RISKY SEXUAL BEHAVIOR AND SUBSTANCE USE AMONG ADOLESCENTS:
A META-ANALYSIS

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ABSTRACT

Adolescents' participation in risky sexual behavior has continued to grow over the past 15 years, as they account for approximately 25% of all new STD cases (⁴). These elevated rates of STD infection have created a sense of urgency in the need to understand the predictors of risky sexual behavior (RSB). Due to its disinhibiting effects on decision-making, the influence of substance use on sexual behavior has been the focus of research for at least two decades. While substance use and risky sexual behavior are among the top predictors of HIV infection in adults, less is known about the moderators of the relation between these two variables across studies amongst adolescents. In response to this crisis, the purpose of this meta-analysis is to examine the strength of the relation between risky sexual behavior and substance use among adolescents and elucidate the gaps in the literature. It will also enable researchers to generate hypotheses that will guide empirical investigations. We employed a multiple pathways approach to investigate the moderators (i.e., gender, type of drug) of the relation between adolescent substance use and risky sexual behavior. Results indicated that gender, type of drug, and level of analysis were significant moderators of the relation between RSB and substance use. Implications and suggestions for future directions will be discussed.

DEDICATION

This dissertation is dedicated to the family members and close friends who offered their support and words of encouragement during this very important time in my life. I am especially thankful for my mother, Mary, father, Vincent, and grandmother, Clara. Hearing how proud they were of me was invaluable.

LIST OF ABBREVIATIONS AND SYMBOLS

α	Cronbach's index of internal consistency
df	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
F	Fisher's F ratio: A ration of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
Q	a statistic used for multiple significance testing across a number of means
r	Pearson product-moment correlation
t	Computed value of t test
$<$	Less than
$=$	Equal to

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INTRODUCTION

Over the past ten years, we have witnessed significant changes in adolescent sexual behavior. Specifically, there has been an overall decline in early onset sexual activity and an overall increase in contraceptive use (Brener, Kann, Lowry, & Wechler, 2006). Despite these improvements, adolescent risky sexual behavior (RSB) remains a significant public health challenge. Rates of sexually transmitted infections (STIs) and sexually transmitted diseases (STDs) have continued to grow, reaching epidemic proportions. Adolescents, for example, comprise approximately 50% of all new STI cases (Weinstock, Berman, & Cates, 2004) and of particular concern are the increases in the rates of HIV infection in this group. Since the development of a vaccine or cure for HIV/AIDS remains a remote possibility, researchers and clinicians have focused their efforts on prevention.

In addition to the personal costs of contracting HIV, there is also a substantial societal cost associated with HIV infection. The development of antiretroviral therapy (ART) not only significantly prolonged the lives of individuals infected with HIV, but it also significantly impacted HIV-related medical care costs (Gebo, Chalsson, Folkemer, Bartlett, & Moore, 1999). The life expectancy for individuals in the United States entering ART at the recommended time (CD4 cell count greater than 500 cells/ μ L) is approximately 24.2 years (Schackman et al., 2006). The lifetime costs, most of which are accounted for by the high costs of medications, are approximately \$618,900. HIV infection presents serious repercussions for adolescents, as there are many associated complications, including neurological problems (McArthur, Brew, & Nath, 2005) and cardiovascular disease (Wang, Chai, Yao, & Chen, 2007).

Growth in the rates of STIs and STDs and associated costs of infection have created a sense of urgency in the need to understand the individual and situational factors that increase one's risk for HIV. One such predictor that has been linked to RSB for over 20 years is substance use. Many researchers have identified substance use as a potential causal factor of RSB due to its perceived ability to disinhibit and/or compromise an individual's decision-making capacity (e.g., Yan, Chiu, Stoesen, & Wang, 2007). More specifically, substance use is believed to hinder one's ability to make appropriate decisions and their concurrent use prior to sexual activity might increase the likelihood of unsafe sexual intercourse (Leigh, 1989; Rotheram-Borus, 2000; Rotheram-Borus, O'Keefe, Kracker, & Foo, 2000; Yan et al., 2007). Additional explanations for the reasons why there might be a relation between risky sexual behavior and substance use are presented in the "Theoretical Explanations" section of this document.

While risky sexual behavior and certain forms of substance use are among the top independent predictors of HIV infection, less is known about the nature of the interaction between these two variables. There is a lack of agreement among researchers as to whether there is such a relation and for those who have found evidence of a connection between RSB and substance use, there is a lack of understanding of the conditions under which this relation exists. Furthermore, variations in methodological choices made by researchers have complicated our ability to interpret the results of studies investigating this association. Understanding the proposed association is crucial, as it has the potential to greatly impact the focus of intervention and prevention programs. To address these key concerns, the present study, a meta-analysis, examines the moderators of the relation between risky sexual behavior and substance use among adolescents.

This paper begins with an examination of background literature on adolescent substance use and risky sexual behavior. Next, major theories used to explain the two risk behaviors are presented. The following section discusses previous research examining the relation between the two variables and HIV risk. Subsequent sections provide summaries of potential moderators of the relation between substance use and RSB; provide information on research synthesis and previous reviews/meta-analyses; the purpose of the study and research questions; and provide information on methodology.

Adolescents and substance use

The results of a national survey of high school seniors found that, at least once in their lifetime, 80% reported drinking alcohol, 30% reported binge drinking, and 29% smoked marijuana (Johnston, O'Malley, & Bachman, 2001). More than half of high school seniors surveyed reported being intoxicated at least once in their lifetime, while 20% of their younger peers, 8th graders, reported intoxication at least once in their lifetime (Johnston, O'Malley, Bachman, & Schulenberg, 2006). Approximately 1 in 7 adolescents between 12 and 17 years of age met DSM-IV criteria for substance dependence or abuse (Epstein, 2002). As one might expect, these rates are even higher for criminal offenders, runaways, and homeless adolescents (Gilvarry, 2000). The negative impact of substance use on outcome, along with its potential fatal consequences, has been well documented. Substance use, for example, has been associated with poor academic performance, deviant behavior, substance abuse in adulthood, and job instability (Ammerman, Ott, Tarter, & Blackson, 1999; Gilvarry, 2000; Sloboda, 2002). Moreover, alcohol consumption was a contributing factor in the top three leading causes of death among U.S. adolescents (National Institute on Alcohol Abuse and Alcoholism, 2003).

Factor analyses have shown that risk factors for adolescent substance use can be divided into four categories: a) psychological functioning, b) familial environment, c) social relationships, and d) life stressors. In terms of psychological functioning, substance use and psychological distress (e.g., depression and anxiety) tend to co-occur in adolescence (Angold et al., 1999; Armstrong & Costello, 2002; Kandel et al., 1997). Regarding familial environment, some studies have found that the nature and quality of familial relationships significantly predicts adolescent substance abuse (Brook et al., 2001; Su et al., 1997), with level of parental monitoring determined to be a protective factor (Barnes et al., 2002; Stewart, 2002).

During adolescence, peer relations are particularly important; specifically, the degree to which adolescents believed that their close friends frequently used drugs significantly predicted their onset of marijuana use (Bailey & Hubbard, 1991; Curran et al., 1997; Wills et al., 2001). Psychologically and physically stressful life events (i.e., divorce, victimization, health problems) have been associated with an increasing amount of substance use over time (Wills et al., 2001). Some studies have found that substance use could be predicted among adolescents who witness violence or who were victimized physically and/or sexually (Kirkpatrick et al., 2000; Lanz, 1995).

In sum, it is widely known and accepted that substance use has an overwhelmingly negative influence on adolescent behavior. For the purposes of this investigation, substance use includes alcohol, marijuana, recreational prescription drug use, and hard drugs (i.e., narcotics, hallucinogens, stimulants, and inhalants). The aim of this section was to provide information on the prevalence of adolescent substance use and to elucidate associated risk factors. Despite the abundance of research in this area, there is still much to be learned. In order to design effective prevention programs, we must address the methodological barriers to our understanding of this

negative behavior. One of the most significant barriers is that of measurement variability.

Variations in the measurement of substance use could have a significant impact on the interpretation of study findings. More specifically, lack of consistency in the definition and measurement of drug use across studies could significantly reduce the generalizability of results. This point is explored further in the “Categorical differences between studies” section.

Adolescents and risky sexual behavior

Adolescence is characterized by an increase in risky behavior, desire for autonomy and peer affiliation, and sexual curiosity (St. Lawrence, 1993; Windle, 1994). Such experimental behavior has the potential to be extremely hazardous, as evidenced by the growing rates of HIV and other STDs in this group (Centers for Disease Control, 2005; Irwin, 1993). More than 45% of high school students reported engaging in sexual intercourse, with boys reporting more sexual activity than girls (CDC, 2004). Furthermore, 18% of boys and 11% of girls reported having four or more lifetime sexual partners. Age at first intercourse has been shown to be a risk factor for adolescents, especially among younger females (e.g., Glei, 1999). Specifically, younger female adolescents often report having male sexual partners who are 2 or more years older and the greater the age difference between the adolescent girl and her male partner, the less likely she is to engage in protected intercourse (Glei, 1999). Research has shown that some adolescents are not only initiating intercourse at an early age (between 13 and 16 years of age) and with multiple partners, but they are also failing to consistently and effectively use condoms and contraceptives (CDC, 2000; Lowry et al., 1994; Seidman & Rieder, 1994; Yan et al., 2007).

Similar to studies investigating risk factors for substance use among adolescents, research examining risk and protective factors for adolescent sexual behavior could be divided into the same four categories: psychological functioning, familial environment, peer influence, and life

stressors. Regarding psychological functioning, risky sexual behavior, particularly among gay or bisexual adolescent males, has been related to low self-esteem, and greater levels of reported anxiety and depression (Rotheram-Borus, Rosario, Reid, & Koopman, 1995). In terms of familial environment, greater parental supervision and monitoring are associated with a reduction in teenage sexual activity and experimentation (Kotchick et al., 2001). It is possible that supportive parenting practices encourage personal and interpersonal responsibility thereby decreasing the desire to engage in high-risk behaviors (Pearson, Muller, & Frisco, 2006).

Peer influence could significantly impact adolescent sexual activity, as some teens engage in intercourse to obtain peer and/or partner approval (Brigman & Knox, 1992; Levinson et al., 1995). And finally, life stressors could influence risky behavior as well. Childhood sexual abuse, for example, has been associated with a greater amount of risky sexual behavior, as well as other problem behaviors during adolescence and adulthood (Raj & Verghese, 2000). Additionally, some studies have linked risky sexual behavior and neighborhood disadvantage (Baumer & South, 2001; Leventhal & Brooks-Gunn, 2000), such that those from more disadvantaged neighborhoods were more likely to engage in RSB.

For the purposes of this investigation, risky sexual behavior includes having intercourse with an intravenous drug user, having unprotected sex, or having intercourse with multiple partners. However, across studies, there has been great variability in the way in which risky sexual behavior is measured. Similar to research in the substance use area, it is often difficult to draw conclusions on the overall impact and prevalence of risky sexual behavior when there is a lack of consistency among researchers on what is meant by the term.

Substance use, risky sexual behavior, and HIV risk

There is evidence that as many as 25% of adolescents engaged in substance use during their most recent sexual encounter (e.g., Grunbaum et al., 2002). Furthermore, adolescents reporting high levels of sexual risk behaviors are 10 times more likely than their low risk peers to report unprotected intercourse while under the influence of drugs or alcohol (Ellickson et al., 1990). Substance abusing adolescents are not only more likely to be sexually active, but they are also more likely to have initiated sex at an earlier age, have approximately 50% more sexual partners than their non-using peers, and have unprotected sex (Bailey, Pollock, Martin, & Lynch, 1999; Dunn, Bartee, & Perko, 2003; Kotchick et al., 2001; Santelli, DiClemente, Miller, & Kirby, 1999; Shrier & Crosby, 2003). Researchers have not only linked risky sexual behavior to substance use, but they have also linked RSB to fatal diseases, such as HIV. For example, heavy alcohol consumption has been associated with increased reports of HIV infection in some adolescents (Ericksen & Trocki, 1992; Shafer et al., 1993). For juvenile detainees, this relation appears to be stronger, as 2 in 3 detainees reported that they had engaged in 10 or more risk behaviors associated with HIV infection that involved substance use or intercourse (Teplin, Mericle, McClelland, & Abram, 2003).

Despite the evidence for a relation between RSB and substance use, the results of studies investigating this association have been variable and methodological differences between studies make generalizability of results difficult (e.g., Ellickson, Collins, Bogart, Klein, & Taylor, 2004; Grunbaum et al., 2002; MacDonald, Wells, & Fisher, 1990). Over 80 studies have directly examined the relation between these variables among adolescents. While not all of them can be summarized in this paper, the results of several studies with significant and null findings are reviewed, respectively.

To begin with, several studies have found significant associations between RSB and substance use. Anderson and Mathieu (1995), for example, conducted a study that examined the impact of alcohol use on high-risk sexual behavior. They surveyed 489 predominantly Caucasian (72%) and heterosexual (96%) college freshman at a southern university in the United States. While mean age or age range was not provided in the study, approximately 61% of the participants were under 21 years of age. Results indicated that 1 in 4 students reported that they had drunk more alcohol than normal to make sexual intercourse easier. Furthermore, males (60%) were more likely to report using alcohol to facilitate sexual behavior than their female peers. Of the males who reported drinking to facilitate intercourse, 61% reported condom use on drinking occasions.

Bachanas et al. (2002) examined the correlates of risky sexual behavior among 158 African American females between ages 12 and 19. Participants were recruited from a health and family planning clinic in the southeast and most attended the clinic to receive birth control or treatment for STDs. This study found a significant and medium effect ($r = .43, p < .01$) of the substance use to RSB relation. Baskin-Sommers and Sommers (2006) examined the relations between substance use and engagement in unprotected intercourse and the likelihood of having multiple sexual partners. Participants were 243 college students between 18 and 24 years of age. Over 50% were Hispanic and approximately 27% were Caucasian. Results indicated that participants who reported ever using alcohol ($r = .21, p < .01$) and methamphetamines ($r = .30, p < .01$) over a 6-month period of time were also more likely to engage in unprotected sex. This study also found a relation between alcohol and methamphetamine use and having more sexual partners.

Bryan, Ray, and Cooper (2007) conducted a study of 267 probated adolescents. Over 70% of the participants were males and almost half were of Hispanic descent. Participants completed self-report questionnaires that focused on their alcohol and condom use behaviors, personality characteristics, and alcohol-related expectancies. Items assessing global RSB and substance use focused on their frequency of use (e.g., how often did you use condoms during intercourse; how often did you drink four or more times a month) over a 6-month period of time. Items assessing event level RSB and substance use were dichotomous measures of whether or not the participants used a condom and whether or not they had been drinking the last time they had intercourse. Regarding the global and event level measurements of risky sexual behavior and substance use, the researchers did not find a significant correlation between the two variables. However, when they examined the event level risk while controlling for condom use on non-drinking occasions, they found that gender ($OR = 3.77$, 95% CI: 1.09-13.00; $B = 1.33$, $p < .05$) and quantity of alcohol use ($OR = 0.59$, 95% CI: 0.37-0.94; $B = -0.53$, $p < .05$) were significant predictors of condom use among females.

Castrucci and Martin (2002) conducted a study examining the relation between risky sexual behavior and substance use among incarcerated adolescents. Participants were 210 adolescents between 12 and 17 years of age, the majority of who were male (78%) and African-American (69%). Data were collected during 40-minute interviews administered by trained research assistants. The results indicated that frequent substance use increased the chances that an adolescent would also be engaging in intercourse with multiple partners ($OR = 11.88$) and would use condoms inconsistently ($OR = 3.06$).

While the previous studies have found significant relations between risky sexual behavior and substance use, the following studies raise doubt about the relation between the variables.

Morrison et al. (2003), for example, studied the relation between alcohol use prior to intercourse and condom use among 112 northwestern adolescents between 14 and 19 years of age. 60% of the participants were in high school, over half were of Caucasian descent, and 70% were female. To enable the researchers to analyze within subject sexual and drug behaviors, participants were randomly assigned to one of two conditions over an eight-week period of time: a daily journaling condition, which required participants to answer questions related to concurrent risky sexual behavior and substance use, or a daily telephone interview condition, in which participants were asked the same questions by a trained interviewer. The researchers examined the proportion of sexual intercourse occasions during which risky sexual behavior and substance use occurred/did not occur. Results indicated that alcohol did not have a significant impact on the adolescents' use of a condom during the sexual event reported; specifically, drinking prior to intercourse and quantity of alcohol consumed did not influence condom use.

Similarly, Bailey, Gao, and Clark (2006) examined the relation between substance use prior to intercourse and condom use among adolescents with substance use disorders. 134 adolescents between the ages 15 and 21 participated in the study. 80% were Caucasian and over 50% were women. Data were collected over a 6-week period of time. Participants provided their responses to tape-recorded questions about their drug use behavior prior to intercourse by phone. The researchers did not find a significant substance use to RSB relation, such that adolescents with substance use disorders were no more or less likely to use a condom during intercourse than their peers without substance use disorders.

Leigh et al. (2008) studied the relation between adolescents' reports of condom use on occasions when alcohol had been consumed prior to intercourse. Participants were either college students or clients at a sexually transmitted diseases clinic between the ages of 18 and 23. Most

of the participants were Caucasian (69% for the clinic sample and 76% for the student sample) and there were slightly more females (51%) in this sample. Participants kept a daily journal in which they recorded their sexual activity and substance use behaviors over an 8-week period of time. Multilevel models predicting condom use from alcohol use prior to sexual intercourse were not significant.

Lastly, Voisin et al. (2007) examined the impact of witnessing community violence on health behaviors and outcomes. Participants were 550 juvenile detainees, half of who were female and majority were either African American (39%) or Caucasian (41%). Adolescents, most of whom were approximately 15 years of age, completed a questionnaire and results indicated that there was no relation between global substance use (i.e., alcohol, marijuana, cocaine, etc.) and condom use.

In sum, the results from the studies mentioned above highlight significant variations in findings regarding the relation between substance use and risky sexual behavior. Several studies have important methodological differences that could not only influence whether or not significance is attained, but could also influence conclusions drawn. Just as findings vary by study, theories attempting to explain the relation, or lack thereof, are also variable.

Theoretical Explanations

The purpose of this section is to provide an overview of the commonly cited interpretations of data finding a relation between the two behaviors. Despite the prevalence of studies finding no effect of substance use on risky sexual behavior, it seems that the majority of studies do find an effect (Cooper, 2002). Although popular beliefs would assume a causal relation between the variables, there are several interpretations used to explain effects. This section focuses on the three that are most commonly cited: causal, reverse causal, and third

variable explanations (Cooper, 2006). It should be noted that this paper does not explore the aforementioned theories, but examines moderators of the relation between RSB and substance use.

Causal interpretations

As previously mentioned, the perception that substance use—alcohol use in particular—has a disinhibiting effect on sexual behavior is widely accepted, despite the inconsistency of the evidence used to support such claims. The most dominant assumptions are that substance use increases one's chances of engaging in intercourse, enhances the sexual experience in some way, and/or encourages sexual risk behaviors that put one at risk for STD infection (Cooper, 2006). According to research on neurocognition and substance use, these assumptions are entirely plausible. As brain development is believed to be the result of a complex interaction between genetics and environmental factors, Riggs and Greenberg (2009) assert that the variability in the timing of neurological development is an important factor in adolescent substance misuse.

Neurologically, the areas of the brain responsible for the experience of pleasure, emotion, reward, and novelty seeking reach maturity prior to areas of the brain that are associated with behavior regulation and higher order processing (Riggs & Greenberg, 2009). For example, researchers have found that the limbic system, which is responsible for emotion control, develops significantly earlier than the frontal cortex, which controls executive functioning, such as decision-making (Gogtay, Giedd, & Rapoport, 2002). As adolescence is characterized by the relatively delayed development of the frontal cortex, youth are more likely to be influenced by neural substrates aimed at the desire for novelty and independence. These developmental factors, along with the influence of environmental factors (e.g., social pressure), are believed to lead adolescents to make decisions that are disproportionately influenced by emotion rather than

reasoning, which increases the likelihood of engaging in risky behaviors (Chambers, Taylor, & Potenza, 2003; Reyna & Farley, 2006).

While the neurocognitive interpretation is a developmentally based theory for the relation between substance use and RSB, Steele and Josephs (1990) proposed the alcohol myopia theory, which is a more specific and pharmacological interpretation of the association between the two behaviors. According to this theory, the disinhibition of behavior is the result of a reduction in decision-making capacity and situational cues in a given sexual event. Specifically, alcohol is believed to influence the range of perceived situational cues and hinders one's ability to extract meaning from those cues. Cues can either be salient or distal. Salient cues, such as arousal, are more cognitively accessible than distal cues, such as fear of a STD, which are less likely to be accessible in a given person under the influence of alcohol.

Similarly, expectancy theory (Hull & Bond, 1986) has also been used to interpret the substance use to RSB relation. According to expectancy theory, adolescents' behavior following the consumption of substances is influenced by their expectations. For instance, if an adolescent expects substance use to have a disinhibiting impact on their sexual behavior, they are more likely to engage in risky behaviors that have been attributed to substance use, such as unprotected sex (Cooper, 2006).

Reverse causal interpretations

Reverse causal interpretations address the “chicken vs. the egg” debate. These types of explanations claim that when the opportunity for intercourse is perceived, an individual's motivations to engage in risky sexual behavior lead him or her to use substances (Cooper, 2006). On the other hand, adolescents might engage in substance use because they believe that it has the potential to enhance their sexual experiences. Similarly, one might use substance use as an

excuse (to oneself and others) for inappropriate behavior, such as RSB. Regardless of the individual motivations, reverse causal explanations assume that people strategically use substances because they believe that substance use has the potential to facilitate the desired behaviors that lead to the sought after sexual outcome.

Third variable interpretations

Third variable interpretations often focus on the stable characteristics of individuals or of their predicament in life that might increase their chances of partaking in both types of risk behaviors. Such personal characteristics, some of which could be genetically based, include: personality features (e.g., sensation seeking, thrill seeking, impulsivity) and mental health status (e.g., depression, psychological disorder). Life predicaments include: family factors (e.g., abuse, neglect, parental substance use, single parent households) and peer influences. All third variable interpretations assume that covariation between substance use and RSB is due to a third variable, or the impact of a shared underlying cause.

Categorical differences between studies

There are several possible reasons for differences in results across studies, most of which could be divided into three categories: sample characteristics, measurement factors, and publication characteristics.

Sample characteristics

Sample characteristics include the type of population and the demographics of participants. There is reason to believe that substance use varies by gender and ethnicity. For example, in several of the studies mentioned above (e.g., Anderson & Mathieu, 1995), the majority of the participants were Caucasian. It is possible that there are ethnic differences in the degree of substance use or substance of choice. According to data from the 2008 National

Household Survey on Drug Abuse (NHSDA), Caucasian, Hispanic, and multiracial adolescents reported the highest rates of current alcohol use (16.3%, 14.8%, and 13.6%, respectively) (SAMSA, 2009). There were significant gender differences between adolescents and emerging adults. Specifically, male and female adolescents (12-17 years old) reported similar rates of alcohol use (14.2% and 15%, respectively), while emerging adult males (18-24 years old) reported significantly more alcohol use (64.3%) than their female peers (58%).

For adolescents between 12 and 17 years of age, American Indians or Alaska Natives (19.2%) were twice as likely to report illicit drug use than individuals of African descent (11%), Caucasians (10.1%), and Hispanics (9.4%) (SAMSA, 2005). Regarding gender, overall, illicit drug use among males and females did not differ significantly (9.5% and 9.1%, respectively) (SAMSA, 2009). Boys, however, reported higher rates of marijuana use than girls (7.3% and 6%, respectively). Drug use during the past month also varied by age group; specifically, among 12 and 13 year olds, recreational prescription drug use (1.5%) and inhalants (1.2%) were the most common drugs (SAMSA, 2009). For 14 and 15 year olds, marijuana (5.7%) and recreational prescription drugs (3%) were the most common substances reported. These drug use preferences were the same for 16 and 17 year olds (12.7% and 4%, respectively), and emerging adults (16.5% and 5.9%, respectively).

The population from which participants are selected is an important factor as well. Voisin et al. (2007) found strong and significant relations between RSB and substance use among juvenile detainees. It is possible that juvenile detainees differ significantly from their same-age peers in regards to their degree of engagement in risky behaviors. Specifically, juvenile detainees might engage in more risky behaviors overall, and risky sexual behaviors and substance use could be a small portion of an overall risky profile.

Nationality of the sample could also be a source of variation in the reported relation or lack thereof between substance use and risky sexual behavior. The customs and behavioral expectations of citizens of some countries might make concurrent substance use and RSB more or less likely. For example, in some countries, it might not be as acceptable for women to engage in alcohol or other drug use, and as a result, women could be less likely to report engaging in such risk behaviors. For example, one study found that, when examining adolescents in 31 countries, females in the United States reported more lifetime marijuana use than females in any of the other countries considered (Bogt, Schmid, Gabhainn, Fotiou, & Volleberg, 2005).

Measurement factors

Measurement factors include: study classification, the method in which substance use and risky sexual behavior is assessed, type and severity of drug use, and the nature of the risky sexual behaviors. Generally, research examining this relation falls into one of three categories: global association, situational, and event level studies (Leigh & Stall, 1993). In **global association studies**, researchers examine the relations between aggregate measures of substance use and risky sexual behavior. The measure of drug use is not restricted to sexual situations. In this case, an individual's global drug use across all situations is considered (see Bachanas et al., 2002).

Situational studies, on the other hand, examine the association between substance use and sexual behavior within the same sexual intercourse event and risky sexual behavior. These studies often compare the proportion of occasions in which substance use occurs during/prior to risky sexual behavior to the proportion of occasions in which substance use and risky sexual behavior are not concurrent (see Morrison et al., 2003).

Of the three broad categories, **event level studies** are often viewed as most efficient due to their specificity. These studies require participants to focus on a particular sexual event to

determine if substance use and risky sexual behavior were simultaneous. In other words, event analyses are distinguishable from situational analyses in that event-level measurements of RSB and substance use ask participants to identify a particular sexual event (e.g., last time you had intercourse) and answer questions about drug use and RSB (see Bryan et al., 2007).

Method of assessment could also have an impact on adolescents' responses to questions about their substance use and sexual behaviors. The most common method of gathering such sensitive information is via self-report questionnaires (e.g., Bachanas et al., 2002). This method might encourage participants to provide honest responses, as their responses to the questionnaires are often anonymous. Some studies gather information via structured interviews (e.g., Castrucci & Martin, 2002). This method of assessment is helpful, as trained research assistants are able to gather detailed information and clarify any ambiguities. Furthermore, for participants with literacy issues, this method ensures that questions are understood. However, for various reasons, it is possible that adolescents overestimate or underestimate their true behaviors when reporting to a live interviewer.

The research on this issue has been mixed. While some studies have found that participants completing a self-report measure were more likely to report socially undesirable behaviors than during a face-to-face interview (e.g., Turner et al., 1998), other studies have found that individuals report more undesirable behaviors during face-to-face interviews (e.g., Tourangeau, Rasinski, Jobe, Smith, & Pratt, 1997). On the other hand, some researchers have not found reporting differences between the two methods of assessment (Webb, Zimet, Fortenberry, Blythe, 1999).

The type of substance use (e.g., alcohol, marijuana, polydrug use) measured in a particular study could impact the conclusions drawn from the results. Certain drugs might have

stronger connections to engagement in risky behaviors due to cultural expectations, availability, and legality (e.g., Rawson, Washton, Domier, & Reiber, 2002). It is possible that alcohol use is often related to risky sexual behavior because individuals are likely to have more access to alcohol and depending on their age, can legally consume the drug without fear of arrest. It is unclear whether certain drugs uniquely impact the brain, such that participation in risky behaviors is likely to increase. Similar to differences in population, the consideration of the severity of participant drug use could be an important moderating factor. For example, individuals who are identified as drug abusers might be more likely to report risky sexual behavior due to an overall higher degree of involvement in risk behaviors. On the other hand, if some individuals use drugs just to facilitate risky sexual behavior, individuals who simply report drug use might be more likely to report RSB. However, drug use is often measured in very broad terms, which could make cross-study comparisons difficult to interpret.

The nature of the risky sexual behavior being analyzed in a study could be a source of variation in results. For example, many studies cite condom use as the measure of RSB. However, having intercourse with multiple partners or with an IV drug user puts an individual at increased risk for HIV infection, which could be influenced by participant drug use. Some participants who engage in drug use prior to intercourse might be less inhibited and more likely to engage in greater risk behaviors; behaviors in which they might not otherwise participate.

Publication characteristics

Lastly, publication characteristics include the year of publication, journal, and the type of document. The year of publication is important, as the study quality might vary with time. For example, newer studies have the benefit of previous research findings and often make use of empirically supported methods of assessing the relation between RSB and substance use. Event-

level studies, for instance, have grown in popularity due to the perception that findings based on retrospection introduce additional bias (Leigh & Stall, 1993). It would be important to determine if improved methods lead to higher or lower effect size estimates. Similarly, the journal in which the study is published could be an important factor, as some journals are known for their vigorous peer-review process and study quality might be better. Lastly, the type of document (unpublished or published manuscript) might be an important source of variation, as studies with null findings are less likely to be published. This could lead to the misperception that the relation between substance use and RSB is stronger than it really is due to publication bias.

Purpose of this study

Health professionals have long acknowledged the fact that one's primary means for protection from STIs and STDs are through the prevention of the behaviors that expose one to risk and through appropriate interventions aimed at increasing protective actions (Leigh & Stall, 1993). Programs for adolescents place emphasis on promoting abstinence, increasing effective condom use, and decreasing substance use (Miller et al., 1997). However, such programs have only met a limited amount of success (Kelly & Kalichman, 1995). Researchers must first determine the strength of the proposed relation between substance use and RSB. This determination is important, as a weak effect of the substance use to risky sexual behavior relation could explain why programs aimed at altering one behavior in hopes of changing the other meet little success.

Developing an understanding of the moderators that influence the adolescent risky sexual behavior to substance use relation is critical to designing effective prevention programs. There is much variability in the way in which drug use and sexual risk have been defined across studies. These typologies and operational definitions are important because they might suggest that HIV

prevention programs may need to be tailored to the group being treated (Malow et al., 2006). This study seeks to determine if these methodological differences impact research findings.

In sum, empirical evidence suggests that understanding the interaction between substance use and risky sexual behavior, along with the moderators of this interaction, is essential to identifying the multiple pathways to HIV infection.

Research Synthesis

In the social sciences, the use of a single study is rarely considered sufficient to answer a research question, as sampling characteristics often significantly influence individual study findings (Cooper, 1989; Hunter, Schmidt, & Jackson, 1982; McGaw, 1997). As a result, the examination of a particular area of research (e.g., substance use and risky sexual behavior) usually requires the consideration of the results across studies. There are two major approaches to research synthesis: literature review and meta-analysis. Traditional literature reviews are often narrative summaries of aggregate research findings (Johnson, 1989) and are unlikely to include unpublished manuscripts (Glass, McGaw, & Smith, 1981). The methods employed in this type of review are often flexible and this flexibility has been associated with criticism regarding high levels of subjectivity. The conclusions drawn from literature reviews could vary widely, as it is often difficult to qualitatively provide an answer to a research question when several studies report conflicting results (Cooper & Rosenthal, 1980). Additionally, in many literature reviews, the inclusionary and/or exclusionary criteria are not always clearly specified, which makes generalizability difficult (McGaw, 1997).

There have been several reviews on the relation between risky sexual behavior and substance use. M. Lynne Cooper (2006), for example, conducted a selective review of naturalistic studies that examined the relation between alcohol use and risky sexual behavior on

adolescents' first dates. While data were correlational, within-subject measurements were conducted on two occasions: with and without alcohol use. According to the review, there were significant gender differences in the influence of alcohol on sexual behavior. Specifically, rates of risky sexual behavior were higher when male partners engaged in alcohol use than when they abstained from use.

The researcher used the alcohol-myopia theory to explain the results. In the case of this review, males might have experienced stronger cues towards behavioral disinhibition because they were more accessible than peripheral cues for engaging in protective behaviors. Consistent with this theory, males in the study were more likely to emphasize the benefits of intercourse on the first date, while females were more likely to emphasize the costs of intercourse on the first date. Condom use was only significantly associated with alcohol use alone under certain conditions: during first intercourse, among younger but not older adolescents, and in older studies. The conclusions from this review suggest that researchers should not focus on the models that best explain the relation between substance use and risky sexual behavior, but focus on the conditions, or moderators, under which various mechanisms are likely to operate.

Kerr and Matlak (1998) conducted a similar, but more extensive, review of the literature examining alcohol use and risky sexual behavior among 11 to 19 year olds. Studies were included if they were published between 1990 and 1996, and had a sample size of at least 100. 11 studies were reviewed in this paper. Overall conclusions fell into 3 categories: 1) sexual activity, 2) condom use, and 3) co-occurrence of risk behaviors. For instance, based on the results of this review, the authors concluded that substance use increases that likelihood of having intercourse. Use, however, does not decrease the likelihood of using condoms during intercourse. Most of the

studies included global measurements of the relation, making it difficult to determine if drug use and risky sexual behavior occurred on the same occasion.

Another type of research synthesis, meta-analysis, represents a quantitative approach to research synthesis. It can often be viewed as a form of survey research in the sense that research studies and reports serve as the population being surveyed (Lipsey & Wilson, 2001). Unlike with literature reviews, meta-analysis can only be used to investigate empirical, quantitative studies. The purpose of a meta-analysis is to encode and analyze statistics that summarize findings in research studies. Researchers employing meta-analysis develop very specific literature search terms and methodological approaches to examining the topic of interest. An effect size, which serves as the standardized representation of the relation between two variables, is used to compare statistics measuring the relation of interest across studies.

There are several advantages of using meta-analysis to synthesize research: 1) each step in the process is documented and open to scrutiny, 2) it is more sophisticated than a traditional literature review, and 3) it employs a structured and strategic way of organizing information from a variety of studies (Lipsey & Wilson, 2001). Some researchers have been critical of some aspects of meta-analysis. For example, there is a concern that meta-analyses are too structured and may not be sensitive to issues such as methodological quality or subtleties related to aspects of study design (Lipsey & Wilson, 2001). This problem has often been tackled through the incorporation of qualitative techniques. For example, a meta-analyst could develop a coding scheme that accounts for differences and similarities across studies.

To date, there have been no comprehensive meta-analytic efforts to synthesize the extensive substance use and risky sexual behavior literature on adolescent and young adult populations. Given this fact, conducting a meta-analysis is essential to understanding the

multiple pathways to HIV risk behaviors in adolescence. The purpose of the meta-analysis is threefold. First, it serves as an investigation of the strength of the relation between risky sexual behavior and substance use among adolescents.

Second, the meta-analysis enables the researcher to examine the moderators of this relation. While substance use prior to sexual intercourse has become a conventional target of prevention efforts aimed at reducing risky sexual behavior, researchers do not have sufficient evidence to support this link (Cooper, 2006). A strategic focus on substance use would be effective only if substance use causally promotes sexual risk. The further examination of the selected studies elucidates the gaps in the literature by facilitating the identification of potential risk and protective factors of the relation between RSB and substance use in the “best studies.” This is significant, as many studies have not examined multiple risk and protective factors simultaneously. Therefore, the third function of the meta-analysis is to facilitate the generation of hypotheses that could guide future research. Beyond the examination of the substance use and risky sexual behavior relation, the results from this study could have broader implications for all risk behavior research. For example, this meta-analysis will focus on moderators of the SU and RSB relation, as well as the methodological differences between studies that could impact findings.

Research Questions

1. What is the strength of the relation between substance use and risky sexual behavior?
 - a. How do sample characteristics, measurement factors, and publication characteristics (e.g., type of sample and publication year) affect effect size estimates?
2. What are the moderators of the substance use to RSB?
 - a. Does type of substance use matter? Are there differences between types of RSBs?

METHOD

Sample of studies

The purpose of the literature search was to identify studies that investigated the bivariate relation between substance use and risky sexual behavior. Studies were retrieved using a modified search strategy recommended by White (1994) and Garrard (2004). Several electronic databases were searched, including: PsycINFO, Health Source, PubMed, CINAHL, Sociological Abstracts, PsycARTICLES, PsychiatryOnline.com, and Academic Search Premier. While the lower limit of the date range was not specified, the upper limit end date was August 2008. This search strategy identified articles whose titles or abstracts paired terms related to risky sexual behavior with terms related to substance use. Wild card terms, or terms ending in special characters, were used to obtain articles that included variations of the search terms. The search terms for adolescents were youth*, teen*, adolescen*, young*, and juvenile. For risky sexual behavior, the terms were AIDS, HIV, STD, risk*, unprotected, protect*, unsafe, safe, condom, sex*, and intercourse. Lastly, substance use search terms were drug, substance, alcohol, cocaine, marijuana, heroin, and meth*. In addition to the search terms, a separate set of terms, called exclusion or “not” terms, were included to reduce the number of unrelated articles generated. Exclusion terms included: mouse, mice, rat*, cell*, serum*, elder*, and tissue*.

Articles included peer-reviewed publications, unpublished manuscripts, such as theses and dissertations, and government reports. The Social Science Citation Index was used to locate articles that had cited Leigh and Stall (1993), which was a seminal study in substance use and

risky sexual behavior. We examined the references from Pritchard and Cox (2007), Richter, Valois, McKeown, and Vincent (1993), Donenberg, Emerson, Bryant, and King (2006), Donovan and McEwan (1995), Darling, Palmer, and Kipke (2005), Robbins and Bryan (2004), Hallfors et al. (2002), Ramrakha, Caspi, Dickson, Moffitt, and Paul (2000), and Naff Johnson (1997), which were randomly selected from the sample. Finally, we wrote the contact authors of the articles identified by these methods to obtain additional work in the area of risky sexual behavior and substance use that may have been missed by our search. The initial search generated 17, 223 abstracts, which included duplicates and incomplete references. After the removal of the duplicates and incomplete references, there were 7, 996 abstracts. The first pass reduced this number to 4,461.

Inclusionary and exclusionary criteria

The next step involved the determination of whether or not a particular study met the criteria for inclusion in the meta-analysis. Identified studies were included if the following criteria were met. 1) Participants were younger than 25 years of age. Many researchers have classified individuals ages 12 thru 24 to be adolescents; however, the range varies significantly. The condition of adolescence is often associated with efforts to obtain employment, advanced education, and partially resulted from the older age at marriage (Dehne & Riedner, 2001). Since the average age of marriage in much of the western world is close to 25 years of age, many researchers have selected this age as the cut-off for adolescence (Dehne & Riedner, 2001).

In the past decade, a new classification, “emerging adulthood,” has been gaining popularity. It has been used to describe individuals in the mid to later end of the previously mentioned age range (Arnett, 2005). Arnett (2005) proposes that five main features characterize emerging adulthood: the exploration of identity, instability, self-focusing, feelings of being in

transition, and the age of opportunities. Adolescents in the 18-24 year age range are significantly different from their younger adolescent peers and should not be studied as a homogenous group.

2) There was a measure of the relation between substance use and risky sexual behavior using the same participants. Substance use was broadly defined and studies were included if there was a measurement of alcohol, marijuana, hard drugs, or psychoactive medications for recreational use. Cigarette smoking alone was not included in the substance use category. Aggregate measures of risky sexual behavior had to include a measurement of condom use or lack thereof. Having multiple sexual partners was also a measure of sexual risk. 3) There was sufficient information to compute effect sizes. For each study, we recorded the sample size and correlation coefficient (or any other statistic that would enable us to extract an effect size). 4) The article had to be written in English.

Articles were excluded if: 1) participants were classified as prostitutes or sex workers, 2) data were presented only as part of conference presentations, and 3) sexual risk was the result of a rape or sexual assault. Conference presentations and raw datasets are not included in this investigation, as it is impractical to obtain a representative sample of such data since presentations are not included in electronic databases. Furthermore, conference presentations and raw dataset are less likely to undergo the same level of examination in the peer-review process. Some researchers have suggested that failure to include grey literature, such as conference presentation, could alter an effect size estimates by approximately 12% (McAuley, Pham, Tugwell, & Moher, 2000). This study, while excluding conference presentations, included unpublished manuscripts. It is much larger than the average meta-analysis and has more power, and thereby flexibility, to refrain from including such presentations. The abstracts of identified articles were examined further for relevance and a “reduced candidate list” of 638 articles was

created. This list was created through the removal of articles that clearly did not contain data relevant to the meta-analysis. Of the 638 articles, 266 contained a statistical measure of the relation between RSB and substance use. We then examined the full text of these 266 articles, finally locating 87 that fit the inclusion criteria and which reported enough data to compute an effect size for the relation between substance use and risky sexual behavior.

Study characteristics coded

Study characteristics were coded with the intention to identify moderators of the relation between substance use and RSB. Studies were coded based on the 3 categories of potential moderators previously mentioned: sample characteristics, measurement factors, and publication characteristics. Regarding **sample characteristics**, the following variables were coded: type of sample (e.g., clinical, community, juvenile, etc), nationality, and demographic information (i.e., mean age, race, gender). For **measurement factors**, the following variables were coded: type of drug use (e.g., alcohol use), drug use severity (e.g., drug user vs. abuser), method of assessment (e.g., self-report, interview, other), operational definitions of risky sexual behavior (e.g., unprotected sex, multiple partners, etc.), substance use (e.g., alcohol, marijuana, etc.), and study classification (i.e., global, situational, or event analyses). Finally, for **publication characteristics**, coded characteristics included: publication year, name of journal, and type of document (e.g., peer-reviewed journal, dissertation, etc.).

Reliability

Two independent raters (advanced graduate students) coded study characteristics and calculated effect sizes for all articles. Inter-rater reliability was computed using Cohen's kappa for categorical variables (Cohen, 1960) and intraclass correlations for continuous variables (ICC) (Fleiss & Cohen, 1973). Cohen's kappa is a measure of "true" agreement; it is a measurement of

the agreement between coders that is achieved beyond that which is expected based on chance and treats all disagreements between coders, equally. The ICC is a measure of the consistency or conformity of ratings of study variables between coders evaluating the same study. In other words, it is the proportion of variance that is associated with differences among variables and describes the degree to which codes within the same group, or variable, resemble each other. A kappa or ICC of at least 0.80 was considered acceptable. These estimates (Intraclass correlations for continuous moderators and Cohen's kappa for categorical moderators) ranged from 0.85 to 1.00, with a median of 0.97. The resolution of differences enabled the coders to recode the variables in which the reliability criterion was not met, independently, until a coefficient of at least 0.80 was reached. Next, the coders viewed each code (for each study) to ensure that 100% consistency was achieved. Discrepancies between coders were resolved through discussions with the research team. One moderator, drug use severity, was not analyzed with the results of this study due to the inconsistencies with which it was measured across studies. This category was meant to distinguish between drug use (a less severe designation), and diagnoses of drug abuse and dependence. Most studies did not include such distinctions and the operational definitions were often unclear and not readily distinguishable.

Computation of effect sizes

Pearson's correlation r was used as the effect size measure, representing the correlation between substance use and risky sexual behavior, due to its ability to account for variations in metrics used in measurement and also because much of the research on this relation utilizes correlation coefficients. Effect sizes were computed using Comprehensive Meta-Analysis (CMA) version 2.2 (Borenstein, Hedges, Higgins, & Rothstein, 2006) and DSTAT version 1.10 (Johnson, 1993), which are statistical programs that allow researchers to perform various

statistics needed to calculate effect sizes. Prior to aggregation, each r was transformed to Z_r using Fisher's r -to- Z transformation function. Afterwards, Z_r was transformed back to r for interpretation purposes. Positive effect sizes indicated higher levels of risky sexual behavior as a function of substance use. Generally speaking, an effect size of $r = \pm .10$ is considered to be "small," $r = \pm .30$ is considered to a "medium" effect, and a larger effect would be those values greater than $r = \pm .50$ (Cohen, 1992; Garrard, 2004; Keppel, Saufley, & Tokunaga Jr., 1992; White, 1994). Where possible, we preferred correlations. For studies that did not report a correlation, we used means and standard deviations, t , F , and p values, and/or the regression coefficient to estimate the correlation coefficient. If such information was not provided, the study was excluded from the sample.

For each study that included multiple measures of drug use or RSB, individual effect sizes were calculated for the relation between each behavior. For example, for studies that reported the use of multiple drugs, an effect size representing the correlation between each drug and a given RSB was calculated. If a single study had multiple assessments of risky sexual behavior (e.g. multiple partners, anal intercourse, unprotected intercourse) measured independently, an effect size for each was calculated and averaged to reduce the number of effect sizes from any single study. We report the number of effects, point estimates, confidence intervals, and tests of significant difference from zero.

When examining moderators, there are two types of analyses that are commonly conducted: fixed-effects and random-effects analyses. This study utilizes random-effects analyses (Lipsey & Wilson, 2001). Fixed-effects procedures involve assigning greater weights to effect sizes from larger studies, which leads to greater reliability and power (Hedges & Olkin, 1985). Random-effects procedures, on the other hand, tend to increase the generalizability of

results. Inferences based on fixed-effects procedures are not generalizable and can only be applied to the specific studies. Inferences based on random-effects analyses, however, can be applied to the broader population of studies from which the meta-analytic sample is drawn. To represent the relation between SU and RSB, a mean effect size at a 95% confidence interval was calculated by averaging the effect sizes of all of the weighted r values.

To determine if moderator analyses were necessary, the researchers tested for the presence of a significant amount of heterogeneity among the effect sizes. This also enabled us to answer the question as to whether the variability in the effect sizes can be explained by study characteristics. Categorical moderators (i.e., type of sample, nationality, race, type of drug use, drug use severity, method of assessment, type of risky sexual behavior, substance use, study classification, and type of document) were examined by testing whether the between-groups heterogeneity Q_b is significantly different from zero. Q_b follows a chi-square distribution and represents the variability in the effect sizes that can be explained by group differences.

Continuous moderators (i.e., mean participant age, percent female, percent Caucasian, percent African descent, percent Hispanic, percent Asian, percent other) were examined using meta-regression, which determines whether the slope between the moderator and effect sizes is significantly different from zero (see DeCoster, 2009). The researcher performed meta-regression to identify heterogeneity among studies. In this case, the standardized effect size served as the dependent variable and aforementioned coding variables served as the independent variables (e.g., mean age, percent female, etc.).

RESULTS

Descriptive analyses. Table 1 reports sample characteristics from each included study. The present meta-analysis was based on 243 single-coded effect sizes, which led to a final sample of 104 independent effect sizes drawn from 87 empirical studies, incorporating more than 120,000 participants. The summary effect size descriptors are presented in Table 2 and Table 3 contains study effect sizes. To calculate the weighted mean effect size, each effect size was weighted by the inverse of its variance. The weighted mean effect size (point estimate) over 104 independent effect sizes was .22 for the random effects model, which would be classified as a small to medium effect according to Cohen's (1992) guidelines. This positive effect size is significantly greater than zero, indicating that reports of substance use are associated with engagement in risky sexual behavior. There was a significant amount of heterogeneity among the effect sizes, indicating that there was more variability in the effect sizes than we would expect due to chance alone.

Although we conducted a comprehensive literature review, we realize that there is often a bias towards the publication of studies with statistically significant results. To evaluate the possible effects of publication bias on the magnitude of these effect sizes, we computed both the fail-safe N statistic (Rosenthal, 1979) and the trim and fill method (Duval & Tweedie, 2000). According to the fail-safe N statistic, there would need to be 7,466 unreported studies averaging null results to reduce the mean effect size to a magnitude where it was no longer significantly different from zero. Rosenthal's (1991) guidelines indicate that it is therefore highly unlikely that the true mean effect size for the relation between substance use and risky sexual behavior is zero.

The trim and fill method is a nonparametric method that measures publication bias through the examination of the symmetry of funnel plots after methodically omitting studies until the plot is symmetrical. Omitted studies are then replaced with comparable imputed values for the missing studies with the intent of preserving the symmetry of the funnel plot. The resulting adjusted mean effect size estimate, $r = .04$, indicates that the inclusion of missing studies could reduce the overall mean effect size from .22 to .04. According to this method, there is a 95% chance that the true effect size is between -0.001 and 0.091. Our results indicate that there is a publication bias.

Moderator analyses. The presence of a significant amount of heterogeneity among the effect sizes suggests the need to perform moderator analyses to determine if variability in the effect sizes can be explained by study characteristics. We considered the categorical moderators (i.e., document type, nationality, type of sample, type of drug, drug use assessment, sexual behavior assessment, drug use definition, risky sexual behavior definition, drug relationship measurement, and risky sexual behavior relationship measurement), as well as the continuous moderators (mean age, percent African descent, percent Caucasian, percent Hispanic, percent Asian, percent Minority, percent female, percent Heterosexual, percent Homosexual, percent Bisexual, and percent other). The categorical moderators were examined by testing whether the between-groups heterogeneity Q_b was significantly different from zero. This statistic follows a chi-square distribution and represents the variability in the effect sizes that can be explained by group differences. The continuous moderators were tested using meta-regression, where we determined whether the slope between the moderator and effect sizes was significantly different from zero. For more information on these analytic procedures see DeCoster (2009).

For an overview of the results of the categorical moderator analyses, see Table 4 and Figures 1 through 10. For each moderator, there were two moderator analyses performed. The first moderator analysis reported included the test for heterogeneity that included all of the available coded effects for a particular variable, including those articles in which multiple effect sizes were calculated using the same population. The second moderator analysis reported included only effect sizes from studies in which independent effects were available.

Document Type. Significant differences in effect size magnitude were observed between peer-reviewed journals and unpublished manuscripts, $Q_b [242] = 10121.59, p \leq .001$ for all effect sizes, and $Q_b [103] = 3797.70, p \leq .001$ for studies that include only independent effect sizes. As expected given the publication bias, peer-reviewed journals ($r = .219$) had more influence on the substance use and risky sexual behavior relation than unpublished manuscripts ($r = .196$).

Nationality. There was a significant effect of nationality, with the effect being largest for studies using populations in New Zealand and Australia, followed by Latin America, Europe, and the United States and Canada. The smallest effects were found among African and Asian populations. It is notable that the effect for Asians was not significant, as the confidence interval contained zero.

Sample Type. The association between substance use and risky sexual behavior differed in strength depending on the type of sample. The largest effect was observed in clinical samples, or among individuals receiving inpatient or outpatient psychiatric treatment. This was followed by community populations, in which individuals often come from a variety of backgrounds. The smallest effects were found in forensic populations, or populations in which adolescents were in

a juvenile facility or directly involved with the juvenile courts. It is notable that the effect for forensic populations was not significant, as the confidence interval contained zero.

Type of drug. The type of drug being assessed did influence effect sizes. The strongest effect was found among individuals who reported multiple drug use (using more than one drug, including drugs and alcohol). Individuals who reported hard drug use and marijuana, respectively, followed this effect in magnitude. The smallest effect was found among studies measuring the relation between risky sexual behavior and alcohol use.

Type of assessment. The association between substance use and risky sexual behavior was moderated by the way in which the behaviors were assessed. Specifically, the effect was largest when either substance use or risky sexual behavior was assessed by means of self-report than when participants were assessed through a face-to-face interview.

Drug use definition. There was a significant effect of the way in which drug use was defined on the SU to RSB relation. The largest effect was found among participants with clinical diagnoses of substance use disorders. This effect was followed in magnitude by studies in which drug use was measured by frequency and/or quantity of use. The smallest effects were found in studies in which drug use was defined dichotomously (e.g., user versus nonuser).

Risky sexual behavior definition. There were significant differences in the observed effect size magnitude depending on the way in which risky sexual behavior was defined. The strongest effect was found among participants reporting intercourse with an intravenous drug user. The magnitude of this effect was followed by studies that used an aggregate measure of risky sexual behavior. The smaller effects were among studies that measured RSB by reports of multiple sexual partners and unprotected intercourse, respectively.

Drug use relationship measurement. The relation between substance use and risky sexual behavior is often measured in one of three ways: globally, or at the situational or event levels. Moderator analyses indicated that there was a significant effect of drug use relationship measurement. Drug use measured at the situational level had the largest effect, followed by those measured globally. The smallest effect was found among studies measured at the event level. The point estimate for the event level studies was very small and the confidence interval ranged from no effect to a small effect, indicating that these studies had little influence on the magnitude of the effect size. It is notable that the effect for the event level measurement was not significant, as the confidence interval contained zero.

Risky sexual behavior relationship measurement. Moderator analyses indicated that there was a significant effect of risky sexual behavior relationship measurement. Risky sexual behavior measured at the global level had the largest effect, followed by those measured at the situational level. Similar to the drug use relationship measurement, point estimate for the event level studies was very small and the confidence interval ranged from no effect to a small effect, once again indicating that these studies had little influence on the magnitude of the effect size.

For an overview of the results of the continuous moderator analyses, see Table 5 and Figures 11 and 12.

Publication year. We found additional support for the relation between substance use and risky sexual behavior in a significant moderator for publication year, such that older studies tended to report higher effect sizes than newer studies.

Age and gender. There was a significant effect of mean age on the SU to RSB relation. Specifically, samples with a higher mean age reported a stronger relation than samples with a lower mean age. Regarding gender, there was a significant influence of percent female on the

strength of the effect such that samples with more females reported stronger relations between substance use and risky sexual behavior.

Ethnicity. The percent of individuals that were of African descent directly impacted the magnitude of the relation between substance use and risky sexual behavior. When there were fewer adolescents of African descent, the magnitude of the effect was higher. The percent Caucasian, Hispanic, Asian, and minority (not otherwise specified) significantly affected the strength of the relation between substance use and risky sexual behavior, such that greater Caucasian, Hispanic, Asian, and minority representation in the sample increased the magnitude of the effect.

Sexual orientation. While there was not a significant effect of sample identification as homosexual, there were significant effects of sample identification as heterosexual, bisexual, and homosexual and/or bisexual, such that the greater the percent of heterosexuals, bisexuals, and homosexuals/bisexuals in the sample, the greater the magnitude of the relation between substance use and risky sexual behavior.

Relations among moderator variables

We used correlations, ANOVAs, and chi-square tests to determine if there were significant relations between moderators (i.e., document type, nationality, sample type, type of drug, risky sexual behavior and drug use assessment, drug use and risky sexual behavior definition, drug use and risky sexual behavior relation measurement, publication year, mean age, percent African descent, Caucasian, Hispanic, Asian, minority, female, heterosexual, homosexual, bisexual, and other). The significant results from these analyses (using $\alpha = .002$ based on a Bonferroni correction) are presented in Table 6. We found that publication year was related to several moderators, including: document type, mean age, the percentage of bisexual

adolescents in the sample, nationality, sample type, type of drug, the way in which drugs and risky sexual behavior were assessed, the definitions of SU and RSB, and measurement of the relation between drug use and risky sex. The type of document was significantly related to the definition of RSB. Mean age was significantly related to the percentage of individuals of African descent, minority backgrounds, and adolescents who identified as heterosexual and bisexual in the sample, nationality, the type of sample, the way in which drug use and risky sex were assessed, defined, and measured.

The percentage of adolescents of African descent was significantly related to the percentage of Caucasian and bisexual adolescents in the sample, nationality, sample type, type of drug, and the way in which drug use and risky sex were defined, assess, and related to each other. The percentage of Caucasian adolescents was significantly related to the percentage of Hispanics, minorities, and combined samples of bisexual and homosexual youth, nationality, sample type, type of drug, and the way in which drug use and risky sexual behavior were defined, assessed, and related to each other. The percentage of Hispanic adolescents was significantly related to the percentage of heterosexual adolescents, sample type, type of drug, and the way in which drug use and risky sexual behavior is defined, assessed, and related to each other. The percentage of Asian adolescents was significantly related to the percentage of minorities, bisexual and combined samples, sample type, and the way in which drug use and risky sexual behavior was defined, assessed, and related to one another. The percentage of minority adolescents was significantly related to the percentage of combined samples, nationality, sample type, type of drug, and the way in which drug use was defined and assessed.

Nationality was significantly related to the publication year, the percentage of Asian, minority, and adolescents of African descent, drug use and risky sexual behavior assessment, and

drug use measurement relation. The percentage of females was related to nationality, sample type, and the way in which drug use and risky sex was assessed and related. The percentage of heterosexual youth was related to the percentage of bisexual and combined samples, and RSB definition. The percentage of bisexual youth present in the sample was related to RSB definition. Sample type was related to mean age, the percentage of Caucasian adolescents in the sample, type of drug, drug use definition, and drug use and risky sexual behavior relation measurement. Type of drug was significantly related to drug use definition and the RSB relation measurement. Drug use assessment was significantly related to the percentage of Caucasian, Hispanic, Asian, and youth of African descent in the sample, and RSB assessment. RSB assessment was significantly related to the publication year and the percentage of adolescents of African descent, and Caucasian and Hispanic youth in the sample.

Drug use definition was significantly related to mean age, the percentage of Hispanics in the sample, sample type, type of drug, and drug use and risky sexual behavior relation measurement. RSB definition was significantly related to the percentage of heterosexual youth in the sample, and drug use and risky sexual behavior relation measurement. Finally, drug use relation measurement was significantly related to RSB relation measurement.

DISCUSSION

The results of studies investigating the relation between risky sexual behavior and substance use have been mixed; many studies have found a positive relation, others have found negative relations, and still others have found no association between the two variables (e.g., Ellickson, Collins, Bogart, Klein, & Taylor, 2004; Grunbaum et al., 2002; MacDonald, Wells, & Fisher, 1990). In the present meta-analysis, we investigated whether a consistent relation exists between substance use and risky sexual behavior. Overall, for investigated measures of substance use and risky sexual behavior, a small to moderate, positive association ($r = .22$) was identified. According to Hemphill (2003), an effect size of this magnitude could represent a moderate effect size. He suggested that Cohen's (1992) effect size guidelines might not accurately reflect the coefficients typically found in applied psychological studies and that researchers should consider having different empirical guidelines depending on the type of study (e.g., treatment, validity). Taken together, the relation between risky sexual behavior and substance use is significant and important to investigate and understand. Engagement in risky sexual behavior can often lead to significant personal and societal costs and associated variables warrant further examination.

Across diverse sample characteristics, measurement factors, and publication characteristics, a reliable positive relation was observed between substance use and risky sexual behavior. Moderator analyses indicated that the degree of association between substance use and risky sexual behavior was not uniform. There were several important moderators of the relation between SU and RSB and their results and implications are presented in this Discussion section. Moderators presented in the following section are organized according to the three categories

describing differences between studies (i.e., sample characteristics, measurement factors, and publication characteristics).

Sample Characteristics

Gender. Few studies have explicitly examined the impact of gender on the SU to RSB relation among adolescents. The results of this study suggest that samples including more females exhibited a stronger relation between risky sexual behavior and substance use. While there are an abundance of studies that examine the relation between RSB and SU, fewer studies have directly examined or explained the impact of gender on the co-occurrence of these two behaviors. Among those studies that have directly examined gender differences, the findings have been mixed and involved mostly adult females (Absalon et al., 2006; Elifson, Klein, & Sterk, 2006; Rowan-Szal, Chatham, Joe, & Simpson, 2000). One study found that there was a significant situational association between alcohol use prior to intercourse and the likelihood of using a condom for females, but not males (Bryan et al., 2007). Specifically, females were twice as likely as their male counterparts to report that contextual factors influenced their decision to engage in unprotected intercourse.

Understanding situational factors that influence substance use and risky sexual behavior are important, especially given the impact of these two behaviors on HIV infection (Brown & Weissman, 1994). For example, female drug users often report greater levels of HIV-risk behaviors, such as risky sexual behavior and intercourse with an IVDU (Absalon et al., 2006). This finding, however, only tells part of the story. There are significant gender differences in relationship status that appear to moderate the association between SU and RSB. For example, female drugs users report greater associations between HIV-risk behaviors and substance use within steady, monogamous relationships thereby increasing their rates of HIV infection

(Absalon et al., 2006). Their male peers, on the other hand, report greater SU and RSB associations in casual sexual partnerships, which is associated with their rates of HIV infection (Absalon et al., 2006).

There are several reasons why the magnitude of the association between substance use and risky sexual behavior might be greater among females than among males. Adolescent females, for instance, are more likely to report having intercourse with older male partners, which increases their likelihood of engaging in risky sexual behavior (DiClemente, et al., 2002; Miller, Clark, & Moore, 1997). Furthermore, research has suggested that these females often gain access to illicit drugs via their older male partners thereby increasing their dependence on the relationship. According to the Theory of Gender and Power, in a romantic relationship, power differentials that favor the male partner often put females at increased health risk (Marin, Coyle, Gomez, Carvajal, & Kirby, 2000). For example, adolescent female drug users may perceive that they have less self-efficacy to insist on condom use when their primary drug supplier is their older male sexual partner (DiClemente et al., 2002). Similarly, when an adolescent female has been using drugs, the difficulty of negotiating condom use with a partner may be exacerbated, especially given the perceived control that the male has over condom use (Bryan et al., 2007; Wingood & DiClemente, 2000).

Taken together, all of this research could suggest that substance use may be more incapacitating for female adolescents, such that the perceived effects of some drugs (e.g., alcohol and marijuana) and the pharmacological effects of others (e.g., hard drugs or polydrug use) might have a significant impact on girls' decision-making capacities. For instance, due to a variety of factors including drug use experience and lower body mass, female adolescents may

overestimate the contribution of alcohol and marijuana, and underestimate the contribution of hard drugs and polydrug use, on their sexual behavior.

Nationality. While research examining the relation between SU and RSB has been conducted around the world, we have little understanding on how these behaviors compare among different groups of adolescents. Therefore, the present meta-analysis examined the impact of nationality on the strength of the association. Adolescents in New Zealand and Australia reported the strongest association between substance use and risky sexual behavior, followed by Latin America, Europe, U.S. & Canada, and Africa. The association between RSB and SU for Asia was not significant. To date, few studies that have compared or contrasted adolescent substance use and engagement in risky sexual behavior across nations.

New Zealand/Australia. Previous researchers have often asserted that the substance use and sexual practices of youth in New Zealand and Australia are comparable to those of adolescents in the United States and Europe (Caspi, Henry, McGee, Moffitt, & Silva, 1995; Dickson, Paul, Herbison, McNoe, & Silva, 1996; Millburn et al., 2007; Newman, Caspi, Magdol, Silva, & Stanton, 1996). The results of this study suggest that the effect is much stronger amongst New Zealander youth. However, it is notable that 3 of the 4 effects for New Zealand and Australia came from the same Dunedin sample. While it is unclear whether or not these results are generalizable to other New Zealanders or Australians, given that the data are from a birth cohort, the results are still informative.

Latin America. There was a small to moderate relation between substance use and risky sexual behavior among Latino youth. This finding is consistent with previous research that has suggested that the rates at which Latin American youth engage in concurrent substance use and risky sexual behavior is similar to the rates reported in the United States and Western Europe

(Brook, Brook, Pahl, & Montoya, 2002). One study found that, among Columbian youth, these behaviors were associated both within and over time (Brook et al., 2002). Columbia and Mexico, as well as other Latin American countries, are often typified by high levels of violence and drug trafficking (Brook et al., 2002; Brouwer et al., 2006). Drug trafficking in Latin America and Mexico has cultivated a drug-based economic system and due to its ability to support the aspirations for wealth for many impoverished Hispanics, drug use, over several generations, has become embedded in some Hispanic cultures (Ramos et al., 2009).

As a result of the strong drug culture, adolescents often report relatively high levels of early hard drug use, which is associated with engagement in risky sexual behavior (Brook et al., 2002; Brouwer et al., 2006). Furthermore, one study found that an interactive effect of victimization on the relation between RSB and SU, such that Columbian adolescents who reported little to no victimization were less likely to report substance use and risky sexual behavior (Brook et al., 2002). This would suggest that, for non-drug using, Columbian youth, protection from victimization could serve as a protective factor against later risky sexual behavior (Brook et al., 2002).

Europe, America, and Canada. Followed by the effect size for Latin American youth, there were small to moderate effects of substance use and risky sexual behavior among European and American/Canadian adolescents. There are many explanations for this observed relation, including a proposed direct effect of substance use on engagement in risky sexual behavior and a host of individual psychosocial factors that could predispose adolescents to engage in both behaviors, such as mental health functioning, beliefs about the influence of substances on sexual behavior, and the impact of familial and environmental factors on behavior (Bellis et al., 2008).

Africa. There was a positive, but small, relation between substance use and risky sexual behavior among African youth. One study found that this relation varied depending on the ethnic background on the youth. Specifically, there was a positive association between methamphetamine use and risky sexual behavior among Coloured adolescents; however, the researchers found a negative association between the behaviors among Black African youth (Wechsberg et al., 2010). The within population variability might explain the small effect and could suggest that there might be other factors contributing to the co-occurrence between RSB and SU. For example, one study found that adolescents in South Africa who reported ever having intercourse were more likely to report substance use as well (Flisher, Ziervogel, Chalton, Leger, & Robertson, 1996). However, other studies have not found a relation between risky sexual behavior and substance use, such that adolescents who reported substance use were no more or less likely to report unprotected intercourse than their non-using peers (Flisher & Chalton, 2001; Palen, Smith, Flisher, Caldwell, & Mpofu, 2006). Furthermore, it has been suggested that, among African adolescents, condom use is not associated with general risk behaviors, such as perpetration of violence, suggesting that the decision to engage in intercourse and the decision to use condoms have different psychological motives for these adolescents.

Asia. It is possible that the reasons that adolescents choose to engage in sexual intercourse differ from the reasons that adolescents choose or choose not to use condoms. For instance, adolescents who engage in intercourse may be motivated by needs for intimacy and social enhancement, while the decision to engage in protected intercourse could be related to one's planning ability, knowledge of contraceptive use, or one's power in the relationship (Choquet & Manfredi, 1992). This is likely the case for Asian adolescents, as there was not a significant association between RSB and SU. Research has shown that adolescents in Asian

countries tend to initiate intercourse during emerging adulthood, especially among females, as female virginity is viewed as an important component in preserving class, reputation, and wealth (Keys, Rosenthal, & Pitts, 2006). Therefore, for those adolescents who are sexually active, some studies have found significant associations between sexual behavior and substance use, but not risky sexual behavior and substance (Kaljee et al., 2005).

Taken together, the results of this moderator analysis, along with previous research, suggest that the association between substance use and risky sexual behavior among adolescents is greater in developed nations and those nations with strong drug trafficking connections. There are likely to be cultural factors involved in the stronger associations in certain countries. For example, in Europe and the United States, substance use and risky sexual behavior have been popularized in entertainment media, such as within adolescent-focused television shows and popular music. Additionally, certain contexts, such as clubs and parties, are often closely linked to the co-occurrence of substance use and risky sexual behavior. Conversely, in developing nations, there may be more government control over entertainment media, such that programs showing such risky behaviors would be considered taboo and culturally inappropriate, or adolescents may have greater difficulty gaining access to drugs and finding opportunities to engage in sexual behaviors, which are often prohibited for females prior to marriage. In these countries, adolescent substance use may be highly uncommon, thus the relation could only be assessed among a smaller group of particularly risky adolescents, making a significant effect of nationality, unlikely.

Ethnicity. Ethnicity was another important moderator of the relation between SU and RSB. Specifically, our results show that, across studies, samples that included larger numbers of Caucasian, Hispanic, and Asian youth reported greater associations between substance use and

risky sexual behavior. We found this to be true even for studies that did not include the ethnicity of the participants in the article and simply reported that they were ethnic minorities or non-Caucasian. In other words, as the percentage of Caucasian, Hispanic, Asian, and unspecified, minority youth increased, so did the strength of the association between substance use and risky sexual behavior. The strongest relation was found for minority adolescents, followed by Hispanic, Asian, and Caucasian youth, respectively. It is difficult to interpret the results for studies that cluster all minorities into one category, as we are unable to determine if cultural differences contribute to the motives of engaging in both behaviors.

Hispanic youth. Some researchers have speculated that culture is among the contributing factors for the co-occurrence of substance use and risky sexual behavior among Hispanic youth. It is possible that Hispanic or Latino adolescents experience greater levels of exposure to substances due to trafficking (Brook et al., 2002). Some researchers have suggested that, culturally, condom use among Latino or Hispanic women may be contrary to cultural norms that assert that women should avoid sexual assertion or expression (Marin & Marin, 1990). Taken together, Hispanic or Latino women may report stronger associations between substance use and risky sexual behavior due to the availability of drugs and cultural norms that may restrict women's perceived power to insist that their male partners use condoms.

Adolescents of African descent. For adolescents of African descent, the magnitude of the relation between substance use and risky sexual behavior was weaker, such that an increase in the representation of adolescents of African descent lead to a weaker association between SU and RSB. Overall, regardless of gender, research has shown that adolescents of African descent report much less substance use than their Hispanic or Caucasian peers; on the other hand, they are more likely to report being sexually active (Blum et al., 2000). It is likely that, for

adolescents of African descent, these behaviors are not strongly related or that there are untapped moderators of this relation for these adolescents.

Gender differences and ethnicity. It is also worth considering the gender differences in substance use. While some researchers have suggested that the gap between male and female drug use is narrowing, other researchers have suggested that gender differences often depend on the ethnicity and culture of the individuals. For example, data from the Monitoring the Future study suggest that, for Caucasian and Asian American youth, there was a gender difference of 7%; for African American youth, the gender difference was 11%; for Mexican, Puerto Rican, and Latino American youth, the gender differences were 14%, 10%, and 9%, respectively (Johnston et al., 2006). These percents may vary by nationality as well. This suggests that, for some females, substance use may be less normative and could be more indicative of a problem behavior syndrome. Problem Behavior Theory (Jessor & Jessor, 1977) has been used to explain the co-occurrence of substance use with other harmful behaviors, such as risky sexual behavior. Using latent growth curve modeling, one study found strong support for the Problem Behavior Theory, showing that the development of substance use covaried with participation in risky sexual behavior (Duncan, Strycker, & Duncan, 1999). Additionally, research has shown that problems with substance use and engagement in risky sexual behavior share similar risk factors, such as emotional dysregulation and victimization (Mezzich et al., 1997).

In sum, the results of this moderator analysis suggest that some ethnic minority youth are at greater risk for participating in drug use and risky sex than their Caucasian peers. As previously indicated, cultural expectations and norms may moderate the relation between these two variables among ethnic minority youth, with the exception of adolescents of African descent. Adolescents of African descent show weaker associations between substance use and risky

sexual behavior, which suggests that these two activities do not go hand-in-hand and this could explain the lackluster results reported by some intervention programs whose aims to reduce HIV-risk behaviors have centered on interventions designed to reduce substance use.

Age. Our results indicate that there was a significant effect of mean age on the risky sexual behavior to substance use relation, such that older adolescents, or samples with a higher mean age, reported greater associations between SU and RSB than younger adolescents. This finding is supported by previous research (e.g., Millburn, 2007). There are many reasons why older youth might report stronger associations between these two risk behaviors. As adolescents age, there is often a reduction in the social controls, such as parental monitoring, that might have previously led to a limited opportunity to engage in risk behaviors. Not only do older adolescents enjoy less parental overseeing, but also they are more likely to befriend peers who engage risky behaviors, thereby inducing pressure to fit-in (Millburn, 2007; Unger et al., 1998). In addition to less supervision and greater social pressures, older adolescents are likely to have more knowledge about the perceived effects of certain drugs on sexual behavior than their younger peers. They may be more likely to ‘test’ the effects of these drugs on their behaviors, including sexual behaviors, due to greater accessibility and knowledge on how to obtain the drugs. During a sexual event, this experimentation with drugs could lead to risky sexual behavior if adolescents are mentally unprepared or fail to recognize the inherent risk to their health and wellbeing due to substance use impairment.

While older adolescents tend to engage in higher rates of risky behaviors, some researchers have suggested that younger adolescents initiating such behaviors are at greater risk due to the higher likelihood of using drugs as a means to self-medicate (Hanna, Yi, Dufour, & Whitmore, 2001). Such adolescents could be more likely to engage in substance use and

concurrent risky sexual behavior as a means to garner attention and support from parents, peers, or sexual partners. Early initiation of substance use and risky sexual behavior prior to entering full adolescence (approx. 14 years old) could be indicative of inherent personality characteristics or an overall risky behavior syndrome that develops during early adolescence and tends to worsen with age and experience (Rose, 1998).

Sample type. The results of this study indicated that there were significant effects of sample type (i.e., clinical, community, or forensic) on the SU and RSB relation.

Clinical populations. Our findings showed that adolescents in clinical settings, such as inpatient or outpatient psychiatric institutions, exhibited a stronger association between risky sexual behavior and substance use than those in community settings. This finding extends previous research in which substance-abusing adolescents in clinical settings, as well as other disturbed youth, were found to engage in higher levels of risky sexual behavior than those without a history of substance abuse (Deas-Nesmith, Brady, White, & Campbell, 1999; Otto-Salaj, Gore-Felton, McGarvey, & Canterbury, 2002; Tapert, Aarons, Sedlar, & Brown, 2001). For example, one study found that, when compared to socially and demographically similar peers in community settings, adolescents with substance use disorders in psychiatric settings reported greater associations between risky sexual behaviors, including intercourse with multiple partners and unprotected intercourse, years after treatment in an inpatient psychiatric setting (Tapert et al., 2001).

Adolescents with psychiatric disorders are at great risk for contracting a sexually transmitted disease (Brown, Danovsky, Lourie, DiClemente, & Ponton, 1997). Furthermore, previous research has demonstrated that adolescents with comorbid psychiatric and substance use disorders within inpatient settings are at increased risk for engaging in HIV-risk behaviors

(DiClemente & Ponton, 1993). Specifically, the relation between substance use and risky sexual behavior appears to be stronger among those diagnosed with externalizing disorders rather than internalizing disorders (Abrantes, Strong, Ramsey, Kazura, & Brown, 2006). Depending on one's diagnosis, inherent in the problems faced by many individuals in treatment for psychological disorders are their deficits in decision-making. Such deficits could increase one's chances of participating in both substance use and risky sex.

Forensic populations. The findings on the association between RSB and SU among adolescents in forensic settings have varied. Although some studies have concluded that adolescents in forensic settings report higher associations between risky sexual behavior and substance use, the results of this study indicate that the effect among forensic populations was the smallest and not significant according to the range of the confidence interval. This finding highlights the utility of meta-analyses in that it demonstrates that across studies, these behaviors are no more likely to co-occur than other risk behaviors. However, methodological differences among studies make it difficult to interpret this effect. For example, many studies conducted on juvenile populations fail to indicate the category in which their alleged crimes fall. It is possible that comparing an adolescent who was arrested for selling drugs is different from one who was arrested for using drugs, or from an adolescent involved in a sexual or physical assault, such that one may be more likely to engage in SU and RSB than another set of risk behaviors. Failure to distinguish between such groups of adolescents could distort this effect. On the other hand, this finding suggests that, overall, juvenile offenders do not differ in their likelihood of engaging in risky sexual behavior and substance use from their peers in community and clinical settings. While these findings are not an indication that juveniles engage in lower levels of substance use and risky sexual behavior, they are an indication that as a group, juvenile populations do not

systematically engage in both behaviors concurrently. Juvenile offenders who are under the supervision of a parole officer are likely to be frequently subjected to random drug tests, which may temporarily decrease their overall drug use. However, in most situations, juveniles are not going to be prosecuted for engaging in risky sexual behavior, which could impact the overall association between SU and RSB.

Sexual orientation. Few studies have examined the impact of sexual orientation on the SU and RSB relation. Our study indicated that there was a significant effect of sexual orientation on the substance use and risky sexual behavior relation, such that, as the percentage of adolescents who self-identified as heterosexual or bisexual increased, the strength of the association between substance use and risky sexual behavior decreased. On the other hand, as the percentage of adolescents who were identified as gay and/or bisexual increased, the magnitude of the association between substance use and risky sexual behavior increased as well. Studies utilizing this category often focus on young men who have sex with men (YMSM). This description includes men who describe their sexual orientation as heterosexual, but engage in intercourse with other men.

Research has shown that same-sex attraction is associated with the frequency of binge drinking (Smith, Lindsay, & Rosenthal, 1999). As adolescence is often a time of sexual discovery and identity development, it is possible that youth who feel ambiguity about their sexual identity are likely to use substances to cope (Celentano et al., 2006). In fact, gay, lesbian, and bisexual youth report more frequent substance use than their heterosexual peers (Blake, Ledsky, Lehman, Goodenow, Sawyer, & Hack, 2001). Additionally, YMSM, especially those who identify themselves as heterosexual, might use substances to relieve the anxiety or reluctance they may have that is related to their participation in high risk sex with other men

(Celentano et al., 2006). There may be contextual factors that contribute to the relation between substance use and risky sexual behavior as well. For example, YMSM who frequent gay bars are more likely to report engaging in substance use and high-risk sexual behaviors with casual partners (Seage et al., 1998).

In a seemingly paradoxical manner, identification as strictly homosexual did not significantly impact the substance use and risky sexual behavior relation. This finding seems to conflict with previous reports of a significant relation between drug use and sexual risk among adult populations. Among adolescents and emerging adults, there does not appear to be a significant impact of homosexuality on the strength of the relation between substance use and risky sex. While some gay youth may engage in high levels of sexual risk or drug use, the two behaviors do not appear to be connected. Much of the research examining the impact of homosexuality on engagement in SU and RSB has been conducted using adolescent or young adult male populations. While it may seem contradictory that YMSM have stronger relations between RSB and SU and gay adolescents and young adults do not show such a relation, there are potential explanations for this difference. One explanation, for example, could involve the level of comfort and acceptance of one's sexual orientation and identity. It could be that gay youth who are open and 'out' about their identity are less likely to engage in substance use to reduce anxieties related to participating in sex with a man. YMSM, on the other hand, could include individuals who are uncomfortable with their sexual preferences and thus use drugs as an excuse to participate in high-risk, sexual behaviors or with the expectation that substance use will lead to or facilitate sexual behavior (Celentano, 2006).

Measurement factors

Method of assessment. Consistent with previous research, there was a significant effect of method of assessment on the association between substance use and risky sexual behavior. The results indicated that adolescents responding by way of self-report, or another self-administered instrument (e.g., audio-CASI), reported stronger associations between risky sexual behavior and substance use than did adolescents who provided responses by way of face-to-face interviews. This finding is consistent with previous research suggesting that the perceived degree of privacy during an interview could affect adolescents' willingness to disclose information on sensitive behaviors (Turner, Danella, Rogers, 1995). The desire for attention and social desirability, which is a desire to cause others to have a positive view of oneself, could influence adolescents' in-person responses to questions inquiring about sensitive or deviant behaviors, such that they either underreport or overreport their levels of engagement in risk behaviors (Alexander, Somerfield, Ensminger, Johnson, & Kim, 1993; Sudman & Bradburn, 1974). Furthermore, research has shown that reports of risky sexual behavior and substance use increase when adolescents completed the audio-CASI, a computerized, self-administered survey, than when they completed paper and pencil, self-report surveys (Turner et al., 1998). These findings suggest that self-administered instruments are one of the most effective ways to gauge an adolescent's degree of participation in high-risk behaviors. In the face-to-face interview context, adolescents may worry about how disclosure of multiple high-risk behaviors might affect the interview's view of them. In contrast, adolescents completing a self-administered instrument may experience a greater sense of anonymity, which could increase the chances of them reporting high risk behaviors such as simultaneous risky sex and substance use without fear of criticism or judgment.

Type of drug. The type of drug used was an important moderator of the strength of the association between substance use and risky sexual behavior. There has been a significant amount of debate regarding which drugs are linked to risky sexual behavior. This meta-analysis has elucidated this question for adolescents.

Multiple drugs. The strongest association was found for adolescents who reported multiple drug use, including the use of alcohol and hard drugs. This finding is consistent with previous research that suggests that individuals who use multiple substances in concurrence with intercourse are less likely to use a condom, are more likely to have casual sex and have multiple sexual partners, and have higher rates of sexually transmitted infections and diseases (MacKenzie, 1993). This effect was followed by use of hard drugs, marijuana, and alcohol, respectively.

Hard drugs. The findings from this study, as well as from previous research, suggest that, more so than any other group of drugs, adolescents reporting hard drug use, such as stimulant use, report greater associations with substance use and sexual risk behaviors, (MacKenzie, 1993). In the short-term, substance users often report enhancements in sexual experiences as well as a heightened sex drive and potential for multiple orgasms. Moreover, the effects of stimulants, such as cocaine and crack, have been likened to the sensation caused by orgasm (MacKenzie, 1993).

Marijuana. The effect of hard drugs on the SU to RSB relation was followed in magnitude by the effect of marijuana. Marijuana has been argued to increase sensitivity to sensation, decrease inhibitions, and distort the senses, such as the sense of time, sound, color, and texture (MacKenzie, 1993). While users report that marijuana has a positive effect on their

perception of sexual pleasure, researchers have demonstrated that marijuana often leads to sexual dysfunction and impotence (MacKenzie, 1993).

Alcohol. Lastly, alcohol has the smallest association with risky sexual behaviors among adolescents. While it is generally assumed that alcohol has disinhibiting effects on behavior, leading to greater sexual risk (Cooper, 2002), the results of this study suggest that this explanation may only be partially accurate, given its small effect. Alcohol affects the central nervous system and often leads to slowed reaction time and memory deficits (MacKenzie, 1993). The small effect of alcohol on the substance use and risky sexual behavior association, as well as its affect on the brain, is consistent with previous research that suggests that an alcohol user's beliefs about the impact of the drug on risky sexual behavior might be more important than the pharmacological effects of the drug (Cooper, 2006; MacKenzie, 1993). Prescription drug use was not included as a moderator due to the paucity of studies that have examined the relation between this drug category and risky sexual behavior.

Type of drug is an important category, as research has shown that, overall, adolescents often show a preference for certain drugs, likely due to availability and perceived effects. For example, results from the 2009 National Survey on Drug Use and Health showed that, for adolescents aged 16 and 17, rates of substance use in the past month were as follows: alcohol (26.3%), marijuana (14.0%), prescription drugs for recreational purposes (4.3%), and hard drugs (3.0%). Adolescent drug use is influenced by individual attitudes and perceptions regarding the risk of initiating drug use and developing addiction (NIDA, 2003). Theoretically, adolescents show a preference for alcohol and marijuana because they perceive these two drugs as less harmful (NIDA, 2003).

While it is encouraging that the drugs with the greatest acute impact on risky sexual behavior, multiple drugs and hard drugs, tend to be used by fewer adolescents, this group of adolescents is likely to be most at-risk for STI and STD infection due to the strong addictive qualities of the drugs and their link to sexual risk behaviors. Furthermore, as alcohol and marijuana have smaller impacts on the magnitude of the effect, yet are used more commonly used by adolescents, one could hypothesize that the relation between substance use and risky sexual behavior may be mostly psychological in nature for adolescents.

RSB definition. Participants having intercourse with an intravenous drug user reported the strongest association between substance use and risky sex. The strength of this relation was followed by studies that used an aggregate measure of risky sexual behavior. The smallest effects were found for studies that measured RSB by means of multiple sexual partners and unprotected intercourse, respectively. There was a relatively small sample of studies that examined the relation between substance use and intercourse with an intravenous drug user (IVDU). While research has shown that intravenous drug use among adolescents is relatively uncommon, adolescents engaging in intercourse with older partners or who participate in survival sex/sex in exchange for drugs report greater associations between RSB and SU, (Bailey, Camlin, & Ennett, 1998). The studies included in this sample were based on a population of homeless or runaway youth.

Previous research has indicated that there are strong contextual influences on high-risk sex and substance use relation among homeless runaway youth. Specifically, these adolescents report greater substance use and greater levels of unprotected intercourse with regular sexual partners, which may increase their risk for STI and HIV infection (Bailey et al., 1998). There was a weaker effect of unprotected sex on the SU and RSB relation. This would suggest that,

while there is a significant association between unprotected intercourse and substance use, there are likely other factors that impact an individual's choice on whether or not to use a condom. For example, motivation to use condoms appears to be unaffected by impairment due to substance use (Bailey et al., 1998). Additionally, the findings from this study could suggest that single measurements of RSB are not as accurate or effective in assessing adolescents' degree of engagement in RSB, which could impact our assessments of the strength of the association between sexual risk behaviors and substance use.

SU definition. Drug use definition was a significant moderator of the relation between substance use and risky sexual behavior. The strongest association was found among participants with clinical diagnoses of substance use disorders. The magnitude of this effect was followed by studies in which drug use was measured by frequency and/or quantity of use. The weakest effect was found in studies in which drug use was measured dichotomously (e.g., user versus nonuser). Adolescents with substance use disorders often report greater participation in risky behaviors, including risky sexual behavior and substance use (Cook et al., 2006). According to the 2003 National Survey on Drug Use, approximately 17.2% of emerging adults reported a diagnosis of alcohol abuse or dependence and about 5.9% reported marijuana abuse or dependence (SAMHSA, 2003).

Adolescents with substance use disorders have reported having at least twice as many sexual partners and were 70% more likely to have been diagnosed with a STD than their peers without substance abuse disorders (Cook et al., 2006). Dichotomous measures of substance use, on the other hand, presented the weakest association. Dichotomous measures are often global measurements of substance use that may or may not present problems for emerging adults; as such measures often fail to assess the severity of substance use or could present a spurious

relation due to the impact of an unidentified third variable, such as personality (Leigh & Stall, 1993). Additionally, the dichotomization of continuous variables often produces less powerful, more skewed, and poorer results. In both cases, substance use disorders and dichotomous measures of substance use could be indicative of an overall tendency to engage in multiple risk behaviors.

RSB relation measurement. One of the most important moderators in this study involved the measurement of the relation between SU and RSB. Specifically, there are three general categories in which this relation is often assessed: globally, at the situational level, and at the event level. Risky sexual behavior measured at the global level had the largest effect, followed by those measured at the situational level. There are many reasons for a significant finding when studies are measured on a global level. First, engaging in risky sexual behavior and substance use could be indicative of a tendency to participate in multiple risk behaviors, representing a problem behavior syndrome. Furthermore, studies measured at the global level often provide information on the type of person who is most likely to use substances and have multiple sexual partners, for example (Bryan et al., 2007).

Secondly, it is possible that the use of certain substances, such as hard drugs, increase the likelihood that someone will engage in risky sexual behavior as a result of the pharmacological effects of the drug. However, this explanation is more evident for situational studies, in which a risky sexual behavior is correlated with a sexual event during which substance use was used prior to or during the sexual situation. The issue with global measurements of RSB in relation to substance use is that one cannot be sure that the behaviors are occurring concurrently, or even within the same time period.

On the other hand, RSB measured at the event level, theoretically, is supposed to assess whether or not there is a temporal relation between RSB and SU. Studies measured at the event level, however, did not significantly impact the substance use to risky sexual behavior relation suggesting that, for adolescents, the selection of specific events during which risky sexual behavior occurred (e.g., the first or last time you had sex) is not related to substance use. These studies are meant to provide information on the types of situations in which substance use is more likely to lead to risky sexual behavior (Bryan et al., 2007). A non-significant finding at the event level could suggest that for many adolescents, risky sexual behavior is just as likely when substance use is not involved as it is under the influence (Brown & Vanable, 2007). Event-level studies are susceptible to retrospective bias and depending the quantity and frequency of drug use, it will likely be difficult for participants to recall specific events, such as the first or last intercourse (Halpern-Felsher, Millstein, & Ellen, 1996).

DU relation measurement. Measurements of drug use behaviors are also assessed in one of three ways: globally, or at the situational or event levels. There was a significant effect of drug use relationship measurement, such that drug use measured at the situational level had the largest effect, followed by those measured globally. This finding is significant and contributes to the literature in that, taken together, the relation between the measurement of risky sexual behavior and substance use will likely produce the strongest estimates of the magnitude of that relation when substance use is measured at the situational level and risky sex is measured at the global level (e.g., a correlation between drug use prior to/during sex and unprotected sex). The effect for studies measured at the event level was very small, indicating that these studies had little to no influence on the strength of the effect size.

Publication characteristics

Publication year. Older studies tended to report higher effect sizes than newer studies. This is likely due to the advances in our knowledge of best practices in terms of studying the relation between substance use and risky sexual behavior. For example, most of the older studies assessed the relation between SU and RSB globally. Newer studies, on the other hand, have incorporated new measurements, such as situational and event-level measurements. Additionally, newer studies also include more specific measures of risky sex and a diversity of substances. Alternatively, lower effect sizes over time could be a function of our advancement in education and knowledge of adolescent risky sexual behavior. Specifically, researchers and clinicians have been examining this relation for over 20 years and it is possible that some intervention and prevention programs and/or initiatives have led to an overall weakening of the relation between these two behaviors.

Document type. There was a significant publication bias, such that published studies reported stronger relations between RSB and SU. This is a potentially serious problem with the risky sexual behavior and substance use published literatures, as discrepancies in findings between unpublished reports and peer-reviewed articles could increase the likelihood of making type I or type II errors and could invalidate findings from published studies. However, adjusting the results of meta-analyses for publication bias by imputing fictional studies, although now accepted as standard within the field, remains a controversial practice for some meta-analysts (Begg, 1997). Furthermore, the fail-safe N suggest that there would need to be a significant amount of studies to average null findings in order to reduce the overall effect size to nonsignificance.

While it is not recommended that meta-analysts fully rely on the imputed effect size based on the fictional studies, it is suggested that measures of publication bias, specifically the

trim and fill method, be used as a means of assessing the sensitivity of the effect size to the effect of missing studies (Sutton, Duval, Tweedie, Abrams, & Jones, 2000). In fact, it has been estimated that publication bias changes the results in fewer than 10% of meta-analyses (Sutton et al., 2000). Aside from publication bias in editorial decision-making, it has been shown that publication bias could be significantly reduced if researchers submitted articles that contain negative, or even null, findings (Olson et al., 2005).

Limitations

Prior to discussing the implications, there are some limitations that must be considered when drawing conclusions from these findings. First, there are inherent limitations present in correlational data. Specifically, while the overall association between substance use and risky sexual behavior was positive, correlational data does not enable assumptions of a causal direction. Accordingly, these data do not indicate whether or not substance use causes risky sexual behavior. The results of this study indicate that there are significant moderators of the relation between SU and RSB, such that an unmeasured variable could account for a significant portion of the relation observed between the two variables. Secondly, there was a significant amount of measurement variability across studies, including variability in periods of recall (e.g., RSB in the past 2 months vs. RSB in the past year), method of assessment, type of population (e.g., national vs. local participants, random vs. convenience), and differences in socioeconomic status. While some of these factors did in fact moderate the relation between RSB and SU, other factors, such as period of recall, type of population, and SES, were not assessed in this meta-analysis. As a result, more studies are needed to examine the potential impact of these contextual factors on the relation between substance use and risky sexual behavior. For example, within event-level studies, the measurement of the relation between risky sexual behavior and substance

use has varied across studies, such that some studies investigated the link between substance use during the first intercourse and others have looked at substance use during the most recent intercourse. Other third variables that should be considered include individual characteristics such as personality and familial factors, such as parental supervision and familial composition (e.g., influence of siblings and extended family members). Despite the variability, there was still an overall relation between substance use and risky sexual behavior.

Implications for intervention and prevention

By and large, the findings from this study are consistent with a considerable body of literature that has suggested that there is a positive relation between substance use and risky sexual behavior. Taken together, these findings warrant the attention of prevention and intervention researchers who implement strategies meant to reduce risky sexual behavior by focusing on adolescent substance use. Although, across studies, there was a positive association between substance use and risky sex, this effect was small to moderate, indicating that there may be individual, contextual, and environmental factors that significantly impact the co-occurrence of these risk behaviors. This effect, however, remains significant and important to our understanding of the relation between these two variables.

The diversity of the potential causes for adolescent participation in these risky behaviors calls for the need to develop targeted intervention programs that are aimed at individuals who participate in similar risk behaviors for similar reasons in similar contexts. In other words, intervention programs should be tailored to the population being treated. For example, young men who have sex with men (YMSM) report increases in substance use and unprotected intercourse in environments typically associated with those behaviors, such as gay bars (Purcell et al., 2001). This would suggest that interventionists and prevention specialists should tailor

their programs to meet the specific needs of this population, as there are specific environments that have been culturally associated with the co-occurrence of these behaviors. Additionally, HIV-positive, YMSM who engage in substance use prior to or during intercourse are more likely to use condoms with partners whose serostatus is known, which has implications for intervention programs. Furthermore, these results suggest that, for most adolescents, the main focus of intervention programs should not be on reducing substance use.

For majority adolescents, the focus should instead be on increasing awareness of the influence of one's substance use expectations on risky sexual behavior and ensuring that condoms are available in high-risk settings (Bryan et al., 2007). In addition to context, culture, ethnicity, and nationality seem to be important sources of variability among findings. For example, previous research has tended to lump adolescents into the same category under the assumption that the similarity in age was more important than dissimilarities due to a variety of factors. Previous studies have shown that drug use behaviors vary by ethnicity and gender. Specifically, one study reported that some moderators of the SU and RSB relation, such as sensation-seeking, frequency and quantity of substance use, and peer influence, were more predictive for Caucasian adolescents than for youth of African American descent (Brown, Miller, & Clayton, 2004). Furthermore, African American adolescent females reported less substance use than their Caucasian and Hispanic peers (Brown et al., 2004). This finding, along with the results of this meta-analysis, suggests that intervention and prevention programs may need to be tailored according to culture, ethnicity, and/or gender.

We found significant differences between nationality and the strength of the association between substance use and risky sexual behavior. This would suggest further needs for modification when considering implementing efficacious programs designed for American and

Canadian youth with adolescents of other nationalities. Within the United States and Canada, within group differences, such as one's racial identity and degree of acculturation, could impact his or her acceptance of substance use and sexual risk behaviors (Brown et al., 2004). Although not examined in this meta-analysis, research suggests that the relation between unprotected intercourse and substance use could be moderated by partner type and relationship status (Brown & Vanable, 2007). As previously mentioned, adolescents are more likely to use substances with casual sexual partners, which is often connected to risky sexual behavior; however, there was no significant relation between SU and RSB with steady sexual partners (Brown & Vanable, 2007).

It would be very informative to gather information from adolescents in steady partnerships. Here, the goal would be to have both partners participate in a research study to determine how situational factors contribute to substance use and sexual risk (Cooper, 2002). Additionally, it would provide insight into relationship factors, such as power differential, that might moderate this relation. Regarding drug of choice, alcohol and marijuana use, which were preferred among adolescents, were least associated with risky sexual behavior. Therefore, intervention and prevention studies should likely incorporate drug education components that inform adolescents involved in hard drug use of the drugs dangers and relation to risky sexual behaviors in order to encourage awareness and preparation. Most substance use and risky sexual behavior intervention programs focus on individual treatment and education. However, for those adolescents and young adults most at-risk for participating in these behaviors, a multisystemic approach may be more effective.

Researchers have investigated several causal models for substance use and engagement in risky sexual behavior, which often include expectations and motivations, personality, parental monitoring, peer influence, and neighborhood and school factors (Bachanas et al., 2002;

DiClemente, Salazar, Crosby, & Rosenthal, 2005; Dutra, Miller, & Forehand, 1999; St. Lawrence, Brasfield, Jefferson, Allyene, 1994). Subsequent intervention programs could include community-based participatory research efforts to address adolescents' needs for supervision and support. This could involve individual and family level intervention, as well as intervention by way of school involvement or community initiatives. The relation between risky sexual behavior and substance use is of great importance due to its relation to HIV infection. However, the perceived seriousness of HIV has changed in the past 20 years, such that it no longer appears to be a 'death sentence,' as many HIV-positive individuals are leading longer and seemingly healthy lives (Gulick, 2000; Remien & Borkowski, 2005).

In the past, most intervention programs focused on motivating HIV-negative individuals to protect themselves from infection; however, there has been a shift in public health research to intervene with individuals who are already infected (CDC, 2006; O'Leary & Wolitski, 2009). Researchers have argued that reflections of moral agency, which refers to processes related to moral decision-making guided by personal standards (Bandora, 1999), take several forms when considered in the context of HIV transmission. For example, HIV-positive individuals should feel a sense of personal responsibility to protect uninfected individuals from harm through disclosure and protected sexual acts (O'Leary & Wolitski, 2009). To increase moral agency and personal responsibility, interventionists have included components to their programs that have emphasized the importance to serostatus disclosure, altruism, and the enhancement of self-efficacy and skills to reduce risk behaviors (Kalichman et al., 2001; O'Leary & Wolitski, 2009; Rotheram-Borus et al., 2004).

Specific treatment recommendations by moderator group

Sample characteristics. The results of this study suggest that female adolescents show stronger associations between risky sex and substance use. Intervention programs should make particular efforts to address the unique needs of females, such as power differentials within relationships and other contextual risk factors. Adolescent females may require additional information on situations that may put them at greater risk for engaging in risk behaviors while using certain substances. It is possible that adolescent females lack the skills necessary to feel confident in their ability to negotiate condom use with older partners, for instance.

Adolescents in New Zealand/ Australia and Latin America reported the strongest associations between substance use and RSB. This would suggest that additional research is needed in order to understand why stronger relations were reported amongst these adolescents. It is possible the intervention and prevention programs in these countries should focus on the impact of substance use on RSB, as there is a strong drug culture in many Latin American countries, for example, and this culture of use could contribute to associations observed between other risk behaviors, such as risky sex. Targeted intervention programs should include cultural components that educate adolescents on the dangers of drug use.

Ethnicity was also an important moderator of the SU and RSB relation. Specifically, the results of this study suggest that the co-occurrence of these two behaviors is stronger for Hispanic, Asian, and Caucasian youth. Intervention programs should target risk factors that put adolescents in these groups at greater risk, which could include cultural and environmental factors. Furthermore, older adolescents report greater associations between substance use and risky sexual behavior. Prevention programs should likely target youth of high school age, as they are more likely to have access to drugs and more freedom from parental oversight to engage in

sexual behavior. The importance of safe sex should be emphasized, as well as the potential pharmacological and cognitive factors that could influence the co-occurrence of these behaviors.

Measurement factors. Adolescents who engage in multiple drug use and hard drug use reported the strongest associations with RSB. Such adolescents may differ from their peers on a variety of levels, including personality and familial factors. Targeted intervention programs should focus on treatment of individual factors that may affect one's coping skills. These findings also have implications for programs that focus on alcohol or marijuana usage. Our results show that alcohol and marijuana have weaker relations with risky sexual behavior, which suggests that those programs focusing on these two drugs may not be as efficacious as those that emphasize multiple drug use or hard drug use.

Broader implications for risk behavior research

The findings from this study could have broader implications for all risk behavior research. For instance, this study has shown that the method in which questions are delivered is very important when attempting to assess sensitive information. Specifically, participants may be more likely to report engagement in risk behaviors when they are given self-report measures. The audio-CASI has been growing in popularity due to the perceived privacy, confidentiality, and control for literacy issues (Brener et al., 2003). Additionally, researchers interested in assessing the temporal relation between risk behaviors could consider collecting data using online daily diary methods (Cooper, 2002). Such a method could reduce the recall bias and enable adolescents to feel as sense of anonymity when completing the study.

The diversity of methodology and assessment techniques often makes examining the impact of mediators and moderators on specific health risk behaviors, difficult. It is important, for reliability and validity purposes, that researchers operationalize behaviors, similarly. For

example, in the risky sexual behavior and substance use literature, these risk behaviors are often measured in a variety of ways, often with insufficient items. This reduces our ability to generalize findings. Additionally, there is often a significant amount of publication bias in prevention and intervention research. This leads to over-inflation or underestimation of effects. It is important for researchers to submit studies with negative or null findings for publication to get a more accurate picture of the relation between risk behaviors.

Conclusion

There were three primary aims of this meta-analysis. First, we sought to statistically measure the strength and moderators of the relation between risky sexual behavior and substance use among adolescents. Second, the meta-analysis facilitated the identification of studies that produced the strongest effect sizes to identify moderators of importance—relationship status, partner type, ethnic identity, and other factors such as personality, parenting practices, peer influence, and neighborhood and school factors. Third, and most importantly, the results of this meta-analysis provide insight into the complexities of the relation between substance use and risky sexual behavior among adolescents thereby influencing future studies on this topic. The results of this meta-analysis suggest that, while there is a relation between risky sexual behavior and substance use, the association is in the small to moderate range, indicating that other factors must be considered in examining this association. Furthermore, the strength of this association varied by gender, nationality, ethnicity, and methodological factors. This suggests that intervention programs for adolescents should be tailored to the characteristics of those being treated. Future research should investigate the effectiveness of multisystemic intervention programs and community-based partnership initiatives.

The results of the collinearity tests were significant among nearly all of the moderator variables. These findings offer additional support for the call for research that will attempt to control for correlated variables, which would enable us to identify the unique variance contributed by each moderators and further help us to understand how they impact the risky sex to substance use relation among adolescents. For example, the percentage of females in the study was significantly related to other moderators, such as nationality, sample type, drug use and risky sex assessment, and relation measurement. These results could suggest that we should expect similar patterns when examining these moderators or that we need additional studies that will compare the independent and interactive effects of these moderators on the SU and RSB relation.

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Table 1. Descriptives from included studies

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Pritchard & Cox (2007)	Europe	1690	15	Community	Alcohol	Condom nonuse	Global	Global
Ramrakha et al. (2000)	Australia/ New Zealand	992	21	Community	Multiple Drugs	General RSB	Global	Global
Hoffman et al. (2006)	Africa	50	19.1	Community	Alcohol	Condom nonuse	Situational	Global
							Global	Situational
Bryan, Ray, & Cooper (2007)	US & Canada	226	15.56	Forensic	Alcohol	Condom nonuse	Event	Event
							Global	Global
Naff Johnson (1996)	US & Canada	262	19	Community	Alcohol	General RSB	Global	Global
							Situational	Global
Poulin & Graham (2001)	US & Canada	1789	16	Community	Alcohol	Condom nonuse	Global	Global
					Marijuana			
					Alcohol	Multiple Sexual Partners	Global	Global
					Marijuana			

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Guo et al. (2002)	US & Canada	625	21	Community	Alcohol Marijuana Hard Drugs	Condom nonuse	Global	Global
Koopman, Rosario, & Rotheram-Borus (1994)	US & Canada	302	15.6	Community	Marijuana Hard Drugs Alcohol Hard Drugs	Condom nonuse Multiple Sexual Partners	Global	Global
Lowry et al. (1999)	US & Canada	11,631		Community	Marijuana Hard Drugs Marijuana Hard Drugs	Condom nonuse Multiple Sexual Partners	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Gomez, Sola, Cortes, & Mira (2007)	Europe	338	18.24	Community	Alcohol	General RSB	Global	Global
Kingree & Betz (2003)	US & Canada	210	15.43	Forensic	Alcohol	Condom nonuse	Event	Event
			14.82	Forensic	Alcohol Marijuana	Condom nonuse	Event	Event
Ellickson et al. (2005)	US & Canada	3401	23	Community	Alcohol	General RSB	Global	Global
					Marijuana Hard Drugs Alcohol Multiple Drugs Multiple Drugs	Condom nonuse	Situational	
Twa-Twa, Oketcho, Siziya, & Muula (2008)	Africa	193	16.34	Community	Alcohol	Condom nonuse	Global	Event
					Multiple Drugs			

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Voisin et al. (2007)	US & Canada	550	15.4	Forensic	Alcohol Marijuana Hard Drugs Multiple Drugs	Condom nonuse	Global Situational	Event
Deas-Nesmith, Brady, White, & Campbell (1999)	US & Canada	90	14.8	Clinical	Multiple Drugs	Condom nonuse	Global	Global
Rotheram-Borus et al. (1994)	US & Canada	131	16.8	Community	Alcohol Marijuana Hard Drugs	Condom nonuse	Global	Global
Bachanas et al. (2002)	US & Canada	158	15.7	Community	Multiple Drugs	General RSB	Global	Global
Donenberg et al. (2001)	US & Canada	86	16.01	Clinical	Multiple Drugs	General RSB	Global	Global
Brown & Venable (2007)	US & Canada	320	18.9	Community	Alcohol	Condom nonuse	Event Global	Event
Roberts & Kennedy (2006)	US & Canada	100	20.2	Community	Multiple Drugs	Condom nonuse	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Strunin & Hingson (1992)	US & Canada	398	17.34	Community	Alcohol Multiple Drugs	Condom nonuse	Situational	Situational
Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Mpofu et al. (2005)	Africa	1526	16.36	Community	Alcohol Marijuana Hard Drugs	Multiple Sexual Partners	Global	Global
Baskin-Sommers & Sommers (2006)	US & Canada	243	21.41	Community	Alcohol Hard Drugs Marijuana Alcohol Hard Drugs Marijuana	Condom nonuse Multiple Sexual Partners	Situational Situational	Situational

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Fergusson & Lynskey (1996)	Australia/New Zealand	953	15.5	Community	Alcohol	Condom nonuse Multiple Sexual Partners	Global Global	Global
Crockett, Raffaelli, & Shen (2006)	US & Canada	518	16.5	Community	Multiple Drugs	General RSB	Global	Global
Cook et al. (2006)	US & Canada	448	20.4	Community	Multiple Drugs	Multiple Sexual Partners Condom nonuse	Global Global	Global
Morrison et al. (2003)	US & Canada	73	17	Community	Alcohol	Condom nonuse	Situational	Situational
Babikian et al. (2004)	Europe	299	18.3	Community	Alcohol	General RSB	Global	Global
MacKeller et al. (2000)	US & Canada	879	16.5	Community	Alcohol	Condom nonuse	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Bailey, Camlin, & Ennett (1998)	US & Canada	289	17	Community	Alcohol	Condom nonuse	Global	Global
					Marijuana			
					Hard Drugs			
					Alcohol	Multiple Sexual Partners	Global	Global
					Marijuana			
					Hard Drugs			
					Alcohol	Condom nonuse	Event	Event
					Marijuana			
Wislar & Fendrich (2000)	US & Canada	12,887	15.2	Forensic	Alcohol	Sex with IV Drug user	Global	Global
					Marijuana			
					Hard Drugs			
						Multiple Sexual Partners	Global	Global
						Multiple Sexual Partners	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Celentano et al. (2006)	US & Canada	3492	18.5	Community	Alcohol Marijuana Hard Drugs	Condom nonuse	Situational	Situational
Grossbard et al. (2007)	US & Canada	2123	18	Community	Alcohol	Multiple Sexual Partners	Situational	Global
Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Heffernan, Chiasson, & Sackoff (1996)	US & Canada	220	17.5	Community	Hard Drugs	Sex with IV Drug user Multiple Sexual Partners	Global	Global
Khasakhala & Mturi (2008)	Africa	3716	19.94	Community	Alcohol	General RSB	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Bailey, Gao, & Duncan (2006)	US & Canada	134	19.7	Other	Alcohol	Condom nonuse	Event	Event
					Multiple Drugs	Condom nonuse	Event Global	
McNall & Remafedi (1999)	US & Canada	817	19.23	Community	Alcohol Marijuana Hard Drugs	Condom nonuse	Situational	Global
Morrison-Beedy, Carey, Feng, & Tu (2008)	US & Canada	102	19.5	Community	Alcohol	Condom nonuse	Global	Global
					Marijuana Hard Drugs			
Gleghorn, Marx, Vittinghoff, & Katz (1998)	US & Canada	766	17.5	Community	Hard Drugs	Multiple Sexual Partners	Global	Global
Kebede et al. (2005)	Africa	16606	19.5	Community	Alcohol Hard Drugs	Condom nonuse	Global	Global
Smith & Brown (1998)	US & Canada	215	20.03	Community	Alcohol	General RSB	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Duncan, Strycker, & Duncan (1999)	US & Canada	172	15.96	Community	Alcohol	General RSB	Global	Global
					Marijuana	General RSB	Global	Global
Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Mpofu et al. (2006)	Africa	630	16.3	Community	Alcohol	Multiple Sexual Partners	Global	Global
Rotheram-Borus, Rosario, Reid, & Koopman (1995)	US & Canada	65	16.5	Community	Alcohol	Condom nonuse	Global	Global
					Multiple Drugs			
Hingson, Strunin, Berlin, & Heeren (1990)	US & Canada	1050	17.5	Community	Alcohol	Condom nonuse	Situational	Situational
					Hard Drugs			
Remafedi (1994)	US & Canada	238	19.9	Community	Multiple Drugs	Condom nonuse	Global	Situational

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Brook, Brook, Pahl, & Montoya (2002)	Latin America	2837	15.1	Community	Multiple Drugs	Condom nonuse Multiple Sexual Partners	Global	Global
Thompson Jr. (2003)	US & Canada	351	16.3	Community	Alcohol Marijuana	General RSB	Global	Global
Baker & Mossman (1991)	US & Canada	23	14.4	Clinical	Multiple Drugs	General RSB Multiple Sexual Partners	Global	Global
Kraft, Rise, & Traeen (1990)	Europe	1172	18.07	Community	Alcohol	Condom nonuse	Event	Event
Crosby et al. (2008)	US & Canada	715	17.8	Community	Multiple Drugs	Condom nonuse	Situational	Situational

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Koniak-Griffin & Brecht (1995)	US & Canada	151	16.64	Community	Alcohol	Multiple Sexual Partners	Global	Global
					Marijuana			
					Hard Drugs	Condom nonuse	Global	
Rotheram-Borus, Mann, & Chabon (1999)	US & Canada	337	21.4	Community	Hard Drugs	Multiple Sexual Partners	Global	Global
					Hard Drugs	Condom nonuse		
Abrantes et al. (2006)	US & Canada	239	15.3	Clinical	Multiple Drugs	Multiple Sexual Partners Condom nonuse	Global	Global Event
Crosby et al. (2008)	US & Canada	715	17.8	Community	Multiple Drugs	Condom nonuse	Situational	Situational
Refaat (2004)	Africa	687	18	Community	Multiple Drugs	General RSB	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Yan, Chiu, Stoesen, & Wang (2007)	US & Canada	5745	16.1	Community	Alcohol	Condom nonuse	Global	Event
					Marijuana	Condom nonuse	Global	
					Hard Drugs Multiple Drugs		Event	
					Alcohol	Multiple Sexual Partners	Global	Global
					Marijuana Hard Drugs			
Mbulo (2005)	Africa	961	20.6	Community	Alcohol	Multiple Sexual Partners Condom nonuse	Global	Global
Donenberg, Emerson, Bryant, & King (2006)	US & Canada	207	15.12	Clinical	Multiple Drugs	General RSB	Global	Global
Tubman & Langer (1995)	US & Canada	115	17.2	Clinical	Alcohol	Condom nonuse	Event	Event

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Hou & Basen-Engquist (1997)	US & Canada	2706	16	Community	Multiple Drugs	Condom nonuse	Event	Event
Bachanas et al. (2002)	US & Canada	92	15.7	Community	Multiple Drugs	Multiple Sexual Partners	Global	Global
						Condom nonuse	Global	
Scivoletto et al. (2002)	Latin America	689	17.7	Community	Alcohol Marijuana Hard Drugs	Condom nonuse	Global	Global
Donenberg, Wilson, Emerson, & Bryant (2002)	US & Canada	169	15.45	Clinical	Multiple Drugs	Condom nonuse General RSB Multiple Sexual Partners	Situational	Global
St. Lawrence & Scott (1996)	US & Canada	249	15.4	Community	Alcohol	Condom nonuse	Situational	Situational

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Siahaan (2007)	US & Canada	5374	18.04	Community	Alcohol Marijuana	General RSB	Global	Global
					Alcohol Marijuana	Multiple Sexual Partners	Global	Global
Yen (2004)	Asia	87	17.05	Forensic	Hard Drugs	Condom nonuse Multiple Sexual Partners	Global	Global
Noell et al. (1993)	US & Canada	56	17	Community	Alcohol Hard Drugs	Condom nonuse Multiple Sexual Partners	Global	Global
				Community	Alcohol Hard Drugs	Condom nonuse Multiple Sexual Partners	Global Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Caspi et al. (1997)	Australia/New Zealand	154	21	Community	Alcohol	General RSB	Global	Global
Stein, Rotheram-Borus, Swendeman, & Millburn (2005)	US & Canada	248	21.3	Community	Multiple Drugs	General RSB	Global	Global
					Hard Drugs			
Tho et al. (2007)	Asia	880	20.1	Community	Alcohol	Condom nonuse	Global	Event
						Multiple Sexual Partners	Global	
Ku, Sonenstein, & Pleck (1993)	US & Canada	1389	19.5	Community	Multiple Drugs	Condom nonuse	Event	Global
						Multiple Sexual Partners	Situational	
Darling, Palmer, & Kipke (2005)	US & Canada	225-687	18.8	Community	Multiple Drugs	Multiple Sexual Partners	Global	Global
Barnes et al. (2007)	US & Canada	606	16.5	Community	Multiple Drugs	Condom nonuse	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Goggin et al. (2002)	US & Canada	193	15	Community	Alcohol Marijuana	Condom nonuse	Global	Global
Fullilove et al. (1993)	US & Canada	338	17	Community	Hard Drugs	Condom nonuse	Global	Event
						Multiple Sexual Partners	Global	Global
Weimann & Berenson (1998)	US & Canada	199		Community	Alcohol	Multiple Sexual Partners	Global	Global
Chen & Yen (2010)	Asia	79		Community	Multiple Drugs	Condom nonuse	Global	Global
Millburn et al. (2007)		896	17.3	Community	Multiple Drugs	General RSB	Global	Global
Lowry et al. (2008)	US & Canada	15548		Community	Multiple Drugs	General RSB	Global	Global
Lester et al. (2010)	US & Canada	264	15.6	Community	Multiple Drugs	Condom nonuse	Global	Global

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Prinstein & La Greca (2004)	US & Canada	55	16.82	Community	Alcohol Marijuana Hard Drugs Alcohol Marijuana Hard Drugs	Condom nonuse Multiple Sexual Partners	Global	Global
Gillmore, Butler, Lohr, & Gilchrist (1992)	US & Canada	214	16	Community	Alcohol Multiple Drugs Alcohol Alcohol	General RSB Multiple Sexual Partners Condom nonuse	Global Situational Global	Global
Kraft & Rise (1991)	Europe	1172	18.15	Community	Hard Drugs	Multiple Sexual Partners	Global	Event

Author Name	Nationality	N	Mean Age	Sample Type	Type of drug	RSB definition	Drug Relationship	RSB Relationship
Morris, Baker, Valentine, & Pennisi (1998)	US & Canada	1428-2354	16	Forensic	Multiple Drugs	Condom nonuse	Global	Global
					Alcohol			
					Alcohol	Multiple Sexual Partners		
Palen et al. (2006)	Africa	158-1155	14	Community	Alcohol	Multiple Sexual Partners	Event	Global
						Condom nonuse		
					Hard Drugs	Condom nonuse	Global	

Table 2. Effect sizes

Author Name	Subgroups	<i>r</i>
Abrantes et al. (2006)		0.197
Babikian et al. (2004)		0.510
Bachanas et al. (2002a)	A = 12-15 years old	-0.029
Bachanas et al. (2002a)	B = 16-19 years old	-0.076
Bachanas et al. (2002b)		0.430
Bailey et al. (1998)		0.401
Bailey et al. (2006)		0.107
Baker et al. (1991)		0.765
Barnes et al. (2007)		0.215
Baskin-Sommers & Sommers (2006)		0.135
Brook et al. (2002)		0.360
Brown & Venable (2007)		0.054
Bryan et al. (2007)		0.000
Caspi et al. (1997)		0.394
Celentano et al. (2006)		0.070
Cook et al. (2006)	A = Males	0.204
Cook et al. (2006)	B = Females	0.235
Crockett et al. (2006)		0.260
Crosby et al. (2008)		0.191
Darling et al. (2005)		0.051
Deas-Nesmith et al. (1999)		0.475
Donenberg et al. (2001)		0.660
Donenberg et al. (2006)		0.540
Donenberg et al. (2002)	A = Males	0.612
Donenberg et al. (2002)	B = Females	0.633
Duncan et al. (1999)	A = Males	0.206
Duncan et al. (1999)	B = Females	0.140
Ellickson et al. (2005)	A = Males	0.408
Ellickson et al. (2005)	B = Females	0.383
Fergusson & Lynskey (1996)	A = Males	0.541
Fergusson & Lynskey (1996)	B = Females	0.501
Fullilove et al. (1993)	A = Males	0.086
Fullilove et al. (1993)	B = Females	0.143
Gillmore et al. (1992)		0.298
Gleghorn et al. (1998)		0.235
Goggins et al. (2002)		0.240
Gomez et al. (2007)		0.211
Grossbard et al. (2007)		0.380
Guo et al. (2002)		0.218
Heffernan et al. (1996)		0.322

Hingson et al. (1990)		0.113
Hoffman et al. (2006)		0.154
Hou & Basen-Engquist (1997)	A = Whites	0.034
Hou & Basen-Engquist (1997)	B = Asian/Pacific	-0.055
Kebede et al. (2005)		0.451
Khasakhala & Mturi (2008)	A = Males	-0.193
Khasakhala & Mturi (2008)	B = Females	0.032
Kingree & Betz (2003)		0.113
Kingree & Phan (2002)		0.126
Koniak-Griffin & Brecht (1995)		0.239
Koopman et al. (1994)		0.236
Kraft et al. (1990)	A = Males	0.214
Kraft et al. (1990)	B = Females	0.256
Kraft & Rise (1991)	A = Males	0.105
Kraft & Rise (1991)	B = Females	0.157
Ku et al. (1993)		0.095
Lester et al. (2010)		0.130
Lowry et al. (1999)		0.374
Lowry et al. (2008)		0.266
MacKeller et al. (2001)	A = Males	0.000
MacKeller et al. (2001)	B = Females	-0.090
Mbulu (2005)		-0.132
McNall & Remafedi (1999)		0.234
Millburn et al. (2007)		0.770
Morris et al. (1998)		0.210
Morrison et al. (2003)		0.033
Morrison-Beedy et al. (2008)		0.228
Mpofu et al. (2005)		0.288
Mpofu et al. (2006)		0.250
Naff Johnson (1996)	A = Males	0.313
Naff Johnson (1996)	B = Females	0.567
Noell et al. (1993)	A = Males	0.226
Noell et al. (1993)	B = Females	0.348
Palen et al. (2006)		0.014
Poulin & Graham (2001)	A = Males	0.061
Poulin & Graham (2001)	B = Females	0.083
Prinstein & La Greca (2004)		0.256
Pritchard & Cox (2007)		0.231
Ramrakha et al. (2000)		0.273
Refaat (2004)		0.457
Remafedi (1994)		0.235
Roberts & Kennedy (2006)		0.237
Rotheram-Borus et al. (1994)		-0.177

Rotheram-Borus et al. (1995)		0.282
Rotheram-Borus et al. (1999)		0.125
Scivoletto et al. (2002)		0.178
Siahaan (2007)	A = Males	0.038
Siahaan (2007)	B = Females	0.037
Smith & Brown (1998)		0.373
St. Lawrence & Scott (1996)		0.211
Stein et al. (2005)		0.341
Strunin & Hingson (1992)		0.020
Tho et al. (2007)	A = Males	0.348
Tho et al. (2007)	B = Females	0.175
Thompson Jr. (2003)		0.306
Tubman & Langer (1995)		-0.662
Twa-Twa et al. (2008)		-0.064
Voisin et al. (2007)		0.068
Weimann & Berenson (1998)		0.397
Wisler & Fendrich (2000)	A = Male	0.160
Wisler & Fendrich (2000)	B = Female	0.126
Yan et al. (2007)		0.149
Yen (2004)		0.045
Yen (2010)		0.165

Table 3. Summary of effect size characteristics.

Number of effects	104
Median r	.21
Mean weighted r	.22
Test comparing r to 0	$Z = 10.214, p < .001$
95% confidence interval around mean weighted r	(.18, .26)
Range of r	(-.66, .77)
Heterogeneity	$Q_w = 3797.70, p < .001$

Table 4. Results of categorical moderator analyses.

<i>Document type</i>		
Peer review Journal	Number of effects	97
	Weighted mean r	.219
	95% CI	.177 to .259
Dissertation/Unpublished	Number of effects	7
	Weighted mean r	.196
	95% CI	.035 to .337
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [242] = 10121.59, $p \leq .001$
	Test of moderator only including independent effects	Qb [103] = 3797.70, $p \leq .001$
<i>Nationality</i>		
United States & Canada	Number of effects	76
	Weighted mean r	.205
	95% CI	.164 to .244
Europe	Number of effects	7
	Weighted mean r	.248
	95% CI	.119 to .368
Latin America	Number of effects	2
	Weighted mean r	.273
	95% CI	.042 to .476
Asia	Number of effects	4
	Weighted mean r	.196
	95% CI	-.023 to .398
Africa	Number of effects	10
	Weighted mean r	.131
	95% CI	.021 to .238
New Zealand/Australia	Number of effects	4
	Weighted mean r	.421
	95% CI	.257 to .561
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [241] = 9332.73, $p \leq .001$
	Test of moderator only including independent effects	Qb [102] = 3070.52, $p \leq .001$

<i>Sample Type</i>		
Community	Number of effects	87
	Weighted mean r	.215
	95% CI	.169 to .260
Clinical	Number of effects	8
	Weighted mean r	.418
	95% CI	.269 to .547
Forensic	Number of effects	8
	Weighted mean r	.110
	95% CI	-.046 to .261
	Number studies with multiple effects	67
	Test of moderator including all effects	Qb [239] = 10121.3, $p \leq .001$
	Test of moderator only including independent effects	Qb [102] = 3797.67, $p \leq .001$
<i>Type of Drug</i>		
Alcohol	Number of effects	66
	Weighted mean r	.173
	95% CI	.121 to .225
Marijuana	Number of effects	29
	Weighted mean r	.193
	95% CI	.145 to .239
Hard drugs	Number of effects	33
	Weighted mean r	.217
	95% CI	.169 to .263
Multiple drugs	Number of effects	37
	Weighted mean r	.276
	95% CI	.197 to .348
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [242] = 10121.59, $p \leq .001$
	Test of moderator only including independent effects	Qb [103] = 3797.70, $p \leq .001$
<i>Drug Use Assessment</i>		
Self-report/Self-administered	Number of effects	57
	Weighted mean r	.235

	95% CI	.178 to .290
Interview	Number of effects	44
	Weighted mean r	.208
	95% CI	.143 to .271
	Number studies with multiple effects	67
	Test of moderator including all effects	Qb [239] = 10112.90, $p \leq .001$
	Test of moderator only including independent effects	Qb [101] = 3795.76, $p \leq .001$
<i>Sexual Behavior Assessment</i>		
Self-report/Self-administered	Number of effects	62
	Weighted mean r	.237
	95% CI	.182 to .291
Interview	Number of effects	41
	Weighted mean r	.196
	95% CI	.128 to .262
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [241] = 10118.14, $p \leq .001$
	Test of moderator only including independent effects	Qb [102] = 3796.03, $p \leq .001$
<i>Drug Use Definition</i>		
Frequency & Quantity of use	Number of effects	41
	Weighted mean r	.282
	95% CI	.213 to .348
Dichotomous user/nonuser	Number of effects	55
	Weighted mean r	.155
	95% CI	.104 to .206
Clinical Diagnosis	Number of effects	9
	Weighted mean r	.304
	95% CI	.238 to .367
	Number studies with multiple effects	62
	Test of moderator including all effects	Qb [228] = 9667.69, $p \leq .001$
	Test of moderator only	Qb [97] = 3720.48, $p \leq .001$

	including independent effects	
<i>Risky Sexual Behavior Definition</i>		
Condom nonuse	Number of effects	71
	Weighted mean r	.153
	95% CI	.104 to .202
Multiple Sexual partners	Number of effects	45
	Weighted mean r	.252
	95% CI	.206 to .297
Intercourse with IV drug user	Number of effects	2
	Weighted mean r	.530
	95% CI	.450 to .602
General Risky Sexual Behavior	Number of effects	28
	Weighted mean r	.382
	95% CI	.272 to .483
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [242] = 10121.59, $p \leq .001$
	Test of moderator only including independent effects	Qb [103] = 3797.70, $p \leq .001$
<i>Drug Use Relation Measurement</i>		
Global association	Number of effects	83
	Weighted mean r	.234
	95% CI	.186 to .280
Situational	Number of effects	19
	Weighted mean r	.307
	95% CI	.209 to .400
Event level	Number of effects	16
	Weighted mean r	.071
	95% CI	-.001 to .142
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [242] = 10121.59, $p \leq .001$
	Test of moderator only including independent effects	Qb [103] = 3797.70, $p \leq .001$

<i>RSB Relation Measurement</i>		
Global association	Number of effects	83
	Weighted mean r	.260
	95% CI	.217 to .303
Situational	Number of effects	9
	Weighted mean r	.124
	95% CI	.071 to .176
Event level	Number of effects	22
	Weighted mean r	.064
	95% CI	.002 to .125
	Number studies with multiple effects	68
	Test of moderator including all effects	Qb [242] = 10121.59, $p \leq .001$
	Test of moderator only including independent effects	Qb [103] = 3797.70, $p \leq .001$

Table 5. Results of continuous moderator analyses.

Publication Year	
Number of effects	242
Unstandardized slope	-.018
Standard error of slope	.0005
Test of slope $\neq 0$	$Z = -39.96, p < .001$
Mean Age	
Number of effects	236
Unstandardized slope	.012
Standard error of slope	.001
Test of slope $\neq 0$	$Z = 10.34, p < .001$
% African descent	
Number of effects	203
Unstandardized slope	-.003
Standard error of slope	.00005
Test of slope $\neq 0$	$Z = -49.61, p < .001$
% Caucasian	
Number of effects	188
Unstandardized slope	.002
Standard error of slope	.00007
Test of slope $\neq 0$	$Z = 35.35, p < .001$
% Hispanic	
Number of effects	180
Unstandardized slope	.0055
Standard error of slope	.00014
Test of slope $\neq 0$	$Z = 38.09, p < .001$
% Asian	
Number of effects	168
Unstandardized slope	.004
Standard error of slope	.0003
Test of slope $\neq 0$	$Z = 15.15, p < .001$
% Minority	
Number of effects	174
Unstandardized slope	.007
Standard error of slope	.0002
Test of slope $\neq 0$	$Z = 34.79, p < .001$
% Female	

Number of effects	236
Unstandardized slope	.0004
Standard error of slope	.00007
Test of slope $\neq 0$	$Z = 6.289, p < .001$
% Heterosexual	
Number of effects	14
Unstandardized slope	-.004
Standard error of slope	.0004
Test of slope $\neq 0$	$Z = -10.10, p < .001$
% Homosexual	
Number of effects	18
Unstandardized slope	.00004
Standard error of slope	.0002
Test of slope $\neq 0$	$Z = .148, p = .88$
% Bisexual	
Number of effects	10
Unstandardized slope	-.028
Standard error of slope	.003
Test of slope $\neq 0$	$Z = -8.76, p < .001$
% Other/Combined (Homosexual and/or Bisexual)	
Number of effects	14
Unstandardized slope	.005
Standard error of slope	.0009
Test of slope $\neq 0$	$Z = 5.27, p < .001$

Table 6. Significant relations among moderators

Variable name	Test
<i>Publication year</i>	
Document type	F (19, 223) = 2.4, p = .001
Mean age	r = .244, p < .001
% Bisexual	r = -.835, p < .001
Nationality	F (19, 223) = 2.29, p = .002
Sample type	F (19, 223) = 2.64, p < .001
Type of drug	F (19, 223) = 2.63, p < .001
Drug use assessment	F (19, 223) = 5.25, p < .001
RSB assessment	F (19, 223) = 5.77, p < .001
Drug use definition	F (19, 223) = 5.52, p < .001
RSB definition	F (19, 223) = 2.35, p < .001
Drug use relation measurement	F (19, 223) = 3.48, p < .001
RSB relation measurement	F (19, 223) = 4.09, p < .001
<i>Document type</i>	
RSB definition	χ^2 [6] = 24.59, p < .001
<i>Mean age</i>	
% African descent	r = -.258, p < .001
% Minority	r = -.297, p = .001
% Heterosexual	r = -.760, p = .001
% Bisexual	r = -.878, p < .001
Nationality	F (68, 168) = 12.38, p < .001
Sample type	F (68, 168) = 15.11, p < .001
Type of drug	F (68, 168) = 3.16, p < .001
Drug use assessment	F (68, 168) = 12.51, p < .001
RSB assessment	F (68, 168) = 10.63, p < .001
Drug use definition	F (68, 168) = 7.60, p < .001
RSB definition	F (68, 168) = 3.01, p < .001
Drug use relation measurement	F (68, 168) = 3.16, p < .001
RSB relation measurement	F (68, 168) = 4.99, p < .001
<i>% African descent</i>	
% Caucasian	r = -.599, p < .001
% Bisexual	r = .957, p < .001
Nationality	F (47, 136) = 5.52, p < .001
Sample type	F (47, 136) = 13.57, p < .001
Type of drug	F (47, 136) = 3.13, p < .001
Drug use assessment	F (47, 136) = 12.29, p < .001
RSB assessment	F (47, 136) = 13.32, p < .001
Drug use definition	F (47, 136) = 10.84, p < .001

RSB definition	$F(47, 136) = 4.29, p < .001$
Drug use relation measurement	$F(47, 136) = 2.44, p < .001$
RSB relation measurement	$F(47, 136) = 3.97, p < .001$
<i>% Caucasian</i>	
% Hispanic	$r = -.77, p < .001$
% Minority	$r = -.347, p < .001$
% Combined (sexuality)	$r = .834, p = .001$
Nationality	$F(44, 106) = 8.51, p < .001$
Sample type	$F(44, 106) = 209.56, p < .001$
Type of drug	$F(44, 106) = 2.71, p < .001$
Drug use assessment	$F(44, 106) = 22.45, p < .001$
RSB assessment	$F(44, 106) = 25.77, p < .001$
Drug use definition	$F(44, 106) = 9.29, p < .001$
RSB definition	$F(47, 136) = 5.86, p < .001$
Drug use relation measurement	$F(47, 136) = 3.17, p < .001$
RSB relation measurement	$F(47, 136) = 5.92, p < .001$
<i>% Hispanic</i>	
% Heterosexual	$r = -.902, p < .001$
Sample type	$F(35, 83) = 23.73, p < .001$
Type of drug	$F(35, 83) = 2.70, p < .001$
Drug use assessment	$F(35, 83) = 21.84, p < .001$
RSB assessment	$F(35, 83) = 30.00, p < .001$
Drug use definition	$F(35, 83) = 12.10, p < .001$
RSB definition	$F(35, 83) = 5.02, p < .001$
Drug use relation measurement	$F(35, 83) = 4.52, p < .001$
RSB relation measurement	$F(35, 83) = 6.04, p < .001$
<i>% Asian</i>	
% Minority	$r = .623, p < .001$
% Bisexual	$r = 1.0, p < .001$
% Combined (sexuality)	$r = -1.0, p < .001$
Sample type	$F(16, 59) = 5.83, p < .001$
Drug use assessment	$F(16, 59) = 6.90, p < .001$
RSB assessment	$F(16, 59) = 8.74, p < .001$
Drug use definition	$F(16, 59) = 7.40, p < .001$
RSB definition	$F(16, 59) = 7.93, p < .001$
Drug use relation measurement	$F(16, 59) = 8.74, p < .001$
RSB relation measurement	$F(16, 59) = 2.61, p < .001$
<i>% Minority</i>	
% Combined (sexuality)	$r = .884, p < .001$
Nationality	$F(28, 102) = 9.80, p < .001$
Sample type	$F(28, 102) = 4.58, p < .001$

<i>Type of drug</i>	F (28, 102) = 3.20, p < .001
Drug use assessment	F (28, 102) = 9.83, p < .001
RSB assessment	F (28, 102) = 8.65, p < .001
Drug use definition	F (23, 102) = 5.39, p < .001
RSB definition	F (23, 102) = 4.09, p < .001
<i>Nationality</i>	
Publication year	F (7, 235) = 5.73, p < .001
% African descent	F (2, 181) = 22.60, p < .001
% Asian	F (2, 73) = 917.38, p < .001
% Minority	F (4, 126) = 304.17, p < .001
Drug use assessment	χ^2 [14] = 70.46, p < .001
RSB assessment	χ^2 [14] = 56.93, p < .001
Drug use relation measurement	χ^2 [14] = 34.70, p = .002
<i>% Female</i>	
Nationality	F (44, 192) = 3.91, p < .001
Sample type	F (44, 192) = 7.53, p < .001
Drug use assessment	F (44, 192) = 4.17, p < .001
RSB assessment	F (44, 192) = 2.91, p < .001
Drug use relation measurement	F (44, 192) = 2.17, p < .001
RSB relation measurement	F (44, 192) = 3.67, p < .001
<i>% Heterosexual</i>	
Bisexual	r = -1.0, p < .001
Combined (sexuality)	r = -1.0, p < .001
RSB definition	F (4, 10) = 46.17, p < .001
<i>% Bisexual</i>	
RSB definition	F (3, 7) = 35.85, p < .001
<i>Sample type</i>	
Mean age	F (3, 233) = 14.97, p < .001
% Caucasian	F (3, 147) = 6.16, p = .001
Type of drug	χ^2 [9] = 45.75, p < .001
Drug use definition	χ^2 [12] = 88.80, p < .001
Drug use relation measurement	χ^2 [6] = 31.52, p < .001
RSB relation measurement	χ^2 [6] = 38.08, p < .001
<i>Type of drug</i>	
Drug use definition	χ^2 [12] = 49.21, p < .001
RSB relation measurement	
<i>Drug use assessment</i>	

% African descent	F (1, 182) = 11.58, p = .001
% Caucasian	F (1, 149) = 21.56, p < .001
% Hispanic	F (1, 117) = 15.56, p < .001
% Asian	F (2, 73) = 12.57, p < .001
RSB assessment	χ^2 [4] = 280.54, p < .001
<i>RSB assessment</i>	
Publication year	F (2, 240) = 7.05, p = .001
% African descent	F (1, 182) = 15.51, p < .001
% Caucasian	F (1, 149) = 26.36, p < .001
% Hispanic	F (1, 117) = 13.59, p < .001
<i>Drug use definition</i>	
Mean age	F (2, 232) = 7.81, p < .001
% Hispanic	F (4, 114) = 4.52, p = .002
Sample type	χ^2 [12] = 88.80, p < .001
Type of drug	χ^2 [12] = 49.21, p < .001
Drug use relation measurement	χ^2 [8] = 30.65, p < .001
RSB relation measurement	χ^2 [8] = 25.62, p = .001
<i>RSB definition</i>	
% Heterosexual	F (2, 12) = 134.27, p < .001
Drug use relation measurement	χ^2 [6] = 28.46, p < .001
RSB relation measurement	χ^2 [6] = 55.53, p < .001
<i>Drug use relation measurement</i>	
RSB relation measurement	χ^2 [4] = 200.60, p < .001

Figure 1. Document type

Figure 2. Nationality

Figure 3. Sample type

Figure 4. Type of drug

Figure 5. Drug use assessment

Figure 6. Sexual behavior assessment

Figure 7. Drug use definition

Figure 8. Risky sexual behavior Definition

Figure 9. Drug use relation measurement

Figure 10. Risky sexual behavior relation measurement

Figure 11. Ethnicity

Figure 12. Sexuality

Note: Identification as homosexual was not a significant moderator.