Graduate School Form
30 Updated 12/26/2015

PURDUE UNIVERSITY
GRADUATE SCHOOL
Thesis/Dissertation Acceptance

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By Devin E. Banks

Entitled

Examining Differential Relationships of Substance Use and Risky Sexual Behavior among African American and White Adolescents

For the degree of Master of Science

Is approved by the final examining committee:

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EXAMINING DIFFERENTIAL RELATIONSHIPS OF SUBSTANCE USE AND RISKY SEXUAL BEHAVIOR AMONG AFRICAN AMERICAN AND WHITE ADOLESCENTS

A Thesis

Submitted to the Faculty

of

Purdue University

by

Devin E. Banks

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

December 2016

Purdue University

Indianapolis, Indiana

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
RSB	Risky sexual behavior
STI	Sexually transmitted infection
SSRT	Scale of Sexual Risk Taking
ZIP	Zero-inflated Poisson

ABSTRACT

Banks, Devin E. M.S., Purdue University, December 2016. Examining Differential Relationships of Substance Use and Risky Sexual Behavior among African American and White Adolescents. Major Professor: Tamika Zapolski.

Adolescents are at disproportionate risk for health consequences associated with risky sexual behavior, including sexually transmitted infections and unintended pregnancy. Racial disparities have also been observed with African American adolescents experiencing higher rates of such negative health outcomes than their White peers. Substance use, particularly alcohol and marijuana use, has been shown to predict risky sexual behavior among adolescents of both racial groups. However, research suggests that alcohol use is more predictive of risky sexual behavior in White adolescents than African American adolescents, perhaps due to significantly higher rates of alcohol use among White adolescents. Given recent trends indicating higher rates of marijuana use among African American adolescents than their White peers and a strong association between marijuana use and risky sexual behavior among African American adolescents, marijuana use may better explain the relationship between substance use and risky sexual behavior among African Americans than alcohol use. Thus, the current study examined whether alcohol and marijuana use have differential effects on adolescent risky sexual behavior by race at the event- and global-level of analysis. To that end, 113 adolescents ages 14-18 (African American = 93, White=20) completed self-report measures of

substance use and risky sexual behavior. Contrary to hypotheses, results revealed no racial differences in the relationship between substance use and RSB. However, post-hoc analyses revealed that marijuana use significantly predicted frequency of sex among African American adolescents above the effects of alcohol. These findings indicate that previously documented racial differences in the relationship between substance use and risky sexual behavior may not be accounted for by marijuana use, but suggest that future studies continue to examine the unique impact of marijuana use on risky sexual behavior, particularly among African American adolescents.

CHAPTER 1. INTRODUCTION

Recent statistics indicate that approximately half of sexually-active high-school females and one-third of males report not using a condom during last sexual intercourse, and that 12% of these students report having four or more lifetime sexual partners (Centers for Disease Control [CDC], 2016). Engagement in risky sexual behaviors (RSBs), such as unprotected sex, is a major public health concern as they are associated with significant negative sexual health outcomes, such as such as transmission and contraction of sexually transmitted infections (STIs)—including HIV—and unintended pregnancy. The CDC (2014c) estimate that 20 million new cases of STIs occur every year with half of these occurring among individuals aged 15–24 years (Satterwhite et al., 2013). Startlingly, youth age 10–17 make up 40% of new HIV diagnoses among all young people age 10–24, most of which are acquired through sexual contact (CDC, 2009). Additionally, although overall percentages of pregnancy are lower among adolescents age 15–17 than adults 18–24, as many as 88% of births within this cohort are a result of unintended pregnancies (CDC, 2009). These statistics indicate that prevention efforts should focus on understanding RSBs that adolescents engage in such as unprotected sex, multiple or concurrent sexual partnerships and other hazardous sexual activity (e.g. sex after substance use, sex with casual partners, sex with promiscuous partners, anal sex;

CDC, 2016; Hoyle, Fejfar, & Miller, 2000; Metzler, Noell, & Biglan, 1992) in order to reduce risk for negative sexual health outcomes.

Understanding risk for RSB is particularly critical for African American youth, as signficant racial disparities in consequences related to RSB have been documented among this subgroup. Compared to their White peers, African American youth report higher rates of STIs, including HIV/AIDS, teen pregnancy and childbirth (CDC, 2009, 2014a, 2014d). Recent statistics from the CDC (2014d) show that the rate of reported cases of both chlamydia and gonorrhea are higher among African Americans age 15–19 than any other race by age group. More alarmingly, this group is 16–20 times more likely to receive a new HIV diagnosis than their White counterparts (CDC, 2009).

Some have posited that higher rates of these health outcomes are due to higher rates of RSBs among African American youth. Although racial differences in rates of RSB have also been observed, the interpretation of these findings are less straightforward. When examined at a group level, African American youth appear to be at higher risk for engagement in RSB with reports of earlier initiation of sex, having more sexual partners, and failure to use any method of preventing pregnancy than their White peers (CDC, 2016). However, these findings must be considered in light of evidence that racial differences vary by gender and type of RSB.

Research has shown that African American, male adolescents are more likely to initiate sexual intercourse earlier (Upchurch, Levy-Storms, Sucoff, & Aneshensel, 1998), have a greater number of lifetime partners, and use condoms less often than their female counterparts and White adolescents of both genders (CDC, 2016; Dariotis, Sifakis, Pleck, Astone, & Sonenstein, 2011; Ku et al., 2012). Moreover, African American, male

adolescents are more likely than any other group to maintain and increase RSB through young adulthood (Dariotis, et al., 2011), and engage in high-risk sexual behaviors such as having sex with at least 14 partners, having sex with another male, having sex for drugs or money (Halpern et al., 2004), and having sex with a prostitute (E. Johnson et al., 1994). Findings are mixed in regards to African American females. Halpern et al. (2004) found that compared to African American and White adolescents of both genders, African American female adolescents were the least likely group to engage in high-risk sexual behaviors. However, other studies indicate that African American adolescent females are more likely than White females to engage in RSB (Hipwell, Stepp, Chung, Durand, & Keenan, 2012; J. Lee, 2008), but that these differences may be accounted for by differences in family structure, parental education and household income (Lauritsen, 1994; Upchurch et al., 1998). Accordingly, national prevalence reports suggest that high school-aged African American and White females engage in some types of RSB at similar rates (CDC, 2016).

Racial differences have also been found based on type of RSB. Nationally representative studies have consistently found racial differences in number of lifetime sexual partners and condom use: African American adolescents and young adults tend to report more lifetime sexual partners, more sexual partners in the last year, and more concurrent partnerships than their White counterparts (CDC, 2016; Ford, Sohn, & Lepkowski, 2002; Khan, Berger, Wells, & Cleland, 2012; Valois, Oeltmann, Waller, & Hussey, 1999). However, White adolescents and young adults tend to report more inconsistent condom use than African Americans (CDC, 2016; Khan et al., 2012; Murphy, Brecht, Herbeck, & Huang, 2009; Reece et al., 2010). Racial differences in

these behaviors are still observed when stratifying by gender (CDC, 2016; Reece et al., 2010; Valois et al., 1999). These findings suggest that while African American youth may be at greater risk for engaging in RSB in general, the effects of gender and type of RSB should be taken into consideration when examining risk pathways to and disparities in sexual health consequences among African American adolescents.

Given the racial differences observed in general rates of RSB, type of RSB, and the association between RSB and sexual health consequences, it is not surprising that research exploring predictive models of adolescent RSB, such as the impact of substance use on RSB, has also noted racial disparities in risk (e.g., E. Johnson et al., 1994). Moreover, much like the literature noted above, these racial difference may be contingent on the type of substance and RSB examined. The current study aims to address the gaps in this literature by examining the differential influence of alcohol and marijuana use on RSB among African American and White youth. I will first provide detail on the effects of alcohol and marijuana use on RSB among youth. Second, I will highlight findings on racial differences in the prevalence of these two substances and their relationship with RSB among African American and White youth. Lastly, I will summarize gaps in the literature on this risk pathway as a function of race and will provide hypotheses for the current study.

1.1 Substance Use and RSB Risk

Substance use has been identified as a consistent correlate of adolescent RSB, including earlier age at first intercourse, condom use, number of sexual partners, and

drinking before intercourse (e.g., Fortenberry, 1995). For example, 21% of sexually active high school students report using alcohol or drugs before last engaging in sexual intercourse (CDC, 2016). One hypothesis for this strong relationship is that substance use and RSB share a common influence. As such, RSB and substance use have frequently been studied in the context of Problem Behavior Syndrome (Donovan & Jessor, 1985), which says that the two should covary overtime. However, more recent research has shown that early-adolescent substance use predicts increased RSB in young adulthood, offering a second hypothesis that substance use is a mechanism by which adolescent RSB emerges (Guo et al., 2002; Hipwell et al., 2012).

Adolescent alcohol use in particular has been found to predict RSB in concurrent and prospective research studies. Alcohol use is linked to greater numbers of sexual partners, condom nonuse, and sex with casual partners among adolescents and young adults (Brookmeyer & Henrich, 2009; Cooper, 2002; Fortenberry, 1995). Research also indicates that early adolescent alcohol use and increasing alcohol use over time predicts increased RSB in later adolescence and young adulthood (Brookmeyer & Henrich, 2009), even after controlling for early sexual behavior (Guo et al., 2002; Hipwell et al., 2012; Stueve & O'Donnell, 2005), conduct problems, and impulsivity (Hipwell et al., 2012).

Although studied less than alcohol use, adolescent marijuana use has also been shown to covary with and predict RSB. Lifetime use of marijuana, age of onset of marijuana use and frequency of marijuana use are associated with ever having sexual intercourse, having an increased number of sexual partners and condom nonuse among high school-aged youth (Lowry et al., 1994; Shrier, Emans, Woods, & DuRant, 1997). Moreover, marijuana use at a young age has been more strongly linked to subsequent

sexual initiation than alcohol use at a young age (Mott & Haurin, 1988). Prospectively, early adolescent marijuana use has been shown to predict sexual debut within a year (Mott & Haurin, 1988) and increased RSB in early adulthood (Guo et al., 2002). At the event level of analysis (i.e., use prior to an event of sexual intercourse), adolescent marijuana use is also associated with decreased likelihood of condom use and has been shown to predict condom nonuse above the effect of alcohol use among high-risk adolescents (Hendershot, Magnan, & Bryan, 2010).

1.2 Racial Differences in Alcohol and Marijuana Use

Although substance use is a strong contributor to RSB in diverse adolescent populations, marked racial differences exist in the prevalence of substance use among adolescents. Regarding alcohol use, African American youth not only report lower levels of use, but also begin drinking later (Catalano et al., 1993; P. B. Johnson, Richter, Kleber, McLellan, & Carise, 2005), engage in less heavy drinking (Bachman et al., 1991; Johnston et al., 2014b; Swendsen et al., 2012; Wallace, Bachman, et al., 2003), show slower increases in drinking rates and quantity throughout adolescence (Johnston et al., 2014b; Swendsen et al., 2012; Warheit, Vega, Khoury, & Gil, 1996), and report higher rates of total abstinence than their White counterparts (Bachman et al., 1991; Wallace, Brown, Bachman, & Laveist, 2003). A recent national survey of youth indicated that 44% of White 12th-graders compared to 28% of African American 12th-graders reported using alcohol in the past 30 days (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014a). Moreover, occasions of heavy drinking were much less likely to be reported by

African American (13%) than White 12th-graders (26%; Johnston et al., 2014b). Notably, the CDC's (2016) most recent national survey of risk behaviors among youth found similar rates of binge drinking for all high school grade levels by race: only 11% of African American youth reported binge drinking in the past 30 days compared to 20% of White youth.

Unlike alcohol, for which racial differences in drinking trends have been relatively stable over the last 30 years (Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2016), racial differences in marijuana use have changed over time such that African American youth have gone from the least likely group to the most likely group to use marijuana. As documented by Johnston et al. (2014a, 2014b), from the late 1970s to the mid-1990s African American adolescents demonstrated much lower rates of daily and lifetime marijuana use than their White peers, but their use has risen sharply since then, converging with that of Whites in the early 2010s to achieve slightly higher rates of use than Whites today. Accordingly, the CDC (2016) found that in 2015, African American high-school students were significantly more likely than White students to report lifetime marijuana use, early initiation of marijuana use, and use of marijuana in the past 30 days. Other studies have found no difference in the prevalence of marijuana use for African American and Whites in early adolescence, but instead have found a greater frequency of use and higher rates of increasing use in African Americans, suggesting that such racial differences in marijuana use may emerge in late adolescence and early adulthood (Chen & Jacobson, 2012; Finlay, White, Mun, Cronley, & Lee, 2012; C. Lee, Mun, White, & Rutgers, 2010).

1.3 Racial Differences in Substance Use Risk for RSB

Racial differences have not only been observed in the prevalence of alcohol and marijuana use, but also in the strength and direction of the relationship between substance use and RSB. The most common finding regarding this relationship is that the effect of alcohol use on RSB is found for both races, but is stronger for White than African American youth (Cooper, Peirce, & Huselid, 1994; Khan et al., 2012; Rothman, Wise, Bernstein, & Bernstein, 2009). However, others have found different effects. Hipwell et al. (2012) found an effect for White youth only, such that that emerging patterns of alcohol use in early adolescence predicted later engagement in RSB for White girls, but not for African American girls, whereas Khan et al. (2012) found an opposite effect of race, with history of alcohol use more strongly and consistently predicting more sexual partners and self-reported history of STIs among African Americans than Whites. However, the latter study also found that current alcohol use was associated with inconsistent condom use in Whites but not African Americans, a result consistent with those of the majority of studies examining this relationship. A potential explanation for these somewhat mixed findings may be that racial differences in the relationship between alcohol use and RSB vary based on the type of RSB outcome studied.

To date, no study has examined racial differences in the impact of marijuana use on RSB among adolescents. However, initial evidence suggests that marijuana use may better predict RSB among African Americans than alcohol use. Specifically, evidence that alcohol is not as strong of a predictor for RSB among African American youth as it is in White youth and that substance use, more broadly, contributes to RSB among African

American adolescents above other important predictors of RSB (e.g., Bachanas et al., 2002; Y. Lee, Cintron, & Kocher, 2014) suggests that substances other than alcohol may be more important contributers to RSB risk among African American youth compared to White youth. One such substance may be marijuana, given higher rates of use among African American adolescents compared to their White peers (e.g., CDC, 2016; Johnston et al., 2014b).

To date, no study has examined such racial differences in the impact of marijuana use on RSB; however, this relationship has been examined among African American youth. Among African American adolescents, marijuana use has been associated with RSB when used proximal to sexual intercourse (Ford & Norris, 1994; du Plessis, Holliday, Robillard, & Braithwaite, 2009; Kingree & Betz, 2003). Moreover, early use or an increasing trajectory of use through adolescence has been shown to predict increased engagement in RSB in later adolescence (Brook, Balka, & Whiteman, 1999), indicating a long-term association between marijuana use and RSB in African American youth. Additionally, studies comparing marijuana and alcohol use proximal to sexual intercourse suggest that marijuana use may have stronger effects on RSB among African American youth. For example, in a sample of African American adolescents and young adults, marijuana use with a sexual partner was more strongly associated with RSB at an event of sexual intercourse than alcohol use with a partner (Ford & Norris, 1994). A more recent study by Kingree and Betz (2003) found that African American youth were more likely to use marijuana than alcohol proximal to sexual intercourse and that marijuana use, but not alcohol use, at sexual intercourse was associated with condom nonuse. However, neither of these studies included a comparison group of White youth and

Kingree and Betz's (2003) sample was very restrictive, including only male juvenile detainees.

Thus, given recent trends indicating higher rates of marijuana use among African American youth than their White peers (CDC, 2016; Johnston, 2014a, 2014b) as well as findings suggesting that marijuana use proximal to intercourse is more strongly associated with RSB than alcohol use proximal to intercourse among African American youth (Kingree & Betz, 2003), marijuana use may better explain the relationship between substance use and RSB for African Americans, thus clarifying racial differences in this risk pathway.

1.4 The Current Study

In sum, marijuana use has been associated with RSB in both African American and diverse adolescent samples. However, to date, no study has directly examined whether there are racial differences between African American and White youth in the magnitude or direction of this effect. Additionally, racial differences have not been examined in regard to the incremental predictive utility of marijuana use above alcohol use on RSBs or vice versa. Thus, two sets of mutual hypotheses will be tested to explore the effects of alcohol and marijuana by race at the event- and global-level (i.e., associations between average rates of each behavior) of analysis. First, to explore the differential effects of alcohol and marijuana at the event level, I hypothesize that (1) African American adolescents will use marijuana and experience marijuana intoxication proximal to sexual intercourse more often than White adolescents and that (2) White

adolescents will use alcohol and experience alcohol intoxication proximal to sexual intercourse more often than African American adolescents. Secondly, I hypothesize that race moderates the effects of global alcohol use and marijuana use on adolescent RSB, such that (1) the relationship between alcohol use and RSB is stronger among Whites and (2) the relationship between marijuana use and RSB is stronger among African Americans.

CHAPTER 2. METHODS

2.1 Participants and Setting

A total of 157 adolescents ages 14-19 were recruited from four after-school programs in the Indianapolis metropolitan area. The current study used a subsample of 118 participants who identified their race and ethnicity as either non-Hispanic African American or non-Hispanic White. Of those participants, 113 provided valid responses. These participants were mostly African American males (57.5%), followed by African American females (24.8%), White males (13.3%), and White females (4.4%; see Table 1) The average participant age was 16.05 (*SD* = 1.48). Due to missing data, the sample size varied by analysis conducted. The total sample size for each analysis is noted in the results section.

Table 1. Sample demographics

	African American	White	Total
Male	65	15	80
% within gender	81.3%	18.8%	100.0%
% within race	69.9%	75.0%	70.8%
Female	28	5	33
% within gender	84.8%	15.2%	100.0%
% within race	30.1%	25.0%	29.2%
Total	93	20	113
% total	82.3%	17.7%	100.0%

2.2 Procedures

Recruitment began in October 2015, upon receiving approval from Indiana University's Institutional Review Board, and concluded in June 2016. Passive consent was obtained for participants ages 14-17 via a letter sent home to parents of all students enrolled in the after-school program at each recruitment site. Interested child subjects whose parents did not waive consent elected to participate in the study at least two weeks after the letters had been delivered to parents. Informed consent or assent was received from all participants who participated in the study.

Participants completed questionnaires anonymously at their respective sites via paper and pencil. No identifying information was collected. Members of the research team were present and available to answer any questions subjects had about the questionnaire per standard operating procedures. The questionnaire took approximately 20 minutes to complete and participants were compensated in the form of a $10 Walmart gift card upon completion of the survey. Subjects who chose to terminate the survey before completion were compensated if more than 50% of the survey was completed.

2.3 Measures

2.3.1 RSB

Engagement in RSB was measured using the Scale of Sexual Risk Taking (SSRT; Metzler, Noell, & Biglan, 1992), a 13-item measure developed for and validated with adolescents age 14–17. Items measure past year engagement in two types of RSB:

moderate indicators of risk such as frequency of sex in the last year and nonuse of birth control (e.g. "When you have heterosexual sex [sex with someone of the opposite sex], how often do you use some kind of birth control?"), and strong indicators of risk such as number of sexual partners, nonuse of condoms and history of an STD infection (e.g. "Have you ever had a sexually transmitted disease such as gonorrhea [clap], syphilis, or chlamydia?"). Response formats are mixed and composed of Yes/No, Likert-type and numerical indication, depending on the item. Responses are weighted based on risk level (moderate or high) and summed to form a total scaled score with a minimum score of 0 and no maximum score (as some items require open-ended numerical indication). The forms of RSB that the scale measures were highly interrelated across the three validation samples and composite scores were highly correlated with measures of other problem behaviors, demonstrating support for the scale's construct and convergent validity (Metzler et al., 1992). Additionally, the SSRT has shown acceptable reliability with African American adolescents (French & Neville, 2008).

For the current study, two items regarding frequency of alcohol and drug use proximal to sex were excluded to reduce confounds with measures of substance use. The data showed weak internal consistency of the amended, 11-item SSRT in the current sample ($\alpha = .52$). The high number of zero values (abstainers from sexual intercourse) in this sample contributed to this low reliability estimate, as only 47 valid cases were examined for internal consistency. Additionally, two items were excluded from this analysis due to having zero variance ("Have you ever had sexual intercourse" and "Have you ever had a sexually transmitted disease").

Because the SSRT showed poor internal consistency in the current sample, items of the SSRT were examined as individual outcomes, including frequency of sex in the past year (open-ended numerical indication), number of sexual partners in the past year (open-ended numerical indication), frequency of sex with a casual partner (4-option Likert), and frequency of condom use (5-option Likert). Frequency of condom use was reversed so that higher values represent more inconsistent use. Thus, higher values on all indicators represent greater RSB.

2.3.2 Alcohol Use

Alcohol use was measured using a single item measuring frequency of alcohol use in the last year from the Monitoring the Future Study (National Institute on Drug Abuse [NIDA], 2010): "On how many occasions have you had alcoholic beverages to drink – more than just a few sips – during the last 12 months?" Responses were scored on a 7-point Likert scale ranging from 0 ("0") to 6 ("40 or more").

2.3.3 Marijuana Use

Marijuana use was also measured using a similar item measuring frequency of marijuana use in the last year from the Monitoring the Future Study (NIDA, 2010). This item was scored on an identical 7-point Likert scale.

2.3.4 Substance Use at Sex

Frequency of alcohol and marijuana use before sexual intercourse were measured using a single item for each with responses on a five-point Likert scale (never = 1 to

always = 5). Alcohol and marijuana use at the last event of sexual intercourse were measured using a single item for each requiring a Yes/No response as were alcohol and marijuana intoxication at the last sexual event (e.g. "Were you drunk/high the last time you had sexual intercourse?").

2.3.5 Careless Responding

Three "bogus" items placed throughout the questionnaire assessed careless responding. One item followed the demographic questions ("I understand at least one word in English), one followed the SSRT ("I have never brushed my teeth") and one followed a measure unrelated to the current study ("I have been to every country in the world"). Responses on the first two bogus items were Yes/No, with the inappropriate response coded as invalid and data for these participants was removed as determined a priori. Responses to the last bogus item ranged from 1 (strongly disagree) to 6 (strongly agree). Participants with responses ranging from 4 to 6 were coded as invalid and their data was also removed.

2.4 Data Analyses

2.4.1 Event-level Hypotheses

Only participants who reported sexual intercourse in the last year were examined to test the event-level hypotheses. As both measures of frequency of substance use at sex were positively skewed, nonparametric tests were used to examine event-level hypotheses. Thus, to test the hypotheses that White adolescents are more likely to use

alcohol proximal to sexual intercourse than African Americans and that African American adolescents are more likely to use marijuana proximal to intercourse than Whites, two Mann Whitney *U* tests were performed with race as the independent variable and frequency of alcohol use or marijuana use proximal to intercourse as the dependent variable. As gender and race are thought to interact to predict risky sexual behavior, Kruskal-Wallis tests were also used to examine differences in race by gender categories.

These hypotheses were also explored at the single-event level (examining use or intoxication at last incident of sex) using chi-squared tests of independence with race as the independent variable for each and alcohol use, marijuana use, alcohol intoxication and marijuana intoxication at last sexual event as the respective dependent variables. Chi-squared tests of independence were also used to examine differences in race by gender categories.

2.4.2 Global-level Hypotheses

To test the primary hypothesis that race moderates the effects of both alcohol use and marijuana use on adolescent RSB, Poisson regression analyses were performed to model count variables. This was most appropriate for two of the dependent variables—frequency of sex and number of sexual partners—which were count variables in which zero values represented abstainers. Thus, only cases greater than zero were included in Poisson analyses predicting frequency of sex and number of partners.

The other two outcome variables—frequency of condom nonuse and frequency of casual sex—were measured on Likert-type scales. However, these latter two variables were also treated as count variables because they demonstrated positively skewed

distributions and overdispersion (larger variances than means). Poisson regression for count data assumes the mean and variance of the outcome are equal (Horton, Kim, & Saitz, 2007), and these two dependent variables exceeded this restriction by having larger variance than means, due in part to large numbers of zero values (72.6% and 80.0% respectively). Such data are referred to as "zero-inflated" (Karazsia & van Dulmen, 2008). Because zero values on these variables could represent abstainers from sex, or sexually active adolescents who refrained from the behavior of interest, a zero-inflated Poisson (ZIP) regression analyses was deemed most appropriate to examine the outcomes of condom nonuse and casual sex.

ZIP models simultaneously estimate two regression equations: the first is a logistic regression model predicting a subpopulation of adolescents who are unable to receive scores other than zero (i.e., abstainers) and the second is a Poisson regression model predicting the number of times the behavior of interest occurs among the subpopulation of adolescents who can receive scores of zero and above (i.e., sexually active adolescents as estimated by the ZIP model).

For these analyses, the Poisson models and count models in the ZIP regression were predicted by age, gender, recruitment site, race, marijuana use, alcohol use, and the interaction between race and use of the substance of interest. Zero-inflated models were predicted by gender, age, and lifetime use of alcohol or marijuana (dichotomized), based on research demonstrating earlier initiation of sexual activity based on these factors (Caminis, Henrich, Ruchkin, Schwab-Stone, & Martin, 2007; Mott & Haurin, 1988).

CHAPTER 3. RESULTS

3.1 Preliminary Analyses

Substance use and RSB outcomes were dichotomized to compare base rates in the current sample with those reported in the most recent national samples (CDC, 2016; Center for Behavioral Health Statistics and Quality, 2015). Prevalence statistics revealed that base rates of substance use and RSB in the current sample were higher than or equivalent to those reported by nationally representative surveys (see Table 2). Data were screened for univariate and bivariate outliers. Two outliers that were more than three standard deviations from the mean were excluded from frequency of sex. No outliers were identified on any other outcome variables.

Variables were also examined for differences in gender, age, and recruitment site. As the distributions of the variables of interest were positively skewed, nonparametric tests were used to examine these demographic differences. With regard to the event-level variables, Mann-Whitney tests revealed no gender differences in frequency of alcohol or marijuana use at sex. Further, Pearson correlations and Kruskal-Wallis tests revealed no differences in substance use at sex based on age or recruitment site, respectively. Further, no demographic differences were found in substance use or intoxication at last sexual intercourse.

Table 2. Prevalence rates of substance use and RSB in current and national samples

	Current Sample (n, %)			National (%)		
	Total	African American	White	Total	African American	White
Alcohol use	29 (25.7)	22 (23.7)	7 (35.0)	(24.0)	(18.7)	(26.7)
Marijuana use	32 (29.2)	27 (30.1)	5 (25.0)	(13.1)	(13.6)	(13.2)
Sex ever	59 (52.2)	52 (55.9)	7 (35.0)	(41.2)	(48.5)	(39.9)
Partners (>=4)*	16 (28.6)	15 (42.0)	1 (16.7)	(11.5)	(19.0)	(9.9)
Condom use^	31 (52.5)	27 (51.9)	4 (57.1)	(43.1)	(36.6)	(43.2)
Casual sex*	22 (39.3)	20 (44.2)	2 (28.6)	-	-	-
Substance use at sex *	10 (17.5)	8 (16.0)	2 (28.6)	(20.6)	(21.8)	(19.3)

Note. National statistics for substance use were derived from Center for Behavioral Health Statistics and Quality (2015). National statistics for RSBs were derived from CDC (2016).
*****Rates among sexually active adolescents only
^Measurement in the current sample is not equivalent to that of the national survey

With regard to the global variables, Mann-Whitney tests revealed that boys reported significantly greater frequency of sex, N = 108 U = 716.00, p = .001, number of partners, N = 112, U = 917.50, p = .008, and frequency of casual sex, N = 110, U = 932.50, p = .005; however, there were no gender differences in frequency of condom nonuse. Pearson correlations revealed that age was significantly correlated with frequency of sex, r = .39, p < .001, number of partners, r = .29, p = .002, and condom nonuse, r = .19, p = .047, but not casual sex. Kruskal-Wallis tests revealed no differences in RSB outcomes based on recruitment site.

3.2 Event-level Hypotheses

Mann-Whitney tests revealed no racial differences in the frequency of alcohol use at sex, N = 56, $U = 144.50$, $p = .800$, or marijuana use at sex, N = 56, $U = 159.50$, $p = .687$. Further, Kruskal-Wallis tests revealed no differences in race by gender category in the frequency of alcohol use, $x^2(3, N = 56) = 2.76$, $p = .430$, or marijuana use at sex, $x^2(3, N = 56) = 1.55$, $p = .670$.

At the single-event level, I used the Yates Continuity of Correction statistic for chi-squared tests to examine differences in substance use and intoxication at last sex due to small cell sizes. Analyses revealed no racial differences in alcohol use at last sex, $x^2(1, N = 57) = .06$, $p = .812$, or marijuana use at sex, $x^2 (1, N = 57) < .001$, $p = 1.000$. Race by gender differences were not tested as no females of either race endorsed alcohol use at last sex, and no White females endorsed marijuana use at last sex.

Similarly, Yates Continuity of Correction statistic was used to examine race differences in alcohol intoxication as no African American adolescents endorsed alcohol intoxication at last sex and rates of marijuana use at last sex were also low. Results revealed no racial differences in alcohol intoxication at last sex, $x^2(1, N = 56) = 1.34$, $p = .246$, or marijuana intoxication at last sex, $x^2(1, N = 51) = 1.01$, $p = .316$. Race by gender differences were not tested due to several cell sizes equal to zero. See Table 3 for means and base rates of all alcohol and marijuana at sex indicators by race.

Table 3. Mean and base rates of substance use at sex by race

	Mean (SD) or Frequency (%)		
	African American	White	Total
Alcohol at sex frequency	1.22 (.68)	1.67 (.41)	1.21 (.65)
Marijuana at sex frequency	1.35 (.80)	1.43 (.79)	1.36 (.80)
Alcohol at last sex	2 (4.0%)	1 (14.3%)	3 (5.3%)
Marijuana at last sex	6 (12.0%)	1 (14.3%)	7 (12.3%)
Alcohol intoxication at last sex	0 (0.0%)	1 (14.3%)	1 (1.8%)
Marijuana intoxication at last sex	4 (8.0%)	2 (28.6%)	6 (10.5%)

Note. N=56

3.3 Global-level Hypotheses

Substance use predictors and indicators of RSB were examined for differences based on race. Mann-Whitney tests revealed no significant race differences in alcohol or marijuana use, or any indicators of RSB. See Table 4 for descriptive statistics by race. Global variables were also examined for zero-order correlations. Frequency of alcohol use was significantly related to condom nonuse and casual sex, but not frequency of sex or number of partners (see Table 5). Marijuana use was significantly related only to condom nonuse (see Table 5). However, marijuana use had correlations of similar magnitude with frequency of sex and number of partners, which were not significant.

Table 4. Descriptive statistics for global variables by race

	N	Mean (SD) or Median (Range)			p-value
		Total	African American	White	
Alcohol use	113	.49 (1.09)	.48 (1.15)	.50 (.76)	.345
Marijuana use	112	.86 (1.74)	.96 (1.87)	.40 (1.39)	.504
Sex frequency	52	7 (1-30)	8 (1-30)	4 (2-12)	.454
Number of partners	56	2 (1-7)	2 (1-7)	1 (1-4)	.183
Condom nonuse	113	0 (0-4)	0 (0-4)	0 (0-4)	.508
Casual sex	110	0 (0-3)	0 (0-3)	0 (0-2)	.207

Note. P-values are based on z-values derived from Mann-Whitney tests.

Table 5. Correlations of global variables

	2	3	4	5	6
1. Alcohol Use	.41***	.17	.12	.23*	.33***
2. Marijuana Use		.20	.20	.20*	.13
3. Sex frequency			.66***	.09	.18
4. Number of partners				.03	.37**
5. Condom nonuse					.21*
6. Casual Sex					

Note. *$p < .05$, **$p < .01$, ***$p < .001$

3.3.1 Alcohol Use and RSB

Results of Poisson regression analyses revealed that after controlling for age, gender, recruitment site, and marijuana use, race and frequency of alcohol use did not significantly interact to predict frequency of sex, n = 51, b = .12, x^2 = .23, p = .631, or number of partners, n = 55, b = -.25, x^2 = .44, p = .506. Similarly, ZIP regression analyses revealed that race did not interact with alcohol use to predict condom nonuse, n = 112, b = -.36, x^2 = .65, p = .421, or frequency of casual sex, n = 109, b = .29, x^2 = .14, p = .711 (see Table 6 for complete regression results). However, plotting the adjusted effects of alcohol use on RSB outcomes by race revealed some patterns in support of the current hypothesis. White adolescents with high frequencies of drinking in the past year were estimated to report a greater number of sex partners (Figure 1B) and more inconsistent condom use than their African American peers with similarly high levels of drinking (Figure 1C). However, effects plots revealed the opposite pattern of racial differences for frequency of sex: at high levels of alcohol use, White adolescents were estimated to have sex less frequently than African American adolescents (Figure 1A). Notably, these plots demonstrated that indicators of RSB remained stable regardless of level of alcohol use among African American adolescents.

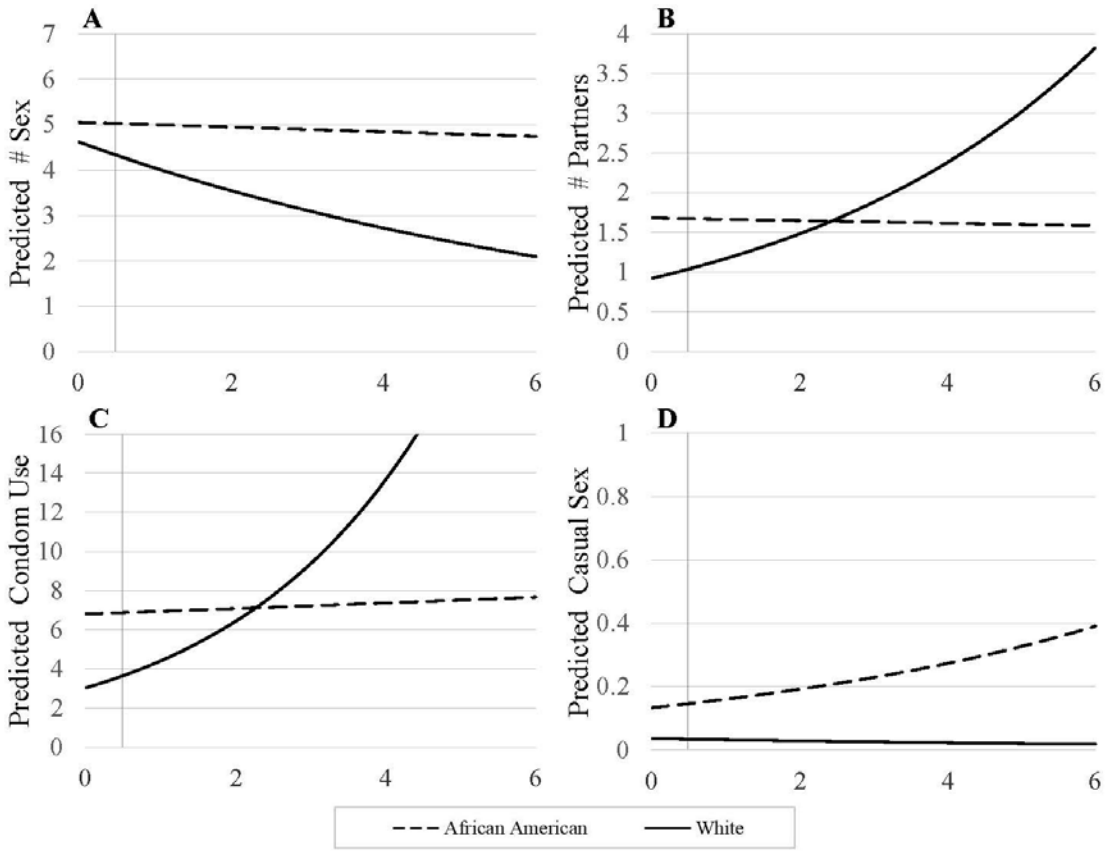

Figure 1. Effects plots predicting RSB from frequency of alcohol use by race

3.3.2 Marijuana Use and RSB

Results of Poisson regression analyses revealed that race and frequency of marijuana use did not significantly interact to predict frequency of sex, n = 51, b = .12, x^2 = .23, p = .961, or number of partners, n = 55, b = -.25, x^2 = .44, p = .561. ZIP regression analyses also revealed no significant interaction effect in the prediction of condom nonuse, n = 112, b = .07, x^2 = .03, p =.871, or frequency of casual sex, n = 109, b = -.02, x^2 < .001, p = .973 (see Table 7 for regression results). Plots of the adjusted effects estimated by these models supported the non-significant results: there appeared to be no racial differences in the effect of marijuana use on any RSB indicator (Figure 2). Further,

Table 6. Results of Poisson and zero-inflated Poisson regression analyses predicting RSB indicators from alcohol use

	# Sex		# Partners		Condom Nonuse				Casual Sex			
					Zero		Count		Zero		Count	
	b	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI
Age	.18***	.11-.26	-.05	-.08-.18	-.34	-.73-.06	-.16	-.42-.10	-.48	-1.20-.25	-.27^	-.54-.01
Gender	.59**	.20-.98	.54*	.03-1.06	-.60	-1.70-.50	-.85*	-1.68-(-.03)	-.57	-5.52-4.38	2.41	-.59-5.41
Use ever	-	-	-	-	.98^	-.03-1.99	-	-	1.59	-.24-3.42	-	-
Marijuana	.05^	.00-.10	.06	-.03-.15	-	-	-.01	-.18-.16	-	-	-.02	.23-.19
Race	.09	-.62-.80	.60	-.41-1.61	-	-	.81	-.77-2.39	-	-	1.29	-.46-3.05
Alcohol	-.13	-.63-.36	.24	-.48-.96	-	-	.38	-.43-1.18	-	-	-.12	-1.67-1.44
Race X Alcohol	.12	-.38-.62	-.25	-.97-.48	-	-	-.36	-1.23-.51	-	-	.29	-1.26-1.85

Note. Recruitment site (n = 4) was included in the model as a covariate but is not depicted here for simplicity. Race was coded 0 (White) and 1 (African American). Gender was coded 0 (Female) and 1 (Male).
^$p < .06$, *$p < .05$, *$p < .01$, *** $p < .001$

there appeared to be little or no effect of marijuana use on RSB indicators regardless of race, with the exception of condom nonuse. Contrary to expectations and to the preliminary positive correlation between marijuana use and condom nonuse, a plot of the effects predicted by ZIP regression revealed that condom use was more consistent at high levels of use compared to no use, particularly among African American youth (Figure 2C).

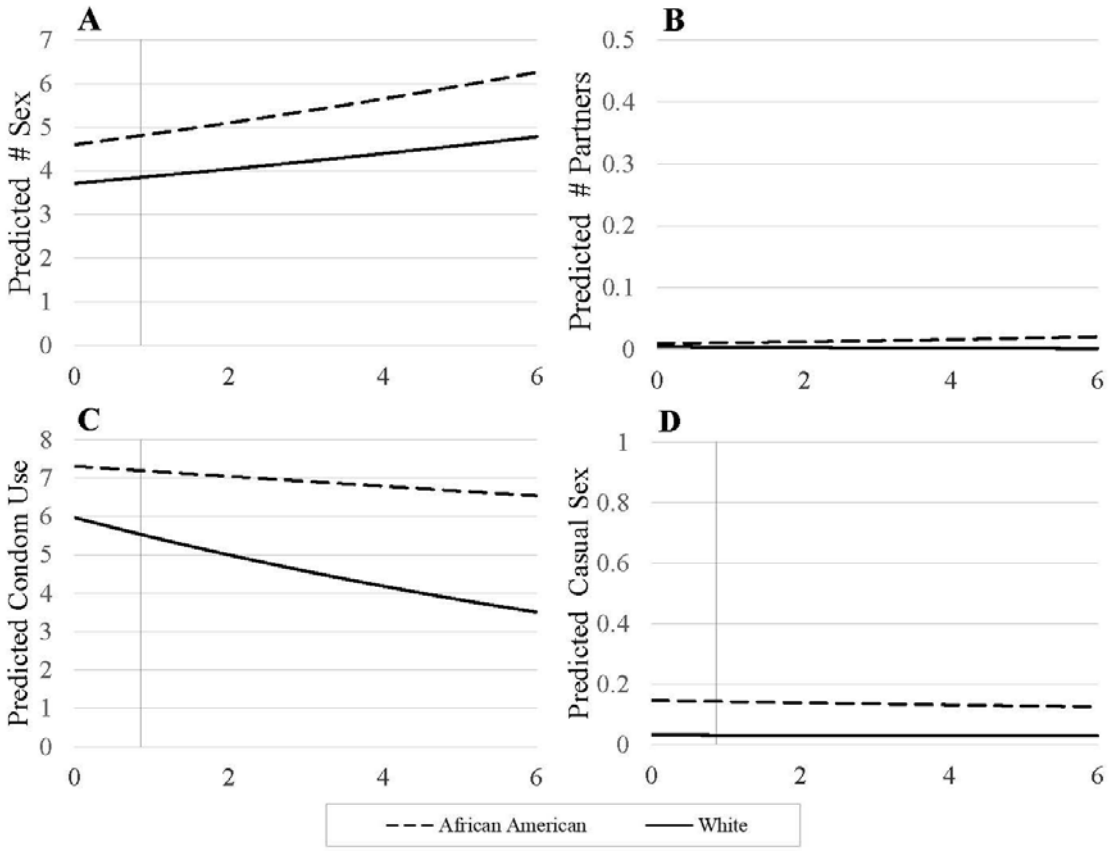

Figure 2. Effects plots predicting RSB from frequency of marijuana use by race

Table 7. Results of Poisson and zero-inflated Poisson regression analyses predicting RSB indicators from marijuana use

	# Sex		# Partners		Condom Nonuse				Casual Sex			
					Zero		Count		Zero		Count	
	b	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI	*b*	95% CI
Age	.18***	.10-.27	.05	-.08-.19	-.37	-.78-.04	-.22	-.52-.08	-.47	-1.20-.25	-.26	-.53-.02
Gender	.61**	.23-.99	.52*	.01-1.04	-.60	-1.71-.51	-.89*	-1.72-(-.06)	-.57	-5.54-4.43	2.44	-.55-5.42
Use ever	-	-	-	-	1.03*	.02-2.03	-	-	1.58	-.25-3.41	-	-
Alcohol	-.01	-.09-.06	-.01	-.14-.13	-	-	.06	-.22-.35	-	-	.17	-.10
Race	.21	-.35-.78	.54	-.39-1.47	-	-	.20	-.1.45-1.86	-	-	1.53	-.19-3.25
Marijuana	.04	-.33-.41	.22	-.33-.77	-	-	-.09	-.84-.66	-	-	-.01	-.95-.94
Race x Marijuana	.01	-.36-.38	-.17	-.72-.39	-	-	-.07	-.78-.92	-	-	-.02	-.97-.94

Note. Recruitment site (n = 4) was included in the model as a covariate but is not depicted here for simplicity. Race was coded 0 (White) and 1 (African American). Gender was coded 0 (Female) and 1 (Male).
*p <.05, *p< .01, *** p< .001

CHAPTER 4. DISCUSSION

Substance use, particularly alcohol and marijuana use, is a strong predictor of RSB in adolescence, but this relationship has been shown to differ by race. Researchers have shown that alcohol use more strongly predicts RSB among White adolescents than their African American counterparts. However, no research has examined whether the relationship between marijuana use and RSB differs by race. Given increasing rates of marijuana use among African American youth and initial findings that African Americans may be more likely to use marijuana proximal to sex, the current study examined whether adolescent alcohol use and marijuana use were differentially related to RSB by race at the event and global levels of analysis, controlling for the other substance. Unfortunately, all hypotheses were unsupported. No racial differences were observed in the impact of alcohol or marijuana use on event-level RSB indicators (i.e., frequency of alcohol or marijuana use at sex, alcohol or marijuana use at last sex, or alcohol or marijuana intoxication at last sex) or global-level indicators (i.e., frequency of sex, number of partners, frequency of condom nonuse, and frequency of casual sex).

Thus, the current research contradicts previous evidence that African American adolescents are less likely to use alcohol proximal to sexual intercourse than White adolescents (Cooper et al., 1994), as well as evidence that alcohol use is associated with increased RSB in White adolescents, but not African American adolescents (Hipwell et

al., 2012). However, the absence of an effect may have been due to a number of methodological and recruitment limitations.

Many characteristics of the study's methodology limited the ability to detect effects. Firstly, modeling RSB indicators using Poisson regression analyses was a more conservative approach than linear regression due to the ordinal, overdispersed, and positively skewed nature of the data. Thus, although Poisson models may have prevented Type I error, they also provided lower power than linear models would have. Taken together with the relatively high rates of dichotomized RSB indicators compared to national estimates, the current study may have had improved power to detect likelihood of RSB had I dichotomized RSB indicators and performed analyses using logistic regression.

Secondly, the low variability and skewed distributions of the variables of interest may have also contributed to measurement errors that reduced power to detect effects. Although rates of RSB indicators appeared equivalent to or higher than those documented by nationally representative surveys of adolescents, only 56 participants in the current study reported sexual intercourse in the past year and far fewer reported specific RSB outcomes. This limitation of the current study not only contributed to decreased power due to decreased variability in the outcome of interest, but also contributed to the SSRT's poor reliability. Although other studies of similar sample size and participant age range have found adequate internal consistency for the SSRT (Metzler et al., 1992; Jones & Furman, 2011), reliability for this scale in the current sample was limited. It is speculated that the low reliability was due in part to the lack of normality and variability in item endorsement, as two items were excluded in the estimate because they were not endorsed

by any participants and over 50% of the total sample was excluded because they scored zero on the SSRT. Due to limited endorsement of study items, it is also plausible that the individual items of the SSRT were unreliable. The impact of these limitations may have been reduced had the current study recruited a sample of adolescents at high risk for RSB (i.e., adolescents receiving treatment for an STD) or included sex in the past year as an inclusion criterion.

One explanation for the discrepancy between reliability estimates of the current study and similar studies is differences in recruitment setting. Whereas other studies examining the SSRT among adolescents have recruited more generally from high schools and households reporting a child of adolescent age (Metzler et al., 1992; Jones & Furman, 2011), the current study recruited adolescents exclusively from after school programs such as those provided by the Boys and Girls Clubs of America. Participation in Boys and Girls Clubs and other after-school activities have been shown to protect against risky behaviors such as substance use and delinquency (Anderson-Butcher, Newsome, & Ferrari, 2003; Mahatmya & Lohman, 2011). Thus, as these after-school programs were tuition-free, located in urban settings, and predominantly male and African American in enrollment, it may be that although the adolescents recruited for the current study were at higher risk for ever engaging in substance use and RSB than the general population, they may have experienced protection from current engagement in risky behaviors due to their involvement in the after-school program.

The current study's recruitment setting may have also contributed to low rates of substance use at sex in the current sample. Research has shown that greater parental monitoring, particularly direct monitoring through the presence of an adult, is associated

with less RSB, marijuana and alcohol use at the global and event levels of analysis (Baker et al., 1999; DiClemente et al., 2001). Thus, the direct adult monitoring provided by an afterschool program may have protected this sample from recent events of substance use proximal to sex. Finally, participants in the study were primarily male and African American, limiting power to detect racial differences and limiting the generalizability of these findings. Thus, future studies interested in the relationship between substance use and RSB may consider recruiting from high schools or census data in order to obtain a more heterogeneous sample with varied levels of risk and protective factors in order to ensure increased variability in substance use and RSB, and recruit a more proportionate sample based on race and gender. Alternatively, researchers interested in adolescents at high risk for these behaviors may consider recruiting from medical clinics or treatment centers to ensure increased variability in outcomes.

As the current sample was predominately African American, post-hoc analyses were conducted among this subgroup of participants to examine whether my findings would support those of Hipwell et al. (2012), who found that alcohol use was not predictive of RSB for African American adolescents. Secondary analysis revealed that alcohol use did not predict any indicators of RSB among African American youth. Taken together with significant positive correlations between alcohol use and RSB (condom nonuse and casual sex) in the greater sample, it is possible that with a larger sample, racial differences may be observed, in accordance with Hipwell et al. (2012) and others (e.g., Cooper et al., 1994; Khan et al., 2012; Rothman et al., 2009).

Post-hoc analyses among the subgroup of African American participants also examined the impact of each substance over the other in the prediction of global

indicators of RSB. Findings indicated that although alcohol use did not predict any RSB indicators above the effect of marijuana use, marijuana use significantly predicted frequency of sex among African American youth above and beyond the effects of alcohol use after adjusting for age, gender, and recruitment site, N = 48, b = .06, x^2 = 5.70, p = .017. This finding supports that of Kingree & Betz (2003), who found that marijuana use had a greater impact than alcohol use on event-level RSB among African American youth. It also supports research among a sample of predominantly racial/ethnic minority adolescents, which reported that frequency of marijuana use predicted a higher frequency of marijuana use before sex and higher rates of condom nonuse after controlling for frequency of alcohol use (Hendershot et al., 2010). Finally, post-hoc analyses examining only African American participants were performed at the event level to examine whether results would directly support those of Kingree & Betz (2003). These analyses examined differences in the likelihood of alcohol or marijuana use at sexual intercourse within the subsample of African Americans. In contrast to the findings of Kingree & Betz (2003) results revealed that African American youth were no more likely to use one substance proximal to intercourse over the other. However, this finding must be interpreted considering the low cell sizes based on low rates of both alcohol and marijuana use at sex, as well as the conservative nature of the Yates-corrected chi-square statistic used due to these low cell sizes (Haviland, 1990).

Considering the limitations of sample size and low variability in RSBs, an important contribution of the current study compared to previous studies examining racial differences in the relationship between adolescent alcohol use and RSB is that the current study controlled for marijuana use. Although the primary hypothesis that race would

interact with alcohol use to predict RSB was not supported, marijuana use did predict an RSB indicator (frequency of sex) above and beyond the contributions of the other predictors. Additionally, its effect on frequency of sex was found above and beyond that of alcohol, suggesting that it may be an early risk factor for later RSB. Among adults, the association between substance use and unprotected intercourse has been shown to be primarily driven by increased frequency of sexual intercourse (Weir & Latkin, 2014; Weir, 2015), suggesting that frequency of sex poses risk not only for other RSB, but also for sexual transmission of STDs (Weir, 2015). Among adolescents, marijuana use has been shown to prospectively predict increased risk of STD diagnoses in emerging adulthood (Hendershot et al., 2010). Taken together, this research suggests that marijuana use in adolescence may increase subsequent risk for sexual transmission of STDs independent of other RSB due to frequency of sexual intercourse; further, the current findings suggest that this risk may be particularly robust among African American adolescents.

Thus, the current results suggest that marijuana use should be considered as a covariate in future studies examining the relationship between alcohol use and RSB. They also suggest that marijuana use may account for previous findings suggesting a robust relationship between substance use and RSB among African American samples (e.g., Bachanas et al., 2002). For example, Elkington, Bauermeister, and Zimmerman (2011) found that alcohol and marijuana use prospectively predicted RSB among high school-aged African Americans; however, like Bachanas et al. (2002), the authors collapsed alcohol and marijuana use, and did not examine the individual contributions of each substance. Future research examining the unique contribution of each of these

substances to RSB among African American youth is warranted to better understand risk for STIs and other poor sexual health outcomes among this vulnerable population.

4.1 Limitations

The findings of this study must be considered in light of its limitations, many of which were discussed in detail above. First, as mentioned above, several characteristics of the study's sample posed limitations on the statistical analyses and results. Although analyses of racial differences were performed, the small sample size, low reliability of RSB indicators, and low variability in the variables of interest due to the protective effect of the recruitment sites did not provide appropriate power to detect differences based on these analyses. Disproportionate subsamples of White and African American adolescents further compounded the sample size limitation, limiting power to detect group differences and limiting the ability to draw conclusions from effects plots, particularly among Whites adolescents, whose enrollment in the current study was very low. The low enrollment of White adolescents in particular precluded me from examining the hypotheses separately among this subsample as I did with African American adolescents. However, the disproportionate recruitment and enrollment of African American participants was likely due to recruiting from urban afterschool programs, rather than an enrollment bias, as the racial demographics of this sample did not appear to differ greatly from that of the recruitment sites involved in the study. A second limitation was the study's cross-sectional design, which precluded me from establishing the directional nature of the relationship between substance use and RSB. That is, I cannot

determine whether RSB and substance use covary overtime or whether one precedes the other. Thirdly, the study also excludes other known risk factors for adolescent RSB such as delinquency, family and peer influences, and STI knowledge (e.g., Doljanac & Zimmerman, 1998; Y. Lee et al., 2014). Fourth, this study relied exclusively on self-report questionnaires. Although there is evidence that substance use and risky sex can be reliably assessed among adolescents, particularly when assessed anonymously (e.g., Hearn, O'Sullivan, & Dudley, 2003; Sieving et al., 2005), it is possible that participants may not have responded truthfully because of the sensitive nature of the questions. Finally, this study only examined racial differences in the relationship between substance use and RSB in African American and White adolescents; however, racial disparities in rates of RSB and substance use, and negative health consequences associated with these behaviors, exist among other racial and ethnic minority groups, particularly Hispanic/Latino and American Indian youth (CDC, 2014b, 2014d, 2016; Faryna & Morales, 2000). Future research should also investigate the relationships between alcohol and marijuana use and RSB among Hispanic and American Indian youth.

4.2 Future Directions

Notably, prospective research published since the inception of this study has found racial differences in the relationship between alcohol use and RSB throughout development. O'Hara and Cooper (2015) found that adolescent alcohol use predicted increased RSB both at baseline and into adulthood among Whites, but not among African Americans after controlling for age, gender and age of sexual debut. However,

researchers have yet to explore the effect of race in the relationship between marijuana use and RSB despite a recent surge in rates of daily marijuana use and declining rates of perceived harm and disapproval among adolescents (Miech et al., 2016). Moreover, like many of the studies previously discussed, O'Hara and Cooper (2015) did not control for other substance use, particularly marijuana use, in their study.

Although the present study found no racial differences in marijuana use proximal to sex or in the relationship between marijuana use and RSB, its sample size and methodology provided severely limited power to detect such effects. It is possible that with the addition of data from participants recruited from more general settings, results may have supported the study's hypotheses and previous research indicating racial differences in the relationship between substance use and RSB. However it is also possible that the racial differences previously documented in the link between alcohol use and RSB are discrete, and not better explained by the inclusion of marijuana as I hypothesized. Finally, it is plausible that there is no effect of race on the relationship between substance use and RSB, as the current null findings suggest.

Despite methodological limitations, I found that marijuana use, but not alcohol use predicted frequency of sex, after adjusting for alcohol use, in this largely African American sample. Taken together with O'Hara and Cooper's (2015) findings, which continue to support the notion that the relationship between drinking and RSB differs by race among adolescents, future research should focus on 1) examining racial differences in the link between marijuana use and RSB and 2) examining mechanisms that account for the relationships between adolescent substance use, and RSB and related

consequences among African Americans, who continue to disproportionately face such consequences.

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