Published in final edited form as:

Arch Sex Behav. 2015 May ; 44(4): 857–871. doi:10.1007/s10508-015-0510-8.

Bidirectional Associations Between Alcohol Use and Sexual Risk-taking Behavior from Adolescence into Young Adulthood

Ross E. O'Hara¹ and M. Lynne Cooper²

Ross E. O'Hara: ohara@uchc.edu

¹Department of Community Medicine and Health Care, University of Connecticut Health Center MC6325, Farmington, CT 06030-6325

²Department of Psychological Sciences, University of Missouri, Columbia, MO

Abstract

Overwhelming evidence indicates that sexual risk-taking behavior and alcohol use are linked, but the nature, strength, and timing of these relations may differ between gender and racial subgroups. These issues were addressed by examining the course and interrelations of both behaviors from adolescence into young adulthood, as well as how these patterns differed between both men and women and between Blacks and Whites. Data came from a representative, community-based sample of 1867 urban participants surveyed up to 5 times over a 15-year period. Although both prospective and trajectory analyses showed that adolescent involvement in one behavior predicted later involvement in the other, most patterns were moderated by gender, race, or both. In general, positive, bidirectional associations were discovered among men and Whites. Among women, adolescent sexual risk-taking behavior positively predicted later drinking, but not vice versa. For Blacks, adolescent alcohol use was inconsistently related to later sexual risk-taking behavior, and adolescent sexual risk-taking negatively predicted later alcohol use. Results suggest that associations between sexual risk-taking behavior and alcohol use are more complex than previously thought and that an adequate understanding of these links must account for both gender and racial differences.

Keywords

sexual behavior; alcohol use; gender differences; racial differences

INTRODUCTION

Popular belief holds that alcohol use is an important cause of sexual risk-taking behavior: When intoxicated, people are more likely not just to have sex, but to have sex in maladaptive ways that increase their risk for sexual (e.g., unwanted pregnancy; sexually transmitted infections), physical (e.g., sexual coercion or victimization), and emotional harm. This contention may be especially true for adolescents, who are still developing the knowledge and skills necessary to regulate their sexual behavior in adaptive ways. Despite a plethora of research examining whether, when, why, and for whom drinking leads to sexual risk, evidence for causality is still inconclusive (Shuper et al., 2010). Although the mechanisms linking sexual risk-taking behavior and alcohol use remain unclear, there is

both theoretical and empirical support for a bidirectional relation between these behaviors (Cooper, 2006). Due to inconsistent findings on this topic, the current study examined prospective effects of each behavior on involvement in the other from approximately ages 13 to 30. More important, we examined whether this link is consistent across gender and racial groups; if it is not, adequate explanations for these associations must account for subgroup differences.

Global Associations between Sexual Behavior and Alcohol Use

Longitudinal studies have consistently shown that reports of typical alcohol use over some past time period (so-called global reports), especially during early adolescence, are associated with global reports of sexual risk-taking behavior from months to years later (for reviews, see George & Stoner, 2000; Zimmer-Gembeck & Helfand, 2008). These findings are consistent with the idea that early alcohol use impairs adolescents' social and/or neural development (Clark, Thatcher, & Tapert, 2008; de Wit, 2009), leading to impaired decision making and riskier sexual choices. Although likely that the link between drinking and sex is due, in part, to third variables, this relation holds controlling for individual and environmental risk factors such as impulsiveness, excitement seeking, conduct problems, disinhibition, peer deviancy, and substance availability (e.g., Cornelius, Clark, Reynolds, Kirisci, & Tarter, 2007; Dogan, Stockdale, Widaman, & Conger, 2010).

Most researchers have assumed that alcohol use precedes sexual risk-taking behavior (e.g., Khan, Berger, Wells, & Cleland, 2012); few studies have therefore examined the possibility that sex promotes drinking (Cooper, 2006). However, longitudinal studies have shown that adolescent sexual behavior predicts later alcohol use (e.g., Cornelius et al., 2007; Stueve & O'Donnell, 2005; Windle, Mun, & Windle, 2007), although the data appear less consistent in this direction than for the reverse pathway (cf. Dogan et al., 2010). Nevertheless, multiple causal mechanisms could explain this global association. For example, some adolescents experience psychological distress following sex (Hallfors, Waller, Bauer, Ford, & Halpern, 2005), which could increase their motivation to use alcohol to cope (Cooper, Agocha, & Sheldon, 2000). Sex might also bring adolescents into contact with older or more deviant peers, increasing their risk for alcohol use (Stattin, Gustafson, & Magnusson, 1989). Regardless of the exact mechanism, these findings emphasize the importance of examining developmental patterns of risky sexual behavior and alcohol use, as well as testing their bidirectional influences on one another.

Generalizability of Effects across Gender and Race

Evidence of pervasive gender and racial differences in the developmental course and prevalence of both sexual behavior (Cavazos-Rehg et al., 2009; Halpern et al., 2004; Oliver & Hyde, 1993) and alcohol use (Cooper et al., 2008; Nolen-Hoeksema, 2004) raises the possibility that associations between drinking and sex differ across subgroups, as well. Although gender or racial differences in the global processes described previously might give rise to these patterns, causal processes that unfold at the event level could provide a better explanation of subgroup differences (for reviews, see Cooper, 2002, 2006; George & Stoner, 2000). For example, alcohol myopia theory posits that acute intoxication impairs cognitive processing such that when an individual perceives both instigating and inhibiting

cues toward sex, the more dominant set of cues (which in naturalistic settings tend to be ones promoting sex) (Cooper & Orcutt, 1997) will exert disproportionate influence over behavior (Steele & Josephs, 1990). Alternatively, expectancy theory argues that intoxicated individuals are more likely to engage in sexual risk-taking behavior only to the extent that they believe alcohol use causes sexual disinhibition (for a review, see Jones, Corbin, & Fromme, 2001). Not only might individuals who hold strong sex-related alcohol expectancies engage in unintended sexual behavior when intoxicated, they might also drink because they desire the expected disinhibitory effects, including reduced sex-related anxiety, increased partner willingness to have sex, or enhanced sexual experience (Cooper, 2002; Dermen & Cooper, 1994; George & Stoner, 2000; Lindgren, Pantalone, Lewis, & George, 2009). Gender and racial differences in the relations between alcohol use and sexual behavior might exist, therefore, to the extent that subgroups differ in the degree to which sexual behavior is perceived as normal and desirable versus deviant or taboo (George & Stoner, 2000), thus giving rise to differences in the number, nature, or relative strength of instigating and inhibitory cues (Steele & Josephs, 1990) or in the content of sex-related alcohol expectancies (Jones et al., 2001).

Gender differences—Theory and research regarding gender differences in the relation between alcohol use and sexual behavior are decidedly mixed. Many researchers contend that drinking and sex should be more strongly associated for women (for a review, see Weinhardt & Carey, 2000), as sex is less normative, more taboo, and carries greater social and physical consequences (i.e., stronger inhibiting cues) for women (Marston & King, 2006). Alcohol, therefore, would be expected to exert a stronger influence on sexual behavior among women who, in general, should be more inhibited with regard to sex than are men (Steele & Josephs, 1990). At the same time, women might also have a greater need to drink as a way to disinhibit sex (Cooper, 2002), avoid social sanctions from sexual behavior (George & Stoner, 2000), or cope with negative affect stemming from sexual involvement (Hallfors et al., 2005).

Conversely, Cooper and Orcutt (1997) showed that sex was more likely to occur on two different first date occasions if the male partner, but not the female partner, consumed alcohol *and* felt conflicted about having sex. Men in this study tended to perceive uniformly high benefits of having sex across occasions, whereas women perceived uniformly high costs, suggesting that the dominant cues that presumably were central to participants' sexual decision making when intoxicated were instigating cues for men, but inhibiting cues for women. Men also hold stronger beliefs about alcohol's capacity to enhance and disinhibit sex (Dermen & Cooper, 1994), and thus may be subject to stronger expectancy effects than women.

A third possibility is that gender differences attenuate over time. As people enter into their twenties and sexual behavior becomes more behaviorally normative, alcohol may have less influence on sexual decision making for both men and women. Similarly, with accumulating sexual experience, alcohol might be perceived as less necessary to initiate, disinhibit, or excuse sexual behavior. In short, theorizing and empirical evidence are presently unclear about the direction and persistence of gender differences in these associations, but strongly support the value of examining such differences.

Racial differences—Few studies have examined racial differences in the relations between alcohol use and sexual risk-taking behavior, and findings have been inconsistent (Cooper, Peirce, & Huselid, 1994; Khan et al., 2012; Stueve & O'Donnell, 2005). This dearth is surprising given that White adolescents initiate alcohol use earlier than Black adolescents, and are more likely to drink heavily through young adulthood (Cooper et al., 2008), whereas Black adolescents sexually debut at an earlier age (Cavazos-Rehg et al., 2009), have more accepting attitudes toward sex, and are less likely to feel guilt and shame about their sexual activity than White adolescents (Cuffee, Hallfors, & Waller, 2007). Accordingly, we would expect Black youth to be less inhibited about sex, less likely to use alcohol to facilitate or excuse sex, and less likely to drink as a coping response to sexual behavior. From this evidence, therefore, we expect positive, bidirectional associations to be generally stronger among White than Black adolescents, although racial differences may attenuate over time as sex becomes increasingly normative among both racial groups.

The Current Study

Longitudinal relations between alcohol use and sexual risk-taking behavior were examined in a 15-year cohort study beginning in adolescence (ages 13 to 19 at baseline). This study is one of few to date (along with Dogan et al., 2010; Stueve & O'Donnell, 2005) that has examined longitudinal, bidirectional associations between sexual risk-taking and alcohol use. These data have multiple unique characteristics, however, which build on and extend prior research. First, the large sample size and racially diverse composition provide sufficient power to test moderation by gender and race, and to conduct true prospective analyses among subsamples of participants with no prior sexual and/or alcohol experience at baseline. Second, participants were followed until approximately age 30, a longer developmental span than measured in previous studies. Finally, these data include multiple indicators of risk involvement that vary in their prevalence and severity, allowing us to investigate the consistency of findings across a range of predictors and outcomes. This approach serves to strengthen confidence in the robustness of the results to the extent that findings replicate across analyses (Shadish, Cook, & Campbell, 2002). The specific hypotheses were:

1. Adolescent alcohol use will predict higher levels of sexual risk-taking behavior both initially and over time.
2. Adolescent sexual behavior will predict higher levels of alcohol involvement both initially and over time.
3. Rates of growth in both behaviors will be examined as a function of adolescent involvement in the other behavior. Although one might expect higher involvement in one behavior during adolescence to predict accelerated growth in the other, developmental research shows that delayed involvement in a behavior is often followed by rapid growth such that initial differences between those initially considered high- versus low-risk diminish over time, a phenomenon known as “catching up” (Stattin & Magnusson, 1990). This pattern seems particularly likely for behaviors like sex and drinking that are more deviant at earlier ages but eventually become normative. Thus, even if early involvement in one behavior

serves as a robust risk factor for the other, the magnitude of this effect may wane over time due to normal developmental processes.

4. Finally, both racial and gender differences are expected in the nature and strength of the bidirectional associations between alcohol use and sexual risk-taking behavior. Although we expect these associations to be stronger among Whites than Blacks, we offer no *a priori* hypotheses regarding gender differences due to conflicting theoretical predictions and empirical evidence.

METHOD

Participants and Procedure

Data came from a longitudinal study of adolescents living in Buffalo, New York, in 1989. At Time 1 (T1), 2544 eligible adolescents were identified through a random-digit dial procedure that oversampled in predominantly Black neighborhoods, and 2051 adolescents participated (81% of identified eligibles; ages 13–19; Mdn = 17 years old). Follow-up interviews were conducted in 1994–1995 (T2; N = 1813; 88% retention; Mdn = 21 years old) and in 2000–2001 (T3; N = 1488; 73% retention from T1; Med = 27 years old). For reasons unrelated to the present study, only participants less than 28 years old at T3 were eligible for T4 (N = 533; 81% of T3 eligibles; Mdn = 27 years old) and T5 (N = 440; 67% of T3 eligibles; Mdn = 28 years old). T4 and T5 interviews occurred between 2001 and 2004, at least 1 year apart. Because we were primarily interested in racial differences between Blacks and Whites, members of other racial/ethnic groups were excluded from these analyses. The final sample for analysis included 1867 individuals (510 White males, 472 White females, 421 Black males, and 464 Black females) who completed 5787 surveys. Attrition analyses showed that men, participants with more sexual involvement at T1, and participants who reported more heavy drinking at T1 were more likely to be lost to follow-up; with the exception of gender, however, these effects were small.

At T1, informed consent was obtained from participants, as well as from parents of minors. From T1 to T3, structured in-person interviews were conducted by professionally-trained interviewers who were matched on gender and 75% of the time on race. More sensitive items, including the majority of questions on sexual behavior and drinking problems, were self-administered rather than interviewer-administered. Sexual items included definitions of key terms and simple line drawings to help ensure common understanding across participants. A small percentage of interviews at T2 (4%) and T3 (18%) were conducted by phone for respondents who had moved away from Buffalo; analyses revealed no method differences when controlling for demographics of those who moved. All interviews at T4 and T5, however, were completed by telephone.

Measures

Sexual risk-taking behavior—Three primary indicators of sexual risk-taking behavior—number of sexual partners, having sex with a stranger, and having a one-night stand—were examined in the present study. Collectively, these behaviors pose risks for sexual, physical, and emotional harm. For example, engaging with multiple sexual partners is associated with higher risk of developing later depression (Hallfors et al., 2005) and experiencing sexual

victimization (Testa, VanZile-Tamsen, & Livingston, 2007). Moreover, having sex with a stranger has been shown to be related to negative consequences such as increased rates of STIs (Bancroft et al., 2004), psychological distress (Claxton & van Dulmen, 2013), and victimization (Perilloux, Duntley, & Buss, 2011).

At T1, participants reported their *lifetime number of sexual partners* (0 = *virgin* to 7 = *more than 15 people*). Because sexual activity is sporadic during adolescence, lifetime number of partners was used as the T1 predictor in all analyses. As an outcome, however, we examined number of sex partners in the past 6 months (reported at each wave in an open-ended format). To maintain rank order of individuals while reducing the undue influence of outliers, participants who reported six or more partners in the past 6 months were coded into a single category (0.3% – 2.3% of the sample at any wave). Also at T1, participants reported whether they ever had *sex with a stranger*, defined as “someone you had met for the first time the same day or evening you had intercourse.” Beginning at T2, participants were also asked if they ever had a *one-night stand*, defined as “intercourse with someone on one and only one occasion.” Responses at subsequent waves were coded to indicate whether the participant had engaged in either behavior since the prior assessment. Finally, because early sexual debut is a risk factor for later sexual risk-taking (Stueve & O'Donnell, 2005), self-reported *age of sexual debut* was included as a covariate in all analyses predicting sexual behavior. In rare cases of inconsistent reports across waves, the value from the earliest report was used.

Lifetime number of sexual partners and having ever had sex with a stranger were moderately correlated at T1, $r = .54$, $p < .001$, suggesting that these measures tap distinct but related constructs. Furthermore, age of sexual debut was negatively but modestly correlated with the primary risk measures at T1 (r 's = $-.22$ to $-.46$), thus further supporting the construct validity of our measures. Finally, evidence suggests that the majority of casual sex partners are not, in fact, strangers (e.g., Grello, Welsh, & Harper, 2006), supporting the validity of these measures as distinct outcomes.

Alcohol use—Four primary indicators of alcohol involvement were examined. *Typical use* was measured with no temporal frame of reference by a composite of two items: usual amount consumed when drinking (1 = *a very small amount* to 4 = *a very large amount*) and frequency of drinking to intoxication (1 = *never been drunk* to 6 = *get drunk almost every day*). *Heavy use* in the past 6 months was also assessed with two items: frequency of drinking five or more drinks on a single occasion and frequency of drinking to intoxication (0 = *never in the past six months* to 8 = *5 or more times a week*). *Drinking problems* were measured at T1 with five items regarding the frequency of problems with parents, friends, dating partners, and at school or work due to participants' alcohol use (Jessor, Donovan, & Costa, 1989). However, because the nature of drinking problems changes markedly between adolescence and adulthood, a short form of the Michigan Alcoholism Screening Test (Selzer, Vinokur, & van Rooijen, 1975) was used from T2 to T5. Along with problems due to alcohol with one's family, romantic partner, and at work, this measure also included more serious forms of abuse, such as symptoms of dependence and treatment seeking. Again, to limit the undue influence of outliers, participants reporting four or more drinking problems were grouped into a single category (0.6% – 1.8% of the sample at any wave). Finally,

because early onset of alcohol use is a robust risk factor for later heavy and problematic drinking (Stueve & O'Donnell, 2005), *age of regular/heavy drinking onset* was controlled for in all analyses predicting drinking outcomes. Age of onset was defined as the younger of the following two self-reports: age of first getting drunk or age of first drinking regularly (defined as "at least once a week for a period of six months or more").

At T1, the set of alcohol indicators was moderately correlated, with r 's ranging from .58 to .79. Furthermore, age of regular/heavy drinking onset was negatively but modestly correlated with the three alcohol measures (r 's = $-.28$ to $-.49$). Thus, as observed for the sexual risk-taking measures, the pattern of correlations among the alcohol measures generally supports their construct validity.

Statistical Analysis

The bidirectional links between sexual behavior and alcohol use were examined via two distinct analytic approaches: true prospective analyses and trajectory analyses. Prospective analyses imposed a clear temporal order on involvement in the two risk behaviors by examining longitudinal effects at T2 among participants who were sexual virgins or who abstained from using alcohol at T1 (approximately one-third of the T1 sample; this approach could not be extended to examine T3 outcomes because few individuals remained in these categories by T2: 6% for sex and 13% for alcohol). Restricting analyses of sexual behavior outcomes to virgins ($n = 675$), and of alcohol outcomes to lifetime abstainers ($n = 610$), allowed us to rule out prior involvement in the outcome behavior functioning as a third variable. These analyses, therefore, provided a much stronger test of causal influence of one behavior on the other than possible in the trajectory analyses.

This approach, however, used only a subset of respondents, and as a result, had lower power to detect subgroup differences. Furthermore, these results may not generalize to the extent that T1 virgins and abstainers systematically differed from those who had prior experience with these behaviors. As expected, virgins were more likely to be female ($n = 375$, 55.1%; Oliver & Hyde, 1993), White ($n = 443$, 65.6%; Cavazos-Rehg et al., 2009), and younger, whereas abstainers were more likely to be Black ($n = 417$, 68.4%; Cooper et al., 2008) and younger, $ps < .05$. Trajectory analyses, in contrast, utilized the entire sample to examine whether initial levels of involvement in one risk behavior predicted initial levels of involvement and patterns of change across development in the other. Due to the larger and more representative sample, this approach provided a more powerful test of the moderation hypotheses and should yield more broadly generalizable results, although it provides a weaker basis for causal inference.

Prospective analysis—Continuous outcomes (i.e., sexual partners, typical use, heavy use, and drinking problems) were analyzed with hierarchical linear regression, and dichotomous outcomes (i.e., sex with a stranger and one-night stand) with hierarchical logistic regression, both conducted with SPSS 19.0. Among T1 virgins, T2 sexual behaviors were regressed on demographics (i.e., race, gender, gender $\times$ race, and T1 age) and T1 alcohol measures. Similarly among T1 lifetime abstainers, T2 alcohol use measures were regressed on demographics and T1 sexual behavior. Because one-night stands were not

measured until T2, this variable was excluded as a predictor of later alcohol use. All analyses also included two- and three-way interactions between gender, race, and behavioral predictors.

Trajectory analysis—Trajectory analyses were conducted in HLM 6.08 (Raudenbush, Bryk, Cheong, & Condon, 2004), with growth in each outcome modeled at Level 1 (L1) as a function of age at wave (Mehta & West, 2000; Raudenbush & Bryk, 2002). This approach optimizes the reliability of parameter estimates by including all available data while also accounting for heterogeneity in age at wave and in length of time between measurements. Age was centered at 14 years for all outcomes except one-night stands, for which age was centered at 18. Growth was described by three parameters: an intercept (estimated mean level of the dependent variable at age 14/18), a slope (instantaneous linear change from age 14/18), and a quadratic term (accelerating or decelerating growth, represented in the equation by age^2). Models predicting continuous outcomes were estimated using restricted maximum likelihood; models predicting dichotomous outcomes were estimated using restricted penalized quasi-likelihood (Breslow & Clayton, 1993), and employed a Bernoulli distribution. All L1 models included a random intercept; random slopes were trimmed when not significant (Nezlek, 2001), which occurred for both dichotomous outcomes.

The Level 2 (L2) models used T1 indicators of alcohol use to predict growth parameters for the three sexual outcomes (controlling for demographics and age of sexual debut), and T1 sexual behaviors to predict the same for the three alcohol use outcomes (controlling for demographics and age of regular/heavy drinking initiation). L2 variables were grand-mean centered where appropriate (Enders & Tofighi, 2007). Moderation was tested by including gender $\times$ predictor and race $\times$ predictor interactions at L2 in separate models; higher-order interactions were not tested because doing so would have produced unwieldy models that included up to five-way interactions (e.g., gender $\times$ race $\times$ predictor $\times$ age $\times$ age). To increase the stability of parameter estimates, non-significant predictors were trimmed from the final L2 models unless required to provide a valid test of a higher-order interaction term (Nezlek, 2001).

RESULTS

Descriptive Statistics

Means and SDs for sexual behaviors and alcohol use at each wave are presented in Table 1. Participants reported an average age of sexual debut of 15.5 ($SD = 3.1$) and approximately 1–2 sexual partners in the past 6 months at each wave. The proportion of participants who reported having had sex with a stranger ranged from .16 to .34 across waves, whereas rates for having a one-night stand ranged from .23 to .51. Participants also reported an average age of regular/heavy drinking initiation of 16.4 ($SD = 2.6$), and drinking problems were generally low (< 1) across waves.

Tests of gender and racial differences revealed patterns consistent with extant epidemiologic evidence. For sexual behavior, men debuted earlier than women ($M = 15.1$, $SD = 3.3$ vs. $M = 16.0$, $SD = 2.7$) as did Blacks relative to Whites ($M = 14.5$, $SD = 2.8$ vs. $M = 16.5$, $SD = 3.0$); men and Blacks also engaged in more sexual risk-taking behaviors across waves. For

alcohol use, men reported earlier initiation of regular/heavy drinking ($M = 16.7$, $SD = 3.5$) than women ($M = 17.2$, $SD = 4.0$) as well as higher levels of use and more drinking problems. Whites ($M = 15.9$, $SD = 3.0$) first drank regularly/heavily on average over 2 years earlier than Blacks ($M = 18.1$, $SD = 4.2$), and were generally more involved with alcohol during adolescence, but these differences waned over time. Also noteworthy, Whites' average age of regular/heavy drinking initiation was about 6 months before their average age of sexual debut, whereas Blacks initiated regular/heavy drinking an average of 3.5 years *after* their sexual debut. Where gender $\times$ race interactions emerged, the general pattern was that Black men reported the highest overall levels of sexual experience and White men reported the heaviest alcohol involvement, whereas Black and White women did not differ.

Influence of Adolescent Alcohol Use on Later Sexual Behavior

Prospective analysis—As shown in Table 2, T1 typical and heavy alcohol use both positively and significantly predicted all T2 sexual behavior outcomes among T1 virgins, as hypothesized. In contrast, T1 drinking problems were unrelated to T2 sexual behavior. Only one effect was qualified by either gender or race: T1 heavy use was related to T2 sexual partners for men, $b = .41$, $p = .04$, but not women, $b = -.03$, $p = .88$. Finally, no gender $\times$ race $\times$ alcohol interactions were found.

Trajectory analysis—As shown in Table 3, a consistent pattern of alcohol effects on growth trajectories in sexual behavior emerged: Higher T1 alcohol use predicted higher initial levels of sexual behavior, as expected, but slower growth, indicating a “catch up” effect (Stattin & Magnusson, 1990). Specifically, all three alcohol predictors showed significant positive intercept and negative linear effects on sexual partners. However, a significant and positive quadratic effect across all three predictors indicated that these initial differences waned but did not disappear completely over time. A similar pattern was found for sex with a stranger, although only T1 heavy use showed a significant quadratic effect. In contrast, only intercept effects were observed for one-night stands, indicating that differences at age 18 in levels of this behavior as a function of prior alcohol involvement were maintained over the course of the follow-up period. Effect sizes ranged from medium to small (Cohen, 1992), with the largest effects found for the intercept components (d 's = .23 to .48, with the exception of typical use predicting one-night stands, $d = .09$), followed by the linear (d 's = .08 to .25) and quadratic components (d 's = .06 to .17).

Despite the consistency of the overall pattern of effects, only two of these nine effects were invariant across both gender and race. As shown in Figure 1A, participants who reported any T1 drinking problems were significantly more likely to have had sex with a stranger by age 14, but showed less proportional change over time (as indicated by the significant negative linear component) relative to those reporting no problems at T1. As shown in Figure 1B, participants with higher T1 levels of typical alcohol use were significantly more likely to have had a one-night stand by age 18, and this difference was maintained across time.

Gender differences—As shown in Table 3, gender differences in the effects of alcohol on linear growth in sexual behavior emerged for five of the nine tests, indicating a consistent pattern. In addition, alcohol effects were also observed on three intercept and one quadratic

growth component. Effects were small in size, with d 's .23 for the intercept components, .16 for the linear components, and .12 for the one significant quadratic component. Plotting separate trajectories by gender and level of use revealed similar interaction patterns across outcomes, two of which are illustrated in Figure 2. Specifically, initially large differences in sexual risk-taking between men who were low versus high in heavy drinking diminished in the mid-to-late twenties, especially for number of partners (Figure 2A). In contrast, patterns for women were inconsistent, and effects were substantially smaller in size compared to men. In the one possible exception to this pattern, women who reported higher initial levels of typical use reported elevated probabilities of having had sex with a stranger by their mid-to-late twenties (Figure 2B). Together, these results suggest that alcohol use is generally unrelated to sexual risk-taking behavior during adolescence among women, but might be associated with a modest elevation in risk during young adulthood. In contrast, drinking predicts substantial elevations in sexual risk during adolescence among men, though initial light users and abstainers appear to “catch up” to the heavy users by the late twenties (Stattin & Magnusson, 1990).

Racial differences—Contrary to expectation, racial differences in the effects of alcohol on trajectories of sexual behavior were less consistent than gender differences and smaller in magnitude, with d 's .10. As shown in Table 3, only two out of nine intercept and linear effects were moderated by race. Nevertheless, plotting separate growth curves by race and level of use revealed patterns largely in support of our hypothesis; two of these are illustrated in Figure 3. Whites who drank more or reported more drinking problems during adolescence consistently engaged in more sexual risk-taking behavior both initially and over time. In contrast, among Blacks, large initial differences in the effects of heavy use on the probability of having sex with a stranger completely dissipated by the mid-to-late twenties (Figure 3A), whereas there was virtually no effect of drinking problems on the probability of one-night stands either initially or over time (Figure 3B). In short, and in support of our hypothesis, alcohol use during adolescence consistently predicted greater sexual risk-taking across time among Whites but not among Blacks, for whom the associations were both selective and time-bound.

Influence of Adolescent Sexual Behavior on Later Alcohol Use

Prospective analyses—As shown in Table 4, number of lifetime sexual partners at T1 predicted higher typical and heavy alcohol use and more drinking problems at T2 among T1 lifetime abstainers, as hypothesized. Having had sex with a stranger at T1 also predicted more typical and heavy use at T2, but not more drinking problems. Only one prospective effect was significantly moderated: a gender $\times$ race $\times$ partners interaction emerged for T2 drinking problems. Breaking down this interaction revealed a significant gender $\times$ partners effect for Whites, $p = .005$, but not Blacks, $p > .17$. Plotting that two-way interaction among Whites showed that T1 lifetime sexual partners was related to more drinking problems at T2 among initially abstaining White females, $b = .42$, $p < .001$, but not their male counterparts, $b = .10$, $p > .12$.

Trajectory analyses—As shown in Table 5, overall effects of sexual behavior on growth trajectories of alcohol involvement were generally consistent with expectation. T1 sexual

behavior predicted higher initial levels of typical alcohol use, heavy use, and drinking problems. Moreover, higher levels of adolescent sexual behavior predicted slower growth in typical and heavy use, and thus some diminution of differences over time. In contrast, initial differences in drinking problems were maintained. Perhaps more provocatively, the presence of significant, positive quadratic effects for typical use suggests that initial differences in use actually increased in magnitude in the mid-to-late twenties among those with higher initial sexual involvement. Effect sizes were similar to those found for effects of early alcohol use on later sexual behavior: d 's ranged from .35 to .52 for the intercept components, .15 to .29 for the linear components, and .13 to .23 for the quadratic components. Despite the consistency of these growth patterns, not one aggregate trajectory generalized across demographic subgroups.

Gender differences—Results revealed only a single gender interaction ($d = .10$; not shown): Having had sex with a stranger by T1 was associated with higher initial rates of drinking problems among both genders, though the effect was stronger for women than men. This effect disappeared over time for women, whereas the initially smaller effect among men was maintained.

Racial differences—As shown in Table 5, a consistent pattern of race $\times$ sexual behavior interactions predicting growth in alcohol use emerged across five of the six models. These plots, two of which are illustrated in Figure 4, reveal a largely similar but unexpected pattern of effects in which Black adolescents with higher initial levels of sexual experience actually reported lower levels of alcohol involvement, at least until their early-twenties. In contrast, White adolescents demonstrated the expected pattern in which higher levels of initial sexual involvement were associated with higher levels of alcohol use. Effects among both racial groups diminished over time such that the stark initial differences were less evident by the mid-to-late twenties for some associations (e.g., Figure 4A), or even by the early twenties for others (e.g., Figure 4B). Effect sizes were in the small-to-medium range (Cohen, 1992) and generally larger for interactions with number of sexual partners, with d 's .40 for the intercept components, .29 for the linear components, and .26 for the quadratic components.

Supplemental Analysis: Exploring Third Variables

Many have argued that the relation between sexual behavior and alcohol use may be spurious, owing to the influence of underlying stable traits or predisposing environmental risks. To address this possibility, we examined correlations among the set of sexual behavior and alcohol use indicators and a range of potential third variables (i.e., socioeconomic status, negative life events, hostility, impulsivity, thrill-seeking, religiosity, self-esteem, and delinquency) to determine whether any omitted variable could plausibly change the current results. According to Mauro (1990), correlations with third variables weaker than $|r| = .20$ are unlikely to alter a significant relation between two variables of primary interest. With one exception, no potential third variable was consistently related to these behaviors across waves at or above this threshold. The exception was T1 delinquency, which was correlated with sexual behavior and alcohol use between $r = .28$ and $r = .41$, $ps < .001$ (a full correlation matrix is available upon request from the first author.) Because delinquency

exhibited sufficiently high correlations with the variables of interest to suggest that it may pose a threat to inference, we tested the complete set of growth curve models with the addition of delinquency as a covariate, following the same modeling procedures used in our primary analyses. Jessor and Jessor (1977) argued that all adolescent deviant behaviors are linked through a common factor (i.e., deviance-prone personality); thus, removing variance due to other forms of delinquency should attenuate the observed effects if the associations between drinking and sex are spurious. Delinquency was measured at T1 as a self-reported count of participants' engagement in delinquent behavior in the past 6 months, including truancy, property crimes, and violence (see Huselid & Cooper, 1994).

Delinquency as a third variable—With two exceptions, all coefficients remained significant and of similar strength to those previously reported when including delinquency as a control variable in the trajectory analyses. These exceptions were the gender $\times$ heavy use interaction for the quadratic component of one-night stands, $b = -.021$, $p = .098$, and the race $\times$ partners interaction for the quadratic component of drinking problems, $b = .001$, $p = .071$. In both cases, however, the magnitude of the coefficients were similar to those observed in the primary analyses ($bs = -.030$ and $.001$, respectively), but were no longer statistically significant. Given that delinquency failed to materially alter our findings, despite posing the strongest third variable threat on both empirical and theoretical grounds, these analyses lend support to the interpretation that sexual risk-taking and drinking do indeed exert some level of mutual influence over time that is not due to any of several plausible underlying third variable causes.

DISCUSSION

The current study analyzed bidirectional relations between sexual risk-taking behavior and alcohol use among White and Black urban adolescents over a 15-year period. The patterns of growth observed provided evidence of bidirectional influence, even after controlling for age of initiation of each risk behavior. Moreover, true prospective analyses that imposed a clear temporal order between behaviors demonstrated that adolescent involvement in one behavior predicted initiation and increases in the other behavior over the next 5 years, lending credence to a causal interpretation. Also consistent with a causal interpretation, supplemental analyses indicated that these associations could not be readily attributed to the spurious effects of any of several key personality, behavioral, or sociodemographic factors.

Consistent with expectation, baseline levels of alcohol use were associated with higher initial levels of sexual risk-taking behavior across all models, just as baseline levels of sexual behavior were associated with higher initial levels of alcohol involvement. Effects on subsequent growth, however, were more complex. Although those initially low on the predictor behavior tended to show accelerated growth in the outcome early on, and thus to “catch up” with their initially riskier counterparts, this phenomenon was attenuated in the majority of cases by a significant positive quadratic effect. Accordingly, and importantly, initial differences between low- and high-risk individuals were mitigated across development, but never fully eliminated. In addition, adolescents who reported higher alcohol involvement continued to report significantly more one-night stands into young adulthood, just as adolescents who were more sexually involved continued to report

significantly more drinking problems into young adulthood. Together with the results of the true prospective analyses, it suggests that high levels of involvement in either behavior during adolescence can have lasting adverse effects on involvement in the other behavior.

Moderation by Gender and Race

Perhaps the most significant findings to emerge, however, involve the relatively consistent patterns of gender differences in the effects of adolescent alcohol use on later sexual involvement, and of race differences in the effects of adolescent sexual behavior on subsequent alcohol involvement. In fact, only 2 of the 15 associations generalized across all subgroups, both of which involved alcohol effects on later sexual behavior, which is the association most commonly found in previous research (e.g., Dogan et al., 2010).

Gender differences—Results indicated that sexual risk-taking behavior during adolescence was a robust predictor of subsequent alcohol use among both men and women. Trajectory analyses, however, revealed gender differences in the alcohol to sex link. For men, alcohol use positively predicted sexual risk-taking across time, although these effects were somewhat attenuated in young adulthood. In contrast, women's alcohol use during adolescence was largely unrelated to sexual behavior, though there was some suggestion of an emergent effect in young adulthood. These findings are consistent with prior results that sex is more likely to occur when men drink, presumably because the dominant cues underlying male conflict over sex are instigating cues which, in turn, set the stage for alcohol-related disinhibition of sexual behavior (Cooper & Orcutt, 1997). That these findings held up in true prospective analyses where reverse causation is implausible, and when controlling for other delinquent behavior, lends support to the idea that drinking might causally promote sexual risk-taking among men, especially during adolescence.

Racial differences—Trajectory analyses demonstrated that among Whites, as hypothesized, adolescent sexual involvement consistently predicted more alcohol use across development, and adolescent drinking consistently predicted more sexual involvement. These results are consistent with the idea that sex is less behaviorally normative and perceived more negatively among White versus Black adolescents (Cavazos-Rehg et al., 2009; Cuffee et al., 2007), thereby suggesting that Whites may be more inhibited with regard to sex and more susceptible to the disinhibiting effects of alcohol use. Even more striking, however, was the complexity of the observed associations among Blacks. First, although initial alcohol use predicted more sexual risk-taking behavior among Black adolescents, these differences disappeared over time, and in some cases, even reversed themselves, which could be interpreted as another example of a “catch up” phenomenon (Stattin & Magnusson, 1990). Conversely, initial levels of sexual behavior among Blacks were associated with lower levels of alcohol use during adolescence, a novel finding that, if replicated, could be extremely important in understanding the nature of risk-taking among Black youths and how to effectively intervene against such risks.

Implications for Future Research

These results have several implications for understanding whether, when, and how sexual risk-taking behavior and alcohol use are related. First, we found evidence of bidirectional

relations, supporting previous findings from an urban, adolescent minority sample (Steuve & O'Donnell, 2005). This evidence is generally consistent with several models of how drinking leads to sexual risk-taking (e.g., Jones et al., 2001; Steele & Josephs, 1990), but also calls for well-developed and well-tested theories of how sexual behavior might causally promote alcohol use. Thus, future research needs to focus more theoretical and empirical attention on the possibility that sexual behavior can lead to riskier patterns of alcohol consumption. One fruitful approach to building a causal argument in real-world settings is the use of intensive longitudinal methods such as daily diary studies or ecological momentary assessment (Bolger & Laurenceau, 2013). Such studies could capture in close to real-time the circumstances under which sexual behavior may promote *or* inhibit alcohol use, and vice versa, as well as how these circumstances vary across subgroups.

Second, we found evidence of distinct gender and racial differences in these bidirectional associations, including the possibility that sexual involvement is associated with lower rates of drinking among Black youth. Clearly, future research should attempt to replicate these findings in other longitudinal datasets that provide substantial diversity in terms of gender and race. Researchers, however, may need to more carefully consider how and why associations between sexual risk-taking behavior and alcohol use differ across key demographic subgroups, and directly assess mediators that might explain these differences. Understanding these mechanisms will be necessary for refining our theoretical models linking sexual behavior and alcohol use. Especially important is to further examine these processes among young Blacks, for whom these relations appear complex, and our understanding of them limited.

Intervention Implications

Although the current study cannot adequately address the underlying processes that link these two behaviors over time, these findings do suggest that effective interventions may need to address both sexual behavior and alcohol use in tandem. For example, interventions that target alcohol-related sexual risks have been shown to be effective in reducing unprotected intercourse (Kalichman et al., 2007). In addition, conducting randomized controlled trials of interventions to determine whether changes in one risk behavior predict subsequent changes in the other would help establish causality between behaviors that otherwise cannot be systematically manipulated. These findings also highlight the need to tailor interventions to the gender and race of the target audience, as reciprocal influences appeared more prominent for men than women, and for Whites than Blacks. For example, reducing adolescent alcohol use might alter men's sexual risk-taking, but not necessarily women's. However, because adolescent sexual behavior predicted increased alcohol use for both men and women, efforts to promote safe-sex or abstinence might have the welcome benefit of also reducing subsequent drinking among both genders. The present data indicate, however, that these suggestions apply primarily to White youth, and that the situation may be very different among Blacks. Indeed, our data showed that sexually active Black youth were actually less likely to be involved with alcohol, a finding that needs to be replicated and carefully dissected before its implications for intervention can be established.

Limitations

Measurement—Several limitations to the study should be noted. All measures were self-reports, which are subject to social desirability biases and memory errors (Schwarz, 1999). Although such problems would typically be exacerbated by the sensitive nature of the content of the present study, every effort was made to ensure participants' privacy (e.g., using computerized interviews), which is considered key to increasing the validity and reliability of responses to sensitive questions (Schaeffer, 2000). Second, drinking problems were measured differently at T1 than in subsequent waves. However, because we were primarily concerned with comparative rather than absolute growth in drinking problems, the change in measurement is less problematic than it might otherwise be. Finally, although not a limitation *per se*, it is worth noting that certain common indicators of sexual risk were not examined in the current study. Most notably, condom use was not tested because the riskiness of this behavior differs across relationship contexts. In general, after an initial increase in condom use during adolescence and young adulthood, this behavior decreases rapidly over time not because people are acting irresponsibly, but because they are entering stable, monogamous relationships and beginning to procreate. The current study also did not examine alcohol effects on adverse sexual consequences such as unintended pregnancy and STIs, as such conditions are inconsistently linked to sexual risk-taking, especially among Black youth (Halpern et al., 2004).

Sample—Completion rates were higher among women and participants who reported less involvement in risk behavior at T1, thus raising the possibility that our results may not generalize to men and more at-risk populations. In addition, differential patterns of growth observed over time could have been influenced by these differential attrition rates. Arguing against a strictly artifactual interpretation of the observed growth patterns, most studies examining the developmental course from adolescence into young adulthood show changes in personality consistent with the age trends observed here (e.g., increasing conscientiousness and emotional stability; Roberts, Walton, & Viechtbauer, 2006). Furthermore, the observed patterns were consistent with "maturing out," in which involvement in most risk behaviors increases until approximately age 25, and then decreases as people adopt more adult roles (e.g., marriage; parenthood) that are generally incompatible with continued risk-taking (Arnett, 2005). Given the strong convergence between our findings and other well-documented developmental patterns in the literature, we believe it is unlikely that differential attrition strongly influenced these results. Also, participants came from a single urban area in the United States, and although the sample was randomly selected, results might not generalize to other regions or countries. Nonetheless, findings using representative but localized community samples tend to generalize well (Hawkins, Catalano, & Miller, 1992).

Effect sizes—Another limitation is that the observed effect sizes were generally small (Cohen, 1992). However, given the multiply-determined nature of complex behaviors such as alcohol use and sex, it may be unrealistic to expect substantially larger effect sizes (Ahadi & Diener, 1989). Furthermore, relations between behaviors were estimated over 5 to 15 years duration, and many effects were moderated, which diminishes the size of main effects due to non-relations (or opposing relations) in some subgroups. Finally, even small effects

can take on great significance when the behaviors are prevalent and potentially damaging in their consequences, as is the case with sexual risk-taking and drinking among adolescents and young adults (Department of Health and Human Services, 2010; Weinstock, Berman, & Cates, 2000).

Causal inference—Finally, although we have framed our discussion primarily in terms of causal processes that might underlie the observed bidirectional associations between drinking and sexual risk-taking behavior, the present data come from a correlational design and thus cannot support unequivocal causal inferences. Nevertheless, the robustness of our findings even after controlling for age of onset of the outcome behavior—shown in past research to be one of the strongest predictors of later problematic involvement (e.g., Stueve & O'Donnell, 2005)—as well as for other delinquency lends indirect support to a causal interpretation of the observed associations. Even more convincing are results from the true prospective analyses showing that alcohol use predicts later sexual behavior among initial virgins, and that sexual behavior predicts later alcohol use among initial abstainers. Such analyses support more confident causal inference because they rule out the possibility that prior involvement in the outcome behavior caused later involvement in both behaviors. Thus, while observational data will never support unambiguous conclusions about cause-effect relationships, the present study provides reasonably strong evidence that adolescent alcohol use and sexual risk-taking behavior exert mutual causal influences on each other over the course of young adulthood.

Acknowledgments

This research was supported by grant AA08047 to M. Lynne Cooper, and preparation of this article was supported by Institutional Research Training Grant AA013526 to Kenneth J. Sher, both from the National Institute on Alcohol Abuse and Alcoholism. Ross E. O'Hara is now at Persistence Plus®, LLC, Boston, MA.

References

- Ahadi S, Diener E. Multiple determinants and effect size. *Journal of Personality and Social Psychology*. 1989; 56:398–406.
- Arnett JJ. The developmental context of substance use in emerging adulthood. *Journal of Drug Issues*. 2005; 35:235–254.
- Bancroft J, Janssen E, Carnes L, Goodrich D, Strong D, Long JS. Sexual activity and risk taking in young heterosexual men: The relevance of sexual arousability, mood, and sensation seeking. *Journal of Sex Research*. 2004; 41:181–192. [PubMed: 15326543]
- Bolger, N.; Laurenceau, J-P. *Intensive longitudinal methods: An introduction to diary and experience sampling research*. New York: Guilford Press; 2013.
- Breslow NE, Clayton DG. Approximate inference in generalized linear mixed models. *Journal of the American Statistical Association*. 1993; 88:9–25.
- Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Schootman M, Bucholz KK, Peipert JF, Bierut LJ. Age of sexual debut among U.S. adolescents. *Contraception*. 2009; 80:158–162. [PubMed: 19631791]
- Clark DB, Thatcher DL, Tapert SF. Alcohol, psychological dysregulation, and adolescent brain development. *Alcoholism: Clinical and Experimental Research*. 2008; 32:375–385.
- Claxton SE, van Dulmen MHM. Casual sexual relationships and experiences in emerging adulthood. *Emerging Adulthood*. 2013; 1:138–150.
- Cohen J. A power primer. *Psychological Bulletin*. 1992; 112:155–159. [PubMed: 19565683]
- Cooper ML. Alcohol use and risky sexual behavior among college students and youth: Evaluating the evidence. *Journal of Studies on Alcohol*. 2002; 14(Suppl):101–117.

- Cooper ML. Does drinking promote risky sexual behavior? A complex answer to a simple question. *Current Directions in Psychological Science*. 2006; 15:19–23.
- Cooper ML, Agocha VB, Sheldon MS. A motivational perspective on risky behaviors: The role of personality and affect regulation processes. *Journal of Personality*. 2000; 68:1059–1088. [PubMed: 11130732]
- Cooper ML, Krull JL, Agocha VB, Flanagan ME, Orcutt HK, Grabe S, Jackson M. Motivational pathways to alcohol use and abuse among Black and White adolescents. *Journal of Abnormal Psychology*. 2008; 117:485–501. [PubMed: 18729604]
- Cooper ML, Orcutt HK. Drinking and sexual experience on first dates among adolescents. *Journal of Abnormal Psychology*. 1997; 106:191–202. [PubMed: 9131839]
- Cooper ML, Peirce RS, Huselid RF. Substance use and sexual risk taking among Black adolescents and White adolescents. *Health Psychology*. 1994; 13:251–262. [PubMed: 8055860]
- Cornelius JR, Clark DB, Reynolds M, Kirisci L, Tarter R. Early age of first sexual intercourse and affiliation with deviant peers predict development of SUD: A prospective longitudinal study. *Addictive Behaviors*. 2007; 32:850–854. [PubMed: 16839696]
- Cuffee JJ, Hallfors DD, Waller MW. Racial and gender differences in adolescent sexual attitudes and longitudinal associations with coital debut. *Journal of Adolescent Health*. 2007; 41:19–26. [PubMed: 17577530]
- Department of Health and Human Services. [Accessed online May 18, 2012] Youth risk behavior surveillance—United States, 2009; Morbidity and Mortality Weekly Report. 2010. p. 59 from www.cdc.gov/mmwr/PDF/ss/ss5905.pdf
- Dermen KH, Cooper ML. Sex-related alcohol expectancies among adolescents: I. Scale development. *Psychology of Addictive Behaviors*. 1994; 8:152–160.
- de Wit H. Impulsivity as a determinant and consequence of drug use: A review of underlying processes. *Addiction Biology*. 2009; 14:22–31. [PubMed: 18855805]
- Dogan SJ, Stockdale GD, Widaman KF, Conger RD. Developmental relations and patterns of change between alcohol use and number of sexual partners from adolescence through adulthood. *Developmental Psychology*. 2010; 46:1747–1759. [PubMed: 20677862]
- Enders CK, Tofighi D. Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods*. 2007; 12:121–138. [PubMed: 17563168]
- George WH, Stoner SA. Understanding acute alcohol effects on sexual behavior. *Annual Review of Sex Research*. 2000; 11:92–122.
- Grello CM, Welsh DP, Harper MS. No strings attached: The nature of casual sex in college students. *Journal of Sex Research*. 2006; 43:255–267. [PubMed: 17599248]
- Hallfors DD, Waller MW, Bauer D, Ford CA, Halpern CT. Which comes first in adolescence—Sex and drugs or depression? *American Journal of Preventive Medicine*. 2005; 29:163–170. [PubMed: 16168864]
- Halpern CT, Hallfors D, Bauer DJ, Iritani B, Waller MW, Cho H. Implications of racial and gender differences in patterns of adolescent risk behavior for HIV and other sexually transmitted diseases. *Perspectives on Sexual and Reproductive Health*. 2004; 36:239–247. [PubMed: 15687082]
- Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin*. 1992; 112:64–105. [PubMed: 1529040]
- Huselid RF, Cooper ML. Gender roles as mediators of sex differences in expressions of pathology. *Journal of Abnormal Behavior*. 1994; 103:595–603.
- Jessor, R.; Donovan, JE.; Costa, FM. *Health Behavior Questionnaire*. Boulder, CO: Institute of Behavioral Science, University of Colorado; 1989.
- Jessor, R.; Jessor, SL. *Problem behavior and psychosocial development*. San Diego, CA: Academic Press; 1977.
- Jones BT, Corbin W, Fromme K. A review of expectancy theory and alcohol consumption. *Addiction*. 2001; 96:57–72. [PubMed: 11177520]
- Kalichman SC, Simbayi LC, Vermaak R, Cain D, Jooste S, Peltzer K. HIV/AIDS risk reduction counseling for alcohol using sexually transmitted infections clinic patients in Cape Town, South

- Africa. *Journal of Acquired Immune Deficiency Syndromes*. 2007; 44:594–600. [PubMed: 17325606]
- Khan MR, Berger AT, Wells BE, Cleland CM. Longitudinal associations between adolescent alcohol use and adulthood sexual risk behavior and sexually transmitted infection in the United States: Assessment of differences by race. *American Journal of Public Health*. 2012; 102:867–876. [PubMed: 22493999]
- Lindgren KP, Pantalone DW, Lewis MA, George WH. College students' perceptions about alcohol and consensual sexual behavior: Alcohol leads to sex. *Journal of Drug Education*. 2009; 39:1–21. [PubMed: 19886159]
- Marston C, King E. Factors that shape young people's sexual behaviour: A systematic review. *Lancet*. 2006; 368:1581–1586. [PubMed: 17084758]
- Mauro R. Understanding L.O.V.E. (left-out variables error): A method for estimating the effects of omitted variables. *Psychological Bulletin*. 1990; 108:314–329.
- Mehta PD, West SG. Putting the individual back into individual growth curves. *Psychological Methods*. 2000; 5:23–43. [PubMed: 10937321]
- Nezlek JB. Multilevel random coefficient analyses of event- and interval-contingent data in social and personality psychology research. *Personality and Social Psychology Bulletin*. 2001; 27:771–785.
- Nolen-Hoeksema S. Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review*. 2004; 24:981–1010. [PubMed: 15533281]
- Oliver MB, Hyde JS. Gender differences in sexuality: A meta-analysis. *Psychological Bulletin*. 1993; 114:29–51. [PubMed: 8346327]
- Perilloux C, Duntley JD, Buss DM. Susceptibility to sexual victimization and women's mating strategies. *Personality and Individual Differences*. 2011; 51:783–786.
- Raudenbush, SW.; Bryk, AS. *Hierarchical linear models*. 2. Thousand Oaks, CA: Sage Publications; 2002.
- Raudenbush, SW.; Bryk, AS.; Cheong, YF.; Congdon, RT. *HLM 6: Hierarchical linear and nonlinear modeling [Computer software manual]*. Chicago, IL: Scientific Software International; 2004.
- Roberts BW, Walton KE, Viechtbauer W. Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*. 2006; 132:1–25. [PubMed: 16435954]
- Schaeffer, N. Asking questions about threatening topics: A selective overview. In: Stone, AA.; Turkkan, JS.; Bachrach, C., editors. *The science of self-report: Implications for research and practice*. Mahwah, NJ: Erlbaum; 2000. p. 105–121.
- Schwarz N. Self-reports: How the questions shape the answers. *American Psychologist*. 1999; 54:93–105.
- Selzer ML, Vinokur A, Van Rooijen L. A self-administered short version of the Michigan Alcoholism Screening Test (SMAST). *Journal of Studies on Alcohol*. 1975; 43:117–126. [PubMed: 238068]
- Shadish, WR.; Cook, TD.; Campbell, DT. *Experimental and quasi-experimental designs for generalized causal inference*. 2002.
- Shuper PA, Neuman M, Kantares F, Baliunas D, Joharchi N, Rehm J. Causal considerations on alcohol and HIV/AIDS—A systematic review. *Alcohol & Alcoholism*. 2010; 45:159–166. [PubMed: 20061510]
- Stattin H, Gustafson SB, Magnusson D. Peer influences on adolescent drinking: A social transition perspective. *Journal of Early Adolescence*. 1989; 9:227–246.
- Stattin, H.; Magnusson, D. *Pubertal maturation in female development: Vol. 2. Paths through life*. Hillsdale, NJ: Erlbaum; 1990.
- Steele CM, Josephs RA. Alcohol myopia: Its prized and dangerous effects. *American Psychologist*. 1990; 45:921–933. [PubMed: 2221564]
- Stueve A, O'Donnell LN. Early alcohol initiation and subsequent sexual and alcohol risk behaviors among urban youths. *American Journal of Public Health*. 2005; 95:887–893. [PubMed: 15855470]
- Testa M, VanZile-Tamsen C, Livingston JA. Prospective prediction of women's sexual victimization by intimate and non-intimate male perpetrators. *Journal of Consulting and Clinical Psychology*. 2007; 75:52–60. [PubMed: 17295563]

- Weinhardt LS, Carey MP. Does alcohol lead to sexual risk behavior? Findings from event-level research. *Annual Review of Sex Research*. 2000; 11:125–157.
- Weinstock H, Berman S, Cates W. Sexually transmitted diseases among American youth: Incidence and prevalence estimates, 2000. *Perspectives on Sexual and Reproductive Health*. 2000; 36:6–10. [PubMed: 14982671]
- Windle M, Mun EY, Windle RC. Adolescent-to-young adulthood heavy drinking trajectories and their prospective predictors. *Journal of Studies on Alcohol*. 2005; 66:313–322. [PubMed: 16047520]
- Zimmer-Gembeck MJ, Helfand M. Ten years of longitudinal research on U.S. adolescent sexual behavior: Developmental correlates of sexual intercourse, and the importance of age, gender and ethnic background. *Developmental Review*. 2008; 28:153–224.

Figure 1. Patterns of alcohol use predicting sexual risk-taking behavior consistently across subgroups. Low = 15th percentile; high = 85th percentile.

Figure 2. Gender $\times$ Heavy use interaction for sexual partners and Gender $\times$ Typical use interaction for stranger sex. Low = 15th percentile; high = 85th percentile.

Figure 3.

Race $\times$ Heavy use interaction for stranger sex and Race $\times$ Drinking problems interaction for one-night stands. Low = 15th percentile; high = 85th percentile.

Figure 4.

Race $\times$ Partners and Race $\times$ Stranger sex interactions for 6 month heavy alcohol use. Low = 15th percentile; high = 85th percentile.

Table 1

Descriptive Statistics for Sexual Behaviors and Alcohol Use

	Overall (<i>Med age</i>)	Time 1 (17 years)	Time 2 (21 years)	Time 3 (27 years)	Time 4 (27 years)	Time 5 (28 years)
<i>Sexual Behaviors</i>						
Lifetime sexual partners	—	2.08 (2.21) ^{abc}	—	—	—	—
6 month sexual partners	1.34 (1.23) ^{abc}	0.98 (1.19) ^{abc}	1.50 (2.06) ^{abc}	1.46 (2.19) ^{abc}	1.38 (1.20) ^{abc}	1.25 (0.90) ^{ab}
Sex with a stranger	.27 (0.34) ^{abc}	.16 (0.37) ^{ab}	.31 (0.46) ^{abc}	.34 (0.47) ^{ac}	.34 (0.47) ^{ab}	.29 (0.46) ^{ab}
One-night stand	.44 (0.40) ^{abc}	—	.51 (0.50) ^a	.39 (0.49) ^{ac}	.28 (0.49) ^{ab}	.23 (0.42) ^{ab}
Age of sexual debut	15.54 (3.08) ^{abc}	—	—	—	—	—
<i>Alcohol Behaviors</i>						
Typical use	1.49 (0.82) ^{abc}	1.10 (1.09) ^b	1.66 (0.98) ^{ab}	1.72 (0.88) ^{ab}	1.66 (0.87) ^{ab}	1.72 (0.84) ^{ab}
6 month heavy use	1.59 (1.63) ^{abc}	1.20 (1.90) ^{ab}	1.99 (2.22) ^{ab}	1.60 (2.03) ^{ab}	1.46 (1.90) ^a	1.28 (1.72) ^a
Drinking problems	0.36 (0.66) ^{abc}	0.34 (0.65) ^{abc}	0.39 (0.90) ^{abc}	0.28 (0.80) ^a	0.22 (0.67) ^a	0.11 (0.48) ^a
Age of heavy/regular drinking initiation	16.36 (2.58) ^{ab}	—	—	—	—	—

Note. SDs noted in parentheses.

^a Gender difference;^b Race difference;^c Gender × Race interaction.

Table 2
True Prospective Analyses of Time 1 Alcohol Use Predicting Time 2 Sexual Outcomes among Time 1 Virgins

	Time 2 sexual partners ¹			Time 2 sex with a stranger ²			Time 2 one-night stand ²		
	R ²	β	χ ²	ROR	χ ²	ROR	χ ²	ROR	
<i>Demographic Covariates</i>									
Gender ³	.064***	.24**	21.62***	5.34***	7.24	1.79*			
Race ⁴		-.12*		1.83		1.01			
Gender × Race		-.19*		0.23**		0.62			
Time 1 age		-.08*		0.95		1.08			
<i>Alcohol Main Effects</i>									
Time 1 typical use	.017***	.15***	9.46**	1.65***	21.91***	1.77***			
Time 1 heavy use	.011**	.11**	4.97*	1.25*	11.41***	1.31***			
Time 1 drinking problems	.005†	.07†	0.43	1.22	1.78	1.35			
<i>Gender Interactions</i>									
Gender × Typical use	.004	.10	0.89	0.79	0.66	1.12			
Gender × Heavy use	.008†	.14*	0.58	0.88	1.69	1.12			
Gender × Drinking problems	.002	.06	1.78	0.53	0.35	1.08			
<i>Race Interactions</i>									
Race × Typical use		-.01		1.23		1.19			
Race × Heavy use		-.06		0.90		1.34			
Race × Drinking problems		-.03		2.16		0.70			

Note. Each Time 1 alcohol predictor analyzed in a separate hierarchical regression: Step 1 = demographic covariates; Step 2 = Time 1 alcohol predictor; Step 3 = Gender × Alcohol and Race × Alcohol interactions. All Gender × Race × Alcohol interactions were non-significant and are not presented. Standardized coefficients presented for variable's initial entry into model. ROR = relative odds ratio.

¹ Linear regression;

² Logistic regression;

³ women = 0, men = 1;

⁴ Black = 0, White = 1.

.10' d
†
>.05' d
*
.10' d

>.100' d

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Hierarchical Linear Models Predicting Initial Level and Growth of Sexual Behavior from Time 1 Alcohol Predictors

	Sexual partners ¹				Sex with a stranger ²				One-night stands ²			
	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic
<i>Covariates</i>												
Gender ³	.14**	.040***	-.0020*	.80***	—	—	.15 [†]	.049*	—	—	—	—
Race ⁴	-.04	-.010	—	.72***	-.058***	—	.01	-.034***	—	—	—	—
Gender × Race	-.09	.029*	—	-.58***	—	—	-.43*	—	—	—	—	—
Age of sexual debut	-.11***	-.010*	.0001***	-.35***	.012***	—	-.39***	.028***	—	—	—	—
<i>Alcohol Behavior Effects</i>												
Time 1 typical use	.35***	-.051***	.0021**	.69***	-.033***	—	.45***	—	—	—	—	—
Time 1 heavy use	.26***	-.036***	.0013***	.52***	-.061***	.0023*	.17	—	—	—	—	—
Time 1 drinking problems	.56***	-.088***	.0036***	.77***	-.038**	—	.37***	—	—	—	—	—
<i>Gender Interactions</i>												
Gender × Typical use	.26***	-.018***	—	.32	-.035*	—	—	—	—	—	—	—
Gender × Heavy use	.25***	-.044**	.0019*	—	—	—	.15	-.030*	—	—	—	—
Gender × Drinking problems	.28*	-.020*	—	—	—	—	—	—	—	—	—	—
<i>Race Interactions</i>												
Race × Typical use	—	—	—	-.27	.039*	—	—	—	—	—	—	—
Race × Heavy use	—	—	—	-.17	.019*	—	.11*	—	—	—	—	—
Race × Drinking problems	—	—	—	—	—	—	.35*	—	—	—	—	—

Note. Values are unstandardized coefficients. Blank cells indicate predictors trimmed from final models.

¹ Modeled as a continuous outcome;

² Modeled as a dichotomous outcome (Bernoulli distribution);

³ women = 0, men = 1;

⁴ Black = 0, White = 1.

p .001;

d_{10}
 $d_{50} > d_{10}$
*

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

True Prospective Analyses of Time 1 Sexual Behavior Predicting Time 2 Alcohol Outcomes among Time 1 Abstainers

Table 4

	Time 2 typical alcohol use		Time 2 heavy alcohol use		Time 2 drinking problems	
	<i>R</i> ²	β	<i>R</i> ²	β	<i>R</i> ²	β
<i>Demographic Covariates</i>						
Gender ¹	.039***	0.16**	.040***	0.15***	.018*	0.07
Race ²		0.13*		-0.01		-0.02
Gender $\times$ Race		-0.04		0.08		0.07
Time 1 age		-0.05		-0.03		-0.07
<i>Sexual Behavior Main Effects</i>						
Time 1 lifetime sexual partners	.011*	0.13*	.018***	0.16***	.007*	0.10*
Time 1 sex with a stranger	.012**	0.11**	.014**	0.12**	.004	0.06
<i>Gender Interactions</i>						
Gender $\times$ Sexual partners	.007	-0.05	.004	-0.07	.025***	-0.22**
Gender $\times$ Stranger sex	.001	0.03	.001	0.10	.004	0.04
<i>Race Interactions</i>						
Race $\times$ Sexual partners		0.16 [†]		0.05		0.24**
Race $\times$ Stranger sex		0.01		-0.04		-0.07
<i>Gender $\times$ Race Interactions</i>						
Gender $\times$ Race $\times$ Sexual partners	.002	-0.14	.000	-0.02	.009*	-0.32*
Gender $\times$ Race $\times$ Stranger sex	.001	0.06	.001	0.06	.001	-0.06

Note. Each Time 1 sexual behavior predictor analyzed in a separate hierarchical regression: Step 1 = demographic covariates; Step 2 = Time 1 sexual behavior predictor; Step 3 = Gender $\times$ Sexual behavior and Race $\times$ Sexual behavior interactions; Step 4 = Gender $\times$ Race $\times$ Sexual behavior interaction. Standardized coefficients presented from variable's initial entry into model.

¹ women = 0, men = 1;

² Black = 0, White = 1.

*** *p* .001;

** *p* .01;

* *p* < .05;

10.
d
f

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 5
Hierarchical Linear Models Predicting Initial Level and Growth of Alcohol Use from Time 1 Sexual Behavior Predictors

	Typical alcohol use			Heavy alcohol use			Drinking problems		
	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic	Intercept	Linear	Quadratic
<i>Covariates</i>									
Gender ¹	.17***	.057***	-.0024***	.25***	.13***	-.005***	-.01	.030***	-.001*
Race ²	.15***	-.009***	—	.14*	.02	-.002*	.02	.010*	-.001*
Gender × Race	.14***	—	—	.41***	—	—	.13***	—	—
Age of drinking initiation	.12***	-.006**	.0006***	-.10***	-.025***	.002***	-.04***	.001*	—
<i>Sexual Behavior Effects</i>									
Time 1 sexual partners	.17***	-.025***	.0011***	.21***	-.008***	—	.06***	—	—
Time 1 sex with a stranger	.75***	-.090***	.0039***	1.16***	-.042**	—	.28***	—	—
<i>Gender Interactions</i>									
Gender × Partners	—	—	—	—	—	—	—	—	—
Gender × Stranger sex	—	—	—	—	—	—	-.15	.027*	—
<i>Race Interactions</i>									
Race × Partners	.26***	-.049***	.0024***	1.63***	-.33***	.017**	.15***	-.022**	.001*
Race × Stranger sex	.56***	-.11*	.0055*	1.63***	-.33***	.017**	—	—	—

Note. Values are unstandardized coefficients. Blank cells indicate predictors trimmed from final models. All outcomes modeled as continuous variables.

¹ women = 0, men = 1;

² Black = 0, White = 1.

*** p .001;

** p .01;

* p < .05.