Published in final edited form as:

Addict Behav. 2014 March ; 39(3): 644–651. doi:10.1016/j.addbeh.2013.11.021.

Do adolescent drug use consequences predict externalizing and internalizing problems in emerging adulthood as well as traditional drug use measures in a Hispanic sample?

Timothy J. Grigsby^{a,*}, Myriam Forster^a, Lourdes Baezconde-Garbanati^a, Daniel W. Soto^a, and Jennifer B. Unger^a

Timothy J. Grigsby: tjgrigsb@usc.edu; Myriam Forster: myriamfo@usc.edu; Lourdes Baezconde-Garbanati: baezcond@usc.edu; Daniel W. Soto: danielws@usc.edu; Jennifer B. Unger: unger@usc.edu

^aUniversity of Southern California, Keck School of Medicine, Department of Preventive Medicine, Institute for Health Promotion and Disease Prevention

Abstract

The present study compares statistical models for three conceptualizations of drug use in 11th grade (past 30 day ever/never use, past 30 day frequency of drug use and past 30 day drug use consequences) with externalizing and internalizing problems in emerging adulthood when controlling for age, academic achievement and socioeconomic status in a Hispanic sample. Multivariate logistic regression models for the different drug use variables were compared when modeling weapon carrying, arrest, multiple lifetime sex partners, drug/alcohol use before sex and condom use in emerging adulthood. A multivariate linear regression model was used to model depression in emerging adulthood as a function of drug use measurement controlling for other covariates and depression in adolescence. Our findings suggest that any conceptualization of drug use will produce equitable results and model fit statistics when examining externalizing problems. However, when investigating internalizing problems, such as depression, lower frequency drug use—and not high frequency—was more strongly associated with depression whereas experiencing high levels of drug use consequences—and not low levels of consequences—was associated with depression in emerging adulthood despite similar model fit values. Variation between drug use and the experience of drug use consequences may lead to misspecification of “at-risk” subgroups of drug users. Implications and future directions are discussed.

Keywords

drug use; drug use consequences; depression; delinquent behavior; risky sex; emerging adulthood; Hispanic; Latino

© 2013 Elsevier Ltd. All rights reserved.

*Corresponding author. Contact information for Timothy Grigsby: 2001 N. Soto St. 3rd Floor, Los Angeles, CA 90033, Phone: 1-949-923-1499, tjgrigsb@usc.edu.

Contributors: Authors JU and LB-G designed the study and wrote the protocol. Authors TG and MF conducted literature searches and statistical analyses. Author TG wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of interest: All authors declare that they have no conflicts of interest.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

1. Introduction

Adolescent drug use is associated with engagement in delinquent behavior (Brook, Whiteman, Finch & Cohen, 1996), risky sexual behavior (Plant, 2013), perpetration—or victimization—of violent behavior (Boles & Miotto, 2003), depression (Hallfors, Waller, Halpern, Brodish & Iritani, 2004), and premature morbidity and mortality (Mokdad, Marks, Stroup, & Gerberding, 2004; Clark, Martin & Cornelius, 2008). Yet, the majority of such investigations have conceptualized drug use as past 30-day drug use or lifetime drug use with less attention given to the stages of drug use (i.e., experimenter, occasional, regular, abuser, etc.) and how these categories of drug using may affect negative health behaviors or long-term outcomes. Researchers have attempted to identify subgroups of drug users such as poly drug users, heavy users, bingers, or those in treatment for substance use disorders at “high risk” for experiencing long-term adverse outcomes (McGinnis & Foege, 1999; Renner Jr., Baxter & Ciraulo, 2004; Viner & Taylor, 2007; Barrett, Mills, Teeson & Ewer, 2012; Stenbacks, Leifman, & Romelsjo, 2010), and this work has demonstrated that subgroups of drug using populations may indeed be at higher risk for adverse outcomes or engagement in other negative health behaviors. However, to the knowledge of the authors there is no work that has investigated the utility of drug use consequences as a predictor of externalizing and internalizing problems.

Drug use consequences are defined as deleterious proximal interpersonal and intrapersonal outcomes resulting from drug use. The operationalization of drug use consequences stems from research on alcohol related consequences, which continues to be a popular area of study due to the legal status, availability and biological effects of alcohol. A focus on drug use consequences as opposed to traditional drug use measures might be advantageous for two reasons. First, it allows researchers to identify problem users—those who continue to use drugs despite the negative experiences of past drug use—and clarify meaningful distinctions in drug use patterns that could improve our understanding, and prediction of, internalizing and externalizing problems. Second, the experience of negative consequences is not unique to any single drug providing more sensitivity to detect common experiences despite disparate patterns of drug use. One would expect type and frequency of drug use to be strongly associated, but not perfectly correlated, with the frequency of drug use consequences. While we may speculate that individuals who continue to use drugs and ignore drug use consequences have enhanced coping skills or the social and tangible resources to manage the short-term consequences of their drug use, this may lead to feelings of invulnerability from long-term consequences.

Of equal concern is the risk of misclassification. The most recent iteration of the American Psychiatric Association's (APA) Diagnostic and Statistical Manual (DSM-5) (APA, 2013), lists eleven criteria for the diagnosis of a substance use disorder of which five are directly concerned with the recurrent experience of drug use consequences as defined above. However, screening for substance use disorders may be misleading if frequency of drug use is assessed before a thorough examination of proximal DUCs. For example, a low-frequency drug user might be considered a “low” risk even if they are experiencing drug use consequences at the same rate as high-frequency drug users. Furthermore, recent evidence has suggested a relationship between alcohol related problems and depression exists (Marmorstein, 2009), and such a misclassification could have grave clinical implications for the drug user if they are classified as a “low” risk and dismissed following screening. Of course, the exact nature of the relationship between type and frequency of drug use with the experience of drug use consequences is unclear, and the variation between the type and frequency of drug use with the experience of drug use consequences may provide meaningful evidence about the relationship between drug use and negative health outcomes.

As such, the aim of the present study is to compare statistical models using three different conceptualizations of drug use in 11th grade to predict externalizing and internalizing problems in emerging adulthood. Specifically, we compare the model fit statistics and patterns of empirical findings using “ever or never” past 30 day drug use, frequency of drug use (i.e., number of times any drug are used) in the past 30 days and drug use consequences experienced in the past 30 days in 11th grade to predict delinquent behaviors, risky sexual behaviors and depression in emerging adulthood among a Hispanic sample in the Los Angeles area who participated in the Project RED study (Unger, Ritt-Olson, Wagner, Soto, & Baezconde-Garbanati, 2009).

Project RED focuses on the Hispanic population due to the unique factors that contribute to the high rates of licit and illicit drug use among Hispanic adolescents relative to other racial/ethnic groups (Schwartz, Unger, Zamboanga, & Szapocznik, 2010; Centers for Disease Control Youth Risk Behavioral Survey (CDC YRBS), 2011). During the high school years Hispanic adolescents report the second highest rates (non-Hispanic whites have the highest prevalence) of past 30-day smoking (17.5%) and the highest rates of alcohol use (42.3%) and binge drinking (24.2%) and outpace other ethnic groups in rates for past 30-day use of marijuana (7.7%) and cocaine (5.4%) or lifetime use of ecstasy (10.6%) (CDC YRBS, 2011).

2. Methods

2.1 School recruitment and study sample

We invited 3,218 ninth-grade students in Los Angeles County to participate in the Project RED (Reteniendo y Entendiendo Diversidad para Salud/Retaining and Understanding Diversity for Health), a longitudinal study of acculturation patterns and health behavior. Approximately 2,420 (75%) provided parental consent and student assent, and 2,222 (92%) completed the initial survey. A total of 1,963 (88%) self-identified as Hispanic or Latino or reported a Latin American country of origin. Students completed measures in the 10th and 11th grades as well. Between the 9th and 10th grade surveys, one school district divided and transferred students from one of the participating schools to a new school. We included the 10th grade class from the new school in the sample as well as any new students who moved to the participating schools, resulting in an additional 704 Hispanic participants in 10th grade. An additional 43 students joined the sample in 11th grade as a result of joining a participating school. The present analysis uses data for students who self-identified as Hispanic, Latino/Latina, Chicano/Chicana, Mexican, Mexican-American, Central American, South American, Mestizo, La Raza, or Spanish.

2.2 Study procedures

2.2.1 High school survey—Trained research assistants visited prospective participants' classrooms in 9th grade to explain the study and distribute consent forms. Students were instructed to take the consent forms home for their parents to sign. If students did not return the consent form, a designated research assistant telephoned the parents to explain the study and request verbal parental consent. Students were independently given the opportunity to assent or decline to participate after their parents provided written or verbal consent. Data collectors returned to the schools when the students were in 10th and 11th grade. Students who could be located in the same schools (as well as students who had transferred to another school participating in the study) completed follow-up surveys in their classrooms. Students provided their contact information and the contact information for a family friend to help locate them should they move during the course of the study. School personnel also provided forwarding information if available. Data collectors telephoned the missing students in the evenings and surveyed them by telephone. There were no statistically

significant differences in self-reported substance use between the students who completed their surveys in the classroom and those who completed their surveys by telephone. A total of three waves of data collection for the original Project RED study were collected in the 9th, 10th, and 11th grades in 2005, 2006, and 2007, respectively. Study procedures were approved by the University of Southern California Institutional Review Board and by the ethics committees from the school districts from which adolescents were recruited. Additional details regarding the original procedures is provided elsewhere (Unger, Ritt-Olson, Wagner, Soto, & Baezconde-Garbanati, 2009).

2.2.2 Emerging adulthood (EA) survey—In 2010, Project RED study staff attempted to re-contact participants from the original Project RED study to participate in a series of surveys about the transition to emerging adulthood among Hispanics. Participants who self-identified as Hispanic, Latino/Latina, Chicano/Chicana, Mexican, Mexican-American, Central American, South American, Mestizo, La Raza, or Spanish were invited to participate in the EA surveys. Tracking procedures produced valid contact information for 2,151 of the original participants. A total of 1,390 (65%) were consented and participated in the initial EA survey. Data for the first EA survey was collected from November 2010 through December 2012. Participants were compensated \$20 for completing the survey and \$3 for updating their contact information in the database for future surveys. The Institutional Review Board at the University of Southern California approved all study procedures.

2.2 Measures

2.2.1 Predictor of interest

Drug use in 11th grade: Three measures of drug use included in the 11th grade survey were used to operationalize drug use for the present study. Ever/never past 30-day drug use was assessed through a single item, “In the last 30 days, have you used...?” with possible responses of tobacco, alcohol, marijuana, cocaine, methamphetamine, ecstasy, hallucinogens, or inhalants. Participants could indicate more than one drug, if applicable, and the number of drugs marked was summed. For analysis, every/never past 30-day drug use was coded none (0), 1 drug (1) and 2 or more drugs (2). If participants indicated using any drug, they were prompted to report the frequency of use in the past 30 days. Possible responses included 0 times/never, 1-2 times, 3-9 times, 10-19 times, 20-39 times, or 40+ times coded 0 through 5, respectively. Responses were summed across all drugs to create a variable for frequency of drug use in past 30 days. We used a median split of 3 (10-19 times total for all drugs endorsed by the participant) to generate low frequency and high frequency users for the analysis with nonusers as the referent category. Of note, tobacco was not included in the present analysis as we were interested in comparing the use of mood altering substances to drug use consequences, and many of the consequences described below are not relevant to tobacco use.

Finally, a modified version of the 18-item Rutgers Alcohol Problem Index (RAPI) (White & Labouvie, 1989) was used to generate a variable for drug use consequences. The measure was originally developed to assess alcohol related consequences, but has been found to be a valid measure of poly drug use consequences (Ginzler, Garrett, Baer, & Peterson, 2007). The modified version of the RAPI used in the current study asked participants about negative consequences they experienced over the past 30 days as a result of alcohol or drug use. Examples include “not able to do your homework or study for an exam” and “passed out or fainted suddenly.” Possible responses were 0 times, 1-2 times, 3-4 times or 5+ times coded 0 through 3, respectively. The responses were summed to create a total drug use consequence variable. A median split was used for those who indicated past 30 day drug use to create three categories for the final analysis: non-users, low consequence users (drug

users with a summed score of 4 or fewer) and high consequence users (drug users with a summed score of 5 or more).

2.2.2 Outcomes of interest

2.2.2.1 Externalizing problems

Delinquent behavior: Past 30-day weapon carrying and past year arrest were used to assess antisocial behavior in emerging adulthood. Participants were asked how many days they carried a weapon (i.e. gun, knife or club) in the past 30 days with possible responses of 0, 1, 2-3, 4-5, and 6 or more (Centers for Disease Control, 2010). Responses were dichotomized where 1 indicated any weapon carrying and 0 indicated none. We also asked participants if they had been arrested in the past year with the possible responses of yes or no, coded 1 and 0 for the analysis.

Risky sexual behavior: Three items taken from the Youth Risk Behavior Survey (Centers for Disease Control, 2010) were used to measure risky sexual behavior in emerging adulthood. The first item asked participants to report the number of lifetime sexual partners with possible responses of 0 (none), 1, 2, 3, 4, 5, and 6 or more. For analysis, the outcome was coded '0' for 2 or fewer sexual partners and '1' for 3 or more sexual partners (Jewkes et al., 2006; Nduna, Jewkes, Dunkle, Shai & Colman, 2010). Participants were asked if they had used drugs or alcohol before their most recent sexual encounter. We coded responses of no '0' and yes '1' for analysis. Finally, we asked the participant if they or their partner used a condom the last time they had sexual intercourse. We coded yes '0' and no '1' for the analysis if the participant indicated having a sexual partner.

2.2.2.2 Internalizing problems

Depression: The 20-item Center for Epidemiological Studies Depression scale (CES-D) developed by Radloff (1977) was used to measure depression in the present study (Cronbach's $\alpha=0.90$). The measure presents participants with different ways they might have felt over the past week and asks them to indicate how often they have experienced, for example, feeling depressed, unable to get going or thought their life had been a failure. Possible responses are rarely or none of the time, some or a little of the time, occasionally or a moderate amount of the time, and most or all of the time which are coded 0, 1, 2 or 3, respectively. Positively worded items are reverse coded and the scores are summed with higher values indicating the presence of more depressive symptomology. The range for the present sample was 0 to 51 during 11th grade and 0 to 55 at the emerging adulthood survey.

2.2.3 Covariates—Age, gender, academic achievement, and socioeconomic status (SES) were included as covariates in all statistical models. Age was measured in years and gender was coded 0 for males and 1 for females. Academic achievement was the mean grade point average that was self-reported for 8th, 9th and 10th grade. The ratio of persons to number of rooms in the participants' household was used as a proxy measure of SES given the relationship between crowding and income (Evans & Kantrowitz, 2002). Age and SES were modeled continuously. Finally, depression (CES-D score) in 11th grade (Cronbach's $\alpha=0.88$) was included as a covariate in the model predicting depression in emerging adulthood.

2.4 Analysis

Individual multivariate logistic regression models were used for each conceptualization of drug use (past 30 day use, frequency of drug use in past 30 days and drug use consequences in past 30 days) when predicting externalizing problems. All models were controlled for age, gender, SES and academic achievement. We present the odds ratios (OR) and 95% confidence intervals (95% CI) for ease of interpretation. Additionally, we present the p-

value for the nonparametric trend test developed by Cuzick (1985) that uses a Wilcoxin approach to handle the ordinal nature of the main predictors used in the analyses. We also present the Hosmer-Lemeshow goodness of fit (GOF) statistic and its corresponding p-value to compare and contrast the fit across the models. The Hosmer-Lemeshow GOF test identifies subgroups as the deciles of fitted risk values. If the observed event rates match the expected even rates it will produce a statistically insignificant result indicating that the model fit the data well (Hosmer & Lemeshow, 2000; Agresti, 2002).

Separate multivariate linear regression models were used for each conceptualization of drug use (past 30 day use, frequency of drug use in past 30 days and drug use consequences in past 30 days) when predicting internalizing problems (i.e., depression). The models controlled for age, gender, SES, academic achievement and depression in 11th grade since depression is generally believed to be a relapsing (Gopinath, Katon, Russo, & Ludman, 2007) or chronic condition (Murphy & Byrne, 2012). Due to the positively skewed nature of the outcome, we used a log₁₀ transformation to satisfy the assumption of normality. Continuous predictors were centered on their mean prior to analysis. We present the beta coefficients and t-test scores to compare empirical findings in addition to the F-test, it's corresponding p-value and the computed r^2 to evaluate model fit between the different statistical models. All analyses were performed using STATA version 12.

3. Results

3.1 Sample characteristics

This convenience sample consists primarily of second-generation Mexican-American youth (72%) residing in Los Angeles County. The average age of participants in 11th grade was 17 (SD=0.67) and approximately 52% of the sample is female. Approximately 64% of the sample reported having less than one room per person and 14% reported having 1 or more rooms per person in their household. The majority of participants reported having a grade point average (GPA) of a C (2.0) or less from 8th through 11th grade (58.3%), 27% reported having a GPA in the B to C range (3.0-2.1), and 13.9%, reported having higher than a B average. Approximately 49% of the sample reported no drug use in the past 30 days at the 11th grade survey, 27% reported using alcohol, 13% reported marijuana use in the past 30 days, 4% reported using inhalants, and a small proportion reported using other illicit drugs. During 11th grade, 16% of the sample reported experiencing 4 or less drug use consequences and 13% reported experiencing 5 or more drug use consequences (Table 1). In EA, approximately 8% of the sample acknowledged carrying a weapon in the past 30 days and 4% indicated that they had been arrested in the previous year. Furthermore, 36% of the sample reported having 3 or more lifetime sexual partners, 14% reported using drugs or alcohol before their last sexual encounter and 42% reported that they, or their partner, did not use a condom during their last sexual encounter. Table 2 presents the correlation matrix for all predictor variables, covariates and dependent variables included in the present study prior to any transformation for the final analysis. As expected, there was a strong and statistically significant positive association between the experience of drug use consequences with past-30 day “yes/no” drug use ($r=0.90$, $p<0.0001$) and frequency of drug use in the past 30 days ($r=0.90$, $p<0.0001$).

3.2 Main findings

3.2.1 Externalizing problems—Table 3 presents the adjusted odds ratios, 95% confidence intervals and model fit statistics when predicting past 30 day weapon carrying and arrest in the past year during EA for the three models using different definitions of drug use in 11th grade—past 30-day drug use (no drug use, 1 drug, 2 or more drugs), frequency of drug use in past 30 days (no drug use, low, high) and drug use consequences in the past 30

days (no drug use, 0-4, and 5 or more consequences). For past 30-day weapon carrying in EA, we observed a similar trend in the ORs with significant findings for the upper categories of never/ever drug use (OR= 2.11, 95% CI = 1.18, 3.78) and drug use consequences (OR= 1.86, 95% CI = 1.08, 3.21) in 11th grade. Using frequency of drug use did not reveal a significant association. All statistical models fit the data well according to the Hosmer-Lemeshow GOF test and each model correctly classified 92.58% of the participants. Of note, all models had 100% specificity and 0% sensitivity when past 30-day weapon carrying was the outcome (Table 3a).

Similarly, there was a trend in the ORs and model fit statistics when evaluating past year arrest in EA (Table 3b). Compared to non-users the odds of being arrested in the past year for participants who reported using two or more drugs in 11th grade was 5.32 (95% CI=2.39, 11.82), while the odds for those who reported a high frequency of drug use was 5.62 times the odds of nonusers (95% CI=2.54, 12.43), and the odds of arrest in the past year for high consequence users was 4.42 times the odds of a nonuser (95% CI=2.07, 9.45). There was no significant increase in the odds of past year arrest for individuals who reported using 1 drug, were low frequency drug users or reported a low number of drug use consequences relative to nonusers. The model fit statistics suggest each model fit the data well and each model independently classified 96.73% of participants correctly.

Table 4 presents the ORs and model fit statistics for three risky sexual behaviors: multiple lifetime sex partners, the use of drugs or alcohol before the last sexual encounter and no condom at last sexual encounter. The trend of results for each modeling approach of drug use was significant ($p<0.001$) when evaluating multiple lifetime sex partners as the outcome. There was a noticeable, and similar, increase in the odds of having 3 or more lifetime sex partners as number of drugs used, frequency of drug use, and number of drug use consequences increased in 11th grade relative to nonusers. The Hosmer-Lemeshow GOF test suggested each model fit the data well with model 3 (past 30 day drug use consequences) fitting the data the best ($p=0.50$) and model 1 (past 30 day ever/never drug use) fitting the data the least well ($p=0.16$). There was a small difference in the number of participants correctly classified, but these differences were negligible (Table 4a).

Compared to non-users, participants who reported using 2 or more drugs in 11th grade had 2.30 times the odds of reporting the use of drugs or alcohol before their most recent sexual encounter in EA (95% CI=1.40, 3.76). Reporting the use of 1 drug in 11th grade was not associated with alcohol/drug use before sex in EA compared to nonusers. Similarly, those who reported low frequency of use or low drug use consequences in 11th grade were not at a statistically significant increase in odds of using alcohol/drugs before sex in EA. However, there was a similar increase in the odds for those who reported high frequency of drug use (OR=2.31, 95% CI=1.40, 3.81) or high number of drug use consequences (OR=1.98, 95% CI=1.25, 3.12). The significance of the trend was slightly weaker for model 3 ($p=0.001$) relative to models 1 and 2 ($p<0.001$). While each model correctly classified 86.33% of participants, there was some variation in the model fit statistics although all models fit the data well. Model 1 appeared to fit the data the best ($p=0.98$) while model 3 fit the data least accurately ($p=0.85$) although it still fit the data well (Table 4b).

Finally, we evaluated the relationship between the three conceptualizations of drug use in 11th grade with lack of condom use at the last sexual encounter at the EA assessment. The results suggest that those using 2 or more drugs, using drugs at high frequency or experiencing a high number of drug use consequences in 11th grade was not associated with lack of condom use in EA. However, there was a significant increase in the odds of not using a condom, relative to non-drug using participants, when endorsing the use of 1 drug in the past 30-days (OR=1.38, 95% CI=1.01, 1.87), using drugs at a low frequency (OR=1.58,

95% CI=1.16, 2.12), or experiencing a low number for drug use consequences (OR=1.50, 95% CI=1.07, 2.09) in 11th grade. While past-30 day drug use and drug use consequences fit the data well ($p=0.41$ and 0.88 , respectively), the Hosmer-Lemeshow GOF test suggests that frequency of drug use in 11th grade is not as good ($p=0.17$) even though it was still a good fit overall (Table 4c).

3.2.2 Internalizing problems—Table 5 presents the results of the multivariate linear regression model for each conceptualization of drug use in 11th grade when examining depression (CES-D score) in EA controlling for age, gender, SES, academic achievement and CES-D score in 11th grade. Unlike the findings with the externalizing problems, there was a noticeable difference in the results across the different models of drug use. We observed an association between the use of 1 drug in 11th grade with CES-D score in EA ($\beta = 0.06$, $t=2.77$, $p<0.01$), and a weaker non-significant association between the use of 2 or more drugs in 11th grade with depressive symptomology in EA (model 1). Similarly, low frequency of drug use in 11th grade had a significant relationship with depressive symptomology in EA ($\beta=0.06$, $t=2.68$, $p<0.01$), and a weaker—albeit significant—relationship between high frequency of drug use in 11th grade and depressive symptomology in EA ($\beta=0.06$, $t=2.03$, $p<0.05$). However, the relationship was inversed when examining drug use consequences where reporting a high number of drug use consequences in 11th grade was strongly associated with depressive symptomology in EA ($\beta=0.12$, $t=4.71$, $p<0.001$), and reporting a low number of consequences was unrelated to depressive symptomology in EA. The trend tests suggest that the association between adolescent drug use and depressive symptomology in EA is inverse where CES-D score decreases as drug use frequency increases (Model 2: $p<0.001$), while the trend test for DUCs suggests the more DUCs incurred, the higher the score on the CES-D measure (Model 3: $p<0.0001$). The model fit statistics all indicate that the models fit the data well with model 3 (drug use consequences) fitting the data the best ($F=5.27$, $p<0.001$) although the improvement in model fit over the other two models may certainly be unimportant. Additionally, all three models explained 13-14% of the variance in EA depressive symptomology.

4. Discussion

The aim of the present study was to evaluate the results and model fit statistics for three conceptualizations of drug use in 11th grade when examining externalizing and internalizing problems in emerging adulthood. We compared past 30-day drug use, frequency of drug use and the experience of drug use consequences while controlling for age, gender, academic achievement and SES in all models. To our knowledge, this is the first study to evaluate drug use consequences as a predictor of externalizing and internalizing behaviors. Moreover, this paper contributes to extant knowledge as it compares an operational definition of drug use consequences to traditional measures of drug use (i.e., past 30 day ever/never drug use and frequency of drug use).

Overall, our results suggest that any conceptualization of drug use will produce equitable results and model fit statistics when examining externalizing problems. However, when investigating internalizing problems, such as depression, special consideration should be given to the operationalization of drug use. We observed that the lower risk categories of drug use were more strongly associated with depressive symptomology in EA when using past 30 day drug use or frequency of drug use as the predictor. However, when we modeled drug use consequences we found that experiencing a high number of drug use consequences relative to others in the sample during 11th grade was significantly related to depressive symptomology in EA. This difference in findings can impact both research and public health efforts to reduce internalizing problems in drug using populations as discussed below.

Given the high correlation between type and frequency of drug use with the experience of drug use consequences in 11th grade, we consider the possibility that individuals reporting a high number of drug use consequences despite relatively low levels of drug use account for the variation in results when predicting depressive symptomology in emerging adulthood. Such drug users may be on distinct long-term trajectories compared to those on the expected course of drug use (i.e., using harder drugs more frequently and experiencing an increased number of drug use consequences). Understanding this variation could have important clinical implications when screening individuals for a substance use disorder using the DSM-5 criteria and suggests that “higher risk” subgroups of drug users would benefit from interventions tailored to the type and frequency of drug use in addition to their experience of drug use consequences. Assessing drug use consequences along with traditional drug use questionnaires will give investigators and public health officials an opportunity to identify and treat problem users before they experience long-term adverse outcomes. Future work would benefit from comparing type and frequency of drug use to the experience of drug use consequences in order to establish an improved classification system of drug use. Nonetheless, more work with low frequency-high consequence drug users is warranted to clarify the nature of these findings.

Our finding that drug use in 11th grade was associated with weapon carrying in EA accedes with previous findings linking drug use to weapon carrying in Hispanic and non-Hispanic samples (Grunbaum, Basen-Engquist, & Pandley, 1998; Vaughn et al., 2012). However, these studies are often conducted in urban areas where drug trafficking is present—a variable we did not consider in the design of the present study. Moreover, we did not have a large proportion of our sample indicate that they had carried a weapon and this lack of power may be a malefactor for the conclusions reached given the observed results. This conclusion is buttressed by the significant trend test suggesting that the odds of carrying a weapon increases as a function of drug use and the rationale that drug users might have to enter hostile environments in order purchase drugs which therefore prompts their need to possess a weapon for protection.

We did observe that increased drug use was associated with arrest in the past year during the EA survey. In particular, we found a significant relationship for drug users if they reported using 2 or more drugs, were in the upper fiftieth percentile for frequency of drug use or reported experiencing 5 or more drug use consequences in the past 30 days during 11th grade. While we did not inquire as to the cause of the arrest, these findings reaffirm previous work showing a relationship between drug use and arrest. Both illicit drug use and heavy drug use—especially alcohol—are associated with property crime and violent offenses (Hoaken et al., 2012; Popovici, Homer, Fang & French, 2012), and it is likely that this caliber of drug user was present in the categories we found to be associated with arrest in the present study. Moreover, according to nationwide statistics (Bureau of Justice Statistics, 2007), approximately 1.5 million arrests were for drug related charges with Hispanics having the second highest rates of drug-related arrests after African-Americans (Sabol & West, 2008). However, this is the first study to find a prospective association between drug use consequences and future arrest. It may be that those who reported experiencing drug use consequences in 11th grade are continuing to experience negative consequences in EA—such as driving under the influence, getting into physical altercations, etc.—that are the cause of arrest. Future work would benefit from qualitative and quantitative work with drug users experiencing consequences to aid in the development of interventions to reduce or eliminate drug use consequences. For example, focus groups or individual interviews could inform researchers as to the motives of drug use despite the experience of drug use consequences. Another possible avenue is the development of real-time interventions vis a vis ecological momentary intervention techniques (Heron & Smyth, 2010) to modify drug use behaviors or increase protective behaviors (e.g., assigning a designated driver) to reduce

the experience of proximal drug use consequences. Current evidence suggests that more work in this research area is needed (Cohn, Hunter-Reel, Hagman, & Mitchell, 2011), and we support this notion.

We found a strong pattern of associations between drug use and multiple lifetime sexual partners regardless of the modeling approach for drug use in 11th grade. However, it should be noted that we asked about multiple sex partners over the lifetime of the participant and we cannot conclude that a prospective association exists due to the ambiguity of the temporal ordering of events. Only participants reporting the use of two or more drugs, high frequency of drug use or experiencing a high number of drug use consequences were likely to report using drugs or alcohol before their most recent sexual encounter. This should be expected as heavier drug users are more likely to continue drug use from adolescence into adulthood and are more likely to engage in risky health behaviors when intimate with other drug users (Fleming, White, Catalano, 2010). Interestingly, we only observed that participants who reported using one drug, using at a low frequency or experiencing few drug use consequences were at increased odds of not using a condom at their last sexual encounter, but there was no association for the higher-level drug users in this sample. Of course, the last sexual encounter may not be representative of all sexual encounters for the participant so the results should be interpreted with caution.

Nevertheless, these findings have important implications. It is well documented that risky sexual behavior is linked to numerous adverse outcomes including infection from sexually transmitted disease (i.e., HIV, human papilloma virus, etc.), unintended pregnancy, or rape underscoring the need for increased sex education for drug users. Education strategies should serve to increase knowledge regarding negative outcomes and improve the perception of risk as previous work has suggested that drug users—whom may be in an altered mental state while engaging in sex—are unlikely to consider the consequences of risky sex practices (de Wit, 2009). Insofar as our findings suggest that lower levels of drug use are associated with risky sexual behavior as opposed to higher levels of drug use also warrants discussion. It is probable that lower level drug users seek out other forms of pleasure whereas heavy users rely solely on drugs in order to experience pleasure. It is equally likely that heavy users are not able to maintain a relationship due to their drug using habits thus explaining their lack of sexual encounters. Regardless of the reason for this lack of association, further work is needed to explore sexual relationships for individuals across the spectrum of drug use.

4.1 Limitations

Results should be interpreted with caution provided the limitations of the study. First, this sample consisted of primarily second-generation Mexican American students from the Los Angeles area that is not representative of the Hispanic population in the United States or the larger non-Hispanic population, in general. Second, drug users were more likely to be lost to follow-up and the sample included in this analysis represents a lower risk population that limits our generalizability. Moreover, approximately 22% of the sample did not endorse a response on the drug use items during the 11th grade survey. As such, the external validity of the results is limited. Third, it has been previously documented that the average age of onset for depression is 15 years (Lewinsohn & Essau, 2002). As such, the reader should take caution in interpreting the findings as drug use prospectively predicting depression. We did find an interesting pattern of associations between drug use and depressive symptomology (as measured by the CES-D), but we cannot conclude that it prospectively causes depression. Finally, we analyzed frequency of drug use and drug use consequences using a median split procedure. This decision limits our generalizability as we present high and low frequency of drug use and experience of drug use consequences as relative to the drug use in

our sample. However, we felt this was necessary as it allowed us to define meaningful lower and higher risk groups of drug users compared to non-users.

4.2 Conclusions

The findings of the present study suggest that drug use consequence measures are useful when predicting externalizing and internalizing problems. It appears that different measures of drug use produce equitable results when predicting externalizing problems such as delinquent and risky sexual behaviors. Of course, this conclusion is speculative provided the limitations outlined above and would benefit from replications using larger and more heterogeneous samples. Furthermore, it is recommended that investigators should take caution when examining internalizing problems, such as depression, where drug use is the predictor of interest. We recommend that researchers compare different measures of drug use prior to computing statistical models, as the results of the present study suggest they might be contradictory. We also encourage more research to investigate the relationship between drug use consequences and future adverse health behaviors and outcomes.

Acknowledgments

Role of funding sources: Funding for this study was provided by National Institutes of Health (NIH) grants DA016310 and CA009492. NIH had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

References

- Agresti, A. Categorical Data Analysis. Hoboken: John Wiley and Sons; 2002.
- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th. Arlington, VA: American Psychiatric Publishing; 2013.
- Barrett EL, Mills KL, Teesson M, Ewer P. Mental health correlates of anger and violence among individuals entering substance use treatment. *Mental Health and Substance Use*. 2012;1–16. ahead-of-print.
- Boles SM, Miotto K. Substance abuse and violence: A review of the literature. *Aggression and Violent Behavior*. 2003; 8(2):155–174.
- Brook JS, Whiteman M, Finch SJ, Cohen P. Young adult drug use and delinquency: childhood antecedents and adolescent mediators. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1996; 35(12):1584–1592. [PubMed: 8973064]
- Bureau of Justice Statistics, Office of Justice Programs, US Department of Justice. [Accessed June 11, 2013] Estimated arrests for drug abuse violations by age group 1970–2006. 2007. Available at: <http://bjs.ojp.usdoj.gov/content/glance/tables/drugtab.cfm>
- Centers for Disease Control and Prevention. [Last accessed on 4 November 2013] Youth Risk Behavior Survey. 2011. Available at: www.cdc.gov/yrbs
- Clark DB, Martin CS, Cornelius JR. Adolescent-onset substance use disorders predict young adult mortality. *Journal of Adolescent Health*. 2008; 42(6):637–639. [PubMed: 18486875]
- Cohn AM, Hunter-Reel D, Hagman BT, Mitchell J. Promoting behavioral change from alcohol use through mobile technology: The future of ecological momentary assessment. *Alcohol Clinical Experimental Research*. 2011; 35(12):2209–2215.
- Cuzick J. A Wilcoxin-type test for trend. *Statistics in Medicine*. 1985; 4:87–90. [PubMed: 3992076]
- de Wit H. Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addiction biology*. 2009; 14(1):22–31. [PubMed: 18855805]
- Evans GW, Kantrowitz E. Socioeconomic status and health: the potential role of environmental risk exposure. *Annual Review of Public Health*. 2002; 23(1):303–331.
- Fleming CB, White HR, Catalano RF. Romantic Relationships and Substance Use in Early Adulthood: An Examination of the Influences of Relationship Type, Partner Substance Use, and Relationship Quality. *Journal of health and social behavior*. 2010; 51(2):153–167. [PubMed: 20617756]

- Ginzler JA, Garrett SB, Baer JS, Peterson PL. Measurement of negative consequences of substance use in street youth: An expanded use of the Rutgers Alcohol Problem Index. *Addictive behaviors*. 2007; 32(7):1519–1525. [PubMed: 17236724]
- Gopinath S, Katon WJ, Russo JE, Ludman EJ. Clinical factors associated with relapse in primary care patients with chronic or recurrent depression. *Journal of affective disorders*. 2007; 101(1-3):57–63. [PubMed: 17156852]
- Grunbaum JA, Basen-Engquist K, Pandey D. Association between violent behaviors and substance use among Mexican-American and non-Hispanic white high school students. *Journal of Adolescent Health*. 1998; 23(3):153–159. [PubMed: 9730358]
- Hallfors DD, Waller MW, Ford CA, Halpern CT, Brodish PH, Iritani B. Adolescent depression and suicide risk: association with sex and drug behavior. *American Journal of Preventive Medicine*. 2004; 27(3):224. [PubMed: 15450635]
- Heron KE, Smyth JM. Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. *British journal of health psychology*. 2010; 15(1):1–39. [PubMed: 19646331]
- Hoaken, PN.; Hamill, VL.; Ross, EH.; Hancock, M.; Lau, MJ.; Tapscott, JL. *Drug Abuse and Addiction in Medical Illness*. Springer; New York: 2012. *Drug Use and Abuse and Human Aggressive Behavior*; p. 467-477.
- Hosmer, DavidW; Lemeshow, S. *Applied Logistic Regression*. New York: Wiley; 2000.
- Jewkes R, Dunkle K, Nduna M, Levin J, Jama N, et al. Factors associated with HIV sero-status in young rural South African women: connections between intimate partner violence and HIV. *International Journal of Epidemiology*. 2006; 35(6):1461–1468. [PubMed: 17008362]
- Lewinsohn, PM.; Essau, CA. Depression in adolescents. In: Gotlib, IH.; Hammen, CL., editors. *Handbook of depression*. Guilford Press; New York: 2002. p. 541-559.
- Marmorstein NR. Longitudinal associations between alcohol problems and depressive symptoms: Early adolescence through early adulthood. *Alcohol: Clinical and Experimental Research*. 2009; 33(1):49–59.
- McGinnis JM, Foege WH. Mortality and morbidity attributable to use of addictive substances in the United States. *Proceedings of the Association of American Physicians*. 1999; 111(2):109–118. [PubMed: 10220805]
- Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA: the journal of the American Medical Association*. 2004; 291(10):1238–1245. [PubMed: 15010446]
- Murphy JA, Byrne GJ. Prevalence and correlates of the proposed DSM-5 diagnosis of Chronic Depressive Disorder. *Journal of affective disorders*. 2012; 139(2):172–180. [PubMed: 22381955]
- Nduna M, Jewkes RK, Dunkle KL, Shai NP, Colman I. Associations between depressive symptoms, sexual behaviour and relationship characteristics: A prospective cohort study of young women and men in the Eastern Cape, South Africa. *Journal of the International AIDS Society*. 2010; 13(1):44. [PubMed: 21078150]
- Plant, M. *Risk-takers: Alcohol, drugs, sex and youth*. Routledge; 2013.
- Popovici I, Homer JF, Fang H, French MT. Alcohol use and crime: findings from a longitudinal sample of US adolescents and young adults. *Alcoholism: Clinical and Experimental Research*. 2012; 36(3):532–543.
- Renner, JA., Jr; Baxter, JD.; Ciraulo, DA. *Pharmacotherapy of Depression*. Humana Press; 2004. *Substance Abuse and Depression*; p. 211-241.
- Radloff LS. The CES-D scale A self-report depression scale for research in the general population. *Applied psychological measurement*. 1977; 1(3):385–401.
- Sabol, WJ.; West, HS. *Prisoners in 2007*. Washington, DC: Bureau of Justice Statistics; 2008. Available at: <http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=903> [Accessed June 11, 2013]
- Schwartz SJ, Unger JB, Zamboanga BL, Szapocznik J. Rethinking the concept of acculturation: Implications for theory and research. *American Psychologist*. 2010; 65(4):237. [PubMed: 20455618]
- Stenbacka M, Leifman A, Romelsjo A. Mortality and cause of death among 1705 illicit drug users: a 37-year follow up. *Drug and alcohol review*. 2010; 29(1):21–27. [PubMed: 20078678]

- Unger JB, Ritt-Olson A, Wagner K, Soto D, Baezconde-Garbanati L. A comparison of acculturation measures among Hispanic/Latino adolescents. *Journal of Youth and Adolescence*. 2007; 36(4): 555–565.
- Vaughn MG, Perron BE, Abdon A, Olate R, Groom R, Wu LT. Correlates of handgun carrying among adolescents in the United States. *Journal of interpersonal violence*. 2012; 27(10):2003–2021. [PubMed: 22258071]
- Viner RM, Taylor B. Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort. *Journal of epidemiology and community health*. 2007; 61(10):902–907. [PubMed: 17873228]
- White HR, Labouvie EW. Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol and Drugs*. 1989; 50(01):30.

Highlights

- We compare statistical models of different conceptualizations of drug use.
- Drug use consequences predict future externalizing problems.
- Drug use operationalization may produce different results when predicting depression.

Table 1Sample characteristics based on information collected on 11th grade survey.

Variable	Frequency	Percent
Drugs use in past 30 days ¹		
Non-user	1,357	49.0
Alcohol	738	26.6
Marijuana	370	13.4
Cocaine	67	2.4
Methamphetamine	37	1.3
Ecstasy	42	1.5
Hallucinogens	41	1.5
Inhalants	123	4.4
Unknown	614	22.2
Drug use consequences experienced in past 30 days		
Non-user	1,357	49.0
Four or less (Lower 50%)	449	16.2
Five or more (Upper 50%)	349	12.6
Unknown	615	22.2
Gender		
Male	1,288	46.5
Female	1,445	52.2
Unknown	37	1.3
Rooms per person (SES)		
Less than one	1,767	63.8
One or more	377	13.6
Unknown	626	22.6
Grade point average (GPA)		
2.0 or less	1,615	58.3
2.1 – 3.0	749	27.0
3.1 or greater	386	13.9
Unknown	20	0.7
Age <i>M (SD)</i>	17 (0.67)	

¹ Total adds up to more than 100% as 181 participants (6.5%) of the sample indicated they used more than one drug in the past 30 days at the 11th grade survey assessment.

Note: SES = Socioeconomic status

Table 2

Correlation matrix for variables included in the present study.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Never/ever drug use	--												
2. Frequency of drug use	0.95***	--											
3. Drug use consequences	0.90***	0.90***	--										
4. Female	-0.09***	-0.09***	-0.05*	--									
5. SES	0.03	0.03	0.02	-0.06*	--								
6. GPA	-0.16***	-0.17***	-0.16***	0.07***	0.09**	--							
7. Age	-0.15***	-0.15***	-0.14***	-0.05*	0.01	-0.24**	--						
8. Weapon carrying	0.07*	0.09**	0.07*	-0.20***	0.04	-0.06*	-0.01	--					
9. Arrest	0.18***	0.17***	0.15***	-0.12***	0.05	-0.10***	0.07*	0.10**	--				
10. Lifetime sex partners	0.20***	0.20***	0.18***	-0.33***	0.10*	-0.03	-0.01	0.10**	0.13***	--			
11. Drug/alcohol use before sex	0.13***	0.12**	0.11**	-0.14***	0.06	-0.07*	0.05	0.06	0.12**	0.26***	--		
12. No condom use	0.03	0.03	0.04	0.12**	-0.05	-0.04	0.06	0.02	0.04	0.05	0.03	--	
13. Depression (CES-D)	0.07*	0.08**	0.13***	0.09**	0.02	-0.04	-0.02	0.01	0.05	0.06*	0.13**	0.09**	--

Note:

*
p<0.05,**
p<0.01,***
p<0.0001. Variables 1-3 reflect past 30-day drug use in 11th grade.

Table 3

Logistic regression model and model fit statistics for externalizing problems for three separate models of drug use.

(a) Past 30 day weapon carrying (n=1,146)			
	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Drug use			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
1 drug or Lower 50%	1.14 (0.66, 1.98)	1.31 (0.77, 2.21)	1.14 (0.64, 2.05)
2+ drugs or Upper 50%	2.11 (1.18, 3.78)	1.78 (0.96, 3.30)	1.86 (1.08, 3.21)
P for trend	0.001	0.002	0.003
Hosmer-Lemeshow GOF	3.83	7.90	4.08
p-value	0.87	0.44	0.85
% correctly classified	92.58%	92.58%	92.58%
(b) Arrested in the past year (n=1,130)			
	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Drug use			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
1 drug or Lower 50%	1.32 (0.53, 3.29)	1.18 (0.45, 2.99)	1.05 (0.36, 3.01)
2+ drugs or Upper 50%	5.32 (2.39, 11.82)	5.62 (2.54, 12.43)	4.42 (2.07, 9.45)
P for trend	<0.001	<0.001	<0.001
Hosmer-Lemeshow GOF	10.93	6.03	7.91
p-value	0.21	0.64	0.44
% correctly classified	96.73%	96.73%	96.73%

Note: Model 1 uses never/ever drug use (none, 1 drug, 2+ drugs), model 2 uses frequency of drug use (none, lower 50%, upper 50%), and model 3 uses drug use consequences (none, lower 50%, upper 50%) within the past 30 days during the 11th grade survey. All models are adjusted for age, SES and academic achievement.

OR = Odds ratio, 95% CI = 95% confidence interval, GOF = Goodness of Fit

Table 4

Logistic regression model and model fit statistics predicting risky sexual behavior in EA using three models of drug use in 11th grade.

(a) Multiple lifetime sex partners (n=884)			
	Model 1	Model 2	Model 3
Drug use	OR (95% CI)	OR (95% CI)	OR (95% CI)
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
1 drug or Lower 50%	1.68 (1.20, 2.34)	1.62 (1.16, 2.26)	1.67 (1.17, 2.40)
2+ drugs or Upper 50%	2.61 (1.70, 4.01)	2.95 (1.89, 4.60)	2.28 (1.57, 3.32)
P for trend	<0.001	<0.001	<0.001
Hosmer-Lemeshow GOF	11.77	11.11	7.34
p-value	0.16	0.20	0.50
% correctly classified	69.46%	70.48%	69.91%
(b) Drug/alcohol use at last sexual encounter (n=994)			
	Model 1	Model 2	Model 3
OR (95% CI)			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
1 drug or Lower 50%	1.23 (0.78, 1.93)	1.25 (0.80, 1.95)	1.22 (0.75, 1.99)
2+ drugs or Upper 50%	2.30 (1.40, 3.76)	2.31 (1.40, 3.81)	1.98 (1.25, 3.12)
P for trend	<0.001	<0.001	.001
Hosmer-Lemeshow GOF	2.04	2.86	4.07
p-value	0.98	0.94	0.85
% correctly classified	86.33%	86.33%	86.33%
(c) No condom use at last sexual encounter (n=926)			
	Model 1	Model 2	Model 3
OR (95% CI)			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
1 drug or Lower 50%	1.38 (1.01, 1.87)	1.58 (1.16, 2.12)	1.50 (1.07, 2.09)
2+ drugs or Upper 50%	1.40 (0.95, 2.07)	1.04 (0.69, 1.57)	1.27 (0.90, 1.80)
P for trend	0.06	0.28	0.11
Hosmer-Lemeshow GOF	8.24	11.63	3.68
p-value	0.41	0.17	0.88
% correctly classified	59.18%	60.26%	60.15%

Note: Model 1 uses never/ever drug use (none, 1 drug, 2+ drugs), model 2 uses frequency of drug use (none, lower 50%, upper 50%), and model 3 uses drug use consequences (none, lower 50%, upper 50%) within the past 30 days during the 11th grade survey. All models are adjusted for age, SES and academic achievement.

OR = Odds ratio, 95% CI = 95% confidence interval, GOF = Goodness of Fit

Table 5

Predicting depression (CES-D score) in emerging adulthood using three definitions for drug use in 11th grade.

	Model 1		Model 2		Model 3	
	β	t	β	t	β	t
Drug use						
None			Reference		Reference	
1 drug or Lower 50%	0.06	2.77***	0.06	2.68***	0.01	0.50
2+ drugs or Upper 50%	0.05	1.90	0.06	2.03*	0.12	4.71***
P for trend	0.01		<0.001		<0.0001	
Model F	2.95		2.95		5.27	
p-value	<0.001		<0.001		<0.0001	
R ²	0.13		0.13		0.14	

Note: (N=1,128)

* p<0.05,

** p<0.01,

p<0.001. Model 1 uses never/ever drug use (none, 1 drug, 2+ drugs), model 2 uses frequency of drug use (none, lower 50%, upper 50%), and model 3 uses drug use consequences (none, lower 50%, upper 50%) within the past 30 days during the 11th grade survey. All models are adjusted for age, gender, SES, academic achievement and CES-D score in 11th grade. Unstandardized beta coefficients are presented.