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SUBSTANCE USE AND RISKY SEX: A LONGITUDINAL INVESTIGATION

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SUBSTANCE USE AND RISKY SEX: A LONGITUDINAL INVESTIGATION

by

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Bachelor of Science
University of South Carolina, 2003

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Master of Arts in

Clinical-Community Psychology

College of Arts and Sciences

University of South Carolina

2014

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DEDICATION

To my parents, Fred & Carole Woodlief, for their support, love, and undying encouragement – I would not be able to do this without you. To my son and source of joy, Emerson Woodlief – you inspire me every day.

ACKNOWLEDGEMENTS

ABSTRACT

The purpose of this study was to prospectively examine the relationship between substance use and risky among a nationally representative sample of adolescents longitudinally from the ages of 16 to 29. Using data collected for the National Longitudinal Survey of Youth 1997 (N=8,984), we found the use of marijuana, alcohol, and cigarettes to be consistently associated, across these ages, with an increased probability of having engaged in sexual intercourse with a stranger. Marijuana was found to have the strongest association with risky sex across the years of the study, followed by cigarettes, then alcohol. The current study improves on previous findings by focusing on the global overlap of these behaviors, using a prospective, longitudinal design, and showing a consistent relationship between the use of alcohol, marijuana, and cigarettes and risky sex behavior from middle adolescence through adulthood. These findings lend support to Zuckerman (1984) and others who believed problem behaviors were strongly associated because of personality traits such as sensation seeking, and they point to the need for the integration of prevention and intervention efforts across problem behaviors.

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CHAPTER 1

INTRODUCTION

Adolescent substance use and its link with other potentially dangerous behavior, such as high-risk sexual behavior, have been characterized as possibly the most important issue in the study of adolescent problem behavior (Cooper, 2002). Adolescents who abuse substances have been shown to be more likely to struggle academically and to be more prone to injuries and deaths from accidents (such as car accidents; The National Center on Addiction and Substance Abuse at Columbia University (CASA), 2011). In addition, substance use in adolescence has been shown to be a risk factor for later psychopathology (Newcomb, Scheier, & Bentler, 1993). In addition to the personal risk to the adolescent, there is a huge financial burden on society as a whole, with the costs associated with underage drinking alone estimated at $68 billion a year in the United States (CASA, 2011). Risky sex (RS) behavior can also have dire consequences for adolescents. Americans aged 15-24 account for almost half of the 19 million new cases of STDs each year (Weinstock, Berman, &Cates, 2004) and nearly half a million teen girls aged 15-19 gave birth in the U.S in 2009 (Weinstock et al., 2004). There were also over 8,000 cases of HIV infection among young people from the ages of 13 to 24 reported to the Center for Disease Control (CDC) in 2009 (CDC, 2009).

The vast majority of the research linking substance use with RS has focused on what Leigh and Stall (1993) called *situational overlap*; that is, examining the increased

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probability of engaging in RS when engaging in substance use. This relation has been clearly established, but far less research has examined *global overlap*, the extent to which substance use and RS are interrelated over time (Cooper, 2002; Duncan, Stryker, & Duncan, 1999; Tapert, Aarons, Sedlar, & Brown, 2001). However, those that have examined these behaviors at the global level have usually found a strong correlation between the two (e.g. Santelli, Brener, Lowry, Bhatt, & Zhabin, 1998; Tapert et.al, 2001). Thus, one of our aims was to increase understanding through this examination of the long-term, global correlation of these behaviors.

In addition to different types of overlap, different realms of RS have been studied. In a review of studies examining the links between substance use and RS, Cooper (2002) found that RS was usually studied as one of two realms: "(1) indiscriminate behaviors, including having multiple partners; having risky, casual or unknown partners; and failure to discuss risk topics prior to intercourse and (2) failure to take protective actions, such as use of condoms and birth control" (p. 102). Cooper's (2002) review found substance use more strongly linked to indiscriminate behaviors than protective behaviors. Therefore, studies of indiscriminate behavior and its relation with substance use are a key research need.

Previous Research

A review of the literature for the current study found a great deal of support for the links between the use and/or abuse of various substances and various types of RS. We were primarily interested in longitudinal studies of these behaviors. We did not find approach, and the a large number of published articles using a longitudinal ones we found were mostly studies lasting only a year or two.

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Duncan, Strycker, and Duncan (1998) assessed a convenience sample of adolescents (N=257) with a mean age of 16 years at the beginning of their study at three time points over 18 months. This study operationalized RS as a mean of four scores representing: (1) number of past year partners; (2) engaging in sex with someone they did not know well; (3) engaging in sex with an IV drug user; and (4) frequency of condom use (reversed scored). They found adolescents who engaged in cigarette use, alcohol use, or marijuana use to be more likely to engage in RS. In their latent growth model, however, only the development of cigarette use covaried significantly with the development of RS behaviors.

Brook, Brook, Pahl, and Montoya (2002) looked at the relationship between illicit substance use and RS (operationalized as frequency of unprotected sexual intercourse) at two time points, two years apart, among urban Colombian adolescents (N=2226). This is not a strong longitudinal design, but they did find that T1 substance use predicted T2 RS controlling for T1 RS, and that T1 RS predicted T2 substance use controlling for T1 substance use. This supports the reciprocal nature of the relationship.

An example of a stronger longitudinal design can be found in a study by Tapert, Aarons, Sedlar, and Brown (2001). This study compared a group of adolescents in San Diego, California involved in treatment for substance use disorders (SUDs; N=105) with a sociodemographically similar sample of youths with no history of SUDs from the same community (N=77). Data on RS and substance use were collected every 2 years over an 8-year period following the initial assessment. Youth who were treated for SUDs were found to be significantly more likely to initiate sexual activity early,

have more sexual partners, more sexual encounters with casual acquaintances, and to use condoms less consistently. At the first follow up, 25% of the female participants (average age= 17.74) from the SUD group reported having had a pregnancy, compared with 7% of the community sample.

Brookmeyer & Henrich (2009) examined the co-occurrence and trajectories of RS and alcohol use in a large (N=1778) sample of adolescents, children of the mothers involved in the NLSY79 study. Participants were followed from age 16 to age 24. This study operationalized RS using an index combining number of partners, condom use during last sexual encounter, and relationship to last sexual partner. The key finding of this study was that sexual risk taking almost always occurred with participants who also engaged in risky alcohol use. Their latent class growth analysis did not identify a sexual risk taking only group.

Most studies we found focused on the episodic relation between substance use, especially alcohol, and RS. However, there are a number of other, non-longitudinal studies that lend support to the correlation between the two in global sense. Palen, Smith, Flisher, Caldwell, and Mpofu (2006) found that South African eighth graders (N=2204) who reported lifetime use of marijuana or alcohol were significantly more likely to also report engaging in sexual intercourse. Among youth who had been sexually active, those that reported alcohol and/or marijuana use were more likely to report inconsistent use of condoms. Similarly, among a convenience sample of 6th to 8th graders in rural Tennessee (N=10,273), Dunn et. al (2008) found that students reporting substance use were significantly more likely to report sexual activity. In fact, more than 90% of those reporting substance use also reported sexual activity. The rates of sexual

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activity for the student sample as a whole were much lower: 18.8% for females and 25.4% for males.

We also found several studies that used data the Youth Risk Behavior Survey (YRBS), which is not longitudinal, but is designed to be a nationally representative sample of young people. Santelli, Brener, Lowry, Bhatt, and Zabin (1998) found that among the 8,450 participants in the 1992 YRBS, those who reported alcohol use were more likely to have had multiple partners in the previous three months. The same held true for females who reported illicit substance use, but not for males. Yan, Chiu, Stoesen, and Wang (2007) studied 9th-12th grade rural students who completed the 2003 YRBS (N=5,745). Among substances, only cigarette smoking in the previous 30 days was found to be associated with unprotected sex. Lifetime use of marijuana and previous 30-day use of alcohol was associated with having multiple sexual partners. Anderson and Mueller (2008) used all YRBSs from 1991 to 2005 (taken every other year) to examine the relationship between substance use and RS. While use of any substance was strongly associated with sexual activity, past month alcohol use was not significantly associated with a higher risk of unprotected sex. Those who reported use of illicit drugs in the past month did have a significantly higher level of unprotected sex.

Although links between substance use and RS have been established, there are limitations. There are few longitudinal investigations of this relationship. Cross-sectional designs and longitudinal designs of two years or less with two time points do not give us the opportunity to see how these behaviors relate over time. In addition, many of these studies only looked at the preventative actions, usually condom use;

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most of the remainder examined having recent multiple partners. We have seen in the studies how substance use sometimes correlates with certain types of risky sexual behavior but not others. A narrow focus on certain aspects of RS behavior has limited our understanding of the ways in which it correlates with substance use.

Theoretical Links

The interrelations between substance use, RS, and other problem behaviors among adolescents led Jessor and Jessor (1977) to posit the existence of a problem-behavior syndrome or a single factor of *unconventional behavior.* Duncan et al. (1999) found support for this theory among adolescents over an 18-month period. Theories of social control (i.e. Hawkins & Weis, 1985) explain the common problem behaviors as stemming from a lack of regard for conventions of society, its institutions, and the family.

Zuckerman (1984), built on the personality theories of Eysenck and Eysenck (as cited in Acton, 2003) and the concept of *impulsivity*, theorizing a personality trait called *sensation seeking*. He and others theorized that impulsivity and sensation seeking could predispose adolescents to involvement with potentially dangerous behaviors such as substance use and RS (Tapert et al., 2001). This theory has been supported in the findings of studies such as Donohew et al. (2000), who found elevated levels of alcohol use and RS behavior among high sensation seekers. If these theories are correct, then strong correlations among these behaviors over time is to be expected.

Study Purpose and Hypotheses

The purpose of this study was to examine the relationship between substance use and RS among a nationally representative sample of adolescents and young adults

longitudinally. Although this relationship has been studied previously, most studies have focused on situational overlap, rather than global overlap (Leigh & Stall, 2003). In addition, there have been very few longitudinal studies of this global relation, none of which has lasted more than a couple of years. Whereas many studies have focused on the protective behavioral aspect of RS, this study examined the indiscriminant behavior category, specifically engaging in sex with strangers. This type of RS fits into Zuckerman's theory linking substance use and RS through the common personality trait of sensation seeking. The use of multilevel modeling (MLM) in this study is a particular strength. Using this approach allowed us to examine variation in RS behavior and its association with substance use both between and within participants over the ten years of the study. None of the other studies reviewed herein examined this interrelation over such a long time period nor did any use a multilevel framework.

We hypothesized that, at any given year, participants who engage in alcohol use, cigarette use, or marijuana use will be more likely to engage in RS. These effects were examined individually. We also hypothesized that marijuana use would have the strongest association with RS, as its use is illegal and less normative, therefore carrying a higher risk.

CHAPTER 2

METHOD

The data used in this study were collected as part of the National Longitudinal Survey Series (Ohio State University, 1997). The United States Department of Labor Bureau of Labor statistics created the NLSY97 to gather data on a nationally representative cohort of people born between the years of 1980 and 1984 and an oversampling of the Black and Hispanic populations born during that same time period. 1997 was the first year of data collection and attempts were made to survey each respondent in each subsequent calendar year. The present study focused on variables related to alcohol and other drug use and risky sexual behavior.

Participants

Households were randomly selected for the NLSY97, with all residents between the ages of 12 and 16 as of January 1, 1997, and their parents who were living in these home being asked to participate. The original youth sample included 8,984 respondents. The proposed study utilized data from annual surveys conducted from 2000 through 2009 (ages 16-19 at the beginning of the study years and 26-29 at the end). The current study excluded the non-Hispanic mixed-race youth, due to that group's small size and heterogeneous nature. In addition, 344 youth were excluded from this study due to failure to answer any questions about either substance use or RS during the study years. We also only used one randomly selected youth per household, due to the computational infeasibility of accounting for the clustered sample design.

Simply including all youth, ignoring the clustering within households, would have caused an underestimation of standard errors. The remaining 6,753 respondents included 1392 Hispanic youth (20.6%), 1,754 non-Hispanic Black youth (26.0%), and 3,607 White youth (53.4%), with 3,490 (48.8%) being male.

Measures

Basic demographic information collected by the NLSY was: age at date of interview, gender, and race/ethnicity. The questions of interest for the current study were related to alcohol, cigarettes, marijuana use and risky sexual behavior. Due to the sensitive nature of these questions, audio computer-assisted self-interview (ACASI) technology was used, enabling respondents to directly enter their answers without revealing them to the interviewer. The questions of interest were asked every year. For alcohol, cigarettes, and marijuana, the respondents were asked if they had used the substance since the date of the last interview. For the sexual behavior question, if the respondent answered yes to having had sexual intercourse and having had sexual intercourse since the date of last interview, they were then asked if, since the date of last interview, they had sex with someone who was a stranger to them. Self-reports on substance use and risky sexual behavior have been shown to have high rates of stability, both longitudinally and cross-sectionally (Barnea, Rahav, Teichman, 1987; Weinhardt, Forsyth, Carey, Jaworski, & Durant, 1998). Shillington & Clapp (1999) found that nearly 95% of adolescents that reported lifetime use of alcohol reported it again at two-year follow up. Discrepancies were higher for cigarettes and marijuana but were still over 80%. In addition, data obtained using ACASI technology have been shown to be reliable and comparable to data collected using face-to-face

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interviews. Turner et al. (1998) actually found risky sexual behaviors were reported by adolescent males at a rate up to three times as high compared with traditional self-administered questionnaires. The NLSY does not have available data on the reliability of the measures used herein; however, they take steps each year to ensure the accuracy of their measures. Each year, approximately 13 percent of those interviewed are randomly selected for re-interview. They are asked a subset of questions a second time to assess the quality of the interview data and to ensure the interview was conducted properly.

Data Analysis Procedure

The multi-level modeling (MLM) procedure was conducted using M*plus* v7.11 (Muthén & Muthén, 2013). We used full information maximum likelihood (FIML) estimation with robust standard errors (MLR) to handle missing data. The parameter estimates it yields are generally superior to those obtained using listwise deletion or other *ad hoc* methods (Schafer & Graham, 2002). We modeled the probability (as logits) of a late adolescent/young adult engaging in risky sex (RS) as a growth function of cigarette use, alcohol use, and marijuana use. The model spans the ages of 16-29. The outcome variable (RS) is binary, with a 'yes or no' response, so a logit link function was employed, with cigarettes, alcohol, and marijuana use as time-varying Level 1 variables.

Our next step was to calculate descriptive statistics for our sample (see Table 1). The prevalence of each type of substance use was found to be comparable to that to estimates of the same for their cohort nationally, using the National Survey on Drug Use and Health from similar years (SAMSHA, 2002-2008). Use rates for alcohol ($\chi^2(2) =$

5.74, $p = 0.057$) and cigarettes ($\chi^2(2) = 1.32$, $p > .517$) were not significantly different, and the difference in marijuana use rates was marginally significant ($\chi^2(2) = 7.47$, $p = .024$). We attempted to do the same for our RS measure; however, national data is not readily available for this specific indicator. Odds ratios (ORs) and 95% confidence intervals will also be presented, in order to provide an estimate of relative risk. The ORs give an estimate of how much more likely it is for RS to occur in an individual in a given year if they engaged in each type of substance use versus if they did not.

Multilevel Analyses

Due to the prevalence of RS increasing from age 16 to 20, then generally decreasing thereafter to age 29 in our sample, a piecewise linear growth model centered at age 20 was constructed. Then our level-one (intra-individual) predictors, cigarettes, alcohol, and marijuana use, were added to the model. The first model (Model 1) tested constrained the effect of each substance use predictors to be equal across time. This is the full, conditional model (Model 2) with level one and level two predictors:

Level 1:

$$\text{Logit}(RS_{ti}) = \beta_{0ti} + \beta_{1ti}\text{GrowthRate1}_t + \beta_{2ti}\text{GrowthRate2}_t + \beta_{3ti}\text{TU}_{ti} + \beta_{4ti}\text{AU}_{ti} + \beta_{5ti}\text{MU}_{ti}$$

Level 2:

$$\beta_{0ti} = \gamma_{00} + u_{0i}$$

$$\beta_{1ti} = \gamma_{10} + u_{1i}$$

$$\beta_{2ti} = \gamma_{20} + u_{2i}$$

$$\beta_{3ti} = \gamma_{30t}$$

$$\beta_{4ti} = \gamma_{40t}$$

$$\beta_{5ti} = \gamma_{50t}$$

Table 2.1

Prevalence and Missingness of Risky Sex and Use by Age

Age	Risky Sex (%)	Cigarette Use (%)	Alcohol Use (%)	Marijuana Use (%)	Missing (%)
16	3.5	36.2	55.7	26.8	68.8-69.9
17	5.6	41.4	56.6	27.7	50.2-50.3
18	6.9	47.4	61.8	29.3	33.0-33.4
19	7.8	46.5	65.7	27.8	19.1-19.3
20	8.0	47.5	72.1	25.9	15.3-15.7
21	7.8	46.8	73.8	24.6	16.3-16.8
22	7.2	46.1	78.1	22.2	17.0-17.4
23	6.5	45.7	80.0	20.8	18.2-18.8
24	6.2	45.8	80.3	20.7	18.3-18.8
25	5.6	44.6	79.5	19.4	17.9-18.5
26	5.0	43.1	78.9	17.8	28.9-29.4
27	5.0	41.7	77.4	17.2	46.0-46.4
28	4.7	41.7	78.1	17.0	62.9-63.1
29	3.6	41.1	77.5	17.9	79.9-80.1

Note: Higher missing rates at the rates at the lowest and highest ages are largely
due to the accelerate design of the NLSY98.

CHAPTER 3

RESULTS

Prevalence rates (as shown in full in Table 2.1) for cigarette use ranged from 36.2% at age 16 to a peak of 47.5% at age 20; for alcohol - from 55.7% at age 16 to 80.3% at age 24; and, for marijuana, from 17.0% at age 28 to 29.3% at age 18. RS prevalence ranged from 3.5% at age 16 to a peak of 8.0% at age 20. In addition, RS prevalence rates for users vs. non-users of each substance (not accounting for use of other substances) were calculated. These are shown in Table 3.1 and the differences in prevalence between users and non-users are shown in Figure 3.1.

In order to compare the strength of the association of type of use with RS, we used Model 1, where each effect was constrained to be equal across years. Marijuana was found to have the strongest effect across time: ($\gamma50 = 1.069$ (.060), Est/SE = 17.812, p < .001) followed by cigarettes ($\gamma30 = .911$ (.066), Est/SE =13.855, p < .001), then alcohol ($\gamma40 = .566$ (.072), Est/SE = 7.861, p < .001) (see Table 3.2 for coefficients). We then tested the same model, allowing the substance use predictors to vary across time. This latter model (Model 2) showed superior fit ($\chi2(39) = 116.57$, p < .001). Table 3.3 shows coefficients for the piecewise linear growth model (Model 2). We used Wald tests to evaluate our hypotheses that use of each of the three substances would be significantly associated with engaging in risky sex. This hypothesis was supported for all three: cigarettes ($\chi^2(14) = 217.68$, $p < .001$; alcohol

$(\chi^2(14) = 85.48, p < .001)$; and marijuana $(\chi^2(14) = 358.54, p < .001)$. In order to test our fourth hypothesis, we ran post-hoc pairwise comparisons (using Wald tests) of the three substances' association with risky sex. As hypothesized, marijuana was found to have a significantly stronger association with RS than either cigarettes $(\chi^2(14) = 29.26, p = .010)$ or alcohol $(\chi^2(14) = 44.67, p = .014)$. Marijuana had a stronger association with RS than cigarette in 8 of the 14 years, and the association was stronger than alcohol in all but one year. In addition, cigarettes were found to have a significantly stronger association with RS than alcohol $(\chi^2(14) = 27.97, p = .014)$. Cigarettes had a stronger association with RS than alcohol in all but three years. Variances and correlations for the random effects of the intercept and slope are reported in Table 3.4.

Odds Ratios

The coefficients shown in Table 2 show the effect of the substance use predictors on the probability (as logits) of engaging in risky sex. Corresponding odds ratios and their confidence intervals are also reported in Table 2. For users of cigarettes, point estimates of the odds of engaging in RS ranged from 1.037 to 5.148 times that of non-users. Alcohol users were estimated to be from .823 (not significantly different from 1) to 2.980 times as likely, and marijuana users from 2.161 to 5.930 times as likely to engage in risky sex.

Predicted Probabilities

For illustrative purposes, we used our logit link function (shown above) to calculate predicted probabilities for users of each substance, and each combination of substances, from age 16 to age 29. These probabilities are shown in Table 3.5.

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Table 3.1
Risky Sex Prevalence for Users and Non-Users

Age	Cigarette Non-Users	Cigarette Users	Alcohol Non-Users	Alcohol Users	Marijuana Non-Users	Marijuana Users
16	.030	.063	.028	.061	.024	.090
17	.028	.106	.029	.072	.033	.127
18	.038	.116	.041	.093	.045	.145
19	.041	.126	.041	.103	.049	.160
20	.049	.123	.049	.111	.050	.181
21	.049	.115	.050	.095	.054	.156
22	.041	.110	.045	.095	.052	.147
23	.035	.075	.038	.088	.045	.144
24	.033	.099	.035	.084	.037	.164
25	.033	.091	.033	.077	.036	.138
26	.034	.078	.033	.073	.036	.126
27	.035	.077	.036	.076	.035	.140
28	.049	.091	.038	.072	.031	.153
29	.023	.065	.021	.049	.023	.101

Table 3.2
Model 1 Coefficients

Fixed Effects		Logit	SE	Est/SE
Intercept, β_{0ti}	γ_{00}	-4.928	.106	-46.607*
Growth Rate 1, β_{1ti}	γ_{10}	0.032	.036	.881
Growth Rate 2, β_{2ti}	γ_{20}	-0.170	.027	-6.172*
Cigarette Use, β_{3ti}	γ_{310}	.911	.066	13.855*
Alcohol Use, β_{4ti}	γ_{410}	.566	.072	7.861*
Marijuana Use, β_{5ti}	γ_{510}	1.069	.060	17.812*

*$p < .05$

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Table 3.3
Model 2 Coefficients

Parameter	Fixed Effects	Logit	SE	Est/SE	Odds Ratio	Confidence Intervals	
Intercept, β_{0ti}	γ_{00}	-4.925	.139	- 35.411*			
Growth Rate 1, β_{1ti}	γ_{10}	0.031	.060	.521		Lower	Upper
Growth Rate 2, β_{2ti}	γ_{20}	-0.288	.051	-5.696*		2.5%	2.5%
Cigarette Use, β_{3ti}	γ_{310}	.037	.332	.110	1.037	.541	1.989
	γ_{320}	1.324	.255	5.186*	3.758	2.279	6.198
	γ_{330}	1.255	.211	5.937*	3.509	2.318	5.310
	γ_{340}	1.080	.169	6.389*	2.944	2.114	4.101
	γ_{350}	.640	.152	4.206*	1.896	1.407	2.554
	γ_{360}	.780	.160	4.876*	2.181	1.594	2.985
	γ_{370}	1.003	.159	6.319*	2.727	1.998	3.723
	γ_{380}	1.018	.154	6.588*	2.767	2.044	3.746
	γ_{390}	.999	.165	6.047*	2.716	1.965	3.755
	γ_{3100}	.855	.160	5.340*	2.352	1.718	3.220
	γ_{3110}	.812	.191	4.244*	2.253	1.548	3.278
	γ_{3120}	.968	.248	3.900*	2.631	1.618	4.279
	γ_{3130}	1.639	.311	5.270*	5.148	2.799	9.470
	γ_{3140}	.631	.379	1.666	1.880	.895	3.953
Alcohol Use, β_{4ti}	γ_{410}	-.194	.311	-.624	.823	.447	1.516
	γ_{420}	-.033	.271	-.121	.968	.569	1.647
	γ_{430}	.208	.209	.998	1.231	.818	1.853
	γ_{440}	.630	.161	3.907*	1.877	1.369	2.574
	γ_{450}	.599	.153	3.915*	1.820	1.349	2.457
	γ_{460}	.422	.156	2.708*	1.525	1.124	2.070
	γ_{470}	.663	.151	4.388*	1.941	1.443	2.609
	γ_{480}	.858	.152	5.662*	2.358	1.752	3.174
	γ_{490}	.851	.174	4.899*	2.341	1.666	3.290
	γ_{4100}	1.052	.176	5.981*	2.862	2.028	4.040
	γ_{4110}	1.092	.206	5.302*	2.980	1.990	4.463
	γ_{4120}	.993	.257	3.862*	2.700	1.631	4.471
	γ_{4130}	.376	.317	1.187	1.456	.783	2.709
	γ_{4140}	.363	.399	.910	1.437	.658	3.139
Marijuana Use, β_{5ti}	γ_{510}	1.503	.379	3.961*	4.494	2.136	9.453
	γ_{520}	1.023	.224	4.572*	2.782	1.794	4.314
	γ_{530}	1.098	.172	6.395*	2.998	2.141	4.197
	γ_{540}	.887	.154	5.765*	2.428	1.796	3.283
	γ_{550}	1.373	.143	9.587*	3.947	2.981	5.227
	γ_{560}	.940	.160	5.861*	2.561	1.870	3.507
	γ_{570}	.770	.165	4.671*	2.161	1.564	2.985
	γ_{580}	798	.161	4.961*	2.222	1.621	3.045
	γ_{590}	1.254	.163	7.689*	3.504	2.545	4.824
	γ_{5100}	1.250	.167	7.469*	3.489	2.514	4.844
	γ_{5110}	1.267	.204	6.216*	3.551	2.381	5.295
	γ_{5120}	1.406	.250	5.601*	4.067	2.489	6.645
	γ_{5130}	1.514	.336	4.505*	4.544	2.352	8.778
	γ_{5140}	1.780	.444	4.006*	5.930	2.482	14.166

*$p < .05$

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Table 3.4
Variances and Covariance of Random Effects

	Variance	Covaraiance	
		1.	2.
1. Intercept, τ_{10}	3.877*	-	
2. Growth Rate 1, τ_{20}	.190*	.531*	-
3. Growth Rate 2, τ_{30}	.134*	-.306*	-.045

*$p < .05$

Table 3.5
Predicted Probabilities of Risky Sex for Users of Each Substance

| Age	Cigarettes (C)	Alcohol (A)	Marijuana (M)	C & A	C & M	A & M	C, A, & M
16	.007	.005	.028	.005	.029	.023	.024
17	.024	.006	.018	.023	.065	.017	.063
18	.023	.008	.020	.029	.067	.025	.081
19	.020	.013	.017	.037	.048	.031	.086
20	.014	.013	.028	.024	.052	.050	.090
21	.012	.008	.014	.018	.030	.021	.044
22	.011	.008	.009	.021	.023	.017	.045
23	.008	.007	.007	.020	.018	.016	.042
24	.006	.005	.008	.014	.021	.018	.049
25	.004	.005	.006	.011	.014	.017	.039
26	.003	.004	.005	.009	.010	.013	.030
27	.003	.003	.004	.007	.010	.011	.027
28	.004	.001	.003	.005	.017	.005	.024
29	.001	.001	.003	.001	.006	.005	.009
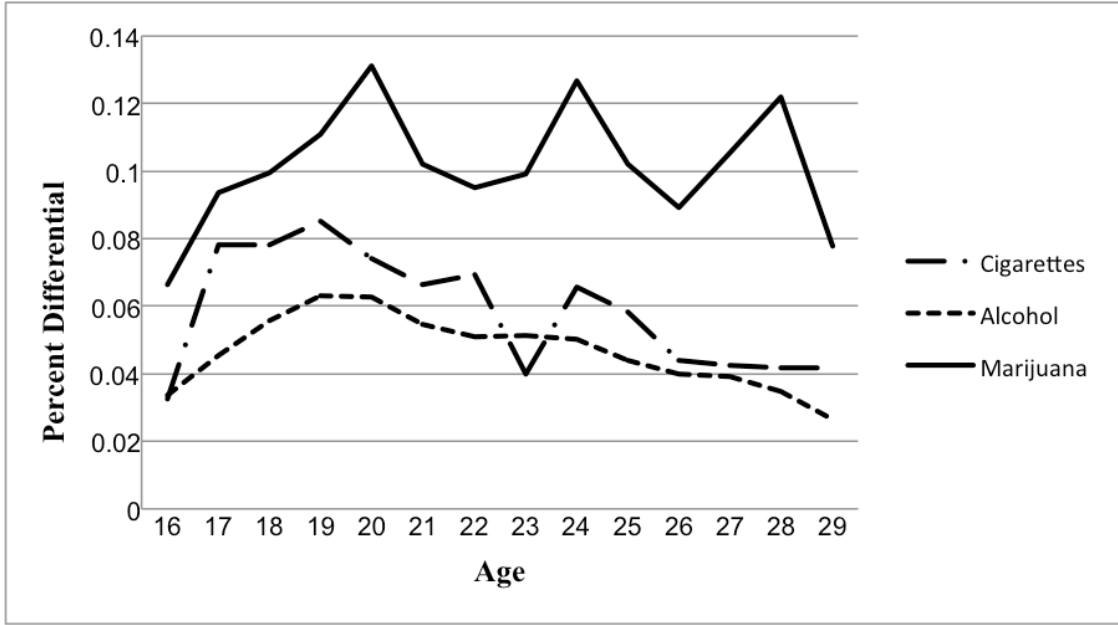
Figure 3.1
Risky Sex Prevalence Increase for Users over Non-Users

CHAPTER 4

DISCUSSION

Our findings show that, among a nationally representative sample that was followed and surveyed yearly from the ages of 16 to 29, marijuana, alcohol, and cigarette use are consistently associated with an increased probability of engaging in risky sex behavior. In addition, marijuana was found to have a stronger association with RS than either alcohol or cigarettes, and cigarettes were found to have a stronger association with RS than alcohol. Because our study shows these relationships to be sustained throughout middle and late adolescence into adulthood, they support the assertions of previous researchers (e.g. Duncan et al., 1998) that it is more valuable to look at the development of various problem behaviors together rather than focus on individual problem behaviors. Most prevention programs address risky sex and substance use separately; however, these results suggest that integrating prevention and intervention efforts to address both could be an important step.

This study supports and builds on the findings of previous studies by having a prospective longitudinal design that covers fourteen years from middle adolescence to early adulthood, and by using a nationally representative sample. Previous studies have found the same relation, but were limited by small samples and short time frames (e.g. Duncan et al., 1998) or by a cross-sectional, rather than longitudinal design (e.g. Yan et al., 2007). Other non- longitudinal studies have found mixed results. Santelli et

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al. (1998) found a concurrent relationship between alcohol use and risky sex (operationalized as having multiple partners and not using a condom), but found an association between illicit substance use and risky sex only among males in the 1992 Youth Risk Behavior Survey. Anderson and Mueller (2008) found a concurrent association between illicit substance use and unprotected sexual intercourse, but not between alcohol use and unprotected sexual intercourse, when looking at the YRBS's conducted between 1991 and 2005. The current study extends these findings by showing a consistent relationship between the use of alcohol, marijuana, and cigarettes and indiscriminate risky sex behavior from late adolescence through adulthood.

The current study looked at the probabilities of users of various substances engaging in sex with strangers and does not establish or assume any causation. Previous research, such as Brook et al. (2002), has shown this relationship to be a reciprocal one. Researchers in that study found that, among Columbian adolescents (N=2226), illicit drug use predicted number of sex partners and frequency of unprotected sex two years later, above and beyond initial level of the risky sex behavior, and also that risky sex behavior predicted illicit drug use two years later, above and beyond initial illicit drug use. If, as Zuckerman (1984) posited, there is a personality trait of sensation seeking that predisposes adolescents and adults to engage in potentially dangerous behaviors, then consistency of the association of RS and substance use is to be expected. The results of the current study support this, with marijuana use being significantly associated with increased probability for having engaged in RS from ages 16 to 29; cigarette use from 17 to 28; and alcohol use from ages 18 to 27. Additionally, if problem behaviors such as risky sex and substance abuse

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are among a set of behaviors that are related to a single trait, or group of traits, these results could be very useful in designing and implementing prevention and intervention efforts that target the underlying causes rather than single symptoms.

Limitations

There are a number of limitations to the current study. In order to test this relationship in a longitudinal, nationally representative sample, we had to use an extant data set. This limited the study to only one realm of risky sex (sex with strangers). Many of the aforementioned studies operationalized risky sex as an index of multiple behaviors, some involving both indiscriminate and protective behaviors. This measure is binary, only telling us if the participant engaged in sex with a stranger (indiscriminate behavior) at least once in the last year. In addition, the operationalization of each type of substance use as using since date of last interview could make the results difficult to interpret. This measure is also binary, simply indicating if the participant has used a given substance at least once in the past year. It's very likely that there is a great deal of variation in both the amount of risky sex and the amount of substance use that participants engaged in. The additional complexity of analyzing the association of amount of use with RS was beyond the scope of this study. Also, the lack of a measure of sensation seeking or impulsivity limits the amount of support that it can lend to these theories.

Future Directions

The limitations of the current study point to directions that future research could take. This study only established an association between one realm of RS and substance use, so the longitudinal relationship between other realms and substance use

still need to be examined. The relationship between both of these behaviors and personality traits is another important area that needs to be studied. Is there a trait such as sensation seeking that is predictive of both RS and substance use? If so, this could be used to help identify those most at risk and in need of preventative interventions.

Some of the most interesting future directions for this research involve looking more deeply at the relationship between substance use and RS. As previously mentioned, the current study was limited by its operationalizations of substance use and RS. Perhaps more generalizable interpretations would be possible by examining the relationships between level of use of each substance and RS. Also, the current study did not look at the interactions between the various kinds of substance use. Future directions could include testing hypotheses related to polydrug use and risky sex.

Conclusions

Among a nationally representative sample followed from the ages of 16 to 29, participants who engaged in marijuana, alcohol, and cigarette use consistently had a significantly increased probability of having also engaged in sex with a stranger, as compared with nonusers. Marijuana use was found to be associated with a higher probability of engaging in sex with a stranger over time than use of either alcohol or cigarettes, and cigarette use was associated with a higher probability of engaging in sex with a stranger over time than alcohol use. These associations lend support to Zuckerman (1984) and others who believed problem behaviors were strongly associated because of personality traits such as sensation seeking. These findings build on and extend previous findings by using a prospective, longitudinal approach and a

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nationally representative sample. They also point to the need for the integration of

prevention and intervention efforts across problem behaviors.

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