363) at the final assessment (age 17). Attrition in the sample was minimized using a variety of techniques. For example, we mailed annual newsletters and birthday cards to the participants and strived to maintain a consistent staff to provide the participants with a degree of security and familiarity. We offered a cash bonus to individuals who moved and kept us informed of their new location, and maintained a list of secondary contacts that could assist in locating individuals if they had moved and not notified us of their new location. Although the participants were involved in several major assessments during childhood, the current analyses only include data collected at high school entry (age 14) and at high school exit (age 17) due to the focus on HRSB practices.

The analytic sample was similar to the region from which it was drawn in terms of family size, income level, occupational status, and ethnic diversity (88% Euro-American, 7% mixed ethnic background, 2% Hispanic, 1% African American, 1% Native American, and 1% Asian American). At high school exit, 55% of the adolescents were living with two biological parents, 13% of the adolescents were living with a biological parent and a stepparent, and most of the remaining youth were living with a single parent. The mean educational level for mothers and fathers was "at least 1 year at a 4-year college." The mean maternal and paternal employment levels were both 6 (i.e., technicians, semi-professionals, or small business owners) on the Hollingshead (1975) 9-level occupational schedule. The mean family income level was $40,000 per year at high school exit (1998–2001). The mean ages for mothers and fathers were 45 and 48 years, respectively.

Procedure

At high school entry and exit, youth and their caregiver(s) participated in an in-person interview and completed a set of questionnaires. The assessments were conducted during a 2-hour home visit. All instruments were checked for ambiguous or unintentionally skipped responses, and collection of missing data was subsequently attempted. Parents and youth were paid for their participation. All measures below were assessed at high school entry with the exception of the number of sexual partners and more general HRSB, which were assessed at high school exit.

Parental monitoring—Monitoring was measured using the House Rules Questionnaire (French & Weih, 1990). Using a scale ranging from 1 (*Almost always true)* to 5 (*Almost always false)*, mothers, fathers, and adolescents responded to 21 statements assessing the extent to which household rules, which govern child responsibilities and unsupervised free

time, exist and were followed. For example, the scale includes statements that assess the extent to which the parent expects the child to "be home after school by a certain time", "finish his/her chores before s/he is allowed to go out with friends", and "be in bed at a certain time", and the extent to which the parent "know(s) which friends my child hangs out with after school" and "ask(s) my child if s/he has homework to do for the next day". The total score was created from the mean of the 21 items. Several items required reverse scoring so that higher scores indicated more parental monitoring. Mother (α = .77), father (α = .84), and adolescent (α = .83) reports were significantly correlated (r's between .56 and .60, $p < .001$) and were averaged to arrive at the final score.

Delinquent peer association—Delinquent peer association was measured using adolescent self-report on the Describing Friends Questionnaire (Capaldi & Dishion, 1985). Adolescents responded 1 (*False*) or 2 (*True*) to 28 items measuring their association with peers who do poorly in school, use substances, and are delinquent (at school and outside of school were measured separately). Several of the items required reverse coding so that higher scores indicated more delinquent peer associations. The delinquent peers construct was created from the mean of the 28 items (α = .75).

Behavior problems—Using a scale ranging from 0 (*Not true*) to 2 (*Very true or often true*), mothers and fathers individually rated their child on 112 behavior problems from the CBCL-total problems scale (Achenbach, 1991). The scale includes items such as "demands a lot of attention" and "gets in many fights." In two-parent families, the summed total behavior problem scores were averaged across both parents to create an index score of behavior problems; in single-parent families, data from the sole parent were used. The inter-parent correlation was .60 (α = .74).

Substance use—This was assessed using mother-report of frequency of adolescent use of tobacco and alcohol. Due to the strong positive skew of the raw data and the resulting potential for statistical bias, responses were condensed to yield either 0 (*Never* or *rarely*) or 1 (*Monthly*, *weekly*, or *daily*). In our sample, 10.0% of mothers reported their youth using tobacco regularly while 41.1% reported them to be regular users of alcohol.

Physical maturity—This was assessed via adolescent self-report of body hair growth and skin changes, coded from 1 (*Not started*) to 4 (*Seems complete*). Scores on the two items were summed to arrive at an index of physical maturity. The two items were moderately correlated (Spearman's r = .39, $p < .001$ for girls; Spearman's r = .32, $p < .001$ for boys).

Romantic relationship status—Adolescents reported their romantic relationship involvement during a structured interview. Based upon their responses, adolescents were coded as either 1 (*Not dating*), 2 (*Casual dating*), 3 (*Dating a partner for less than two months*), and 4 (*Dating a partner for more than two months*). In our sample, 42.6% (n = 150) were not dating, 20.7% (n = 73) were casually dating several partners, 18.8% (n = 66) were dating a partner for less than two months, and 17.9% (n = 63) were dating a partner for more than two months.

Sexual experimentation—Sexual experimentation was measured using self-report (Capaldi et al., 2002). Adolescents responded 0 (*No*) or 1 (*Yes*) to participating in the following behaviors in the past year: kissing, touching above the waist, and touching below the waist. The sexual experimentation construct was created by summing the three items (α = .88). In our sample, 54.2% (n = 201) reported kissing a partner, 47.2% (n = 175) reported touching above the waist, and 34.8% (n = 129) reported touching below the waist.

Adolescent sex ("gender")—This was coded as 0 (*Male*) and 1 (*Female*) and was controlled in each analysis. To avoid confusion, this will hereafter be referred to as "gender." Our sample was 48.0% female ($n = 178$). There were sex differences in physical maturity [$F(1, 338) = 50.02$, $p < .001$] and romantic relationship status [$F(1, 350) = 17.98$, $p < .001$], with females being more advanced in both areas.

Number of sexual partners—Participants reported on their number of sexual partners (i.e., sexual intercourse) in the past year, coded from 0 (*No partners*) to 3 (*3 or more partners*). In our sample, 54.1% ($n = 186$) reported zero partners, 16.0% ($n = 55$) reported one partner, 7.8% ($n = 27$) reported two partners, and 22.1% ($n = 76$) reported three or more partners.

Health-risking sexual behavior (HRSB)—We used number of sexual partners (defined above) along with the following four indicators: (1) having had sex with a stranger/someone known less than 24 hours (coded as 1 [*Yes*] or 0 [*No*]); (2) using birth control during intercourse (coded as 1 [*Always*] or 0 [*Not Always*]); (3) discussing birth control with sexual partners (coded as 1 [*Always*] or 0 [*Not Always*]); and, (4) either becoming pregnant (girls) or impregnating someone (boys) (coded as 1 [*Yes*] or 0 [*No*]). These factors have been used in prior studies as indicators of health-risking sexual behavior (Capaldi et al., 2002, DiClemente et al., 1992; K. S. Miller et al., 1997; Siebenbruner et al., 2007). Among non-abstainers in our sample ($n = 167$), 21.0% ($n = 35$) reported having had sex with a stranger, 28.3% ($n = 47$) did not always use birth control, 34.1% ($n = 57$) did not always discuss birth control, and 10.8% ($n = 18$) had either been impregnated or impregnated a partner.

Analysis Plan

We performed two sets of analyses (all quantitative predictors were standardized before conducting the analyses). In the first (i.e., variable-oriented) set of analyses, we conducted a Poisson regression in which the self-reported number of sexual partners at high school exit was regressed on the predictors (i.e., parental monitoring, association with delinquent peers, behavior problems, substance use, physical maturity, romantic relationship status, and sexual experimentation). In this analysis, we were only able to consider the number of sexual partners as an outcome, since it is the only measure of HRSB that would be expected to have complete data across the entire sample (i.e., abstaining youth would not be expected to use birth control or become pregnant). Our first model for this analysis (Model 1) incorporated all the predictors except sexual experimentation, which was subsequently inserted in the regression (Model 2) to assess its impact as a mediator. By performing this analysis, we were able to assess (1) the impact of each predictor on the number of sexual partners across the entire sample and (2) the general effectiveness of sexual experimentation as a mediator.

In Poisson regression, a significant regression coefficient indicates that a one-unit change in the associated predictor corresponds to a change of some magnitude in the dependent variable (DV). The general equation for a DV (Y) and multiple predictors (X_1, X_2) is as follows:

$$\log_e(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots \quad (1)$$

This equation can be re-written as:

$$Y = (e^{\beta 0}) * (e^{\beta 1 X1}) * (e^{\beta 2 X2}) \ldots = (e^{\beta 0}) * (e^{\beta 1})(e^{X1}) * (e^{\beta 2})(e^{X2}) \ldots \quad (2)$$

Thus, in our analysis, the size of the change in the count of sexual partners can be calculated by exponentiating significant regression coefficients. Since a count-based outcome cannot be zero, a negative regression coefficient, when exponentiated, is < 1, which through multiplication with other model terms will reduce the overall count (i.e., the DV). In contrast, a positive regression coefficient, when exponentiated, is > 1 and serves to increase the overall count.

In the second (i.e., person-oriented) set of analyses, we empirically evaluated whether our sample was composed of multiple distinct groups of HRSB using Latent Class Analysis (LCA). As discussed above, abstaining youth would not be expected to have data for many of our measures of HRSB, but in this case we can group abstaining youth *a priori* and conduct the LCA on the remaining youth. Thus, the LCA can be considered an evaluation of whether there were distinct groups of *sexually active* youth in our sample. For comparisons between models, we would be guided by the BIC (Bayesian Information Criterion), adjusted for sample size; a lower BIC represents a better-fitting model. Starting with a model specifying one group, we ran the model, incremented the group count, and ran the model again until the best-fitting model was evident. The LCA was run twice, once with only the measures of HRSB and again with the predictors discussed above (i.e., parental monitoring, etc.) to determine if results would vary.

If distinct groups were found, our next step would be to create dummy codes representing the contrasts between groups. For example, if three groups were found, as in Siebenbruner et al. (2007), we would create two dummy codes representing the contrast between the reference group and each of the other two groups; Siebenbruner et al. used the sexually abstaining group as their reference group, with the two dummy codes representing the contrasts between the abstaining vs. low-risk and the abstaining vs. high-risk adolescents. We would next use multinomial logistic regression to simultaneously regress the dummy codes representing the group contrasts on the predictors (i.e., parental monitoring, association with delinquent peers, behavior problems, substance use, physical maturity, romantic relationship status, and sexual experimentation).

In logistic regression, the general equation for a DV (Y) and multiple predictors (X_1, X_2) is as follows:

$$\log_e [Y/(1-Y)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots \quad (3)$$

This equation can be re-written in a similar fashion to equation (2) above. The ratio [Y/(1−Y)] is the “odds ratio” (OR), which indicates the relative probability of belonging to one group (Y) as opposed to another (1−Y) (the OR is sometimes written as [p/q], where q = 1−p). A significant coefficient in a multinomial logistic regression would suggest that the associated variable was able to predict group membership, with a one-unit change in the predictor corresponding to a significantly increased or reduced risk of belonging to the target group instead of the reference group (an OR greater than one suggests increased odds of belonging to the target group instead of the reference group, and an OR less than one suggests the opposite). As above, we used two models (Model 1 and 2) to assess sexual experimentation as a mediator. In contrast to the variable-oriented approach described above, this analysis would reveal whether different factors were important precursors for different groups, and whether sexual experimentation served as a mediator for one group but not the other. For example, Siebenbruner et al. (2007) found that alcohol use differentiated the abstainers from the low-risk group, while drug use differentiated the abstainers from the high-risk group.

RESULTS

The means, SD, and intercorrelations for all variables are shown in Table 1. Standard deviations are not presented for dichotomous variables. Spearman's correlations were used with number of sexual partners due to the count-based nature of this variable. Nearly every variable correlated with number of sexual partners to some degree, with the exception of alcohol use and physical maturity. We conducted follow-up analysis and found that neither of these variables correlated with any aspect of HRSB, so we removed them from further consideration. Parental monitoring, association with delinquent peers, problem behavior, tobacco use, and romantic relationship status were significantly correlated with sexual experimentation, suggesting that sexual experimentation may serve as a mediator for these variables. There was a moderate degree of missing data (10–15%), but these data were MCAR [Missing Completely at Random; Little's MCAR test, $\chi^2(15) = 12.03$, *ns*], which indicated that the missing data did not introduce bias into the analyses.

The results from the Poisson regression are shown in Table 2. In Model 1, all of our theory-based predictors were significant (gender was not significant). Parental monitoring was a negative predictor, and as a result the exponentiated regression coefficient was < 1 (i.e., higher levels of parental monitoring served to *reduce* the count of sexual partners); all other coefficients were positive. In Model 2, sexual experimentation emerged as a strong predictor, and the predictive power of parental monitoring, association with delinquent peers, behavior problems, tobacco use, and romantic relationship status was reduced, with parental monitoring reduced to insignificance. Sobel's test of mediation was significant in each case (test statistic < −2.50 or > 2.50, all $p < .05$ or less). No significant gender differences (i.e., interaction effects for gender) were found.

Our first step in conducting the person-oriented analysis was to empirically evaluate whether our sample contained distinct groups of sexually active adolescents. As discussed above, we removed the sexual abstainers ($n = 185$) from the sample and then subjected the remaining individuals to LCA using the indictors of sexual risk-taking discussed above (i.e., number of partners, sex with a stranger, discussing and using contraceptives, and pregnancy). The results suggested a two-group solution (adjusted BIC = 1164.71 vs. 1166.58 for one group and 1167.21 for three groups; entropy > .99). The first of the two groups ($n = 132$) were considered low risk in that they had, on average, 1.92 sexual partners and were highly unlikely to have sex with someone they just met (indeed, no individual in this group responded affirmatively to this question). The second group ($n = 35$) was considered high risk in that they had a greater number of sexual partners (2.81) and were more likely to have sex with someone they just met (no individual in this group responded negatively to this question). The low-risk group was marginally more likely to discuss birth control with partners [$\chi^2(1) = 3.60$, $p = .058$], but there were no group differences in propensity to use birth control [$\chi^2(1) < 1$] or rates of pregnancy [$\chi^2(1) < 1$]. Nineteen individuals could not be classified due to missing data in the HRSB variables. The LCA including predictors confirmed a two-group solution, but given that an additional 31 individuals were not classified due to missing data in the predictors, the classification from the original LCA without predictors was used in the subsequent analysis.

Our next step was to use these groups (i.e., abstainers, low-risk, and high-risk) in a multinomial logistic regression, in which the abstainers were considered to be the reference group; thus, the group contrasts were between the abstainers and the low- and high-risk individuals, respectively. The results from the logistic regression are shown in Table 3. In Model 1, the overall likelihood ratio test was significant, $\chi^2(16) = 119.17$, $p < .001$, and Nagelkerke pseudo-R^2 was .39. In predicting membership in both the low- and high-risk groups, we found that parental monitoring, association with delinquent peers, and romantic

relationship status were the strongest predictors. In addition, behavior problems and tobacco use distinguished the high-risk group from the abstainers. For Model 2, the overall likelihood ratio was again significant, $\chi^2(18) = 157.49$, $p < .001$, and Nagelkerke pseudo-R^2 was .49. A likelihood ratio test confirmed that Model 2 demonstrated improved fit, $\chi^2(2) = 38.32$, $p < .001$. As with the Poisson regression, sexual experimentation emerged as a strong predictor and the predictive power of parental monitoring, association with delinquent peers, behavior problems (high-risk group only), tobacco use (high-risk group only), and romantic relationship status was reduced or eliminated. Sobel's test was significant in each case (test statistic < −2.40 or > 2.40 for low-risk vs. abstainers and test statistic < −2.20 or > 2.20 for the high-risk vs. abstainers, all $p < .05$ or less). No significant interaction effects for gender were found, but a significant main effect for gender did emerge in Model 2; the positive sign on the regression coefficient indicated that girls were more likely to be in the low-risk group as compared to the abstaining group. Gender was not a significant predictor of membership in the high-risk group as compared to the abstainers.

DISCUSSION

The purpose of the current study was to examine the precursors of HRSB at high school exit within a community-based sample. We first examined predictors of number of sexual partners across the entire sample (see Table 2) and found evidence to support coercion theory (parental monitoring, association with delinquent peers), and problem behavior theory (problem behaviors, tobacco use), with limited evidence for a biosocial model (romantic relationship status only, not physical development). These associations were found within this relatively normative sample, in which approximately one-half of the adolescents had not yet engaged in sexual intercourse with a partner. This extends prior findings that only generalized to high-risk populations (e.g., DiClemente et al., 1992; Siebenbruner et al., 2007) and is the first attempt to integrate the various theories into a single analysis. The fact that at least limited support was found for all three (even when controlling for the effects of the others) confirms the robustness of these theories and suggests that their respective developmental paths are at least somewhat independent of one another.

As hypothesized, sexual experimentation partially or completely mediated the links between the number of sexual partners and parental monitoring, association with delinquent peers, behavior problems, tobacco use, and romantic relationship status. This suggests that one mechanism by which these factors impact HRSB is by encouraging or promoting early or precocious sexual experiences, even if those experiences do not end in intercourse. Thus, early sexual experimentation may be a useful starting point for future research and intervention efforts. Since this variable was measured at age 14 in our sample, these results also support calls for early sex education and prevention programs in the effort to reduce HRSB (Somers & Surmann, 2005).

Some effects, such as association with delinquent peers, were not completely mediated by sexual experimentation, suggesting that there are multiple pathways by which these factors exert their influence on adolescent sexual behavior. For example, association with delinquent peers may lead to greater substance use, which in turn can raise the risk of unwanted sexual intercourse or lower the likelihood of contraceptive use (Castilla, Barriob, Belzac, & de la Fuente, 1999; Poulin & Graham, 2001). Additional research is needed to explore the diverse paths between these precursors and adolescent HRSB.

The LCA and multinomial logistic regression, using a broader measure of HRSB, confirmed many of the results from the Poisson regression. As hypothesized, we found three groups (abstainers, low-risk, and high-risk). Unlike Siebenbruner et al. (2007), who found that

different variables predicted membership in different groups in some cases, we found that the same set of variables generally predicted group membership across all groups. The primary differences, outside of tobacco use, seemed to arise due to the more extreme nature of the high-risk group (and, consequently, stronger effects for each predictor). For example, behavior problems was a significant predictor of group differences when considering the high-risk group as compared to the abstainers, but was only marginal when differentiating the low-risk and abstaining groups; likewise, association with delinquent peers was only marginal in the high-risk model, and not at all predictive in the low-risk model. Tobacco use did significantly differentiate the high-risk group from the abstainers and did not differentiate between the low-risk and abstaining group, but this was only before sexual experimentation was entered (see Table 3, Model 1); in other words, tobacco use was no longer a significant differentiator of group membership once rates of sexual experimentation were taken into account. In general, the comparable results for both components of the logistic regression suggest that the two sexually active groups in our sample (i.e., low- and high-risk) may not, in fact, be two completely distinct groups; or, more specifically, the groups may not be qualitatively different but may be quantitatively different. Although the behaviors of the two sexually active groups were at least partially distinct, they may not represent two unique etiologies of adolescent HRSB.

Although the results from the variable- and person-oriented models were similar, they were not identical. One difference between the two sets of results, as noted above, related to tobacco use. The significant results for tobacco use in the Poisson regression (see Table 2, Model 2) might suggest that tobacco use predicted HRSB across the entire sample. However, in the multinomial logistic regression, tobacco use only differentiated the high-risk from the abstaining group (see Table 3, Model 1), suggesting that tobacco use did not differentiate between the low- and high-risk groups. Indeed, in a post-hoc analysis, we found that the rate of tobacco use was not significantly different between the low- and high-risk groups [$\chi^2(1) = 1.73$]. At the same time, the significant effect for tobacco use in the logistic regression disappeared when sexual experimentation was entered (see Table 3, Model 2) but remained significant in the Poisson regression (see Table 2, Model 2). This suggests that levels of tobacco use may have been correlated with number of sexual partners in one group but not in another. In a post-hoc analysis, we found that tobacco use was correlated with number of partners in the low-risk group (Spearman's $r = .21$, $p < .05$) and not in the high-risk group (Spearman's $r = .05$). Although this finding must be replicated, tobacco use may be an indicator of a willingness among sexually active yet risk-averse adolescents to engage in more low-risk forms of deviant behavior. Among more risk-prone adolescents, however, tobacco use may not be seen as particularly risky or deviant and thus not predictive of related behaviors such as health-risking sexual behavior. It may be that, among higher-risk adolescents, more serious substance use would be predictive of HRSB. This hypothesis is consistent with the results from Siebenbruner et al. (2007), who found that, among a high-risk sample, alcohol use differentiated the abstainers from the low-risk-taking adolescents, while drug use differentiated the abstainers from the high-risk-takers. Further research is needed to more thoroughly explore this issue.

An additional difference between the variable- and person-oriented results related to gender. Girls were more likely to be in the low-risk group as compared to the abstaining group, but were not more likely to be in the high-risk group as compared to the abstainers. Correspondingly, gender was only a marginally significant predictor of the number of sexual partners when considered across the entire sample (see Table 2). The results from the variable-oriented analysis, considered alone, would seem to suggest that girls could be at greater risk for HRSB. However, the results from the person-oriented analysis suggest that, while girls may be more sexually active (i.e., greater likelihood of belonging to the low-risk group as compared to the abstaining group), they are not necessarily engaging in more

health-risking behaviors (i.e., no greater likelihood of belonging to the high-risk group vs. the abstainers). The results for gender, as with tobacco use, highlight the way in which the results from the variable- and person-oriented analyses can be seen as complimentary, with each adding depth and detail to the other and enabling a more nuanced overall interpretation. However, we note that the measures of HRSB in the Poisson and LCA/logistic regressions were slightly different (i.e., number of partners vs. a broader measure including sex with strangers, contraceptive use, and pregnancy), and this may have played a role in the differences between the sets of findings. Thus, we suggest caution when comparing the results between the two approaches.

Limitations and Future Directions

Despite the theoretical significance of the present work, several limitations should be noted. First, sexual experimentation and HRSB were measured via self-report. As such, they were limited by the willingness of participants to accurately report sexual behavior and by subject recall. The conclusions of the current study would be strengthened by the use of other informants. However, it is important to recognize the complexity that would be involved in gathering such data and the potential biases that other-report data on sexual practices might have.

Second, examining the mechanisms of change that occur during high school would also strengthen the understanding of what causes some individuals to progress from sexual experimentation to HRSB within the high school period. For example, studies with annual high school data might be able to identify the key developmental periods within high school when peer or parental influences wax and wane in terms of their influence on youth HRSB. Related to this, it would be important to examine middle school and post–high school variables. Which middle school predictors are important in the development of HRSB? What variables are important in the maintenance of these behaviors? Studies with shorter intervals between assessments might be able to address these questions.

Third, the present study focused on a community-based sample to examine the development of HRSB within a normative, middle-class population. In addition, the present sample was primarily Euro-American. To best inform interventions targeting the reduction of HRSB, additional studies should examine whether the same set of variables predicts HRSB in high-risk or more diverse samples.

With regard to our analysis plan, some may quibble with our decision to use LCA rather than applying the criteria from Siebenbruner et al. (2007) when determining group membership. The qualitative difference in the two samples (i.e., high-risk vs. normative) argues against applying their criteria, however, and our use of LCA can be considered more conservative than applying arbitrary criteria of our own design. Further, our results provide interesting insight into the relative levels of HRSB across different populations.

Conclusion

Together, these results provide support for all four of the theoretical frameworks discussed above: coercion theory, problem behavior theory, the biosocial model, and the gateway hypothesis. The results were strengthened by the longitudinal nature of the design and the ability to therefore test predictive pathways. The results from this study serve to not only extend and broaden our view of the factors that contribute to adolescent HRSB but also provide new insight into the processes associated with these factors. Future research investigating a wider range of mediators would shed additional light on the etiology of adolescent sexual behavior.

Our findings also confirm that preventive intervention strategies that focus on deterring delinquent peer association and behavior problems and improving parental monitoring (Eddy & Chamberlain, 2002; Leve, Chamberlain, & Reid, 2005; Stanton et al., 2000) can coexist with or even augment strategies that aim to reduce substance use (Griffin, Botvin, & Nichols, 2006) and reduce HRSB (Meschke, Bartholomae, & Zentall, 2000). That is, even in a normative community sample, prevention efforts to target improved monitoring and reduction of problem behavior might prove efficacious in preventing adolescent engagement in HRSB.

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References

Achenbach, TM. Manual for the Child Behavior Checklist/4-18 and 1991 Profile. Burlington: University of Vermont Department of Psychiatry; 1991.

Allen JP, Porter MR, McFarland FC. Leaders and followers in adolescent close friendships: Susceptibility to peer influence as a predictor of risky behavior, friendship instability, and depression. Development and Psychopathology. 2006; 18:155–172. [PubMed: 16478557]

Ary DV, Duncan TE, Biglan A, Metzler CW, Noell JW, Smolkowski K. Development of adolescent problem behavior. Journal of Abnormal Child Psychology. 1999a; 27:141–150. [PubMed: 10400060]

Ary DV, Duncan TE, Duncan SC, Hops H. Adolescent problem behavior: the influence of parents and peers. Behaviour Research and Therapy. 1999b; 37:217–230. [PubMed: 10087640]

Biglan A, Metzer CW, Wirt R, Ary D, Noell J, Ochs L, Hood D. Social and behavioral factors associated with high-risk sexual behavior among adolescents. Journal of Behavioral Medicine. 1990; 15:245–261. [PubMed: 2213868]

Castilla J, Barriob G, Belzac MJ, de la Fuente L. Drug and alcohol consumption and sexual risk behaviour among young adults: Results from a national survey. Drug and Alcohol Dependence. 1999; 56:47–53. [PubMed: 10462092]

Capaldi DM, Crosby L, Stoolmiller M. Predicting the timing of first sexual intercourse for at-risk adolescent males. Child Development. 1996; 67:344–359. [PubMed: 8625717]

Capaldi, DM.; Dishion, TJ. Describing Friends Questionnaire. 1985. Unpublished manuscript

Capaldi DM, Stoolmiller M, Clark S, Owen LD. Heterosexual risk behaviors in at-risk young men from early adolescence to young adulthood: Prevalence, prediction, and STD contraction. Developmental Psychology. 2002; 38:394–406. [PubMed: 12005382]

Costa FM, Jessor R, Donovan JE, Fortenberry JD. Early initiation of sexual intercourse: The influences of psychosocial unconventionality. Journal of Research on Adolescence. 1995; 5:93–121.

Crowley TJ, Raymond KM, Mikulich-Gilbertson SK, Thompson LL, Lejuez CW. A risk-taking “set” in a novel task among adolescents with serious conduct and substance problems. Journal of the American Academy of Child and Adolescent Psychiatry. 2006; 45:175–183. [PubMed: 16429088]

DiClemente RJ, Durbin M, Siegel D, Krasnovsky F, Lazarus N, Camacho T. Determinants of condom use among junior high school students in a minority, inner city school district. Pediatrics. 1992; 89:197–202. [PubMed: 1734383]

Dishion, TJ.; French, DC.; Patterson, GR. Development and ecology of antisocial behavior. In: Cicchetti, D.; Cohen, DJ., editors. Developmental psychopathology. Vol. 2. New York: Wiley; 1995. p. 421-471.

Eddy JM, Chamberlain P. Family management and deviant peer association as mediators of the impact of treatment condition on youth antisocial behavior. Journal of Consulting and Clinical Psychology. 2000; 68:857–863. [PubMed: 11068971]

Fergusson DM, Boden JM, Horwood LJ. Cannabis use and other illicit drug use: Testing the cannabis gateway hypothesis. Addiction. 2006; 101:556–569. [PubMed: 16548935]

French DC, Dishion TJ. Predictors of early initiation of sexual intercourse among high-risk adolescents. Journal of Early Adolescence. 2003; 23:295–315.

French, DC.; Weih, S. House rules: A measure of parental involvement. 1990. Unpublished manuscript

Griffin KW, Botvin GJ, Nichols TR. Effects of a school-based drug abuse prevention program for adolescents on HIV risk behaviors in young adulthood. Prevention Science. 2006; 7:103–112. [PubMed: 16604429]

Henggeler SW, Halliday-Boykins CA, Cunningham PB, Randall J, Shapiro SB, Chapman JE. Juvenile drug court: Enhancing outcomes by integrating evidence-based treatments. Journal of Consulting and Clinical Psychology. 2006; 74:42–54. [PubMed: 16551142]

Hollingshead, AB. Four factor index of social status. Department of Sociology, Yale University; New Haven, CT: 1975. Unpublished manuscript

Jessor, R.; Jessor, SL. Problem behavior and psychosocial development: A longitudinal study of youth. New York: Academic Press; 1977.

Jessor R, Van Den Bos J, Vanderryn J, Costa FM, Turbin MS. Protective factors in adolescent problem behavior: Moderator effects and developmental change. Developmental Psychology. 1995; 31:923–933.

Kandel, DB. Stages and pathways of drug involvement: Examining the gateway hypothesis. New York: Cambridge University Press; 2002.

Kershaw TS, Ethier KA, Milan S, Lewis JB, Niccolai LM, Meade C, et al. The influence of pregnancy, sexually transmitted diseases, and human immunodeficiency virus perceived susceptibility patterns on sexual risk reduction for adolescent females. Journal of Community Psychology. 2005; 33:313–331.

Lanza ST, Collins LM. A new SAS procedure for latent transition analysis: Transition in dating and sexual behavior. Developmental Psychology. 2008; 44:446–456. [PubMed: 18331135]

Leve LD, Chamberlain P, Reid JB. Intervention outcomes for girls referred from juvenile justice: Effects on delinquency. Journal of Consulting and Clinical Psychology. 2005; 73:1181–1185. [PubMed: 16392991]

Meschke LL, Bartholomae S, Zentall SR. Adolescent sexuality and parent-adolescent processes: Promoting healthy teen choices. Family Relations. 2000; 49:143–154.

Meschke LL, Zweig JM, Barber BL, Eccles JS. Demographic, biological, psychological, and social predictors of the timing of first intercourse. Journal of Research on Adolescence. 2000; 10:315–338.

Miller BC, Norton MC, Curtis T, Hill EJ, Schvaneveldt P, Young MH. The timing of sexual intercourse among adolescents: Family, peer and other antecedents. Youth & Society. 1997; 29:54–83.

Miller KS, Clark LF, Wendell DA, Levin ML, Gray-Ray P, Velez CN, et al. Adolescent heterosexual experience: A new typology. Journal of Adolescent Health. 1997; 20:179–186. [PubMed: 9069018]

Miller KS, Forehand R, Kotchick BA. Adolescent sexual behavior in two ethnic minority samples: The role of family variables. Journal of Marriage and the Family. 1999; 61:85–98.

Patterson, GR. Coercive family processes. Eugene, OR: Castalia; 1982.

Patterson, GR.; Reid, JB.; Dishion, TJ. Antisocial boys. Eugene, OR: Castalia; 1992. A social learning approach. IV.

Phinney VG, Jensen LC, Olsen JA, Cundick B. The relationship between early development and psychosexual behaviors in adolescent females. Adolescence. 1990; 25:321–332. [PubMed: 2375259]

Poulin C, Graham L. The association between substance use, unplanned sexual intercourse and other sexual behaviours among adolescent students. Addiction. 2001; 96:607–621. [PubMed: 11300964]

Rodgers KB. Parenting processes related to sexual risk-taking behaviors of adolescent males and females. Journal of Marriage and the Family. 1999; 61:99–109.

Seidman SN, Mosher WD, Aral SO. Predictors of high-risk behavior in unmarried American women: Adolescent environment as risk factor. Journal of Adolescent Health. 1994; 15:126–132. [PubMed: 8018685]

Siebenbruner J, Zimmer-Gembeck MJ, Egeland B. Sexual partners and contraceptive use: A 16-year prospective study predicting abstinence and risk behavior. Journal of Research on Adolescence. 2007; 17:179–206.

Somers CL, Surmann AT. Sources and timing of sex education: Relations with American adolescent sexual attitudes and behavior. Educational Review. 2005; 57:37–54.

Stanton BF, Li X, Galbraith J, Cornick G, Feigelman S, Kaljee L, Zhou Y. Parental underestimates of adolescent risk behavior: a randomized, controlled trial of a parental monitoring intervention. Journal of Adolescent Health. 2000; 26:18–26. [PubMed: 10638714]

Tildesley EA, Hops H, Ary D, Andrews JA. Multitrait-multimethod model of adolescent deviance, drug use, academic, and sexual behaviors. Journal of Psychopathology and Behavioral Assessment. 1995; 17:185–215.

Udry RJ. Biological predispositions and social control in adolescent sexual behavior. American Sociological Review. 1988; 53:709–722.

von Eye A, Bogat GA. Person-oriented and variable-oriented research: Concepts, results, and development. Merrill-Palmer Quarterly. 2006; 52:390–420.

Whitaker DJ, Miller KS, Clark LF. Reconceptualizing adolescent sexual behavior: Beyond did they or didn't they? Family Planning Perspectives. 2000; 32:111–117. [PubMed: 10894256]

Whitbeck LB, Yoder KA, Hoyt DR, Conger RD. Early adolescent sexual activity: A developmental study. Journal of Marriage and the Family. 1999; 61:934–946.

Table 1

Means, Standard Deviations, and Intercorrelations

Variable	1	2	3	4	5	6	7	8	9	10
1. Parental Monitoring	-									
2. Association with Delinquent Peers	−.22***	-								
3. Behavior Problems	−.06	.37***	-							
4. Tobacco Use	−.08	.11*	.10							
5. Alcohol Use	−.13*	.06	−.07	−.02	-					
6. Physical Maturity	−.22***	.06	.06	.11*	−.05	-				
7. Romantic Relationship Status	−.04	.13*	.08	.07	−.01	.11*	-			
8. Sexual Experimentation	−.22***	.39***	.23***	.17**	−.02	.11	.28***	-		
9. Adolescent Gender	−.06	−.07	.04	.01	.04	.36***	.22***	−.05	-	
10. Number of Sexual Partners	−.21***	.37***	.28***	.20***	−.02	.10	.42***	.56***	.12*	-
M	3.58[a]	1.35[b]	20.22[c]	.10[d]	.41[d]	6.59[e]	2.12[f]	1.52[g]	.48[d]	.98[g]
SD	.58	.17	18.07	-	-	1.01	1.15	1.33	-	1.23
N	334	338	335	319	319	340	352	332	371	344

[a] Range of possible scores 1 to 5.

[b] Range of possible scores 1 to 2.

[c] Range of possible scores 0 to 224.

[d] Dichotomous variable (0 and 1).

[e] Range of possible scores 2 to 8.

[f] Range of possible scores 1 to 4.

[g] Range of possible scores 0 to 3.

* $p < .05$.

** $p < .01$.

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*** $p < .001$.

Table 2

Poisson Regression Predicting Number of Sexual Partners

	Model 1			Model 2		
	B	***SE* B**	**e^B**	**B**	***SE* B**	**e^B**
Parental Monitoring	−.14*	.06	.87	−.06	.05	-
Association with Delinquent Peers	.28***	.06	1.32	.15*	.06	1.16
Behavior Problems	.13**	.04	1.14	.10*	.04	1.11
Tobacco Use	.42**	.15	1.52	.33*	.14	1.39
Romantic Relationship Status	.34***	.06	1.40	.21**	.07	1.23
Gender	.08	.14	-	.24†	.13	-
Sexual Experimentation	-	-	-	.63***	.11	1.88

Note. All quantitative predictors were standardized (i.e., centered at zero and re-scaled to create a standard deviation of one) before conducting the regression to enable more straightforward interpretation of the results.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Multinomial Logistic Regression Predicting Group Membership

	Model 1			**Model 2**		
Low-Risk (vs. Abstainers)						
	B	***SE* B**	**OR**	**B**	***SE* B**	**OR**
Parental Monitoring	−.44**	.17	.65	−.35†	.18	-
Assoc. with Delinquent Peers	.51**	.17	1.66	.27	.19	-
Behavior Problems	.31†	.18	-	.35†	.20	-
Tobacco Use	.77	.51	-	.55	.53	-
Romantic Relationship Status	1.05***	.16	2.85	.95**	.18	2.60
Gender	.46	.32	-	.89*	.36	2.43
Sexual Experimentation	-	-	-	.95***	.18	2.59
High-Risk (vs. Abstainers)						
	B	*SE* B	OR	B	*SE* B	OR
Parental Monitoring	−.60*	.24	.55	−.55*	.26	.58
Assoc. with Delinquent Peers	.78**	.24	2.19	.45†	.26	-
Behavior Problems	.52*	.22	1.68	.50*	.25	1.64
Tobacco Use	1.26*	.64	3.53	.77	.68	-
Romantic Relationship Status	1.08***	.25	2.93	.95***	.27	2.58
Gender	−.11	.51	-	.23	.57	-
Sexual Experimentation	-	-	-	1.32***	.34	3.73

Note. OR = Odds Ratio. All quantitative predictors were standardized before conducting the regression.

Model 1: likelihood ratio test $\chi^2(16) = 119.17$, $p < .001$; Nagelkerke pseudo-$R^2 = .39$. Model 2: likelihood ratio test $\chi^2(18) = 157.49$, $p < .001$; Nagelkerke pseudo-$R^2 = 49$.

† $p < .10$.

* $p < .05$.

** $p < .01$.

***$p < .001$.