Published in final edited form as:

Drug Alcohol Depend. 2008 August 1; 96(3): 233–248. doi:10.1016/j.drugalcdep.2008.03.012.

The Interaction of Conduct Problems and Depressed Mood in Relation to Adolescent Substance Involvement and Peer Substance Use

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Abstract

Conduct problems are strong positive predictors of substance use and problem substance use among teens, whereas predictive associations of depressed mood with these outcomes are mixed. Conduct problems and depressed mood often co-occur, and such co-occurrence may heighten risk for negative outcomes. Thus, this study examined the interaction of conduct problems and depressed mood at age 11 in relation to substance use and problem use at age 18, and possible mediation through peer substance use at age 16. Analyses of multirater longitudinal data collected from 429 rural youths (222 girls) and their families were conducted using a methodology for testing latent variable interactions. The link between the conduct problems X depressed mood interaction and adolescent substance use was negative and statistically significant. Unexpectedly, positive associations of conduct problems with substance use were stronger at lower levels of depressed mood. A significant negative interaction in relation to peer substance use also was observed, and the estimated indirect effect of the interaction on adolescent use through peer use as a mediator was statistically significant. Findings illustrate the complexity of multiproblem youth.

Keywords

Conduct Problems; Depression; Substance Use; Adolescence; Peer Influence

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Author Contributions

W. Alex Mason conceptualized the research questions, conducted the statistical analyses, and drafted the manuscript. Julia E. Hitchings performed data management duties, conducted literature searches, and edited the manuscript. Richard L. Spoth designed the original study, lead the data collection effort, and edited the manuscript. All authors have contributed to and approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest.

1. Introduction

This study examined the extent to which conduct problems and depressed mood interact to influence substance use and problem substance use among adolescents, and tested the degree to which peer substance use potentially mediates these links. Although rates of use for certain substances have been declining in recent years among teens in many developed countries, overall levels of substance use remain unacceptably high (Hibell et al., 2004). To illustrate, 77% of high school seniors in the United States had used alcohol at some point in their lifetimes in 2004, 53% had used cigarettes, and 46% had used marijuana/hashish (Johnston et al., 2005). Alcohol and tobacco currently are among the top contributors to global disease burden as measured by disability-adjusted life years (World Health Organization, 2002). Many substance users do not progress to problem substance use, which refers to the experience of adverse consequences, such as relationship difficulties or school troubles, that result from substance consumption. However, those who do experience problem use are at risk for continued difficulties, including the development of substance-related disorders (Lewinsohn et al., 1996) as defined in the International Statistical Classification of Diseases and Related Health Problems (ICD-10, World Health Organization, 2004) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR, American Psychiatric Association, 2000).

Research has identified risk and protective factors across individual, peer, school, family, and community domains that are associated with teen substance use (Hawkins et al., 1992). Less is known about risk and protective factors for problem substance use (Stice et al., 1998). Identifying predictors of problem use may be useful for the development of interventions that target key factors to reduce the harms that can result from substance use (Toumbourou et al., 2007). For example, Newcomb and Bentler (1989) suggested from their review of the literature at the time that internal psychological processes (e.g., self-medication of depressed mood) may play an important role in problem substance use. Recently, investigators have begun to elucidate psychological and behavioral conditions, such as conduct problems and depressed mood, that increase risk for the full range of substance involvement, including use, problem use, and substance-related disorders (Glantz and Leshner, 2000).

1.1. Consequences of Conduct Problems for Substance Involvement

Conduct problems, whether they are measured categorically or dimensionally, are common among teens. Conduct problems typically precede the initiation of substance involvement (Huba and Bentler, 1983, Kuperman et al., 2001), and manifestations of conduct problems, such as delinquency, positively predict substance use (Mason and Windle, 2002, Ellickson and Hays, 1991, King et al., 2004, Shedler and Block, 1990), problem use (Stice et al., 1998, White, 1992, Windle, 1990), and substance-related disorders (Harford and Muthén, 2000). For example, prior analyses of data from the current longitudinal project have shown that self-reported delinquency as early as age 11 was an indirect positive predictor of problem substance use at age 18 through elevated alcohol use at age 16 for boys and girls in this rural adolescent sample (Mason et al., 2007b). These findings are consistent with developmental theories suggesting that early antisocial behavior provides an important pathway leading to the development of substance-related disorders (Tarter and Vanyukov, 1994, Zucker, 1994).

1.2. Consequences of Depressed Mood for Substance Involvement

Adolescent major depression is another prevalent DSM disorder that has been shown to be associated with substance use (Boys et al., 2003), as well as with substance-related disorders (Armstrong and Costello, 2002, Marmorstein and Iacono, 2001). Some research suggests that when substance abuse co-occurs with depression, the onset of depression tends to

precede the onset of substance abuse (Clark and Mokros, 1993, Deykin et al., 1986). Likewise, subclinical depressed mood is relatively common among teens, and there is some evidence that elevated levels of depressed mood increase risk for substance use (King et al., 2004, Wills et al., 1999, Windle and Windle, 2001), problem use (Stice et al., 1998), and substance-related disorders (Lewinsohn et al., 2000, Costello et al., 1999). In our own research on the current sample (Mason et al., 2007b), depressed mood as early as age 11 positively predicted problem substance use at age 18 among females, controlling for delinquency.

These findings may be consistent with the self-medication hypothesis (Khantzian, 1985), which states that some depressed individuals turn to substance use as a way to alleviate the symptoms of their depression. Similarly, it has been suggested that indicators of negative affect, in addition to antisociality, may provide another important developmental pathway leading toward substance-related disorders (Tarter and Vanyukov, 1994, Zucker, 1994). However, findings regarding the predictive associations of depressed mood with adolescent substance use and problem use are much less consistent than those for conduct problems. For example, some investigators have failed to find links between depressed mood and adolescent substance use and problem use (Brook et al., 1998, Clark et al., 1999, Hansell and White, 1991), especially when controlling for conduct problems and related confounding factors (Capaldi and Stoolmiller, 1999, Fergusson and Woodward, 2002, Stice et al., 1998). Findings from these latter studies are noteworthy because they illustrate the importance of considering both conduct problems and depressed mood together in relation to adolescent substance involvement. Most studies have focused on one of these predictors in isolation from the other.

1.3. Substance Involvement and the Interaction of Conduct Problems and Depressed Mood

As stated by Sroufe (1997), comorbidity of disorders is the rule, not the exception for youth. In this regard, studies have found that conduct disorder and major depression often co-occur among adolescents (Kovacs et al., 1988, Loeber and Keenan, 1994). Similarly, teens often display elevated levels of severity in conduct problems and depressed mood, and the co-occurrence of conduct problems and depressed mood is particularly common, possibly placing individuals at heightened risk for adverse outcomes (Capaldi, 1991). In our own project work (Mason et al., 2007b), we have only examined estimated additive effects of delinquency, as one indicator of conduct problems, and depressed mood on adolescent substance involvement. A few studies have examined the interaction of conduct problems and depressed mood in relation to specific adjustment outcomes (Capaldi, 1991, Capaldi, 1992, Marmorstein and Iacono, 2001, Marmorstein and Iacono, 2003, Miller-Johnson et al., 1998, Capaldi and Stoolmiller, 1999, Pardini et al., 2007), but findings are mixed, especially for substance use.

Pardini et al. (2007) found that early adolescent depressive symptoms positively predicted young adult alcohol use disorder symptoms and diagnoses only among those who also displayed high levels of early adolescent conduct disorder symptoms in a sample of high-risk boys. Similarly, Marmorstein and Iacono (2001, 2003) found that, compared with either disorder in isolation, comorbid conduct disorder and major depression predicted greater maladjustment in several domains, including substance dependence, among a community sample of adolescent twins. These studies are consistent with the hypothesis that the co-occurrence of multiple problems heightens risk for negative outcomes (Lewinsohn et al., 1995, Riggs et al., 1995). However, Capaldi and Stoolmiller (1999) failed to find statistically significant estimated interactive effects of adolescent conduct problems and depressive symptoms on later substance use (see also, Capaldi, 1992). Miller-Johnson et al. (1998) examined tobacco, alcohol, and marijuana use across Grades 6, 8, and 10 among a sample of African American teens categorized into groups according to their levels of

conduct problems and depressive symptoms. Although they reported some instances in which risk for substance use was greatest in the comorbid conduct problems and depression group, the authors also noted instances in which risk was no greater in the comorbid group compared to the conduct-problems-only group.

Mixed findings regarding the interaction of conduct problems and depressed mood might be due to several factors, including variation in sample characteristics across studies; previous studies have recruited, for example, clinical (e.g., Riggs et al., 1995) and high-risk (e.g., Capaldi, 1991) youth. Less focus has been placed on longitudinal studies of general community samples of youth. Differences in the definition and measurement of key constructs across studies also might explain mixed findings in this literature, with some research focusing on the categorical assessment of ICD and DSM disorders (e.g., Marmorstein and Iacono, 2001) and other research focusing on the dimensional assessment of subclinical problems (Capaldi and Stoolmiller, 1999). Finally, mixed findings might be due to certain methodological limitations of prior studies. In particular, the difficulty of finding significant interactions within field research is well known (e.g., McClelland and Judd, 1993). This difficulty is due, in part, to the presence of measurement error in the constructs used to assess interactions (Jaccard and Wan, 1995). Thus, latent variable analyses that correct for measurement error are needed.

1.4. Peer Substance Use as a Possible Mediating Mechanism

Although some studies have reported statistically significant estimated interactive effects of conduct problems and depressed mood on substance involvement, the potential mediating mechanisms involved in these associations have not yet been examined. Co-occurring conduct problems and depressed mood may be associated with increased risk for problems in several domains of life (Capaldi, 1992, Marmorstein and Iacono, 2003), especially within the peer domain during adolescence due to the increased salience of peer influences during this developmental period (Steinberg and Morris, 2001). For instance, teens who are elevated on both conduct problems and depressed mood may have difficulty forming and maintaining prosocial relationships with conventional peers; instead, such teens may gravitate toward deviant peer networks (Kaplan, 1975, Kaplan, 1980, Patterson et al., 2000). Association with substance-using peers, in particular, is a strong risk factor for substance use (Brook et al., 1989, Farrell and White, 1998) and problem use (Mason et al., 2007a).

1.5. Study Objectives

1.5.1 Objective One—Adopting a dimensional approach, with problem areas measured on a continuum of severity, the first objective of this study was to examine, using latent variable modeling techniques, the interaction of early adolescent (age 11) conduct problems and depressed mood and consequences for late adolescent (age 18) substance use and problem substance use among a community sample of rural adolescents. Identifying early adolescent predictors of late adolescent substance use and problem use may provide information useful for designing efficacious, developmentally timed interventions to prevent substance involvement. Notwithstanding the importance of early adolescence, the consequences of co-occurring problems for substance involvement may be particularly salient when the overall levels of conduct problems and depressed mood are elevated during the teen years (Windle and Windle, 2001). Thus, a series of supplemental analyses was conducted under Objective One to examine the interaction of trait-like conduct problems and depressed mood, measured as averages across four time points extending from age 11 to age 16.

Note that the purpose of this investigation was to examine the consequences of conduct problems and depressed mood for the development of a general orientation to substance use

and the experience of problems associated with such use among teens. Thus, substance use was defined as a latent variable indexing use versus nonuse of alcohol, tobacco, and marijuana. These are the three most prevalent forms of adolescent substance use (Johnston et al., 2005), and research shows that multiple substance use among teens is common (Newcomb, 1992).

Although findings have been mixed, we expected that the interaction of conduct problems and depressed mood would heighten risk for later substance use and problem use. Because problem use requires some level of substance intake (Stice et al., 1998), analyses tested for possible indirect associations of the predictors, especially the interaction of conduct problems and depressed mood, with problem use through substance use.

1.5.2. Objective Two—The second objective of this study was to begin exploring peer substance use as a possible mechanism linking co-occurring conduct problems and depressed mood in early adolescence (age 11) with substance involvement in late adolescence (age 18). Biddle, Bank, and Marlin (1980) found that, whereas parental influence on alcohol use was strong in early adolescence at an average age of 12.9 years, peer influence was most important in middle adolescence at an average age of 15.2 years. Thus, peer substance use in mid-adolescence (measured at age 16 in the current study) may be one mediating link in the association of the conduct problems X depressed mood interaction with adolescent substance involvement. Identifying the mechanisms linking earlier risks with later outcomes may provide information useful for the development of preventive interventions designed to interrupt the progression from conduct problems and depressed mood to substance involvement. We expected that if conduct problems and depressed mood have a statistically significant estimated interactive effect on either substance use or problem use, regardless of the pattern of the interaction, then that effect might be mediated through peer substance use.

1.5.3. Covariates—Analyses included early onset-substance use, parental problem drinking, gender, and parent education as covariates to capture early adolescent propensity for experiencing adverse consequences related to substance use. Early-onset substance use is a risk factor for the development of problem use (Nelson and Wittchen, 1998, Hawkins et al., 1997), and inclusion of this variable in the analyses helped control for the stability of substance use over the time frame of the study. Most likely through a combination of heritable and environmental mechanisms (Hopfer et al., 2003), parental problem drinking increases risk for substance use and problem use among teens (Chassin et al., 1999). Although similarities in rates of substance use initiation for boys and girls have been documented (Barnes et al., 1993), boys tend to have higher rates of problem use relative to girls (Regier et al., 1990); therefore, gender was included as a covariate. Finally, analyses controlled for parent educational attainment, which has been shown to be associated with missingness in the current study.

2. Method

2.1. Participants

Data were drawn from a larger longitudinal study of rural adolescents and their families, some of whom participated in a universal substance use prevention program.¹ Families with sixth graders in rural communities of a Midwestern state were invited to participate in the study. Of the 883 eligible families, 49% ($N = 429$) agreed to participate and completed the Wave 1 assessment in the Fall of 1993. Similar studies conducted at the time of this trial have reported comparable initial recruitment rates (Spoth and Redmond, 1994). Importantly, analyses of data collected from a prospective participation factor survey have documented

the representativeness of the sample with respect to a range of family sociodemographic characteristics (Spoth et al., 1998), indicating that participants did not differ appreciably from eligible nonparticipants. The average age of target youth was 11 years when the study began, and the average age of mothers and fathers at the study's outset was 37 and 40 years, respectively.

Teens were followed periodically from age 11 to age 18 in this longitudinal panel study, and both self-report and parent-report data were collected over time. Seventy-one percent ($n = 305$) of adolescents who completed the baseline assessment also participated at age 18. Comparisons of assessment dropouts versus completers across a range of sociodemographic characteristics and psychosocial variables have revealed minimal differences. There is consistent evidence, however, that families with more highly educated parents were more likely to stay in the study than families with less highly educated parents (Spoth et al., 1998).

Participating families had an average of three children when the study began, and most were dual-parent in structure (83%). The target child was a girl in 52% ($n = 222$) of families. Most mothers (56%) and fathers (52%) reported having some post-high school education. The median annual household income in the sample was \$32,000 in 1993. As a reflection of the region in which the study was conducted, over 95% of the sample was White.

2.2. Procedure

Families received information describing the assessments and the program components of the prevention trial, along with an initial questionnaire for each parent and the target child to complete individually prior to an in-home visit. Families were then contacted by a project staff member to schedule the in-home assessment, which included additional questionnaires for each participating family member to complete. On average, in-home visits lasted 2.5 hours. Each individual was compensated approximately \$10/hour for their involvement in the study. Identical procedures were used to conduct follow-up assessments at approximately 9, 21, 33, 51, and 75 months after the baseline assessment, when students were in the 6th (age 12), 7th (age 13), 8th (age 14), 10th (age 16), and 12th (age 18) grades, respectively. All participants were assured of the confidentiality of their responses, and the procedures were approved by the Human Subjects Review Committees at the University of Washington and Iowa State University.

2.3. Measures

2.3.1. Conduct problems—Early adolescent conduct problems were measured as a latent variable comprised of three multi-informant indicators at age 11. Specifically, six items from the Child Behavior Checklist - Youth Self Report (CBCL-YSR, Achenbach, 1991) were used to assess self-reported conduct problems within the past 6 months, and parallel reports were obtained from mothers and fathers in reference to the target adolescent. Items asked about the extent to which adolescents were mean/cruel to others, destroyed their own property, destroyed the property of others, got into fights, physically attacked people, and threatened people; thus, the conduct problems measures tapped into aspects of teens' aggression, destruction of property, and serious violations of rules (American Psychiatric Association, 2000). Response options were "not true" (0), "somewhat or sometimes true"

¹The current data were collected as part of an evaluation of the Preparing for the Drug Free Years (PDFY) preventive intervention (currently called Guiding Good Choices), a training program for parents of children aged 8–14 years. Based on the Social Development Model (Hawkins and Weis, 1985), PDFY conveys information about the risks for substance use and seeks to enhance parenting and parent-child interactional skills. The PDFY program evaluation, which itself is part of a larger collaboration between investigators from the University of Washington and Iowa State University (see Spoth et al., 1998, Spoth et al., 2001), is described in greater detail in Kosterman et al. (2001).

(1), and “very or often true” (2). For each reporter, a scale was computed as the average response to all items. Alpha reliability was .72 for adolescent reports, .79 for mother reports, and .70 for father reports. Descriptive frequency analyses showed that, in the sixth grade, 24% of adolescents reported meanness/cruelty to others, 15% reported destroying their own property, 5% reported destroying things belonging to others, 17% reported getting into fights, 5% reported physically attacking people, and 10% reported threatening people in the sixth grade. Also, 19% of teens reported two or more conduct problems, 8% reported three or more problems, and 4% reported four or more problems.

Measures for the supplemental analyses were created, first, by repeating the steps described above to form indicators of self-reported, mother-reported, and father-reported adolescent conduct problems at ages 12, 13, 14, and 16. Next, trait-like measures of conduct problems were computed within each rater as the mean of the assessments across time, from age 11 to age 16. The measures for adolescents ($\alpha = .79$), mothers ($\alpha = .92$), and fathers ($\alpha = .84$) served as indicators of a trait conduct problems latent variable.

2.3.2. Depressed mood—Early adolescent depressed mood was measured as a latent variable with three multi-informant indicators at age 11. Eight items from the CBCL-YSR were used to assess self-reported feelings of depressed mood within the past 6 months, and parallel reports were obtained from mothers and fathers in reference to the target adolescent. Items asked about the extent to which adolescents felt lonely, cried a lot, tried to hurt self, thought of suicide, felt unloved, felt worthless or inferior, felt guilty, and felt sad or unhappy. Responses were provided on the same 3-point scale used for conduct problems. For each reporter, a scale was computed as the average response to all items. Alpha reliability was .76 for adolescent reports, .75 for mother reports, and .73 for father reports. Descriptive frequencies showed that 48% of teens reported loneliness, 33% reported crying, 3% reported trying to hurt themselves, 4% reported thoughts of suicide, 15% reported feeling unloved, 11% reported feeling worthless, 23% reported feeling sad or depressed, and 13% reported feeling guilty in the sixth grade. Also, 38% of teens reported two or more symptoms of depressed mood, 23% reported three or more symptoms, 15% reported four or more symptoms, and 7% reported five or more symptoms.

Again, measures for the supplemental analyses were created by repeating the steps described above to form indicators of self-reported, mother-reported, and father-reported adolescent depressed mood at ages 12, 13, 14, and 16. Next, trait-like measures of depressed mood were computed within each rater as the mean of the assessments across time, from age 11 to age 16. The measures for adolescents ($\alpha = .78$), mothers ($\alpha = .86$), and fathers ($\alpha = .85$) served as indicators of a trait depressed mood latent variable.

2.3.3. Substance use—Late adolescent substance use was measured as a latent variable with three indicators at age 18. Adolescents were asked to report their frequency of smoking cigarettes, drinking alcohol, and using marijuana within the past 12 months. Recall that the goal of this study was to examine predictors of substance use defined as a general orientation to involvement (or not) with the three most commonly used substances among teens; therefore, these three variables were dichotomized to represent use (coded 1) versus nonuse (coded 0) of the particular substance. Because the original substance use variables were highly skewed, dichotomization of the indicators also facilitated the latent variable modeling analyses² (cf. Farrington and Loeber, 2000). Within the past year at age 18, 45%

²The original substance use variables displayed skewness values of 1.44, 9.65, and 8.33 for cigarette use, alcohol use, and marijuana use, respectively. Comparison with the values shown in Table 1 for the dichotomized variables reveals that skewness, although not eliminated, was reduced considerably.

of adolescents reported smoking cigarettes, 72% reported drinking alcohol, and 16% reported using marijuana. Alpha reliability of these three indicators was .60.

2.3.4. Problem substance use—Late adolescent problem substance use was measured as a latent variable with three indicators at age 18. Adolescents reported on their current substance use problems with four questionnaire items (e.g., “How often has your use of alcohol, marijuana, or other drugs caused you to behave in ways that you later wished you hadn’t?” and “How often has your use of alcohol, marijuana, or other drugs hurt your relationship with your parents?”). Response options were “never” (0), “rarely” (1), “sometimes” (2), and “very often” (3), and a scale was computed as the average response to the items ($\alpha = .84$). Descriptive analyses indicated that 71% of the respondents reported no substance use problems, whereas 13% reported one problem, 6% reported two problems, and 10% reported three problems; none reported having all four substance use problems.

Self-reported problem drinking in the past 12 months was assessed with four items that were averaged to compute an overall scale ($\alpha = .76$). Sample items include “When drinking, how often did you have trouble remembering what you had done when you were drinking?” and “When drinking, how often did you get sick or pass out?” Response options were “never” (0), “once” (1), “twice” (2), “three times” (3), and “four or more times” (4). Descriptive analyses showed that 61% of the respondents reported no problem drinking symptoms, whereas 16% reported one symptom, 10% reported two symptoms, 7% reported three symptoms, and 6% reported all four symptoms.

Finally, mothers and fathers each were asked two questions regarding whether or not target children received treatment within the past year for alcohol problems and for drug problems. A single dichotomous variable representing presence (coded 1; 7% of youth) versus absence (coded 0; 93% of youth) of parent-reported service use for any substance-related problem was created from these items.

Most of the problems listed above likely follow soon after substance use; therefore, both the substance use and problem use factors were measured in late adolescence. Research has supported the validity and reliability of adolescent self-reports of substance use and problem use (e.g., Winters et al., 1990).

2.3.5. Peer substance use—In middle adolescence (age 16), when peer influences typically increase, adolescents were asked to report on six survey items how many of their close friends used various substances (e.g., alcohol, tobacco, marijuana, and other illicit drugs) in the past year on a scale ranging from “none of them” (1) to “all of them” (5). Items were summed to create a composite scale ($\alpha = .81$). To control for prior peer substance use, analyses included a dichotomous variable indexing any involvement with close friends who used any substance such as alcohol, tobacco, marijuana, and other illicit drugs in early adolescence, at age 11; 21% of the adolescents reported having any close friends who used substances at this time point.

2.3.6. Covariates—Analyses included a measure of self-reported early onset substance use at age 11, computed as a dichotomous variable that indexed use (coded 1) or nonuse (coded 0) of any one of the following substances: cigarettes, smokeless tobacco, alcohol, marijuana, inhalants, and other illicit drugs. Seven items from the Iowa Youth and Families Project (Conger and Conger, 2002) were used to measure parent problem drinking. Specifically, mothers and fathers were asked about the extent to which they experienced several consequences from drinking alcohol in the past 12 months at Wave 1 on a scale ranging from “never” (1) to “often” (4). Sample items include “How often have you had family problems because of drinking too much?” and “How often have you felt the need to

cut down on drinking?” Items were averaged separately for mothers and fathers, then standardized and summed to create an overall parental problem drinking scale. Additionally, analyses included a measure of parent education at Wave 1 (i.e., highest grade of schooling reported by both parents) and gender (coded 1 for males and 0 for females). Finally, a variable indexing intervention group (coded 1, $n = 221$) versus control group (coded 0, $n = 208$) status was included in the analyses.

Descriptive statistics for all study variables, excluding those created for the supplemental analyses, are reported in Table 1; additional information about the measures of trait-like conduct problems and depressed mood is available on request. Several of the measures listed above were either created for the current project or were adaptations of items drawn from similar longitudinal studies (Elliott et al., 1985, Conger and Conger, 2002).

2.4. Data Analyses

Analyses were conducted using latent variable interaction structural equation modeling (SEM). In this study, an approach was used that estimates interaction effects between continuous latent variables via full-information maximum likelihood estimation with robust standard errors using a numerical integration algorithm (Klein and Moosbrugger, 2000). This approach is available in Mplus 3.13 (Muthén and Muthén, 1998–2004), and has the advantage of being easier to implement than many approaches, such as those that require nonlinear constraints (for a review of current approaches to latent interaction analysis, see Marsh et al., 2004). Analyses also used full-information maximum likelihood missing data estimation procedures, which yield more efficient and less biased parameter estimates than traditional methods for dealing with missing data, such as listwise deletion (Schafer and Graham, 2002).

As mentioned, the data were drawn from a longitudinal study with a preventive intervention incorporated within it; thus, care was taken in conducting the etiological analyses in the current context. Intervention analyses have revealed differences between experimental groups in the levels and rates of certain risk factors and problem behavior outcomes, such as parent-child interaction quality (Kosterman et al., 2001) and substance use (Spath et al., 1998, Spath et al., 2001). However, there has been little evidence of differences between experimental groups in the relationships among variables that play a role in the etiology of substance use and problem use. To illustrate, we compared the fit of a multiple-group model that constrained to equivalence across conditions all covariances among the 16 variables included in the model depicted in Figure 1: the three indicators of conduct problems, the three indicators of depressed mood, the three indicators of substance use, and the three indicators of problem substance use, as well as the measures of early substance use, parental problem drinking, gender, and parent education. Results from this highly conservative test showed that the constraints did not significantly reduce model fit, $\chi^2(120, N = 429) = 137.43, p = .13$, indicating that the relationships among the variables could be considered the same across experimental groups. Subsequent analyses were based on the pooled sample,³ including intervention status as a covariate.

³Analyses were replicated using the control-only sample ($n = 208$). As expected, statistical power was limited; however, comparisons of the results revealed that the vast majority of estimated parameters, although not identical, were comparable in direction and magnitude.

3. Results

3.1. Study Objective One

3.1.1. Model specification—The hypothesized model to address study Objective One was guided by the research of Klein and his colleagues (Klein and Moosbrugger, 2000, Klein and Stoolmiller, 2003), and is illustrated in Figure 1.⁴ An important feature of the model is the estimation of an interaction between the two exogenous latent independent variables: conduct problems and depressed mood. Using Mplus notation, the latent interaction is depicted as a filled circle in Figure 1. Although certain approaches to the estimation of latent interactions require the formation of product indicators for a new latent interaction factor (e.g., Kenny and Judd, 1984), the maximum likelihood approach⁵ used in this study estimates the interaction effect from the first-order or main-effect factor indicators without creating a new latent variable.

Indicators of the latent predictor variables were derived from multirater reports of adolescent conduct problems and depressed mood. Each latent variable included reports from target adolescents, mothers, and fathers. In this way, the exogenous latent variables represent common factors that account for shared variance in reports of either conduct problems or depressed mood across family raters (Cook and Goldstein, 1993). Because each rater may bring a unique perspective or response pattern to the assessment of adolescent conduct problems and depressed mood, the common factors are unlikely to account for all of the systematic variance in their respective indicators. Thus, the error term for each exogenous latent variable indicator (i.e., e1–e6 in Figure 1) is expected to include, in addition to random measurement error, systematic variance that is associated with each rater. To account for rater effects, the covariance between the error term of the conduct problems indicator and the error term of the depressed mood indicator was estimated within each of the three raters (e.g., e1 with e4 for adolescent report in Figure 1).

To scale the latent independent variables and to identify the model, the variance of each factor was constrained to 1.0; all factor loadings were freely estimated. Standardizing the exogenous factors facilitated interpretation of the interaction results. The latent problem use variable was scaled by constraining the factor loading of the substance use problems indicator to 1.0; the residual variance of the latent endogenous variable was freely estimated (i.e., d2 in Figure 1). The service use indicator of the problem substance use factor was specified as a binary categorical dependent variable in the Mplus syntax. The latent substance use variable was scaled in a similar manner, with past-year marijuana use serving as the reference indicator. Each substance use indicator was specified as a binary categorical dependent variable in Mplus.⁶ In addition, covariates were included as exogenous variables

⁴The Mplus 3.13 default of adaptive numerical integration with 15 integration points per dimension was used for the current analyses. The structural equation model depicted in Figure 1 has four dimensions of integration; Muthén and Muthén (1998–2004) note that the computational burden is “heavy” for models with 3 to 4 dimensions of integration (p. 326). Alternative numerical integration options were implemented (e.g., nonadaptive numerical integration with 10 integration points), resulting in identical substantive conclusions.

⁵Marsh et al. (2004) found that maximum likelihood-based approaches to latent interactions can lead to Type I errors when distributions of the indicators for the exogenous latent variables are highly non-normal. As would be expected, the conduct problems and depressed mood latent variable indicators used in the current study were somewhat non-normally distributed (see Table 1). The MLR estimator in Mplus 3.13 generates standard errors for parameter estimates that are robust to non-normality. In addition, we replicated the analyses of this study after log-transforming the variables to normalize their distributions. Substantive conclusions from these analyses were identical to those reported herein. As an additional check, a latent interaction analysis was conducted using the unconstrained approach advocated by Marsh et al. (2004). Once again, the primary substantive finding, which is described below, was corroborated using this alternative analytic strategy. Taken together, these analyses suggest that the findings reported below do not simply represent artifacts of the modeling strategy.

⁶Analyses of the measurement model for the substance use latent variable revealed that the factor loadings for alcohol use and cigarette use could be constrained to equivalence, which improved the performance of the latent variable by reducing the occurrence of model estimation difficulties. A chi-square difference test showed that this constraint did not significantly reduce model fit compared to a model that freely estimated the two loadings, $\chi^2_{\text{difference}}(1, N = 429) = .46, p > .05$.

correlated with one another as well as with the conduct problems and depressed mood latent variables.

Conventional model fit indices are not provided for analyses based on the MLR estimator using a numerical integration algorithm in Mplus 3.13, and currently the applicability of such indices is unknown for latent variable interaction models. However, estimated loglikelihood values do permit likelihood ratio model difference tests for the comparison of nested models. To evaluate the fit of the measurement model prior to conducting model comparisons, a basic confirmatory factor analysis (CFA) of the latent variables depicted in Figure 1 was conducted. All covariances among the latent variables were freely estimated. The fit between the data and the model was acceptable, $\chi^2 (23, N = 429) = 81.06, p < .05$, Comparative Fit Index (CFI) = .93, Tucker Lewis Index (TLI) = .92. Note that the chi-square statistic is often significant in structural equation models based on moderate to large sample sizes, which has led to the development of alternative fit indices; the recommended cut-off value for fit indices, such as the CFI, is greater than .90 and close to .95 (Hu and Bentler, 1999). All factor loadings were statistically significant ($p < .001$). There was a strong relationship between conduct problems and depressed mood ($r = .61, p < .001$), as well as between substance use and problem use ($r = .83, p < .001$). Whereas conduct problems was significantly related to substance use ($r = .19, p < .05$) and problem use ($r = .22, p < .01$), depressed mood was unrelated to these outcomes.

3.1.2. Nested model comparisons—We began by specifying a baseline model that included the measurement model depicted in Figure 1, with only one freely estimated structural path: the regression of problem use on substance use. This baseline model served as a starting point for the model comparisons (M1: Loglikelihood = -3988.15, parameters = 61). Conduct problems, depressed mood, and the covariates were included in the analysis as correlated exogenous variables, and the latent interaction was included as well; however, all paths leading from these predictors to the endogenous latent variables were constrained to zero in Model M1. Constraints were systematically released in subsequent models to test the extent to which freely estimating certain paths (e.g., the interactions) significantly improved the fit of the model.

As a second step, paths leading from conduct problems, depressed mood, and each of the covariates to the two endogenous latent variables were freely estimated (M2: Loglikelihood = -3975.08, parameters = 75). The relative fit of these nested models was compared using a chi-square difference test.⁷ The fit of the second model, which added the predictors as a set, was significantly better than that of the baseline model, $\chi^2 (14, N = 429) = 26.15, p < .05$. Interestingly, neither conduct problems nor depressed mood had statistically significant predictive associations with substance use ($b = .69, p > .05$ for conduct problems and $b = -.15, p > .05$ for depressed mood) and problem use ($b = .21, p > .05$ for conduct problems and $b = -.07, p > .05$ for depressed mood) in Model M2; however, the possibility remained that these variables could interact to influence the outcomes. Next, the interactions were tested. In Model M3, the association of the latent interaction with substance use was freely estimated (M3: Loglikelihood = -3971.99, parameters = 76). Results showed that the fit of the third model improved over the fit of Model M2, $\chi^2 (1, N = 429) = 6.20, p < .05$, indicating an interaction of conduct problems and depressed mood in relation to substance use. Finally, the association of the latent interaction with problem use was added as an additional parameter (M4: Loglikelihood = -3971.676, parameters = 77); however, the chi-square difference test comparing M3 with M4 was nonsignificant, $\chi^2 (1, N = 429) = .65, p > .05$. Including an interaction in relation to problem use did not significantly improve

⁷ $\chi^2_{\text{difference}} = -2 * \log\text{likelihood}_{\text{difference}}$.

model fit. Note that additional analyses were conducted to examine a possible three-way interaction of conduct problems, depressed mood, and gender in relation to substance use and problem use; however, there was no evidence for higher-order interactions. Thus, we settled on M3 as the final model, including an estimated interaction effect of conduct problems and depressed mood on substance use.⁸

3.1.3. Interaction in relation to adolescent substance use—Unstandardized path estimates from Model M3 are reported in Table 2 (standardized estimates for these analyses are not provided by Mplus 3.13). The relationship between the conduct problems X depressed mood product term at age 11 and substance use at age 18 was negative and statistically significant. To interpret the interaction, methods commonly used in product term regression analysis were adopted (Aiken and West, 1996). Parameter estimates were reconceptualized in terms that permitted an examination of the slope of substance use regressed on conduct problems at different values of depressed mood (holding the covariates, which were standardized prior to interpretation, constant at their means). To plot the interaction, values representing 1 standard deviation above the mean of depression (1), the mean of depression (0), and 1 standard deviation below the mean of depression (−1) were chosen. Arbitrarily, values of .5 and 1.5 were chosen to represent low and high conduct problems, respectively, to anchor the lines of each simple slope.

The interaction is depicted in Figure 2. Unexpectedly, the positive slope for the regression of substance use on conduct problems was steeper at lower levels of depressed mood. Following procedures outlined in Aiken and West (1996, pp. 14–22), significance tests of each simple slope were computed. Results showed that the association of conduct problems with substance use was positive and statistically significant at 1 standard deviation below the mean of depressed mood ($b = 2.035, p < .05$). Simple slopes at the mean ($b = 1.20$) and 1 standard deviation above the mean ($b = .36$) of depressed mood, although positive, were not significantly different from zero ($p > .05$). Because moderation analyses are symmetric, we also considered conduct problems as the moderating variable. Examining the link between depressed mood and substance use at different levels of conduct problems showed that depressed mood had a positive but nonsignificant association with the outcome at 1 standard deviation below the mean of conduct problems and a negative but nonsignificant association with the outcome at 1 standard deviation above the mean of conduct problems.

As expected, the link between substance use and problem use in late adolescence was positive and statistically significant. A subsequent analysis was conducted to test the statistical significance of the estimated indirect effect (through substance use) of the conduct problems X depressed mood interaction on problem use. Using the formula provided in Baron and Kenny (1986), results showed that the indirect effect was nonsignificant, $b^{indirect} = -.21, se = .14, p > .05$.

None of the covariates was significantly related to substance use, and none of the covariates had associations with problem use over and above the influence of substance use. Thus, in the multivariate context of Model M3, distal associations of the early adolescent covariates with the late adolescent substance use outcomes did not emerge as statistically significant predictors over and above the estimated effect of the conduct problems X depressed mood product term.

⁸Additional tests were conducted in which the constraints on the interaction effects were released in the reverse order, beginning with problem substance use rather than substance use. Results from these model comparisons were identical to those reported herein. When compared to Model M2, a model that freely estimated only the additional path from the interaction to problem use did not display significantly improved fit, $\chi^2_{difference}(1, N = 429) = .03, p > .05$. This model, therefore, was still rejected in favor of Model M3, which included the interaction effect on substance use.

3.1.4. Supplemental analyses—To examine the extent to which more stable, trait-like expressions of conduct problems and depressed mood interact to predict later substance use and problem use, supplemental analyses were conducted by repeating the series of models described above with latent variables representing conduct problems and depressed mood over time, from age 11 through age 16. To conserve space, results from these analyses are only briefly summarized. As before, the best fitting model was Model M3, which included a latent conduct problems X depressed mood interaction in relation to substance use but not to problem use. Unstandardized path estimates for the final supplemental model are reported in Table 3. Importantly, the association of the conduct problems X depressed mood product term, measured from age 11 through age 16, with substance use at age 18 was negative and statistically significant. Identical steps as those described above were taken to interpret the interaction. Results revealed that the link between conduct problems and substance use was positive and statistically significant both at 1 standard deviation below the mean of depressed mood ($b = 2.68, p < .01$) and at the mean of depressed mood ($b = 1.79, p < .01$). The simple slope at 1 standard deviation above the mean of depressed mood was statistically nonsignificant ($b = .91, p > .05$). Casting conduct problems as the moderating variable, the relationship between depressed mood and substance use was positive but nonsignificant at 1 standard deviation below the mean of conduct problems and negative but nonsignificant at 1 standard deviation above the mean of conduct problems.

3.2. Study Objective Two

3.2.1. Model specification—To explore one possible mechanism in the link between the conduct problems X depressed mood product term and substance use, Model M3 (see Table 2) was expanded to include peer substance use as a mediating variable (see Figure 3). In this “mediated moderation” model (Baron and Kenny, 1986), our primary focus was on the statistical significance of the estimated indirect effect of the interaction on substance use through peer substance use. Note once again that conventional model fit indices currently are not provided as output in latent interaction analyses using Mplus. Adding the manifest peer substance use variables at ages 11 and 16 to the basic CFA described above resulted in comparable model fit, $\chi^2 (29, N = 429) = 94.35, p < .05$, CFI = .93, TLI = .92, which is to be expected since the fundamental measurement model is the same across these CFAs. Examining results from the expanded CFA revealed that conduct problems but not depressed mood had statistically significant associations with the age 11 ($r = .19, p < .01$) and age 16 ($r = .31, p < .001$) peer substance use variables, which themselves were significantly correlated ($r = .22, p < .001$). Adolescent substance was significantly associated with peer substance use ($r = .17, p < .05$ at age 11; $r = .56, p < .001$ at age 16), and peer substance use at age 16 had a significant positive relationship with adolescent problem use at age 18 ($r = .37, p < .001$).

3.2.2. Interaction in relation to peer substance use—Unstandardized path estimates for the mediated moderation model are provided in Table 4. Results showed that the relationship between the conduct problems X depressed mood product term at age 11 and peer substance use at age 16 was negative and statistically significant. Procedures outlined by Aiken and West (1996) were used to interpret the interaction, which is depicted in Figure 4. Consistent with the results for adolescent substance use, the positive slope for the regression of peer substance use on conduct problems was steeper at lower levels of depressed mood. Tests of the statistical significance of simple slopes revealed that the association of conduct problems with peer substance use was positive and statistically significant at 1 standard deviation below the mean ($b = 2.39, p < .001$), at the mean ($b = 1.78, p < .001$), and 1 standard deviation above the mean ($b = 1.16, p < .05$) of depressed mood. Thus, although the strength of the relationship between conduct problems and peer substance was attenuated at a high level of depressed mood, a significant positive link

remained. Examining the association of depressed mood with peer substance use at different levels of conduct problems showed that depressed mood had a negative and statistically significant association with the outcome at 1 standard deviation above the mean of conduct problems ($b = -1.367, p < .01$); simple slopes at the mean and 1 standard deviation below the mean of conduct problems were negative but nonsignificant.

3.2.3. Mediation test—In addition to the association of the interaction with peer substance use, there was a positive and statistically significant link between peer substance use at age 16 and adolescent substance use at age 18. The direct relationship between the conduct problems X depressed mood interaction and adolescent substance use was nonsignificant in the mediation model. More importantly, the estimated indirect effect through peer substance use was statistically significant, $b = -.34, se = .17, p < .05$. Early adolescent substance was positively related and parent educational attainment was negatively related to peer substance use at age 16, over and above the influence of earlier peer substance use. As expected, there was a positive link between substance use and problem use at age 18. Again, however, there were limited effects of the early adolescent covariates on the late adolescent outcomes.

4. Discussion

Findings from latent variable analyses revealed an interaction of conduct problems and depressed mood at age 11 in relation to substance use at age 18, illustrating the importance of considering these behavioral and psychological problems together rather than in isolation (Capaldi, 1991, Kovacs et al., 1988, Loeber and Keenan, 1994). Contrary to the expectation that conduct problems and depressed mood would synergistically increase the likelihood of later problems as evidenced by a positive interaction, we found a statistically significant negative interaction. Thus, high levels of both conduct problems and depressed mood interacted to reduce risk for later substance use among youth. Probing the estimated interactive effect revealed that a positive association between conduct problems and substance use was present only when depressed mood was low. A similar buffering interaction pattern was observed when examining trait-like conduct problems and depressed mood.

These findings stand in contrast to prior research that has reported heightened risk for substance involvement as a result of co-occurring conduct problems and depression (Miller-Johnson et al., 1998, Pardini et al., 2007, Riggs et al., 1995, Marmorstein and Iacono, 2003). Our goal was to examine the interaction of conduct problems and depressed mood, measured as dimensional constructs, in relation to substance use and problem use among a community sample of rural adolescents. Thus, certain characteristics of this study may explain the discrepancy in findings. For example, other studies have been based on clinical samples (e.g., Riggs et al., 1995) or relied on categorical assessment of more serious psychiatric disorders (Marmorstein and Iacono, 2003).

Capaldi and Stoolmiller (1999) examined conduct problems X depressive symptoms interactions in relation to a range of outcomes, including substance use, measured in late adolescence and early adulthood using data collected from a sample of high-risk boys. In their study, statistically significant interaction effects were observed for only three outcomes: driver's license suspensions, causing pregnancy, and fatherhood. Capaldi and Stoolmiller (1999) summarized these findings by noting that "The pattern of effects was similar for all three models; the interaction term was negative...The association was positive at lower and moderate levels of depressive symptoms and was less strong at high levels of depressive symptoms" (p. 75). These findings illustrate that the basic interaction pattern observed in this study is not without precedent in the adolescent conduct problems-

depression literature. Also, it is noteworthy that no interaction of conduct problems and depressive symptoms in relation to substance use was revealed in Capaldi and Stoolmiller (1999). It is possible that measurement error in the conduct problems and depressive symptoms constructs, which were manifest variables in the regression analyses, lowered the power of the statistical test of the interaction (Jaccard and Wan, 1995). Only significant interaction patterns were reported in the Capaldi and Stoolmiller (1999) study; therefore, it is unknown if the regression coefficient for the conduct problems X depressive symptoms product term might have revealed a similar, though statistically nonsignificant, negative estimated interaction effect for substance use.

Whether conduct problems and depressed mood were measured at age 11 or as trait-like constructs, the interaction of these variables was not significantly related to problem use over and above substance use. Moreover, the estimated indirect effect of the interaction on the distal outcome through substance use was nonsignificant. The possibility remains that positive (or negative) interactions might be observed in relation to other serious outcomes, such as hard drug use. Also, there were few statistically significant predictive associations of the covariates with the late adolescent outcomes in the multivariate models.

There are at least three explanations for the relatively weak covariate relationships in this study. First, one reason for including the age 11 covariates was to control for indicators of early propensity for substance use and problem use, which are behaviors that tend to emerge later in adolescence (Johnston et al., 2002). Thus, the covariates were rather distal to the outcomes; stronger associations might have been observed with a shorter time lag between these sets of variables. Second, because youth cannot experience the adverse consequences of substance use without a certain level of consumption, we were interested in the extent to which the covariates might have an association with problem use over and above the strong influence of substance use. Finally, for substance use as an outcome, the covariates were required to predict use over and above earlier behavioral and emotional problems, as represented by the latent conduct problems X depressed mood product term. Prior project analyses have demonstrated predictive influences of covariates, such as parent problem drinking, on substance-related outcomes among youth, but did not include latent constructs of conduct problems and depressed mood as competing predictors (Mason et al., 2007b). Mason et al. (2007b) also reported a few gender differences in associations between either delinquency (as one indicator of conduct problems) or depressed mood and substance involvement; however, no higher-order interaction with gender was found in the current analyses. Mason and his colleagues did find that delinquency at age 11 was a positive predictor of substance involvement for both gender groups, and the present findings suggest that the tendency for depressed mood to attenuate the link between early adolescent conduct problems and later substance use is similar for boys and girls.

4.1. Mediated Moderation Analysis: Peer Substance Use

Although our initial expectation was that conduct problems and depressed mood would interact to heighten risk for later problems, the possibility remained that peer substance use could mediate the negative link between the interaction term at age 11 and substance use at age 18. Consistent with the findings discussed above, results from the mediated moderation analysis showed that there was a statistically significant negative interaction of conduct problems and depressed mood in relation to peer substance use. The positive association of conduct problems with peer use was attenuated as the level of depressed mood increased. Peer substance use was significantly related, in turn, to adolescent substance use, and the estimated indirect effect of the interaction on substance use through peer use was statistically significant, providing some evidence for mediation.

Findings from the mediated moderation analysis may help to explain substantively the buffering interactions observed in this study. Substance use is an activity that requires motivation, planning, and activation (e.g., to acquire the substances and find a location to use them), and the opportunity to use substances among teenagers often occurs within the context of social interactions with peers. Indeed, involvement with substance-using peers is one of the strongest risk factors for adolescent substance use (e.g., Brook et al., 1989, Farrell and White, 1998). Although investigators are still seeking to understand the causal direction of influence, there is evidence that early conduct problems can lead to increased involvement with deviant and substance-using peers, possibly through a selection process (Elliott et al., 1985, Kandel, 1978). It has been suggested that depressed mood, also, can increase deviant peer associations, as psychologically distressed individuals lose their stake in conforming to conventional peer groups and seek positive self-regard through antisocial involvements and activities (Damphousse and Kaplan, 1998). However, depressed mood often is typified by avoidance patterns, such as reduced activity and increased inhibition (Jacobson et al., 2001); thus, the negative emotions and decreased activity that accompany depressed mood (Petersen et al., 1993) may disrupt establishment of the type of friendships that often result from earlier conduct problems, that is, friendships centered around externalizing activity. For example, among teens with a high level of conduct problems, experiencing a high level of depressed mood may interrupt the deviancy training process that has been shown to lead to the development of new forms of problem behavior, such as substance use (Patterson et al., 2000).

Of course, youth with co-occurring conduct problems and depressed mood are not completely inactive and inhibited, as evidenced by their involvement in aggressive and destructive acts that are the defining characteristics of conduct problems. Still, relative to their counterparts who are elevated on conduct problems but unhindered by depressed mood, they may be less likely to develop deviant peer associations, and less likely to participate in the types of adolescent problem behaviors that have a strong social element, such as substance use. This may explain why high levels of depressed mood and conduct problems can interact to reduce risk for later peer and adolescent substance use, as shown in this study. Additional studies are needed to examine other possible mediating mechanisms, such as academic achievement (Masten et al., 2005), and to more rigorously test putative causal risk processes using genetically-informed designs and experimental methods (Rutter, 2000).

4.2. Complexity of Multiproblem Youth

Although depressed mood attenuated the link between conduct problems and substance use in this study, it is important to note that this finding does not imply that depressed youth are protected from negative outcomes. Indeed, research clearly indicates that depressive symptomatology increases risk for subsequent impairments in mental and physical health, including later depression and suicide (Fergusson and Woodward, 2002). As stated by Masten and her colleagues (2005), this “underscores the complexity of designating a particular domain of behavior as pervasively good or bad, risky or protective” (p. 741). Reducing early adolescent depressed mood, whether it co-occurs with conduct problems or not, may help prevent the development of clinical depression and associated impairments, which currently represent one of the most costly health burdens worldwide (Moussavi et al., 2007).

4.3. Prevention and Treatment Implications

Findings from this study may have implications for the prevention of adolescent substance use. For example, interventions that target conduct problems among youth may not only reduce antisocial behavior, but may also prevent, secondarily, the initiation and maintenance of substance use. Moreover, prevention programs that emphasize prosocial peer

relationships and the acquisition of substance use refusal skills may help interrupt the progression toward substance use. Such preventive interventions may need to be implemented prior to the transition to adolescence, a developmental period during which conduct problems and depressed mood can manifest themselves as more stable, trait-like problems. Of course, our findings suggest that certain youth may experience a complex constellation of problems with a unique pattern of consequences. Experiencing multiple problems may buffer risks for certain outcomes, while heightening risk for others. A challenge for clinicians is to know how to treat youth who are elevated on both conduct problems and depressed mood. Research shows that the consequences of conduct problems are pervasive and long lasting (Fergusson et al., 2005, Mason et al., 2004). This might suggest that when faced with the concurrent presenting symptoms of conduct problems and depressed mood, priority should be given to treatment of the former. Indeed, the failure hypothesis (Capaldi and Stoolmiller, 1999, Patterson and Capaldi, 1990) suggests that some youth may develop depression in response to the adverse consequences that result from their conduct problems. Reducing conduct problems may have the additional benefit of reducing depression. However, the consequences of depressed mood (e.g., suicidal ideation) can be severe and life-threatening (Esposito and Clum, 2002); therefore, any judgment about treatment priority must consider an individual's risk for negative consequences, including self-harm. Importantly, studies of the co-occurrence of conduct problems and depressed mood promise to inform the development of interventions that address the unique needs of multiproblem youth (Biglan et al., 2004).

4.4. Limitations

Findings should be interpreted in light of several limitations. The sample was drawn from rural Midwestern communities in the United States, therefore the extent to which the results generalize to racially and ethnically diverse adolescents or to youth in urban and suburban settings is unknown. Although attrition rates were not excessive, the possibility of attrition bias in this longitudinal study spanning adolescence should be considered. Note, however, that we attempted to minimize such bias by explicitly incorporating a variable associated with missingness into the models and by conducting advanced missing data analyses.

Due to concerns over respondent burden, truncated versions of certain scales were adopted for use in this rich longitudinal study. For example, the extent to which our subset of items for the conduct problems and depressed mood measures captures the full CBCL subscales is unknown in this sample. Moreover, these measures do not allow us to determine, with reference to any widely agreed upon standard, the degree to which respondents may have fallen within the clinical range of severity on conduct problems and depressed mood. There is some evidence for the construct and predictive validity of these truncated measures, as illustrated by the current findings and those of prior project analyses (Mason et al., 2007b).

Also concerning measurement, the problem substance use construct drew heavily from indicators of problem alcohol use, and none of the problem use items referred to adverse consequences resulting from cigarette smoking. Additional lack of correspondence in the outcome variables was due to the fact that the substance use measures were restricted to indicators of alcohol, tobacco, and marijuana use, whereas the problem use measures included the possibility of problems due to the use of other illicit drugs. The absence of complete correspondence in these two latent variables may limit the conclusions that can be drawn about both the indirect and direct predictors of problem substance use in this study. Reports of treatment utilization for problem substance use among the adolescent participants at age 18 were obtained from parents, who might not have been fully aware of their child's service use. Peer substance use was assessed via adolescent reports, which could have contributed to an inflated association between peer and adolescent substance use (Ennett and Bauman, 1993). Moreover, there was a rather lengthy two year lag between the

assessments of peer substance use and adolescent substance involvement. Additional dynamic, multivariate analyses are needed to enhance our understanding of the changes in peer substance use that occur over this time span, and to account for the additional developmental processes and possible competing causal influences that likely influence substance use during late adolescence.

As mentioned, the purpose of this investigation was to examine the consequences of conduct problems and depressed mood for the development of a general orientation to substance use. Because these analyses were unable to disentangle any associations that might be specific to a particular substance, further research conducted at a finer-grained level of investigation is needed to examine possible substance-specific processes. Finally, there has been rapid development over the past few years in latent variable modeling techniques for the analysis of longitudinal data. For example, our multiwave data have been analyzed using dual process growth curve modeling to examine reciprocal relationships over time (Mason et al., 2003), which is a technique that also is well-suited for addressing questions about longitudinal mediation (Cheong et al., 2003). The latent interaction analyses reported herein provide an advancement over certain traditional analytic techniques, such as product term regression. Still, as software and hardware capabilities improve, the ability to blend and extend state-of-the-art models (e.g., latent interaction growth curve modeling - Li et al., 2000, Wen et al., 2002) holds promise for addressing more advanced questions.

4.5. Summary and Conclusion

Despite these limitations, the current study enhances our understanding of the co-occurrence of conduct problems and depressed mood in relation to peer and adolescent substance use. Latent variable analyses of multirater longitudinal data revealed that the links between conduct problems and peer and adolescent substance use were positive and statistically significant at low levels of depressed mood in this community sample of rural adolescents; at higher levels of depressed mood, the estimated effects of conduct problems remained positive but were attenuated. This is the first study to demonstrate that peer substance use may serve as a mediating mechanism in the link between co-occurring conduct problems and depressed mood in early adolescence and substance use in late adolescence. Compared to those who are elevated on conduct problems only, young boys and girls who are elevated on both conduct problems and depressed mood may be at lower risk for peer and adolescent substance use, but their risk for other serious outcomes, such as clinical depression, likely remains high. Promoting positive youth development across multiple life domains might require interventions that are tailored to the unique needs of multiproblem youth.

Acknowledgments

We thank Jennifer A. Bailey, Eric C. Brown, Charlie Fleming, and Rick Kosterman for their comments on an earlier draft of the manuscript.

Role of Funding Sources

Funding for this study was provided by the NIDA grant # 5R01DA018158-02; the NIDA had no further role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

This research was supported by a grant from the National Institute on Drug Abuse (5R01DA018158-02). The authors would like to thank Jennifer A. Bailey, Eric C. Brown, Charles B. Fleming, and Rick Kosterman for their comments on earlier drafts of this paper.

References

- Achenbach, TM. Manual for the Child Behavior Checklist/4-18 and 1991 Profile. Burlington: University of Vermont Department of Psychiatry; 1991.
- Aiken, LS.; West, SG. Multiple Regression: Testing and Interpreting Interactions. Thousand Oaks, CA: Sage; 1996.
- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders DSM-IV-TR. 4. Washington, DC: American Psychiatric Association; 2000.
- Armstrong TD, Costello EJ. Community studies on adolescent substance use, abuse, or dependence and psychiatric comorbidity. *J Consult Clin Psychol* 2002;70:1224–1239. [PubMed: 12472299]
- Barnes GM, Welte JW, Dintcheff BA. Decline in alcohol use among 7–12th grade students in New York State, 1983–1990. *Alcohol Clin Exp Res* 1993;17:797–801. [PubMed: 8214417]
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–1182. [PubMed: 3806354]
- Biddle BJ, Bank BJ, Marlin MM. Social determinants of adolescent drinking: What they think, what they do, and what I think and do. *J Stud Alcohol* 1980;41:215–241. [PubMed: 7374141]
- Biglan, A.; Brennan, PA.; Foster, SL.; Holder, HD. *Helping Adolescents at Risk: Prevention of Multiple Problem Behaviors*. New York: Guilford Press; 2004.
- Boys A, Farrell M, Taylor C, Marsden J, Goodman R, Brugha T, Bebbington P, Jenkins R, Meltzer H. Psychiatric morbidity and substance use in young people aged 13–15 years: Results from the Child and Adolescent Survey of Mental Health. *Br J Psychiatry* 2003;182:509–517. [PubMed: 12777342]
- Brook JS, Cohen P, Brook DW. Longitudinal study of co-occurring psychiatric disorders and substance use. *J Am Acad Child Adolesc Psychiatry* 1998;37:322–330. [PubMed: 9519638]
- Brook JS, Nomura C, Cohen P. A network of influences on adolescent drug involvement: Neighborhood, school, peer, and family. *Genet Soc Gen Psychol Monogr* 1989;115:125–145.
- Capaldi DM. Co-occurrence of conduct problems and depressive symptoms in early adolescent boys: I. Familial factors and general adjustment at Grade 6. *Dev Psychopathol* 1991;3:277–300.
- Capaldi DM. Co-occurrence of conduct problems and depressive symptoms in early adolescent boys. II. A 2-year follow-up at Grade 8. *Dev Psychopathol* 1992;4:125–144.
- Capaldi DM, Stoolmiller M. Co-occurrence of conduct problems and depressive symptoms in early adolescent boys: III. Prediction to young-adult adjustment. *Dev Psychopathol* 1999;11:59–84. [PubMed: 10208356]
- Chassin L, Pitts SC, DeLucia C, Todd M. A longitudinal study of children of alcoholics: Predicting young adult substance use disorders, anxiety, and depression. *J Abnorm Psychol* 1999;108:106–119. [PubMed: 10066997]
- Cheong J, MacKinnon DP, Khoo ST. Investigation of mediational processes using parallel process latent growth curve modeling. *Struct Equation Model* 2003;10:238–262.
- Clark DB, Parker AM, Lynch KG. Psychopathology and substance-related problems during early adolescence: A survival analysis. *J Clin Child Psychol* 1999;28:333–341. [PubMed: 10446682]
- Clark, DC.; Mokros, HB. Depression and suicidal behavior. In: Tolan, PH.; Cohler, BJ., editors. *Handbook of Clinical Research and Practice With Adolescents*. Oxford, England: John Wiley & Sons; 1993. p. 333–358.
- Conger RD, Conger KJ. Resilience in Midwestern families: Selected findings from the first decade of a prospective, longitudinal study. *J Marriage Fam* 2002;64:361–373.
- Cook WL, Goldstein MJ. Multiple perspectives on family relationships: A latent variable model. *Child Dev* 1993;64:1377–1388. [PubMed: 8222878]
- Costello EJ, Erkanli A, Federman E, Angold A. Development of psychiatric comorbidity with substance abuse in adolescents: Effects of timing and sex. *J Clin Child Psychol* 1999;28:298–311. [PubMed: 10446679]
- Damphousse K, Kaplan HB. Intervening processes between adolescent drug use and psychological distress: An examination of the self-medication hypothesis. *Social Behavior and Personality* 1998;26:115–130.

- Deykin EY, Hsieh C-c, Joshi N, McNamara JJ. Adolescent suicidal and self-destructive behavior: Results of an intervention study. *J Adolesc Health Care* 1986;7:88–95. [PubMed: 3957753]
- Ellickson PL, Hays RD. Antecedents of drinking among young adolescents with different alcohol use histories. *J Stud Alcohol* 1991;52:398–408. [PubMed: 1943094]
- Elliott, D.; Huizinga, D.; Ageton, SS. *Explaining Delinquency and Drug Use*. Thousand Oaks, CA: Sage; 1985.
- Ennett ST, Bauman KE. Peer group structure and adolescent cigarette smoking: A social network analysis. *J Health Soc Behav* 1993;34:226–236. [PubMed: 7989667]
- Esposito CL, Clum GA. Psychiatric symptoms and their relationship to suicidal ideation in a high-risk adolescent community sample. *J Am Acad Child Adolesc Psychiatry* 2002;41:44–51. [PubMed: 11800204]
- Farrell AD, White KS. Peer influences and drug use among urban adolescents: Family structure and parent-adolescent relationship as protective factors. *J Consult Clin Psychol* 1998;66:248–258. [PubMed: 9583328]
- Farrington DP, Loeber R. Some benefits of dichotomization in psychiatric and criminological research. *Crim Behav Ment Health* 2000;10:100–122.
- Fergusson DM, Horwood LJ, Ridder EM. Show me the child at seven: The consequences of conduct problems in childhood for psychosocial functioning in adulthood. *J Child Psychol Psychiatry* 2005;46:837–849. [PubMed: 16033632]
- Fergusson DM, Woodward LJ. Mental health, educational, and social role outcomes of adolescents with depression. *Arch Gen Psychiatry* 2002;59:225–231. [PubMed: 11879160]
- Glantz MD, Leshner AI. Drug abuse and developmental psychopathology. *Dev Psychopathol* 2000;12:795–814. [PubMed: 11202044]
- Hansell S, White HR. Adolescent drug use, psychological distress, and physical symptoms. *J Health Soc Behav* 1991;32:288–301. [PubMed: 1940211]
- Harford TC, Muthén BO. Adolescent and young adult antisocial behavior and adult alcohol use disorders. A fourteen-year prospective follow-up in a national survey. *J Stud Alcohol* 2000;61:524–528. [PubMed: 10928722]
- Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychol Bull* 1992;112:64–105. [PubMed: 1529040]
- Hawkins JD, Graham JW, Maguin E, Abbott R, Hill KG, Catalano RF. Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. *J Stud Alcohol* 1997;58:280–290. [PubMed: 9130220]
- Hawkins JD, Weis JG. The social development model: An integrated approach to delinquency prevention. *J Prim Prev* 1985;6:73–97.
- Hibell, B.; Anderson, B.; Bjarnasson, T. *The 2003 ESPAD Report: Alcohol and Other Drug Use Among Students in 35 European Countries*. Stockholm: Swedish Council for Information on Alcohol and Other Drugs; 2004.
- Hopfer CJ, Crowley TJ, Hewitt JK. Review of twin and adoption studies of adolescent substance use. *J Am Acad Child Adolesc Psychiatry* 2003;42:710–719. [PubMed: 12921479]
- Hu, L-t; Bentler, PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equation Model* 1999;6:1–55.
- Huba GJ, Bentler PM. Test of a drug-use causal model using asymptotically distribution free methods. *J Drug Educ* 1983;13:3–14.
- Jaccard J, Wan CK. Measurement error in the analysis of interaction effects between continuous predictors using multiple regression: Multiple indicator and structural equation approaches. *Psychol Bull* 1995;117:348–357.
- Jacobson NS, Martell CR, Dimidjian S. Behavioral activation treatment for depression: Returning to contextual roots. *Clin Psychol: Sci Pract* 2001;8:255–270.
- Johnston, LD.; O'Malley, PM.; Bachman, JG. *Secondary School Students*. Vol. I. Bethesda, MD: National Institute on Drug Abuse; 2002. *Monitoring the Future National Survey Results on Drug Use, 1975–2001*.

- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2004. (NIH Publication No. 05-5726). Bethesda, MD: National Institute on Drug Abuse; 2005.
- Kandel DB. Homophily, selection, and socialization in adolescent friendships. *Am J Sociol* 1978;84:427–436.
- Kaplan, HB. Self-attitudes and deviant behavior. Pacific Palisades, CA: Goodyear; 1975.
- Kaplan, HB. Deviant behavior in defense of self. New York: Academic Press; 1980.
- Kenny DA, Judd CM. Estimating the nonlinear and interactive effects of latent variables. *Psychol Bull* 1984;96:201–210.
- Khantzian EJ. The self-medication hypothesis of addictive disorders. Focus on heroin and cocaine dependence. *Am J Psychiatry* 1985;142:1259–1263. [PubMed: 3904487]
- King SM, Iacono WG, McGue M. Childhood externalizing and internalizing psychopathology in the prediction of early substance use. *Addiction* 2004;99:1548–1559. [PubMed: 15585046]
- Klein A, Moosbrugger H. Maximum likelihood estimation of latent interaction effects with the LMS method. *Psychometrika* 2000;65:457–474.
- Klein AG, Stoolmiller M. Detecting latent interaction effects in behavioral data. *Methods Psychol Res Online* 2003;8:113–126.
- Kosterman R, Hawkins JD, Haggerty KP, Spoth R, Redmond C. Preparing for the drug free years: Session-specific effects of a universal parent-training intervention with rural families. *J Drug Educ* 2001;31:47–68. [PubMed: 11338965]
- Kovacs M, Paulauskas S, Gatsonis C, Richards C. Depressive disorders in childhood: III. A longitudinal study of comorbidity with and without risk for conduct disorders. *J Affect Disord* 1988;15:205–217. [PubMed: 2975293]
- Kuperman S, Schlosser SS, Kramer JR, Bucholz K, Hesselbrock V, Reich T, Reich W. Developmental sequence from disruptive behavior diagnosis to adolescent alcohol dependence. *Am J Psychiatry* 2001;158:2022–2026. [PubMed: 11729019]
- Lewinsohn PM, Rohde P, Seeley JR. Adolescent psychopathology III. The clinical consequences of comorbidity. *J Am Acad Child Adolesc Psychiatry* 1995;34:510–519. [PubMed: 7751265]
- Lewinsohn PM, Rohde P, Seeley JR. Alcohol consumption in high school adolescents: Frequency of use and dimensional structure of associated problems. *Addiction* 1996;91:375–390. [PubMed: 8867200]
- Lewinsohn PM, Solomon A, Seeley JR, Zeiss A. Clinical implications of “subthreshold” depressive symptoms. *J Abnorm Psychol* 2000;109:345–351. [PubMed: 10895574]
- Li F, Duncan TE, Acock A. Modeling interaction effects in latent growth curve models. *Struct Equation Model* 2000;7:497–533.
- Loeber R, Keenan K. Interaction between conduct disorder and its comorbid conditions: Effects of age and gender. *Clin Psychol Rev* 1994;14:497–523.
- Marmorstein NR, Iacono WG. An investigation of female adolescent twins with both major depression and conduct disorder. *J Am Acad Child Adolesc Psychiatry* 2001;40:299–306. [PubMed: 11288771]
- Marmorstein NR, Iacono WG. Major depression and conduct disorder in a twin sample: Gender, functioning, and risk for future psychopathology. *J Am Acad Child Adolesc Psychiatry* 2003;42:225–233. [PubMed: 12544183]
- Marsh HW, Wen Z, Hau KT. Structural equation models of latent interactions: Evaluation of alternative estimation strategies and indicator construction. *Psychol Methods* 2004;9:275–300. [PubMed: 15355150]
- Mason WA, Hitchings JE, McMahon RJ, Spoth RL. A test of three alternative hypotheses regarding the effects of early delinquency on adolescent psychosocial functioning and substance involvement. *J Abnorm Child Psychol* 2007a;35
- Mason WA, Hitchings JE, Spoth RL. Emergence of delinquency and depressed mood throughout adolescence as predictors of late adolescent problem substance use. *Psychol Addict Behav* 2007b; 21:13–24. [PubMed: 17385951]

- Mason WA, Kosterman R, Hawkins JD, Haggerty KP, Spoth R. Reducing adolescents' growth in substance use and delinquency: Randomized trial effects of a parent-training prevention intervention. *Prev Sci* 2003;4:203–213. [PubMed: 12940470]
- Mason WA, Kosterman R, Hawkins JD, Herrenkohl TI, Lengua LJ, McCauley E. Predicting depression, social phobia, and violence in early adulthood from childhood behavior problems. *J Am Acad Child Adolesc Psychiatry* 2004;43:307–315. [PubMed: 15076264]
- Mason WA, Windle M. Reciprocal relations between adolescent substance use and delinquency: A longitudinal latent variable analysis. *J Abnorm Psychol* 2002;111:63–76. [PubMed: 11866180]
- Masten AS, Roisman GI, Long JD, Burt KB, Obradovic J, Riley JR, Boelcke-Stennes K, Tellegen A. Developmental cascades: Linking academic achievement and externalizing and internalizing symptoms over 20 years. *Dev Psychol* 2005;41:733–746. [PubMed: 16173871]
- McClelland GH, Judd CM. Statistical difficulties of detecting interactions and moderator effects. *Psychol Bull* 1993;114:376–390. [PubMed: 8416037]
- Miller-Johnson S, Lochman JE, Coie JD, Terry R, Hyman C. Comorbidity of conduct and depressive problems at sixth grade: Substance use outcomes across adolescence. *J Abnorm Child Psychol* 1998;26:221–232. [PubMed: 9650628]
- Moussavi S, Chatterji S, Tandon A, Patel V, Ustun B. Depression, chronic diseases, and decrements in health: Results from the World Health Surveys. *Lancet* 2007;370:851–858. [PubMed: 17826170]
- Muthén, LK.; Muthén, BO. *Mplus User's Guide*. Los Angeles: Muthén and Muthén; 1998–2004.
- Nelson CB, Wittchen HU. DSM-IV alcohol disorders in a general population sample of adolescents and young adults. *Addiction* 1998;93:1065–1077. [PubMed: 9744137]
- Newcomb, MD. Understanding the multidimensional nature of drug use and abuse: The role of consumption, risk factors, and protective factors. In: Glantz, MD.; Pickens, R., editors. *Vulnerability to Drug Abuse*. Washington DC: American Psychological Association; 1992. p. 255–297.
- Newcomb MD, Bentler PM. Substance use and abuse among children and teenagers. *Am Psychol* 1989;44:242–248. [PubMed: 2653136]
- Pardini D, White HR, Stouthamer-Loeber M. Early adolescent psychopathology as a predictor of alcohol use disorders by young adulthood. *Drug Alcohol Depend* 2007;88S:S38–S49. [PubMed: 17257781]
- Patterson, GR.; Capaldi, DM. A mediational model for boys' depressed mood. In: Rolf, J.; Masten, AS.; Cicchetti, D.; Nuechterlein, K.; Weintraub, S., editors. *Risk and Protective Factors in the Development of Psychopathology*. New York: Cambridge University Press; 1990. p. 141–163.
- Patterson GR, Dishion TJ, Yoerger K. Adolescent growth in new forms of problem behavior: Macro- and micro-peer dynamics. *Prev Sci* 2000;1:3–13. [PubMed: 11507792]
- Petersen AC, Compas BE, Brooks-Gunn J, Stemmler M, Ey S, Grant KE. Depression in adolescence. *Am Psychol* 1993;48:155–168. [PubMed: 8442570]
- Regier DA, Farmer ME, Rae DS, Locke BZ, Keith SJ, Judd LL, Goodwin FK. Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) Study. *JAMA* 1990;264:2511–2518. [PubMed: 2232018]
- Riggs PD, Baker S, Mikulich SK, Young SE, Crowley TJ. Depression in substance-dependent delinquents. *J Am Acad Child Adolesc Psychiatry* 1995;34:764–771. [PubMed: 7608050]
- Rutter M. Psychosocial influences: Critiques, findings, and research needs. *Dev Psychopathol* 2000;12:375–405. [PubMed: 11014744]
- Schafer JL, Graham JW. Missing data: Our view of the state of the art. *Psychol Methods* 2002;7:147–177. [PubMed: 12090408]
- Shedler J, Block J. Adolescent drug use and psychological health: A longitudinal inquiry. *Am Psychol* 1990;45:612–630. [PubMed: 2350080]
- Spoth R, Redmond C. Effective recruitment of parents into family-focused prevention research: A comparison of two strategies. *Psychol Health* 1994;9:353–370.
- Spoth R, Redmond C, Shin C. Direct and indirect latent-variable parenting outcomes of two universal family-focused preventive interventions: Extending a public health-oriented research base. *J Consult Clin Psychol* 1998;66:385–99. [PubMed: 9583342]

- Spoth R, Redmond C, Shin C. Randomized trial of brief family interventions for general populations: Adolescent substance use outcomes 4 years following baseline. *J Consult Clin Psychol* 2001;69:627–642. [PubMed: 11550729]
- Sroufe L. Psychopathology as an outcome of development. *Dev Psychopathol* 1997;9:251–268. [PubMed: 9201444]
- Steinberg L, Morris AS. Adolescent development. *Annu Rev Psychol* 2001;52:83–110. [PubMed: 11148300]
- Stice E, Barrera JM, Chassin L. Prospective differential prediction of adolescent alcohol use and problem use: Examining the mechanisms of effect. *J Abnorm Psychol* 1998;107:616–628. [PubMed: 9830249]
- Tarter RE, Vanyukov M. Alcoholism: A developmental disorder. *J Consult Clin Psychol* 1994;62:1096–1107. [PubMed: 7860808]
- Toumbourou JW, Stockwell T, Neighbors C, Marlatt GA, Sturge J, Rehm J. Interventions to reduce harm associated with adolescent substance use. *Lancet* 2007;369:1391–1401. [PubMed: 17448826]
- Wen Z, Marsh HW, Hau KT. Interaction effects in growth modeling: A full model. *Struct Equation Model* 2002;9:20–39.
- White HR. Early problem behavior and later drug problems. *J Res Crime Delinquency* 1992;29:412–429.
- Wills TA, Sandy JM, Shinar O, Yaeger A. Contributions of positive and negative affect to adolescent substance use: Test of a bidimensional model in a longitudinal study. *Psychol Addict Behav* 1999;113:327–338.
- Windle M. A longitudinal study of antisocial behaviors in early adolescence as predictors of late adolescent substance use: Gender and ethnic group differences. *J Abnorm Psychol* 1990;99:86–91. [PubMed: 2307771]
- Windle M, Windle RC. Depressive symptoms and cigarette smoking among middle adolescents: Prospective associations and intrapersonal and interpersonal influences. *J Consult Clin Psychol* 2001;69:215–226. [PubMed: 11393599]
- Winters KC, Stinchfield RD, Henly GA, Schwartz RH. Validity of adolescent self-report of alcohol and other drug involvement. *Int J Addict* 1990;25:1379–1395. [PubMed: 2132719]
- World Health Organization. *The World Health Report 2002: Reducing Risks, Promoting Healthy Life*. Geneva: World Health Organization; 2002.
- World Health Organization. *International Statistical Classification of Diseases and Related Health Problems: Tenth Revision*. Geneva: World Health Organization; 2004.
- Zucker, RA. Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholism and for contextual contributions to risk. In: Zucker, R.; Boyd, G.; Howard, J., editors. *The development of alcohol problems: Exploring the biopsychosocial matrix of risk*. National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 26. Rockville, MD: National Institute on Alcohol Abuse and Alcoholism; 1994. p. 255-289.

Figure 1.

Latent variable model of the interaction of conduct problems and depressed mood at age 11 in relation to substance use and problem substance use at age 18. Note. A = adolescent report, M = mother report, F = father report, CON = conduct problems, DEP = depressed mood, PY = past year, CIG = cigarette smoking, ALC = alcohol drinking, MAR = marijuana use, PROBS = substance use problems, SERVE = service use, and PDRINK = problem drinking. Covariates include early substance use, parental problem drinking, gender, parent education, and intervention status.

Figure 2. Estimated effects of conduct problems (age 11) on substance use (age 18) at different levels of depressed mood (age 11).

Figure 3.

Mediated moderation model. A = adolescent report, M = mother report, F = father report, CON = conduct problems, DEP = depressed mood, PY = past year, CIG = cigarette smoking, ALC = alcohol drinking, MAR = marijuana use, PROBS = substance use problems, SERVE = service use, and PDRINK = problem drinking. Covariates include early substance use, parental problem drinking, gender, parent education, and intervention status.

Figure 4. Estimated effects of conduct problems (age 11) on peer substance use (age 16) at different levels of depressed mood (age 11).

Table 1

Descriptive Statistics for the Study Variables

Variable, Age, and Reporter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Gender																			
2. Parent Education-11P	.00																		
3. Early Subst. Use-11A	.16 [†]	-.07																	
4. Parent Prob. Drinking ^a -11P	.01	-.18 [†]	.06																
5. Peer Subst. Use-11A	.14 [†]	-.01	.26 [†]	.04															
6. Conduct Problems-11A	.18 [†]	-.15 [†]	.21 [†]	.08	.25 [†]														
7. Conduct Problems-11M	.19 [†]	-.12 [*]	.21 [†]	-.01	.06	.39 [†]													
8. Conduct Problems-11F	.10	-.01	.07	-.03	-.01	.24 [†]	.41 [†]												
9. Depressed Mood-11A	-.11 [*]	-.07	.04	.15 [*]	.08	.48 [†]	.22 [†]	.20 [†]											
10. Depressed Mood-11M	.02	-.08	.08	.06	.02	.23 [†]	.50 [†]	.25 [†]	.37 [†]										
11. Depressed Mood-11F	-.09	-.03	.03	.04	-.01	.16 [†]	.17 [†]	.42 [†]	.29 [†]	.34 [†]									
12. Peer Subst. Use-16A	.03	-.18 [†]	.29 [†]	.09	.22 [†]	.18 [†]	.22 [†]	.08	.02	.00	.07								
13. Cigarette Use-18A	.04	-.16 [†]	.08	.03	.13 [*]	.18 [†]	.08	.04	.11	.01	.10	.34 [†]							
14. Alcohol Use-18A	-.05	-.07	.09	.08	.08	.02	-.01	-.07	-.01	-.05	.03	.34 [†]	.42 [†]						
15. Marijuana Use-18A	.01	-.04	.08	.12	.14 [*]	.16 [†]	.12	.02	.03	.02	.07	.39 [†]	.42 [†]	.26 [†]					
16. Substance Problems-18A	.03	-.04	.20 [†]	.06	.07	.20 [†]	.16 [†]	-.03	.08	.05	.03	.29 [†]	.31 [†]	.27 [†]	.48 [†]				
17. Problem Drinking-18A	-.11	-.09	.14 [*]	.08	.03	.04	-.03	-.01	.01	-.04	.05	.24 [†]	.25 [†]	.32 [†]	.21 [†]	.52 [†]			
18. Service Use-18P	.11	-.12	.13	.15	.02	-.01	.08	-.06	-.08	-.08	.09	.18 [*]	.17 [*]	.16 [*]	.17 [*]	.45 [†]	.33 [†]		
19. Intervention Status	.01	.02	.14 [†]	.02	.10	.04	.07	.06	.04	.02	.04	-.01	-.09	-.03	-.03	-.01	.04	.01	
Mean:	.48	13.42	.08	.00	.21	.14	.16	.14	.22	.21	.17	10.71	.45	.72	.16	.95	1.31	.07	.52
SD:	.50	1.84	.27	1.49	.41	.25	.28	.23	.27	.26	.22	4.18	.50	.45	.37	1.90	2.36	.26	.50
Skew:	.07	.63	3.06	2.45	1.42	3.06	2.25	1.99	1.66	1.99	1.39	1.31	.22	-.97	1.82	2.23	2.51	3.27	-.06
Kurtosis:	-2.00	.34	7.42	9.03	.03	13.41	6.06	3.97	3.86	6.61	1.72	2.37	-1.97	-1.06	1.34	4.50	7.48	8.75	-2.01

*

 $p < .05$;[†] $p < .01$;

^a $p < .001$.

^aComprised of mother-report and father-report items that were standardized prior to the computation of the scale. A = adolescent report; M = mother report; and F = father report.

Table 2

Estimates From the Model of the Conduct Problems X Depressed Mood Interaction Effect (Age 11) on Substance Use (Age 18)

Predictor	<u>Substance Use</u>		<u>Problem Substance Use</u>	
	b	se	b	se
Male gender	-.47	.70	-.19	.22
Early substance use	1.14	1.03	.86	.57
Parent problem drinking	.31	.30	.04	.08
Parent education	-.12	.14	.03	.05
Intervention status	-.71	.60	.08	.19
Conduct problems (Age 11)	1.24	.76	.23	.23
Depressed mood (Age 11)	-.13	.56	-.11	.21
Conduct problems × Depressed mood	-.86 *	.43	-----	-----
Substance use (Age 18)	-----	-----	.24 *	.10

*
 $p < .05$.

Table 3

Estimates From the Model of the Conduct Problems X Depressed Mood Interaction Effect (Ages 11–16) on Substance Use (Age 18)

Predictor	Substance Use		Problem Substance Use	
	b	se	b	se
Male gender	−.77	.73	.04	.23
Early substance use	1.21	.96	1.03	.56
Parent problem drinking	.24	.27	.03	.08
Parent education	−.08	.14	.01	.05
Intervention status	−.61	.55	.11	.19
Conduct problems (Ages 11–16)	1.91 [*]	.78	−.13	.22
Depressed mood (Ages 11–16)	−.10	.62	.13	.22
Conduct problems X Depressed mood	−.96 [*]	.42	-----	-----
Substance use (Age 18)	-----	-----	.26 [†]	.10

*
 $p < .05$;

[†]
 $p < .01$.

Table 4

Estimates From the Mediated Moderation Model

Predictor	Peer Substance Use		Substance Use		Problem Substance Use	
	b	se	b	se	b	se
Male gender	-.100	.55	-.18	.70	-.18	.22
Early substance use	2.78*	1.10	-.02	.94	.87	.57
Parent problem drinking	.26	.19	.16	.26	.04	.08
Parent education	-.28 [†]	.10	-.08	.15	.03	.05
Intervention status	-.61	.46	-.46	.57	.06	.20
Peer substance use (Age 11)	1.79 [†]	.58	-----	-----	-----	-----
Conduct problems (Age 11)	1.75 [†]	.51	.41	.70	.26	.23
Depressed mood (Age 11)	-.71	.41	.16	.53	-.08	.21
Conduct problems X Depressed mood	-.66 [†]	.23	-.61	.39	-----	-----
Peer substance use (Age 16)	-----	-----	.51 [†]	.17	-.02	.04
Substance use (Age 18)	-----	-----	-----	-----	.23 [†]	.09

*
 $p < .05$;[†]
 $p < .01$;[‡]
 $p < .001$.