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Patterns of Adolescent Sexual Behavior Predicting Young Adult Sexually Transmitted Infections: A Latent Class Analysis Approach

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Abstract Adolescent sexual behavior is multidimensional, yet most studies of the topic use variable-oriented methods that reduce behaviors to a single dimension. In this study, we used a person-oriented approach to model adolescent sexual behavior comprehensively, using data from the National Longitudinal Study of Adolescent Health. We identified five latent classes of adolescent sexual behavior: Abstinent (39 %), Oral Sex (10 %), Low-Risk (25 %), Multi-Partner Normative (12 %), and Multi-Partner Early (13 %). Membership in riskier classes of sexual behavior was predicted by substance use and depressive symptoms. Class membership was also associated with young adult STI outcomes although these associations differed by gender. Male adolescents' STI rates increased with membership in classes with more risky behaviors whereas females' rates were consistent among all sexually active classes. These findings demonstrate the advantages of examining adolescent sexuality in a way that emphasizes its complexity.

Keywords Sexual behavior · Adolescence ·
Latent class analysis · Sexually transmitted infections

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Introduction

Adolescent sexual behavior is an important area of study from both normative developmental and risk perspectives. Engaging in sexual behavior in adolescence is normative and developing healthy sexuality is an important part of adolescent development (Brooks-Gunn & Paikoff, 1993; Tolman & McClelland, 2011). However, sexual behavior also carry risks for young people—adolescents and young adults aged 15–24 years account for nearly half of all new STI infections and about 15 % of sexually active adolescents reported a pregnancy in the past year (Finer, 2010; Weinstock, Berman, & Cates, 2004). Adolescent sexuality is a complex, multidimensional phenomenon that can consist of attitudes, values, behavior, knowledge, and relationships (Diamond & Savin-Williams, 2009; Welsh, Rostosky, & Kawaguchi, 2000). Even the more specific domain of sexual behavior is multidimensional: adolescents engage in a variety of different sexual behaviors (e.g., vaginal intercourse, oral sex) and do so in a number of different contexts (with romantic or non-romantic partners, with or without condoms). However, most studies of adolescent sexual behavior examine correlates of a single behavior or examine multiple behaviors in separate models. For example, a study may focus on predictors of age at first intercourse or use of a condom at most recent sex. A person-centered approach focusing on particular patterns of characteristics or behaviors that occur simultaneously can describe phenomena more fully. This, in turn, can help describe adolescent sexual behavior more holistically and emphasize key patterns of behaviors that occur in a population. This is important in examining adolescent sexual behavior, because single behaviors may be risky not in isolation, but rather in combination with other behaviors. This approach is consistent with recent calls to examine diverse sexual behaviors jointly, including both normative and risky aspects (Tolman & McClelland, 2011; Welsh et al., 2000).

Antecedents and consequences of sexual risk behavior are typically studied using a *variable-centered approach,* in which each dimension of sexual behavior is examined separately. These approaches, which include regression analysis, require that the association between a risk factor and each aspect of sexual risk behavior (e.g., number of partners, oral sex) be quantified in separate models. An advantage is that this allows for an investigation of the specific aspects of behavior for which a predictor confers significant risk. However, a separate examination of each aspect of sexual behavior does not reflect the complex, real-life experiences of adolescents or provide a comprehensive view of individual behavior. In contrast, a *person-centered approach* can provide unique insight regarding how an individual's entire spectrum of sexual behaviors interact, what predicts particular patterns of behavior, and what the consequences are (von Eye & Bergman, 2003).

A small number of studies have used person-oriented methods to examine adolescent sexual behavior. For example, one study used latent class analysis (LCA) to identify classes marked by different timetables of vaginal, oral, and anal sexual behavior, finding that classes marked by initiation of both vaginal and oral sex in the same year were the most common, with small numbers of individuals belonging to classes marked by less typical patterns of initiation (Haydon, Herring, Prinstein, & Halpern, 2012). Another study examined latent profiles of sexual risk behavior marked by condom use, number of partners, and frequency of sex, finding groups marked by both relatively healthy and relatively risky patterns of sexual behavior. Specifically, four classes were selected for sexually active 11th and 12th graders: Condom Users, One Partner, Two Partners, and Risk-Takers (Beadnell et al., 2005). One recent study used LCA with a wide variety of indicators, including pre-coital behaviors, intercourse and oral sex, number of partners and contraceptive use, and found classes marked by low, medium, and high risky behaviors; however, because of the young age of the sample (M age around 15 years), only a relatively small percentage (about 20 %) had engaged in sexual intercourse and, therefore, these classes primarily differentiated between those who were sexually active and those who were not, rather than encompassing the different behaviors and circumstances that comprise adolescents' sexual behavior (Hipwell, Stepp, Keenan, Chung, & Loeber, 2011). One study that did examine a variety of dating and sexual behaviors later in adolescence showed five distinct classes of behaviors, including classes marked by no sexual activity and relatively healthy and risky behaviors (Lanza & Collins, 2008).

These studies have begun to demonstrate the benefits of a multidimensional approach to modeling sexual behavior, providing insight into various behavior patterns. However, there are several ways to expand upon this work. First, most studies have used convenience samples of adolescents, such as a single school district (Beadnell et al., 2005) or girls in a single city (Hipwell et al., 2011). One study that used a nationally representative

sample focused only on timing of several sexual behaviors (Haydon et al., 2012). Including indicators of circumstance of sexual encounters (e.g., condom use, partners) will provide a more complete picture of adolescent sexual behavior. Another study that did focus on a wider range of behavior and contexts used an early adolescent sample in which relatively few people were sexually active (Hipwell et al., 2011). Thus, relatively little is known about the multidimensional nature of sexual behavior during the middle or late adolescent years, when sexual behavior is more common than in early adolescence.

In addition, little is known about how such patterns of behavior may be associated with future health outcomes. Such an analysis would provide information about the validity of class membership as a predictor of later health and provide health educators and prevention scientists information about who is at greatest risk. Adolescents and young adults have high rates of STIs (Weinstock et al., 2012), which can lead to negative health outcomes, including cancers and pelvic inflammatory disease (Gillison et al., 2008; Gray-Swain, & Peipert, 2006; Scully, 2005). Several different facets of sexual behavior have been linked to STIs, including early age at first intercourse, inconsistent condom use, and sex with multiple partners (Alfonsi & Shlay, 2005; Gallo et al., 2007; Kaestle, Halpern, Miller, & Ford, 2005; Kelly, Borowski, Flocke, & Keen, 2003; Upchurch, Mason, Kusunoki, & Johnson, 2004; Wald et al., 2005; Winer et al., 2006). However, although these individual factors have some utility in predicting STI risk, the interplay of different factors may predict whether an individual contracts an STI. For example, an individual who has sex with multiple partners but uses condoms consistently may be at lower risk of certain STIs than someone with fewer partners who does not use condoms. Thus, it is important to examine rates of STIs for adolescents with different patterns of sexual behaviors. Research has documented that women have a greater risk of STIs (CDC, 2008, 2011), due in part to biological factors associated with being a receptive sexual partner; thus, we will examine gender differences in how class membership is associated with future STIs.

Finally, we can address the nature of health disparities and comorbidities related to adolescent sexual behavior more fully using person-centered methods. Being male, African American, and gay or bisexual have been associated with riskier sexual behaviors in variable-oriented studies (Douglas et al., 1997; Eisenberg, 2001; Espinosa-Hernandez & Lefkowitz, 2009; Goodenow, Netherland, & Szalacha, 2002; Manning, Giordano, & Longmore, 2006; Reece et al., 2010; Saewyc, Poon, Homma, & Skay, 2008; Santelli, Lindberg, Abma, McNeely, & Resnick, 2000). However, studying variables in isolation may not fully address the specific patterns of behavior that different individuals engage in. For example, African American adolescents report greater likelihood of sexual intercourse and having a greater number of sexual partners; however, they are also more likely to use condoms than individuals from other ethnic groups (Beckman & Harvey, 1996; Douglas et al., 1997; Espinosa-

Hernández and Lefkowitz 2009; Santelli et al., 2000). Problem behavior theory (Jessor & Jesssor, 1977) suggests that risky sexual behavior co-occurs with other problem behaviors and research has linked earlier age of first intercourse, sex with multiple partners, and non-use of condoms to use of alcohol (Costa, Jessor, Donovan, & Fortenberry, 1995; Tubman, Windle, & Windle, 1996; Whitbeck Yoder, Hoyt, & Conger, 1999), tobacco (Tubman et al., 1996), and marijuana (Tubman et al., 1996), as well as depressive symptoms (Lehrer, Shrier, Gortmaker, & Buka, 2006; Shrier, Harris, Sternberg, & Beardslee, 2001). Less is known, however, about how these factors may be associated with different patterns of sexual behavior.

To explore the multidimensional nature of adolescent sexuality more fully, we used LCA (Collins & Lanza, 2010; Goodman, 1974), which is a person-centered approach that can be used to identify subgroups of adolescents with unique patterns of sexual behavior. Using nationally representative data from the National Longitudinal Study of Adolescent Health (Add Health) (see Harris, 2011), we attempted to identify latent classes of adolescents with particular comprehensive profiles of sexual behavior measured by timing of oral and vaginal sex, condom use, number of sexual partners, and non-relationship partners. We then describe these classes more fully by examining demographic distributions of class membership. Next, we examined how substance use and depression predicted class membership. Finally, we examined how class membership was associated with young adult STI rates, to provide a better understanding of the specific adolescent behavioral patterns associated with later risks.

Method

Participants and Procedure

Participants were a subsample of individuals from the contractual sample of Add Health (for details, see Harris, 2011). Eighty high schools and associated middle schools were sampled, employing a clustered sampling design and survey weights to ensure that the sample was representative of schools in the U.S. with respect to region, urbanicity, school type, school size, and ethnicity. Participants initially completed in-school and in-home interviews in 1994–1995 (Wave I), when they were in 7th–12th grade. Follow-up in-home interviews occurred during 1995–1996 (Wave II), 2001–2002 (Wave III), and 2007–2008 (Wave IV). Because patterns of sexual behavior likely differ at different stages of adolescence, we used a subsample that was relatively homogeneous on age. Thus, our analytic sample included adolescents who were aged 16, 17 or 18 and also in Grades 10, 11 or 12 at their Wave II interview ($N = 4{,}158$). In addition, because of our interest in young adult outcomes, we included only indi-

viduals who completed the Wave IV survey. Our resulting sample contained 3,395 individuals (54.1 % female, 18.3 % African American, 10.8 % Hispanic, 4.1 % other race, .9 % gay, 5.0 % bisexual, 7.4 % no sexual attraction, M age at Wave II = 16.9 years). This sample did not vary from the full Wave II sample of 16–18 year-olds on gender, race/ethnicity, sexual orientation, or sexual behaviors. Note that we included participants who reported a non-heterosexual sexual attraction, because sexual minority individuals often engage in sexual risk behaviors, including those with opposite sex partners (Saewyc et al., 2008).

Data from three of the four in-home interviews were used in this study: adolescent interviews at Waves I and II and a young adult interview at Wave IV. Classes of adolescent sexual behavior were determined from measures at the Wave II interview, predictors of class membership were from Wave I, and young adult STIs were measured at Wave IV.

Measures

Indicators of Sexual Behavior Latent Class Membership

Indicators used to estimate the latent classes were five aspects of adolescent sexual behavior, measured at Wave II. *Timing of first intercourse* indicated whether an adolescent was still abstinent at the Wave II interview (coded 1, 52 %) or reported engaging in first intercourse at a normative (age 15 or later; coded 2, 32 %) or an early (age 14 or younger; coded 3, 13 %) age. The cutoff was similar to prior studies of adolescent sexual behavior (e.g., Lanza, Kugler, & Mathur, 2011) and was used to ensure that all adolescents in the adolescent sample were older than the age of normative sexual initiation). *Condom use at first sex* indicated whether a participant was still abstinent (coded 1, 48 %) or used (coded 2, 34 %) or did not use (coded 3, 18 %) a condom at first intercourse. We chose this measure of condom use because condom use at first sex is associated with future condom use (Shafii, Stovel, Davis, & Holmes, 2004) and all participants who had ever had sex answered it (not just those with recent experiences), giving the item greater variability. *Non-relationship sex* measured whether a participant had ever engaged in sex with a non-relationship partner in their lifetime (1 = never had intercourse, 50 %; 2 = had only relationship partners, 21 %; 3 = had at least 1 non-relationship partner, 29 %). *Number of past-year partners* measured how many partners a participant reported in the Wave II interview, calculated from the relationship roster, which asked about specific sexual partners (1 = never had intercourse, 54 %; 2 = only 1 partner, 25 %; 3 = 2+ partners, 21 %). *Timing of oral sex* measured whether a participant had never engaged in oral sex (coded 1, 52 %) or reported engaging in oral sex at a normative (age 15 or later; coded 2, 36 %) or an early (age 14 or younger; coded 3, 11 %) age. Oral sex was only

measured at Wave IV and thus was a more retrospective measure than the others; we coded individuals as having oral sex only if they reported engaging in this behavior by their age at the Wave II assessment.

Note that there were several instances within these questions in which participants could have provided inconsistent information across waves or different parts of the same survey. Latent class models estimate and remove measurement error (Lanza & Collins, 2008), making these type of inconsistencies less problematic. Because measurement error is estimated and removed from the structural part of the model, we were able to retain the entire analytic sample and reduce possible bias in parameter estimates that can result from casewise deletion.

Predictors of Class Membership

All predictors were drawn from Wave I. Demographic predictors included gender, race/ethnicity (White, Black, Hispanic, and other), and sexual orientation (exclusively opposite-sex attraction, any same-sex attraction, and no attraction) based on two questions asking participants whether they were attracted to males and females. Because of the small number of participants reporting exclusively same-sex attraction at Wave I, we combined categories for gay/lesbian and bisexual orientation. In addition, we examined prevalence by socioeconomic status (SES). Based upon parents' Wave 1 income and household size, four categories were created: less than 1.5 times the 1994 poverty threshold (24 %), 1.5–2.5 times the poverty threshold (23 %), 2.5–4 times the poverty threshold (29 %), and more than 4 times the poverty threshold (25 %), consistent with prior research with Add Health data (Goodman, 1999). Behavioral predictors included alcohol use (never used, 38 %; experimental [used but not drunk in past year], 29 %; and heavy [drunk in past year], 33 %) and marijuana use (never, 70 %; ever, 30 %). We also predicted class membership by depressive symptoms (nondepressed vs. depressed), measured by a 19-item scale based on the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). We dichotomized depressive symptoms using a cut-off that corresponded to a diagnosis of clinical depression, as in prior studies using Add Health data (23 for girls and 21 for boys) (see Lehrer et al., 2006; Roberts, Lewinsohn, & Seely, 1991). According to this cutoff, 9 % of adolescents met criteria for depression.

Young Adult STI

STI in past year, measured at Wave IV, was a dichotomous indicator of whether a participant reported being diagnosed with any of nine different STIs (chlamydia, gonorrhea, trichomoniasis, syphilis, genital herpes, genital warts, human papilloma virus, pelvic inflammatory disease, HIV/AIDS) in the past year (0 = no STI; 1 = STI reported). STI in the past year was reported by 9 % of participants.

Statistical Analyses

Our statistical analyses proceeded in four steps. First, we used PROC LCA in SAS (Lanza, Collins, Lemmon, & Schafer, 2007) to conduct an LCA based on five indicators of adolescent sexual behavior. We included survey weights so that the results were more representative of the adolescent population of the US. We relied on information criteria (e.g., AIC and BIC) as well as interpretability to select the number of latent classes. After selecting a model, we examined the demographic distribution of class membership by incorporating each variable as a grouping variable and then examined the behavioral predictors of class membership using LCA with covariates (Collins & Lanza, 2010). Finally, we assessed how adolescent classes of sexual behavior predicted young adult STIs and how these associations differed by gender using the SAS macro LCA_Distal, which allows for model-based estimation of latent class-specific distributions of outcomes (Yang, Tan, Lanza, & Wagner, 2012). This model-based approach provides less biased estimates of associations between class membership and outcomes compared to standard approaches (Lanza, Tan, & Bray, 2011). All software used here is freely available at http://methodology.psu.edu.

Results

Latent Class Analysis Model

In the first analytic step, we compared models with one through eight latent classes. AIC indicated a six-class model was optimal whereas BIC indicated a four-class solution (Table 1). Based on a careful inspection of the four-, five-, and six-class models, we selected a five-class model. This model was chosen over the four-class model because the five-class model differentiated classes based on timing of vaginal intercourse and prior research on sexual behavior has shown age at first intercourse to be an important predictor of later outcomes (Kaestle et al., 2005; Meier, 2007; Upchurch et al., 2004). The 5-class model was preferable to the 6-class model because the classes were more interpretable and all classes were qualitatively distinct from one another (i.e., class separation was better).

Using item-response probabilities, we interpreted the 5 classes as shown in Table 2; we list them roughly in order from least risky to most risky behavior. The largest class, containing nearly 40 % of participants, was labeled Abstinent; this class contained people who had a high probability of reporting that they had never engaged in oral or vaginal sexual behavior. Differentiated from the Abstinent class only by a high probability of engaging in oral sex, the Oral Only class contained 10 % of participants. The Low-Risk class contained 25 % of participants and was marked by a high probability of being sexually active but engaging in less risky behavior: first sex after age 14,

Table 1 Fit statistics for LCA models of adolescent sexual behavior with 1–8 latent classes

No. of classes	G^2	AIC	BIC	CAIC	aBIC	Entropy
1	11,616.59	11,636.59	11,697.89	11,707.89	11,666.12	1.00
2	924.00	966.00	1,094.73	1,115.73	1,028.01	1.00
3	397.14	461.14	657.31	689.31	555.63	0.89
4	216.74	302.74	566.33	609.33	429.70	0.82
5	129.87	237.87	568.89	622.89	397.31	0.81
6	85.15	215.15	613.60	678.60	407.07	0.76
7	65.65	217.65	683.54	759.54	442.05	0.78
8	52.94	226.94	760.25	847.25	483.82	0.77

AIC Akaike Information Criteria, *BIC* Bayesian Information Criteria, *CAIC* Consistent Akaike Information Criteria, *aBIC* Adjusted Bayesian Information Criteria

use of a condom at first sex, sex with only relationship partners, sex with only one recent partner, and oral sex after age 14. Two additional classes, Multi-Partner Normative (12 %), and Multi-Partner Early (13 %), were differentiated from the Low-Risk class by probabilities on two indicators: adolescents in these classes were characterized by having had non-relationship partners and having more than one partner in the past year. These two classes primarily differed from each other based on whether first intercourse occurred before or after age 14. Individuals in the Multi-Partner Early class also had the highest probability of reporting early oral sex (.39).

Probabilities of Class Membership by Demographic Variables

In the next stage of our analysis, we examined the distributions of class membership by gender, race/ethnicity, sexual orientation, and SES (Table 3). Male adolescents had higher probabilities of being in the Oral Sex class (16 %) compared to female adolescents (5 %) whereas female adolescents (27 %) were more likely than males (16 %) to be in the Low-Risk behavior class. Compared to other race/ethnicity categories, African American adolescents were much less likely to be in the Abstinent class and much more likely to be in the Multi-Partner Early class. African American adolescents also has the highest likelihood of being in the Low-Risk class and the lowest likelihood of belonging to the Multi-Partner Normative class. Class membership was relatively similar across the other racial/ethnic groups, except that White adolescents were more likely to be in the Multi-Partner Normative and less likely to be in the Multi-Partner Early class. We also found a number of differences by sexual orientation. Adolescents who were attracted to individuals of the same sex (either exclusively or in addition to the opposite sex) were less likely to be in the Abstinent class than those with no same-sex attraction and more likely to be in the Oral Only and Multi-Partner Early classes. Finally, proportions were similar across SES groups, with a few exceptions: adolescents in the lowest SES group were

less likely to be in the Oral Only class and more likely to be in the Multi-Partner Early class.

Predictors of Class Membership

Next, we included alcohol use, marijuana use, and depression as predictors of class membership using LCA with covariates (Table 4). Low-Risk was selected as the reference group in the logistic regression model predicting latent class membership. Odds ratios represent the difference in odds of membership in other classes compared to Low-Risk for individuals reporting a particular behavior. Experimental drinkers had lesser odds of belonging to the Abstinent (OR = .42) or Oral Sex (OR = .54) classes relative to the Low-Risk class. Heavy drinking was associated with increased odds of membership in the two Multi-Partner classes and lesser odds of membership in the Abstinent class relative to the Low-Risk class. A similar pattern was found with marijuana use: adolescents who used marijuana had greater odds of belonging to the Multi-Partner Normative class and lesser odds of being in the Abstinent class relative to the Low-Risk class. Adolescents with a clinical level of depressive symptoms had lesser odds of being in the Abstinent class and greater odds of being in the Multi-Partner Early class relative to the Low-Risk class, compared to adolescents who did not have a clinical level of depressive symptoms.

Class Membership Predicting Young Adult STIs

In our last stage of analyses, we estimated the proportion of adolescents in each sexual behavior class reporting a past-year STI in young adulthood. Results are shown in Fig. 1. Rates of STIs differed by gender and latent class membership ($p < .001$). For women, being in any class marked by vaginal intercourse in adolescence was associated with an increased risk of STI in young adulthood. Nine percent of young adult women in the Abstinent class in adolescence reported an STI, compared to about 13–16 % of women in the Low-Risk, Multi-Partner

Table 2 Latent Class prevalence and item-response probabilities for five class model of adolescent sexual behavior

	Class 1: Abstinent	Class 2: Oral Only	Class 3: Low-Risk	Class 4: Multi-Partner Normative	Class 5: Multi-Partner Early
Latent class prevalence					
	39 %	10 %	25 %	12 %	13 %
Item-response probabilities					
Indicators					
Timing of first sex					
Never had sex	*1.00*	*1.00*	.00	.00	.00
Normative timing	.00	.00	*.87*	*.99*	.22
Early timing	.00	.00	.13	.01	*.78*
Condom use at first sex					
Never had sex	*.99*	*.70*	.00	.00	.00
Used condom at first sex	.01	.17	*.68*	*.66*	*.54*
No condom at first sex	.00	.13	.32	.34	*.46*
Non-relationship sex					
Never had sex	*1.00*	*1.00*	.00	.00	.00
Relationship only	.00	.00	*.72*	.15	.08
Non-relationship	.00	.00	.28	*.85*	*.92*
Number of recent partners					
0	*.98*	*.61*	.27	.06	.10
1	.02	.14	*.72*	.05	.30
2+	.00	.25	.01	*.88*	*.60*
Timing of oral sex					
Never had oral sex	*.80*	.33	.36	.19	.31
Normative timing	.18	*.49*	*.52*	*.67*	.30
Early timing	.02	.18	.12	.14	.39

Item-response probabilities greater than .45 italicized to facilitate interpretation

Table 3 Adolescent sexual behavior latent class prevalence as a function of gender, race/ethnicity, sexual orientation, and socioeconomic status

	Class 1: Abstinent (%)	Class 2: Oral Only (%)	Class 3: Low-Risk (%)	Class 4: Multi-Partner Normative (%)	Class 5: Multi-Partner Early (%)
Gender					
Male	35	16	16	17	16
Female	42	5	27	12	14
Race/ethnicity					
White	43	9	20	28	0
Black	19	10	28	0	43
Hispanic	47	8	22	14	10
Other	51	13	19	11	6
Sexual orientation					
Opposite sex only	42	7	24	13	15
Same sex	18	20	24	15	23
No attraction	54	12	25	5	5
Socioeconomic status					
<1.5 × poverty threshold	37	7	30	12	15
1.5 to <2.5 × poverty threshold	38	14	28	15	4
2.5 to <4 × poverty threshold	44	11	27	10	7
>.4 × poverty threshold	38	15	29	11	7

Normative, and Multi-Partner early classes. However, for men, only membership in the Multi-Partner Early class was associated with increased STI rates. Only 2 % of men who were Abstinent as adolescents reported an STI in young adulthood, compared to about 5–6 % of men in the Oral Only, Low-Risk, and Multi-Partner Normative classes. However, about 12 % of men who had been in the Multi-Partner Early class reported an STI.

Discussion

This study demonstrated the utility of LCA for research on sexual behavior by empirically confirming the assertion made by many researchers in this area that adolescent sexuality is a complex, heterogeneous phenomenon (Haydon et al., 2012; Tolman & McClelland, 2011; Welsh et al., 2000). The classes uncovered in this study expand on previous person-oriented work (Beadnell et al., 2005; Haydon et al., 2012; Hipwell et al., 2011) by examining a diverse range of predictors in a representative middle adolescent sample. We identified five classes, which varied in their types of sexual behavior. This model demonstrates the advantages of a person-centered, LCA approach: unlike traditional models, which may examine correlates of a single behavior, we showed classes with different patterns of behavior based on a number of dimensions, including timing, relationships, and number of partners. In addition, we demonstrated that these classes had predictive value, as young adult rates of STIs differed by adolescent class membership. This association may be a result of adolescents establishing patterns of behaviors in adolescence that they continue in young adulthood and these behaviors result in later STIs. Thus, this study demonstrates how LCA can be used to study patterns of sexual behaviors. This method can be useful in more holistic approaches

Table 4 Odds ratios and confidence intervals showing the effect of earlier substance use and depression on sexual behavior latent class membership relative to low-risk class

	Class 1: Abstinent	Class 2: Oral Sex	Class 3: Low-Risk	Class 4: Multi-Partner Normative	Class 5: Multi-Partner Early	Change in 2*LL
Alcohol use						737.68***
Experimental	0.42*	0.54*	REF	1.24	0.93	
	[.33, .54]	[.30, .99]		[.63, 2.42]	[.60, 1.44]	
Heavy	0.15*	1.19	REF	3.77*	2.33*	
	[.10, .24]	[.68, 2.08]		[2.25, 6.31]	[1.21, 4.49]	
Marijuana Use						882.52***
Marijuana use	0.20*	1.60	REF	4.18*	2.02	
	[.13, .31]	[.91, 2.81]		[2.96, 5.92]	[.58, 7.09]	
Depression						44.98***
Depressed	.54*	1.82	REF	1.25	1.80*	
	[.35, .83]	[.99, 3.35]		[.72, 2.17]	[1.11, 2.92]	

LL Log Likelihood

* $p < .05$; ** $p < .01$; *** $p < .001$
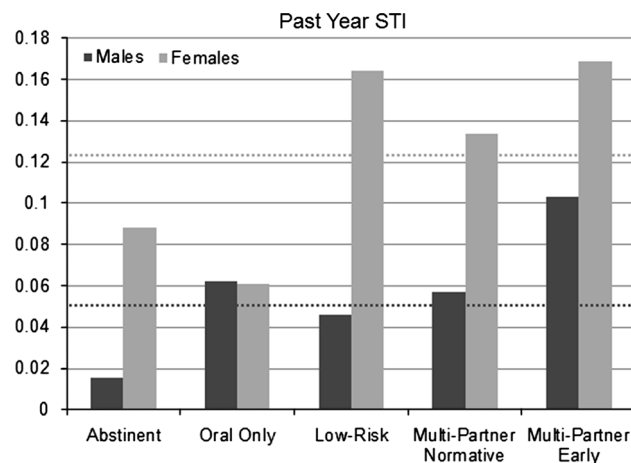
Fig. 1 Estimated probability of reporting an STI in the past year at Wave IV (age 28–30), conditional on class membership at Wave II (age 16–18). *Dotted lines* represent the overall rate of STIs for male and female young adults. Both gender and class membership were significant predictors of STI ($p < .001$)

combining both risky and normative behaviors as recently advocated by researchers (Tolman & McClelland, 2011).

Despite the emphasis on risky behavior in the popular press and in the literature, the majority of adolescents (aged 16–18) are either abstinent or engage in patterns of sexual behavior that may be associated with low risk. A smaller, but still substantial, minority of adolescents engaged in behaviors such as sex with multiple partners, non-relationship partners, and early sex that may place them at risk of adverse physical and mental health outcomes (Kaestle et al., 2005; Meier, 2007; Upchurch et al., 2004). A quarter of adolescents belonged to classes marked by non-relationship sex and recent sex with multiple partners, with

about half of these adolescents belonging to a class marked by early sex. Recently, research has begun to focus on non-coital experiences, such as oral sex, and associated risks. Our study identified a small group of adolescents who had engaged in oral, but not vaginal, sex; membership in this class was predicted by a number of factors, including being male, gay, or bisexual; using substances; and having high levels of depressive symptoms. Because individuals typically engage in both vaginal and oral sex for the first time within 6 months of each other (Lindberg, Jones, & Santelli, 2008), it is possible that adolescents, and in particular heterosexual adolescents, may only belong to this class for a short time before transitioning to classes marked by vaginal intercourse. Thus, future research should examine characteristics and motivations of adolescents who engage in only non-coital behaviors, how predictors and consequences of membership in this class differ across adolescents of different sexual orientation, and how adolescents transition from Oral Only to other classes of behavior.

Although condom use is viewed as an important factor in adolescent sexual health, none of these classes was differentiated from others by use or non-use of condoms. For all classes experiencing vaginal sex, the probability of using a condom at first intercourse was greater than that of not using a condom, although not overwhelmingly so. Thus, although individuals in the generally higher-risk Multi-Partner Early class had lower probability of condom use than those in the Multi-Partner Normative or Low-Risk classes, adolescents in all of these classes may or may not have used a condom at first sex. It is possible that condom use at first sex is not strongly related to individual, personal characteristics, but instead is more influenced by situational factors. Thus, despite the fact that some classes are marked by less risky behaviors, these results stress the importance of promoting

condom use for all adolescents. This is particularly important, given that consistent condom use among adolescents is relatively low (Kenyon, Sieving, Jerstad, Pettingell, & Skay, 2010) and rates of STIs are high (Weinstock et al., 2004).

Not surprisingly, we found gender differences in these results, both in terms of membership in individual classes and differential STI outcomes in adulthood. In general, male adolescents had greater probabilities of being in classes marked by more risky behavior whereas female adolescents were more likely to be abstinent or engage in patterns of lower-risk behavior. Results showing gender differences in sexual behavior should be interpreted with caution, however: male and female adolescents are presumably often having sex with others from this same population and thus differences in self-reports of sexual behaviors that occur in a dyadic context may partially indicate gender differences in reporting, rather than actual behavioral differences (Brown & Sinclair, 1999). Nonetheless, these gender differences are strikingly different from those observed in the association with the outcome of young adult STIs. Consistent with prior research (Centers for Disease Control 2008, 2011), women had higher rates of reporting STIs than men and this difference was consistent across all latent classes (although less pronounced for the Oral Sex Only class, a difference that could be driven by male same-sex behavior, which carries greater risk) (Scott, Bernstein, Raymond, Kohn, & Klausner, 2010). In addition, belonging to a class marked by more risky behaviors was associated with increasing STI risk for men whereas rates of STIs were similar for women in the Low-Risk, Multi-Partner Normative, and Multi-Partner Early classes. This suggests that male sexual risk behavior may be a better predictor of STI risk than female behavior and that women who engage in less risky behaviors may still be at risk of STIs if their partners engage in risk behaviors. This emphasizes the importance of including information about sexual partners in studies of sexual risk behavior, as well as placing increased emphasis on particular subgroups of male adolescents in prevention programs.

Other demographic predictors were also associated with class membership. Consistent with prior, variable-oriented studies showing earlier timing of first sex among African Americans (Cavazos-Rehg et al., 2009), we found that African American adolescents were more likely to belong to the Multi-Partner, Early class and less likely to be abstinent. One strength of our study was the inclusion of sexual minority adolescents, whose sexual behavior is understudied despite their increased risk of STIs and unwanted pregnancies (Eisenberg, 2001; Garofalo, Wolf, Kessel, Palfrey, & DuRant, 1998; Goodenow et al., 2002; Saewyc et al., 2008). Consistent with past research, we found that individuals with same-sex attraction had lesser probabilities of being abstinent and greater probabilities of membership in some classes marked by more risky behaviors. This is not confined to non-coital behaviors, as same-sex attracted individuals were much more likely to engage in risky patterns of early vaginal intercourse with multiple and non-relationship partners as well.

These riskier patterns of behavior may be a way of responding to stigma against homosexuality, or may be a part of exploring a sexual identity that they are questioning (Saewyc et al., 2008). Whatever the explanation, our findings demonstrate the importance of including gay and lesbian adolescents in studies of sexual behavior, and suggest that sexuality education and prevention programs should address the issues faced by sexual minority adolescents.

In addition to identifying how demographic factors predict class membership, we examined how behavioral and mental health factors were associated with class membership. Experimental drinking was associated with having vaginal sex, but not with engaging in riskier patterns of behavior. However, heavy episodic drinking and marijuana use were associated with increased odds of membership in classes marked by multiple and non-relationship partners. This expands on prior, variable-oriented studies linking substance use to early sexual behavior and multiple partners (Costa et al., 1995; Tubman et al., 1996; Whitbeck et al., 1999) by showing that substance use behaviors may be differentially associated with different patterns of behavior. Depression was also associated with riskier sexual behaviors, namely membership in the Multi-Partner Early class. Because early sexual behavior occurred before the Wave II assessments, it is difficult to determine whether the increased depressive symptoms are a cause or a result of early sexual behavior, and there is evidence for both pathways (Lehrer et al., 2006; Meier, 2007). Although further research should attempt to provide a better understanding of direction and causal effects of this association, our results do suggest that depression is associated with risky patterns of sexual behavior during adolescence.

These findings have several other implications for sexuality education and risk prevention programs. First, our results suggest that adolescent behavior patterns are associated with young adult health outcomes. This, in turn, suggests the long-term importance of programs aimed at reducing sexual risk and promoting healthy behaviors. Second, these results indicate several groups of people that are overrepresented in groups marked by higher-risk behaviors, who could be an important target of prevention programs: male, African American, and same-sex-attracted adolescents, as well as adolescents who use substances and who have high levels of depressive symptoms. Finally, our findings demonstrated that adolescents vary in the sexual behaviors they engage in, when they engage in these behaviors, and with whom. Prevention messages may not have the same impact on different types of adolescents. For example, abstinence messages may be less effective for individuals who have already engaged in sexual behavior at an early age, whereas messages about the importance of using condoms may seem less relevant to individuals who have or would only engage in sex with a romantic partner, which they may perceive as less risky. Thus, programs should carefully consider and examine how prevention messages may impact different subgroups of individuals.

There were several limitations of this study that provide opportunities for future research. Several measures used in this study had limitations. For example, questions about oral sex were not asked until Wave IV. Because of the lack of research on oral sex (Halpern-Felsher, Cornell, Kropp, & Tschann, 2005), including a retrospective measure seemed appropriate, although there may be bias caused by the time between behavior and report of behavior. The measures of first intercourse did not include information about whether sex was consensual and our measure of condom use may not fully encompass adolescents' contraceptive behaviors. The only item at Wave I measuring any aspect of sexual identity focused on sexual attraction and thus we have no information about how adolescents self-identify or about same-sex behavior. We used a measure of self-reported STIs and thus did not have information about individuals who may have had an undiagnosed STI.

In addition to these specific limitations, this research presents several opportunities for future research. Several factors that are important to future health outcomes were not included in this analysis. For example, we had no information about individuals' sexual partners (apart from whether any were non-relationship partners), and partner behavior could play a role in associations between class membership and later outcomes. In addition, future research could examine classes determined not only by adolescents' sexual behavior, but also their attitudes. This may be particularly important in assessing how sexual behavior is associated with later mental health outcomes. For example, adolescents who have more negative attitudes about sex or are more religious may experience more negative consequences of early sexual behavior than adolescents who have more positive views about being sexually active. Finally, this study only examined class membership at one point in time; future research could use techniques like latent transition analysis to examine transitions in class membership over time (Lanza & Collins, 2008).

Despite these limitations, this study made several contributions to the literature on adolescent sexual behavior. First, it showed the utility of applying LCA to research on adolescent sexual behavior, demonstrating five classes of behavior marked by different patterns of risk. Second, it used longitudinal data from a nationally representative sample of adolescents and survey weights, increasing generalizability of the findings. In addition, these results shed light on several risk factors for more risky sexual behavior, suggesting possible targets for future interventions. Finally, our results suggest that adolescent patterns of behavior do predict young adult STIs, confirming the importance of prevention efforts for adolescents based on comprehensive profiles of sexual behavior.

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