Published in final edited form as:

J Abnorm Child Psychol. 2013 October ; 41(7): 1041–1051. doi:10.1007/s10802-013-9752-x.

Early Adolescent Growth in Depression and Conduct Problem Symptoms as Predictors of Later Substance Use Impairment

Carolyn A. McCarty, Ph.D.,

University of Washington and Seattle Children's Hospital, Center for Child Health, Behavior, and Development, M/S: CW8-6; P. O. Box 5371, Seattle, WA 98145, Phone: (206) 884-8243, Fax: (206) 884-7801, cmccarty@u.washington.edu

Brian T. Wymbs, Ph.D.,

Seattle Children's Research Institute, M/S: CW8-6; P. O. Box 5371, Seattle, WA 98145

W. Alex Mason, Ph.D.,

Boys Town National Research Institute for Child and Family Studies, 14100 Crawford Street, Boys Town, NE 68010

Kevin M. King, Ph.D.,

University of Washington – Psychology Department, P. O. Box 351525, Seattle, WA 98108

Elizabeth McCauley, Ph.D.,

University of Washington and Seattle Children's Hospital, M/S: W-3636, 4800 Sand Point Way NE, Seattle, WA 98105

John Baer, Ph.D., and

VA Medical Center, Box 358280 – S116 – ATC; 1660 S. Columbian Way, Seattle, WA 98108

Ann Vander Stoep, Ph.D.

University of Washington, 6200 NE 74th Street, Suite 110, Seattle, WA 98115

Abstract

Most studies of adolescent substance use and psychological comorbidity have examined the contributions of conduct problems and depressive symptoms measured only at particular points-in-time. Yet, during adolescence, risk factors such as conduct problems and depression exist within a developmental context, and vary over time. Though internalizing and comorbid pathways to substance use have been theorized (Hussong, Jones, Stein, Baucom, & Boeding, 2011), the degree to which developmental increases in depressive symptoms and conduct problems elevate risk for substance use impairment among adolescents, in either an additive or potentially a synergistic fashion, is unclear. Using a school-based sample of 521 adolescents, we tested additive and synergistic influences of changes in depressive symptoms and conduct problems from 6th to 9th grade using parallel process growth curve modeling with latent interactions in the prediction of late adolescent (12th grade) substance use impairment, while examining gender as a moderator. We found that the interaction between growth in depression and conduct disorder symptoms uniquely predicted later substance use problems, in addition to main effects of each, across boys and girls. Results indicated that adolescents whose parents reported increases in both depression and conduct disorder symptoms from 6th to 9th grade reported the most substance use-related impairment in 12th grade. The current study demonstrates that patterns of depression and conduct problems (e.g., growth vs. decreasing) are likely more important than the static levels at any particular point-in-time in relation to substance use risk.

Keywords

substance use; depression; conduct problems; comorbidity; growth modeling

Substance use onset and escalation during adolescence are common (Botvin & Griffin, 2007; Centers for Disease Control and Prevention, 2009; Johnston, O'Malley, Bachman, & Schulenberg, 2011; Leatherdale, Hammond, & Ahmed, 2008). Alcohol consumption is the most prevalent form of substance use during this developmental period, whereas marijuana is the most commonly used illicit drug among teens (Johnston et al., 2011). Substance use can adversely impact adolescent brain maturation in critical areas related to cognitive control and socioemotional processing (Brown & Tapert, 2004; Chambers, Taylor, & Potenza, 2003) and is associated with diminished psychosocial functioning in school, family, and peer contexts (Windle & Windle, 2006). Impairment due to substance use, particularly occurring in late adolescence, can disrupt the transition to adulthood by compromising the attainment of subsequent developmental milestones, such as school and work accomplishments and relationship formation (Ellickson, Tucker, & Klein, 2003; Lynne-Landsman, Bradshaw, & Jalongo, 2010; Windle & Windle, 2006). Understanding the factors that predict adverse consequences resulting from adolescent substance use will help inform the development and refinement of substance use preventive interventions.

Both conduct problems and depressive symptoms are prominent risk factors for substance use and substance use impairment in adolescence (Fleming, Mason, Mazza, Abbot, & Catalano, 2008; Hussong et al., 2011). Externalizing characteristics (also called undercontrol or disinhibition) serve as very important etiologic predictors of a pathway to substance use involvement and impairment (Zucker, Heitzeg, & Nigg, 2011). Conduct problems in both middle childhood and adolescence are related to increased risks of longer-term substance use, abuse and dependence, even after controlling for attentional problems (Fergusson, Horwood, & Ridder, 2007). An "internalizing pathway" to the development of substance use also has been theorized, in which core underlying difficulties with negative affect and depressive symptoms become associated with substance use through "a cognitive, social, and biological risk structure in which alcohol [and other substances] primarily serves as a negative reinforcement strategy for regulating distressing affect and associated cues" (Hussong et al., 2011, pp. 392–393). By comparison to the robust evidence for the role of conduct problems, links between depressive symptoms and substance use in adolescence have been less strong and found less consistently in the literature (Chassin & Ritter, 2010; King, Iacano, & McGue, 2004), with some studies reporting null findings and others reporting either small positive or small negative associations (Hooshmand, Willoughby, & Good, 2012; Hussong et al., 2011; McCarty et al., 2013). However, the evidence is accumulating towards a probable role for depressive symptoms in adolescence when the outcomes involve impairing levels of substance use, rather than level of use (McCarty et al., 2013).

Although seemingly different in presentation, depressive and externalizing problems are highly comorbid among adolescent populations, and co-occurrence may be more prevalent than experiencing either depressive or externalizing symptoms alone, particularly if considering symptoms rather than diagnoses (Angold, Costello, & Erklani, 1999; Boylan, Vaillancourt, Boyle, & Szatmari, 2007; Zoccolillo, 1992). Children for whom depressive and externalizing symptoms co-occur have been shown to experience worse outcomes, including greater risk for substance abuse and suicide, than their peers with either depressive or externalizing symptoms alone (Ingoldsby, Kohl, McMahon, & Lengua, 2006; Rockhill, Vander Stoep, McCauley, & Katon, 2009; Wolff & Ollendick, 2006).

While there is general agreement that comorbid psychopathology between internalizing and externalizing disorders occurs more frequently than expected by chance, there is considerable controversy over why comorbidity occurs so commonly. Researchers have suggested a number of plausible explanations for this high prevalence, including that comorbidity can be attributed to symptom overlap within different forms of psychopathology, that comorbidity is simply a marker of severity, that there are common antecedents between psychological disorders, or that there is reciprocal causality, i.e. conduct problems give rise to depressive problems and visa versa (Capaldi, Patterson, Stoolmiller, 1991; Cohen, Brook, Cohen, Velez, Garcia, 1990; Fergusson, Lynskey, Horwood, 1996; Rohde, Lewinsohn, Seeley, 1991).

Gender differences in the role of depression on adolescent substance use and the meaning of comorbid depression and conduct problems have also been explored. Whereas some studies have found that higher levels of early depressed mood were associated with increased risk of use among boys but not girls (Crum, Storr, Ialongo, & Anthony, 2008; Mason, Hitchings, & Spoth, 2008; Tapert et al., 2003), others have found a stronger association for girls (Fleming et al., 2008; Marmorstein, 2009; Mason, Hitchings, & Spoth, 2007) or no association (McCarty et al., 2012). A higher proportion of girls, compared to boys, with conduct disorders have comorbid depression (Marmorstein & Iacono, 2001; Robins & Price, 1991; Zoccolillo, 1992) but findings from the Minnesota Twin Family Study showed a relatively high proportion of boys, compared to girls, with major depressive disorder who had comorbid conduct disorder (Marmorstein & Iacono, 2003). Initial attempts to describe the course and stability of co-occurring depressive symptoms and conduct problems suggest that comorbidity is highly stable in boys and girls (Ingoldsby et al., 2006; Vander Stoep et al., 2012).

Hussong and colleagues (2011), in describing the internalizing pathway, hypothesize that internalizing and externalizing mechanisms may coexist and interact over time and development, creating additional shared risk for substance use. For some youth, externalizing problems may serve to exacerbate problems with negative affect underlying internalizing symptoms, such as when risk for alcohol use may be “potentiated by impulsive reactions to and means adopted for regulating emotions” (Hussong et al., 2011, p. 398). In support of this hypothesis, there is emerging evidence that conduct problems and depressive symptoms could be most harmful in relation to substance use involvement when they co-occur. For example, youth with co-occurring depressive and conduct symptoms in the 5th grade reported the highest levels of substance use 2 years later (Ingoldsby et al., 2006). Several other studies have yielded findings consistent with the idea that depression acts synergistically with conduct problems to increase risk of later alcohol and other substance problems (Capaldi, 1991; Marmorstein & Iacono, 2001; Marmorstein, Iacano & Malone, 2010; Pardini, White, & Stouthamer-Loeber, 2007). One such study, conducted with 17-year old female twins, found that girls with both conduct disorder and major depression had significantly more symptoms of alcohol dependence than those with either disorder alone (Marmorstein & Iacono, 2001). However, this study was cross-sectional and therefore could not examine timing of onset or suggest etiological pathways. Two other studies conducted with young adolescent boys found that those with co-occurring depression and conduct problems were at particular risk for developing alcohol or substance use disorders (Capaldi, 1991; Pardini et al., 2007). Two other studies have found support for interactions between depression and conduct problems, but these studies were in opposite directions, with Marmorstein et al. (2010) finding increased risk with co-occurrence, particularly for girls, and Mason, Hitchings, et al. (2008) reporting a negative interaction between depressed mood and conduct problems, such that positive associations of conduct problems with substance use were stronger at lower levels of depressed mood.

Most of the extant studies have examined the contributions of conduct problems and depressive symptoms measured only at a single follow-up assessment (Capaldi & Stoolmiller, 1999; Henry et al., 1993; Ingoldsby et al., 2006), providing information about how contemporaneous levels and co-occurrence of symptoms related to risk for later substance use. Although these studies have been informative, we know that conduct problems and depression are dynamic, co-evolving phenomena in adolescence. As adolescence progresses, onset of depressive disorders becomes more prevalent, and symptoms accumulate over the teen years for many youth (Hankin et al., 1998). Likewise, externalizing behaviors, including conduct problems, are elevated during this period, with increasing status violations (e.g., running away from home, swearing, truancy; Bongers, Koot, van der Ende, & Verhulst, 2004). Depressive symptoms and conduct problems also exhibit linked temporal changes during adolescence, such that increases for youth in one symptom domain are associated with relative increases in the other domain (Measelle, Stice, & Hogansen, 2006; Rohde et al., 1991). The degree to which increases in depressive symptoms and conduct problems over early adolescence contribute to risk for substance use impairment in late adolescence, either additively or synergistically, merits further understanding (Marmorstein et al., 2010).

The goal of the current study was to test aspects of Hussong et al.'s (2011) recent theoretical model of the internalizing pathway to substance use problems, specifically whether growth in early depression symptoms is moderated by growth in externalizing problems. The current study draws on longitudinal data to examine changes in depression and conduct problems during early adolescence as predictors of substance use impairment in late adolescence. Using parallel process growth curve modeling with latent interactions, we tested additive and synergistic influences of changes in depression symptoms and conduct problems from 6th to 9th grade in relation to substance use impairment in 12th grade. We first hypothesized that elevated growth factors (intercepts, slopes) of depression symptoms and conduct problems would prospectively predict greater substance use impairment in 12th grade. Additionally, we hypothesized that a latent interaction between the slopes of depression symptoms and conduct problems would be prospectively associated with substance use impairment, such that youth exhibiting increases in depression symptoms and conduct problems from 6th to 9th grade would be at greatest risk for impairment in Grade 12. Finally, given evidence suggesting the possibility that prospective associations between depression symptoms and substance use problems may vary between males and females, we tested whether gender would moderate findings.

Method

Sample

The Developmental Pathways Project (DPP) is a community-based prospective cohort study designed to examine the antecedents, phenomenology, and outcomes of depression and conduct problems in early adolescence. DPP participants were recruited from four Seattle-area public schools located in distinct areas within the city, and together have a racial/ethnic distribution that is nearly identical to the total enrolled student population of the school district. Universal emotional health screening was carried out with sixth grade students at these schools in 4 consecutive years (2001–2004; Vander Stoep, McCauley, Thompson, Kuo, & Herting, 2005). Students whose parents provided written permission were invited to provide their own assent prior to screening.

Students eligible for screening included 6th graders who had a 3rd grade reading comprehension level or higher. Of the 2920 eligible students, 2187 (74.9%) were screened. Each year following screening, a random sample of students, stratified by their scores on the Mood and Feelings Questionnaire (MFQ) for depression (Costello & Angold, 1988) and

Youth Self Report (YSR) externalizing scale for conduct problems (Achenbach & Rescorla, 2001), were identified for participation in the longitudinal study.

A stratified random sample of 807 students was selected for longitudinal follow-up with students scoring high ($> .5$ SD above sample mean) on depressive and/or conduct problem scores over-sampled according to a ratio of 1:1:1:2 from the four psychopathology screening groups (comorbid [CM], depressed only [DP], conduct problem only [CP], elevated on neither dimension [NE]). Since in the general school population, the ratio is approximately 1 CM: 1 DP: 1 CP: 6 NE, this sample selection approach yielded an over-representation of children in the CM, DP, and CP groups relative to their distribution in the general population. Of those selected, 521 (64.6%) students and their parents/guardians consented to participate in the DPP. At baseline, participants were 12.0 years-old on average (range 11–13.6), 51.6% male and included 1.4 % Native Americans, 24.9% Black, 24.1 % Asian/Pacific Islanders, and 10.1% Hispanics; the remaining 39.5% were Caucasian. Nearly half (48.1%) were raised in households with a total income under \$50,000.

In-home interviews were conducted with participating students and parents/guardians (76% biological mothers, 15% biological fathers, 9% other relatives) by two trained research interviewers who were blind to participants' psychopathology risk group status. Parents and adolescents provided written consent/assent respectively to participate in the interviews. Baseline interviews were conducted within 3 months of screening (Fall 6th Grade), and in-person follow-up interviews were conducted 6, 12, 18, 24, 36 and 72 months afterward (Fall 12th grade). Of the participants originally enrolled in DPP, 91% were retained through 12th grade.

Measures

Depression and conduct disorder symptoms—As part of assessments in the fall of 6th, 7th, 8th, and 9th grade, the Diagnostic Interview Schedule for Children (DISC) was administered (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). The DISC is designed to make psychiatric diagnoses by applying DSM IV criteria pertaining to anxiety, mood, disruptive behavior and other disorders. The DISC has well-established psychometric properties, including strong agreement between clinician-administered DISC diagnoses and diagnoses made from clinical interviews (Schwab-Stone et al., 1996). Parents of DPP adolescents completed the Major Depression Disorder (MDD) and Conduct Disorder (CD) DISC modules. MDD and CD symptoms endorsed as occurring within the past year were summed to form MDD and CD symptom counts.

Substance use impairment—A modified version of the 23-item Rutgers Alcohol Problem Inventory (RAPI; White & Labouvie 1989) was used to measure negative marijuana and alcohol-related consequences within the past 6 months. Adolescents reported their level of use-related impairment in personal, social and academic functioning domains using a 5-point Likert-type scale ranging from 0 (*never*) to 4 (*more than 10 times*). The sum total of these ratings was the index of use-related impairment. The RAPI has demonstrated good test-retest reliability as well as discriminant and construct validity in both general and clinical samples of adolescents (Miller et al., 2002; White & Labouvie 1989, 2000) and has been shown to be reliable when assessing consequences of substance use other than alcohol (Ginzler, Garrett, Baer, & Peterson, 2007). In this study, 12th grade RAPI scores ($\alpha = .95$) were the primary outcome measure and 6th grade RAPI scores ($\alpha = .92$) were included as a covariate to control for problems due to early use.

Analytic Plan

This study used parallel process latent growth curve models to test the main and interaction effects of growth in MDD and CD symptoms from 6th to 9th grade on 12th grade substance use impairment. First, we estimated separate unconditional growth curve models for parent ratings of adolescent MDD and CD symptoms assessed from 6th to 9th grade, and then tested a parallel process growth model of MDD and CD symptoms over time that estimated the covariances among growth factors. Next, we examined a main effects-only model testing the intercept and slopes of MDD and CD symptoms as risk factors for adolescent-reported substance use impairment in 12th grade (Figure 1A). Then we evaluated a synergistic model where the latent interaction between MDD and CD slopes was tested as a predictor of 12th grade substance use impairment over and above main effects (Figure 1B). Finally, we examined whether participant gender interacted with main and synergistic latent variables in the prediction of substance use impairment.

Latent growth curve modeling was conducted with Mplus 6.1 (Muthén & Muthén, 2010) using the maximum likelihood estimator robust to non-normality (MLR), due to skewed symptom count data (statistic/SEs ranged from 7.13–19.71). Fit for individual and parallel process models was assessed using χ^2 , root mean square error of approximation (RMSEA), and comparative fit index (CFI). A model is considered a good fit for the data when χ^2 is nonsignificant (or when $\chi^2/df < 2$), and when RMSEA $\leq .06$ and CFI $\geq .95$ (Hu & Bentler, 1999). Mplus offers a latent variable interaction procedure using MLR and a numerical integration algorithm, but it does not compute standard fit indices for these models (Muthén & Muthén, 2010). As such, fit of main and synergistic effect models was compared by estimating Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) indices. Lower AIC and BIC scores indicate better fit (Kline, 2011). Difference testing was also conducted using loglikelihood values. As MLR was used to test model fit, loglikelihood scaling correction factors were used to estimate whether fit differed significantly between main and synergistic models, and synergistic models with and without gender as a moderator (Muthén & Muthén, 2010). All participants contributed at least some data to these analyses (65.6% had no missing data); no cases were dropped owing to missing data because full-information maximum likelihood estimates were utilized. This method has become a preferred strategy for dealing with missing data (Schafer & Graham, 2002). However, as participants with missing data were more likely to be ethnic minorities and lower income than those with no missing data (see McCarty et al., 2012), these variables were included as covariates in all models tested.

Results

Preliminary Descriptive Statistics

Table 1 provides descriptive statistics for MDD and CD symptoms from 6th to 9th grade. More than half of the sample (51.5%) had 12th grade RAPI summary scores > 0 (i.e. indicative of at least some substance use impairment; $M = 4.23$, $SD = 8.06$). Inter-correlations among 6th–9th grade MDD symptoms, 6th–9th grade CD symptoms and 12th grade substance use problems are presented in Table 2. Only 9th grade MDD ($r = .13$) and 8th and 9th grade CD indicators ($r = .12$ and $.18$, respectively) were significantly associated with 12th grade RAPI summary scores.

Unconditional Models of MDD and CD Symptoms

For these models, loadings of the intercept [1,1,1] and slope [0,1,2,3] factors were fixed at values that correspond to linear change, with intercepts set at 6th grade. The linear model for MDD symptoms fit the data well, $\chi^2_{(5, N = 519)} = 11.89$, $p < .05$, CFI = .99, RMSEA = .05. There was a significant average decrease in symptoms ($M = -.18$, $SE = .06$, $p < .01$) and

significant variability around the slope (variance = .39, SE = .14, $p < .01$). The average intercept and slope of MDD were not significantly correlated ($r = -.39$, $p = .16$). Given that descriptives suggested that average MDD levels in 9th grade may not have followed a linear path relative to data collected in 6th–8th grade, alternative growth models were also tested. First, we attempted to fit models testing quadratic growth in MDD symptoms (quadratic factors = 0, 1, 4, 9). The quadratic growth model fit the MDD symptom count data better than the linear growth model, $\Delta\chi^2(4) = +11.61$, $p < .05$, but the variances of both the linear and quadratic slopes were nonsignificant ($p > .10$). Second, we re-analyzed linear models allowing the 9th grade slope factor loading to be freely estimated [0,1,2,*]. Results indicated that this model fit better for the MDD symptom data, $\Delta\chi^2(1) = +7.54$, $p < .01$. The mean of the slope ($M = -.32$, SE = .08, $p < .01$) and the variability around the slope (variance = .91, SE = .30, $p < .01$) were also significant. As such, we adopted a linear growth model freely estimating the 9th grade slope factor for MDD symptoms.

The linear model for CD symptoms fit the data well, $\chi^2_{(5, N = 519)} = 7.10$, $p = .21$, CFI = 1.00, RMSEA = .03. There was a significant average increase in CD symptoms ($M = .17$, SE = .04, $p < .01$) and significant variability around the slope ($M = .19$, SE = .06, $p < .01$). The average intercept and slope of CD were not significantly correlated ($r = .14$, $p = .43$). As with MDD, alternative growth models were also tested for CD symptoms. The quadratic model did not fit the CD symptoms better than the linear model, $\Delta\chi^2(4) = +6.14$, $p = .18$. Allowing the 9th grade slope factor to be freely estimated [0,1,2,*] also did not improve fit of model, $\Delta\chi^2(1) = +.36$, *ns*. Thus, we adopted the original linear growth model for CD symptoms.

Parallel Process Model

For this model, all covariances (no directional paths) among the growth factors were estimated, and the covariances among residuals of MDD and CD symptoms measured within-grade were fixed to be equal across grades; substance use impairment was not included at this stage. The parallel process growth model displayed acceptable fit, $\chi^2_{(20, N = 519)} = 25.94$, $p = .17$, CFI = 1.00, RMSEA = .02. There was a significant average decrease in MDD symptoms ($M = -.31$, $p < .01$) and a significant average increase in CD symptoms ($M = .18$, $p < .01$). Variance around the slopes was significant for both MDD and CD symptoms. Higher initial levels of MDD symptoms were associated with higher initial levels ($r = .38$, $p < .01$) and steeper increases in CD symptoms ($r = .22$, $p < .05$). There was a trend for higher initial levels of MDD symptoms to be associated with steeper decreases in MDD symptoms over time ($r = -.29$, $p = .06$). Correlations between the slope of MDD and the intercept and slope of CD were nonsignificant, as was the correlation between the intercept and slope of CD.

Main and Interaction Effects of MDD and CD Growth on Alcohol Impairment

Main effect and synergistic models tested whether growth in MDD and CD symptoms operated uniquely or interactively in the prediction of later substance use impairment. To specify the most parsimonious main and synergistic effect models, nonsignificant covariances among growth factors in the parallel process model reported above were constrained to zero. First, a model was tested with covariances between the MDD and CD growth factors and RAPI scores. This model fit the data well, $\chi^2_{(54, N = 520)} = 129.86$, $p < .01$, CFI = .95, RMSEA = .05, AIC = 24815.01, BIC = 24968.21. Results indicated that initial CD symptom levels were positively associated with later impairment due to alcohol/marijuana use ($r = .16$, $p < .01$). However, neither the CD slope nor the MDD growth factors were associated with later use-related impairment. Next, regression paths from the MDD and CD growth factors to use-related impairment were estimated. This model fit the data well, $\chi^2_{(51, N = 520)} = 60.50$, $p = .17$, CFI = .99, RMSEA = .02, AIC = 19087.82, BIC =

19215.43. Results of this model indicated that growth in MDD symptoms did not prospectively predict substance use problems over and above growth in CD symptoms, and vice versa. Only initial levels of CD were positively associated with 12th grade substance use problems.

However, the synergistic model fit the data significantly better than the main effect model ($\Delta AIC = -649.32$, $\Delta BIC = -645.06$; loglikelihood scaled $\Delta\chi^2(1) = 24.07$, $p < .01$). As shown in Figure 2, the interaction between growth in MDD and growth in CD symptoms uniquely predicted later substance use impairment. Results indicated that adolescents whose parents reported increases in both MDD and CD symptoms from 6th to 9th grade reported the most substance use-related impairment in 12th grade (Figure 3), relative to adolescents whose parents reported increases in only MDD or CD, or neither. To validate the results of our synergistic model, we replicated our findings using an alternative technique to compute interactions between latent variables. First, we re-analyzed the main effect model in Mplus and requested factor scores for each of the latent variables. Using the slope factor scores, we computed an interaction term (MDD slope * CD slope = MDD*CD) and regressed 12th grade substance use impairment on this term as well as the intercept and slope main effect terms. [The rationale and procedures for this approach are discussed elsewhere (Jöreskog, 2000).] Using this alternative analytic strategy, we again found that the interaction between MDD and CD slopes was a unique predictor of later substance use problems ($b = .47$, $SE = .24$, $p = .05$). As before, adolescents whose parents reported increasing levels of MDD and CD symptoms from 6th to 9th grade tended to have more substance use impairment in 12th grade.

Finally, the model including gender as a moderator did not fit the data better than the synergistic effect model ($\Delta AIC = +9.86$, $\Delta BIC = +26.88$; loglikelihood scaled $\Delta\chi^2(1) = 0.71$, $p = .95$). We found that gender did not moderate synergistic associations between change over time in depression symptoms and conduct problems in the prediction of 12th grade substance use impairment ($B = .35$, $SE = .28$, $p = .20$). As above, the only significant predictors were growth in depression symptoms ($B = .52$, $SE = .05$, $p < .01$), growth in conduct problems ($B = 8.02$, $SE = .42$, $p < .01$), and their interaction ($B = 10.74$, $SE = .45$, $p < .01$).

Discussion

One key advance offered by the current study is that depression and conduct disorder symptoms were modeled as dynamic and co-evolving factors over the early adolescent years. The current study demonstrates that patterns of growth in depression and conduct problems may be even more important in predicting later substance use impairment than the static level at any particular point-in-time. These findings integrate with previous studies regarding the associations between depression and conduct problems and substance use. While the vast majority of studies examining associations between depression and substance use have focused exclusively on level of depression (Chassin, Pitts, & Prost, 2002; Hussong, Curran, & Chassin, 1998; Kaplow, Curran, Angold, & Costello, 2001; King et al., 2004; Mason, Hitchings, et al., 2008; Mason, Kosterman, et al., 2008; Pardini et al., 2007; White, Xie, Thompson, Loeber, & Stouthamer-Loeber, 2001), including our own previous work (McCarty, Rhew, Murowchick, McCauley, & Stoep, 2011; McCarty et al., 2012), only a few studies have examined change over time in depression as it relates to substance use. Fleming et al. (2008) examined depression and substance use (alcohol and marijuana) as dual-process growth models between 8th and 11th grades and found that changes in the two variables were positively associated, indicating that increases in depression were associated with greater increases in alcohol use, with similar findings when marijuana use was modeled (Fleming et al., 2008). However, conduct symptoms were not controlled for in these analyses. In terms

of literature examining conduct problems across time, one study using latent growth curve analyses found that conduct problems predict time-specific variation in alcohol use trajectories, but not vice-versa (Loeber, Stepp, Chung, Hipwell, & White, 2010).

The finding regarding the interaction between depression and conduct symptom growth is consistent with the broader literature on comorbidity, suggesting that youth with co-occurring symptoms may be worse off compared to youth with one problem area as they develop (Ingoldsby et al., 2006; Rockhill et al., 2009; Vander Stoep et al., 2012). Our findings are also consistent with the results of a six-year longitudinal study conducted on the National Longitudinal Study of Adolescent Health sample, which found interactions between changes in conduct disorder and depressive symptoms in predicting alcohol problems from early adolescence through early adulthood, particularly among females, “indicating that both delinquent behavior and depressive symptoms were associated with high levels of alcohol problems in early adolescence and that their combination was particularly toxic” (Marmorstein et al., 2010). The current study replicates these findings, though our findings were consistent across gender. Thus, although gender differences in rates of depression and conduct disorder symptoms may exist, this does not necessarily translate to differential associations with later substance use impairment for boys and girls. Key differences between the current study and Marmorstein’s 2010 study include: we used a robust measure of DSM depressive and conduct problems based on symptom counts over the past year from a diagnostic survey instrument, compared to their measure of depressive symptoms over the last 2 weeks; their data comprises three waves over 6 years, whereas our data comprises five waves over 6 years; and our measurement of broader substance use problems using a standardized tool versus their assessment of alcohol-specific problems.

The current study in combination with this prior work provides support for co-occurring heterotypic mental health predictors of substance use impairment in late adolescence, including the well-established externalizing pathway, the theorized internalizing pathway, and also an overlapping, comorbid pathway as described as “two mechanisms...that may coexist and interact over development...such that some variance in AUDs is accounted for by their shared impact” (Hussong et al., 2011, p. 392). Youth with internalizing symptoms and depression in particular, as a disorder with central features of affective dysregulation, may be particularly likely to use substances when paired with prominent externalizing features such as impulsivity and a tendency to “act out” and/or disobey rules of behavior. Although there has been relatively less focus on the comorbid and internalizing pathways to substance use, there is an extensive body of research documenting high prevalence of comorbidity between conduct problems and depression (Wolff & Ollendick, 2006).

Yet it is important to note that at least one other study has found a negative interaction between depressed mood and conduct problems, such that positive associations of conduct problems with substance use were stronger at lower levels of depressed mood (Mason, Hitchings, et al., 2008). In other words, that study found support for the externalizing pathway to substance use exclusively, with attenuation of risk for the comorbid pathway. Several major differences in study design between our study and Mason, Hitchings, et al. (2008) may underlie these discrepant findings, including their examination of depressed mood at a single point in time versus our modeling of growth in depression across 4 years; their use of a rural sample and our use of an urban sample; and their measurement of depressed mood by CBCL and our measurement of depressive symptoms by diagnostic interview.

Limitations and Strengths

This study is limited by the use of a regional sample that may not generalize to other settings or populations, including clinical populations; however, the findings are from a general,

community sample and therefore have implications for adolescent development and prevention. While we utilized both parent report (depression and conduct problems symptoms) and youth report (substance use impairment) data in the model, it is possible that using different informants would have changed study findings. While we attempted to run models using youth informant data, simple unconditional growth models fit poorly, and models of an interaction term using youth report would not converge. Reliance on parental reports of symptoms may have resulted in an underestimation of depression and conduct disorder symptoms. Future research should consider both moderators and mediators of these associations. A strength of the study is the use of latent variables which addresses unreliability of measurement, providing a less-biased method of evaluation compared to models using measured variables. Moreover, results of sensitivity analyses using a factor score approach were substantively similar to results of our latent interaction model, increasing our confidence that changes in MDD and CD symptoms interact to predict use-related impairment in this sample. Taken together, these findings suggest that the most salient aspects of depressive symptoms that pertain to substance use impairment include growth in depression (i.e., persistent and recurrent symptoms over time) and depressive symptoms that are comorbid with conduct disorder symptoms.

Clinical Implications

Several clinical implications follow from these results. First, results point to the interrelationship of risk among conduct problems, depression, and substance use. Hence, efforts to assess risk of substance use problems among adolescents will be advanced by including assessments of current conduct problems and depression; evidence of either, and particularly of both, should raise clinical concern about future substance use problems. Previous research has also indicated that effective short-term treatment for adolescent depression significantly reduces the rate of subsequent substance use disorders (Curry et al., 2012). The results of this study underscore this finding, and suggest that intervention strategies which target the co-occurrence of conduct disorder and depression to address substance use and its adverse consequences are worthy of further research.

Second, our data suggest that patterns of change in symptom levels of depression and conduct disorder over time were more important than overall aggregated symptom levels in the prediction of substance use outcomes. Hence, youth who display growth or persistence of depression or conduct disorder symptoms over time should be identified and specifically targeted for prevention and early intervention. Thus, a preferred method of assessment of substance use risk requires more than a single or moment-in-time assessment, but rather ongoing capture of patterns of behavior and symptoms over time. The critical task becomes one of identifying youth who are escalating or persisting in their symptoms over time. These results points to the paramount importance of frequent and repeated screening and monitoring of mental health problems and substance use during adolescence.

Acknowledgments

This work was supported by grants from the National Institutes of Health, including R01 AA018701 (awarded to Dr. McCarty), R01 MH/DA63711 (awarded to Dr. Vander Stoep), R01 MH079402 (awarded to Drs. Vander Stoep and McCauley), Seattle Children's Hospital Steering Committee Grant and American Foundation for Suicide Prevention Grant (awarded to Dr. Vander Stoep), and UW Provost Bridge Funding (awarded to Drs. Vander Stoep and McCauley). Portions of the analyses were presented at the biannual conference of the Society for Research on Adolescence, Vancouver, Canada. (March, 2012).

References

Achenbach, T.M.; Rescorla, L.A. Manual for the ASEBA School-Age Forms & Profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth & Families; 2001.

- Angold A, Costello EJ, Erkanli A. Comorbidity. *Journal of Child Psychology and Psychiatry*. 1999; 40:57–87. [PubMed: 10102726]
- Bongers IL, Koot HM, van der Ende J, Verhulst FC. Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development*. 2004; 75:1523–1537. 10.1111/j.1467-8624.2004.00755.x. [PubMed: 15369529]
- Botvin GJ, Griffin KW. School-based programmes to prevent alcohol, tobacco and other drug use. *International Review of Psychiatry*. 2007; 19:607–615. 10.1080/09540260701797753. [PubMed: 18092239]
- Boylan K, Vaillancourt T, Boyle M, Szatmari P. Comorbidity of internalizing disorders in children with oppositional defiant disorder. *European Journal of Child and Adolescent Psychiatry*. 2007; 16:484–494.
- Brown SA, Tapert SF. Adolescence and the trajectory of alcohol use: Basic to clinical studies. *Annals of the New York Academy of Sciences*. 2004; 1021:234–244. 10.1196/annals.1308.028. [PubMed: 15251893]
- Capaldi DM. Co-occurrence of conduct problems and depressive symptoms in early adolescent boys: I. Familial factors and general adjustment at Grade 6. *Development and Psychopathology*. 1991; 3:277–300.
- Capaldi DM, Stoolmiller M. Co-occurrence of conduct problems and depressive symptoms in early adolescent boys: III. Prediction to young-adult adjustment. *Development and Psychopathology*. 1999; 11:59–84. [PubMed: 10208356]
- Centers for Disease Control and Prevention. Youth risk behavior surveillance—United States, 2009. *Morbidity and Mortality Weekly Report* 2010. 2009; 59:1–146.
- Chambers RA, Taylor JR, Potenza MN. Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *The American Journal of Psychiatry*. 2003; 160:1041–1052. 10.1176/appi.ajp.160.6.1041. [PubMed: 12777258]
- Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. *Journal of Consulting and Clinical Psychology*. 2002; 70:67–78. 10.1037/110022-006x.70.1.67. [PubMed: 11860058]
- Chassin, L.; Ritter, J. Vulnerability to substance use disorders in childhood and adolescence. In: Ingram, RE.; Price, JM., editors. *Vulnerability to psychopathology: Risk across the life span*. 2. New York: Guilford Press; 2010. p. 107-134.
- Cohen, P.; Brook, JS.; Cohen, J.; Velez, CN.; Garcia, M. Common and uncommon pathways to adolescent psychopathology and problem behavior. In: Robins, L.; Rutter, M., editors. *Straight and devious pathways from childhood to adulthood*. Cambridge University Press; Cambridge: 1990. p. 242-258.
- Costello EJ, Angold A. Scales to assess child and adolescent depression: Checklists, screens, and nets. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1988; 27:726–737. 10.1097/00004583-198811000-00011. [PubMed: 3058677]
- Crum RM, Storr CL, Ialongo N, Anthony JC. Is depressed mood in childhood associated with an increased risk for initiation of alcohol use during early adolescence? *Addictive Behaviors*. 2008; 33:24–40. [PubMed: 17587505]
- Curry J, Silva S, Rohde P, Ginsburg G, Kennard B, Kratochvil C, March J. Onset of alcohol or substance use disorders following treatment for adolescent depression. *Journal of Consulting and Clinical Psychology*. 2012; 80:299–312. 10.1037/a0026929. [PubMed: 22250853]
- Ellickson PL, Tucker JS, Klein DJ. Ten-year prospective study of public health problems associated with early drinking. *Pediatrics*. 2003; 111:949–955. 10.1542/peds.111.5.949. [PubMed: 12728070]
- Fergusson DM, Horwood LJ, Ridder EM. Conduct and attentional problems in childhood and adolescence and later substance use, abuse and dependence: Results of a 25-year longitudinal study. *Drug and Alcohol Dependence*. 2007; 88(Suppl 1):S14–26. 10.1016/j.drugalcdep.2006.12.011. [PubMed: 17292565]
- Fergusson DM, Lynskey MT, Horwood LJ. Origins of comorbidity between conduct and affective disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1996; 35:451–460. [PubMed: 8919707]

- Fleming CB, Mason WA, Mazza JJ, Abbott RD, Catalano RF. Latent growth modeling of the relationship between depressive symptoms and substance use during adolescence. *Psychology of Addictive Behaviors*. 2008; 22:186–197. 10.1037/0893-164X.22.2.186. [PubMed: 18540716]
- Ginzler JA, Garrett SB, Baer JS, Peterson PL. Measurement of negative consequences of substance use in street youth: An expanded use of the Rutgers Alcohol Problem Index. *Addictive Behaviors*. 2007; 32:1519–1525. 10.1016/j.addbeh.2006.11.004. [PubMed: 17236724]
- Hankin BL, Abramson LY, Moffitt TE, Silva PA, McGee R, Angell KE. Development of depression from preadolescence to young adulthood: Emerging gender differences in a 10-year longitudinal study. *Journal of Abnormal Psychology*. 1998; 107:128–140. [PubMed: 9505045]
- Henry B, Feehan M, McGee R, Stanton W, Moffitt TE, Silva P. The importance of conduct problems and depressive symptoms in predicting adolescent substance use. *Journal of Abnormal Child Psychology*. 1993; 21:469–480. 10.1007/BF00916314. [PubMed: 8294648]
- Hooshmand S, Willoughby T, Good M. Does the direction of effects in the association between depressive symptoms and health-risk behaviors differ by behavior? A longitudinal study across the high school years. *The Journal of Adolescent Health*. 2012; 50:140–147. 10.1016/j.jadohealth.2011.05.016. [PubMed: 22265109]
- Hu, L-t; Bentler, PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*. 1999; 6:1–55. 10.1080/10705519909540118.
- Hussong AM, Curran PJ, Chassin L. Pathways of risk for accelerated heavy alcohol use among adolescent children of alcoholic parents. *Journal of Abnormal Child Psychology*. 1998; 26:453–466. [PubMed: 9915652]
- Hussong AM, Jones DJ, Stein GL, Baucom DH, Boeding S. An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors*. 2011; 25:390–404. 10.1037/a0024519. [PubMed: 21823762]
- Ingoldsby EM, Kohl GO, McMahon RJ, Lengua L. Conduct problems, depressive symptomatology and their co-occurring presentation in childhood as predictors of adjustment in early adolescence. *Journal of Abnormal Child Psychology*. 2006; 34:603–621. 10.1007/s10802-006-9044-9. [PubMed: 16967336]
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Marijuana use continues to rise among U S teens, while alcohol use hits historic lows. 2011. Retrieved from <http://www.monitoringthefuture.org>
- Jöreskog, KG. Latent variable scores. 2000. Retrieved from <http://www.ssicentral.com/lisrel/advancedtopics.html>
- Kaplow JB, Curran PJ, Angold A, Costello EJ. The prospective relation between dimensions of anxiety and the initiation of adolescent alcohol use. *Journal of Clinical Child Psychology*. 2001; 30:316–326. 10.1207/S15374424JCCP3003_4. [PubMed: 11501249]
- King SM, Iacono WG, McGue M. Childhood externalizing and internalizing psychopathology in the prediction of early substance use. *Addiction*. 2004; 99:1548–1559. 10.1111/j.1360-0443.2004.00893.x. [PubMed: 15585046]
- Kline, RB. Principles and practice of structural equation modeling. 3. New York, NY: Guilford Press; 2011.
- Leatherdale ST, Hammond D, Ahmed R. Alcohol, marijuana, and tobacco use patterns among youth in Canada. *Cancer Causes Control*. 2008; 19:361–369. 10.1007/s10552-007-9095-4. [PubMed: 18058247]
- Loeber R, Stepp SD, Chung T, Hipwell AE, White HR. Time-varying associations between conduct problems and alcohol use in adolescent girls: The moderating role of race. *Journal of Studies on Alcohol and Drugs*. 2010; 71:544–553. [PubMed: 20553663]
- Lynne-Landsman SD, Bradshaw CP, Ialongo NS. Testing a developmental cascade model of adolescent substance use trajectories and young adult adjustment. *Development and Psychopathology*. 2010; 22:933–948. 10.1017/S0954579410000556. [PubMed: 20883591]
- Marmorstein NR. Longitudinal associations between alcohol problems and depressive symptoms: Early adolescence through early adulthood. *Alcoholism: Clinical and Experimental Research*. 2009; 33:49–59.

- Marmorstein NR, Iacono WG. An investigation of female adolescent twins with both major depression and conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2001; 40:299–306. 10.1097/00004583-200103000-00009. [PubMed: 11288771]
- Marmorstein NR, Iacono WG. Major depression and conduct disorder in a twin sample: Gender, functioning, and risk for future psychopathology. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2003; 42:225–33. [PubMed: 12544183]
- Marmorstein NR, Iacono WG, Malone SM. Longitudinal associations between depression and substance dependence from adolescence through early adulthood. *Drug and Alcohol Dependence*. 2010; 107:154–160. 10.1016/j.drugalcdep.2009.10.002. [PubMed: 19926409]
- Mason WA, Hitchings JE, Spoth RL. Emergence of delinquency of depressed mood throughout adolescence as predictors of late adolescent problem substance use. *Psychology of Addictive Behaviors*. 2007; 21:13–24. [PubMed: 17385951]
- Mason WA, Hitchings JE, Spoth RL. The interaction of conduct problems and depressed mood in relation to adolescent substance involvement and peer substance use. *Drug and Alcohol Dependence*. 2008; 96:233–248. 10.1016/j.drugalcdep.2008.03.012. [PubMed: 18455886]
- Mason WA, Kosterman R, Haggerty KP, Hawkins JD, Redmond C, Spoth RL, Shin C. Dimensions of adolescent alcohol involvement as predictors of young-adult major depression. *Journal of Studies on Alcohol and Drugs*. 2008; 69:275–285. [PubMed: 18299769]
- McCarty CA, Rhew IC, Murowchick E, McCauley E, Stoep AV. Emotional health predictors of substance use initiation during middle school. *Psychology of Addictive Behaviors*. 2011 10.1037/a0025630.
- McCarty, CA.; Vander Stoep, A.; Wymbs, BT.; McCauley, E.; Adrian, M.; Baer, JS.; Myaing, M. Longitudinal studies of adolescent depression and substance use: A systematic review and some methodological considerations. 2013. Manuscript in preparation
- McCarty CA, Wymbs BT, King KM, Mason WA, Vander Stoep A, McCauley E, Baer J. Developmental consistency in associations between depressive symptoms and alcohol use in early adolescence. *Journal of Studies on Alcohol and Drugs*. 2012; 73:444–453. [PubMed: 22456249]
- Measelle JR, Stice E, Hogansen JM. Developmental trajectories of co-occurring depressive, eating, antisocial, and substance abuse problems in female adolescents. *Journal of Abnormal Psychology*. 2006; 115:524–538. 10.1037/0021-843X.115.3.524. [PubMed: 16866592]
- Miller ET, Neal DJ, Roberts LJ, Baer JS, Cressler SO, Metrik J, Marlatt GA. Test-retest reliability of alcohol measures: Is there a difference between internet-based assessment and traditional methods? *Psychology of Addictive Behaviors*. 2002; 16:56–63. [PubMed: 11934087]
- Muthén, LK.; Muthén, BO. *Mplus User's Guide*. Sixth. Los Angeles, CA: Muthén & Muthén; 2010.
- Pardini D, White HR, Stouthamer-Loeber M. Early adolescent psychopathology as a predictor of alcohol use disorders by young adulthood. *Drug and Alcohol Dependence*. 2007; 88(Suppl 1):S38–49. 10.1016/j.drugalcdep.2006.12.014. [PubMed: 17257781]
- Robins LN, Price RK. Adult disorders predicted by childhood conduct problems: Results from the NIMH Epidemiologic Catchment Area Project. *Psychiatry*. 1991; 54:113–132.
- Rockhill CM, Vander Stoep A, McCauley E, Katon WJ. Social competence and social support as mediators between comorbid depressive and conduct problems and functional outcomes in middle school children. *Journal of Adolescence*. 2009; 32:535–553. 10.1016/j.adolescence.2008.06.011. [PubMed: 18694594]
- Rohde P, Lewinsohn PM, Seeley JR. Comorbidity of unipolar depression: II. Comorbidity with other mental health disorders in adolescents and adults. *Journal of Abnormal Psychology*. 1991; 100:214–22. [PubMed: 2040773]
- Schafer JL, Graham JW. Missing data: Our view of the state of the art. *Psychological Methods*. 2002; 7:147–177. [PubMed: 12090408]
- Schwab-Stone ME, Shaffer D, Dulcan MK, Jensen PS, Fisher P, Bird HR, Rae DS. Criterion validity of the NIMH Diagnostic Interview Schedule for Children Version 2.3 (DISC-2.3). *Journal of the American Academy of Child and Adolescent Psychiatry*. 1996; 35:878–888. 10.1097/00004583-199607000-00013. [PubMed: 8768347]
- Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME. NIMH diagnostic interview schedule for children version IV (NIMH DISC-IV): Description, differences from previous versions, and

- reliability of some common diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2000; 39:28–38. [PubMed: 10638065]
- Tapert SF, Colby SM, Barnett NP, Spirito A, Rohsenow DJ, Myers MG, Monti PM. Depressed mood, gender, and problem drinking in youth. *Journal of Child & Adolescent Substance Abuse*. 2003; 12:55–68.
- Vander Stoep A, Adrian MC, Rhew IC, McCauley E, Herting JR, Kraemer HC. Identifying comorbid depression and disruptive behavior disorders: Comparison of two approaches used in adolescent studies. *Journal of Psychiatric Research*. 2012; 46:873–881. [PubMed: 22575333]
- Vander Stoep A, McCauley E, Thompson K, Kuo ES, Herting JR. Universal screening for emotional distress during the middle school transition. *Journal of Emotional and Behavioral Disorders*. 2005; 13:213–223. 10.1177/10634266050130040301. [PubMed: 21430789]
- White HR, Labouvie EW. Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol*. 1989; 50:30–37. [PubMed: 2927120]
- White HR, Labouvie EW. Longitudinal trends in problem drinking as measured by the Rutgers Alcohol Problem Index. *Alcoholism: Clinical and Experimental Research*. 2000; 24(76A)
- White HR, Xie M, Thompson W, Loeber R, Stouthamer-Loeber M. Psychopathology as a predictor of adolescent drug use trajectories. *Psychology of Addictive Behaviors*. 2001; 15:210–218. [PubMed: 11563798]
- Windle, M.; Windle, RC. Alcohol consumption and its consequences among adolescents and young adults. In: Galanter, M., editor. *Alcohol problems in adolescents and young adults: Epidemiology, neurobiology, prevention and treatment*. New York: Springer; 2006. p. 67-83.
- Wolff JC, Ollendick TH. The comorbidity of conduct problems and depression in childhood and adolescence. *Clinical Child and Family Psychology Review*. 2006; 9:201–220. 10.1007/s10567-006-0011-3. [PubMed: 17053962]
- Zoccolillo M. Co-occurrence of externalizing disorder and its adult outcomes with depressive and anxiety disorders: A review. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1992; 31:547–556. [PubMed: 1592790]
- Zucker RA, Heitzeg MM, Nigg JT. Parsing the undercontrol/disinhibition pathway to substance use disorders: A multilevel developmental problem. *Child Development Perspectives*. 2011; 5:248–255. 10.1111/j.1750-8606.2011.00172.x. [PubMed: 22116786]

A) Main Effect Model

B) Synergistic Model

Figure 1. Main effect (A) and synergistic (B) models estimated to test growth in MDD and CD symptoms as unique and interactive risk factors for later substance use problems

Figure 2.

Results of synergistic model examining MDD and CD symptoms as interactive risk factors for substance use problems. Unstandardized betas and standard errors are provided. Solid lines indicate significant paths ($p < .05$), while dashed lines indicate nonsignificant paths. Intercorrelations among latent variables are omitted to preserve clarity. Numbers in brackets are freely-estimated indicator scores for 9th grade MDD symptoms.

Figure 3.
Growth of MDD symptoms from 6th to 9th grade interacts with growth of CD symptoms during same period to prospectively predict substance use problems in 12th grade.

Table 1

Descriptive statistics for depressive and conduct disorder symptoms

	6th Grade ^a M (SD)	7th Grade ^b M (SD)	8th Grade ^c M (SD)	9th Grade ^d M (SD)
MDD	4.65 (3.73)	4.03 (3.47)	3.75 (3.51)	3.90 (3.65)
CD	1.92 (2.51)	1.99 (2.49)	2.17 (2.78)	2.40 (2.96)
RAPI	0.21 (2.35)			

Note: MDD = Symptom count for parent-rated adolescent major depressive disorder generated by DISC, with scores ranging from 0–22; CD = Symptom count for parent-rated adolescent conduct disorder generated by DISC, with scores ranging from 0–26; RAPI = Rutgers Alcohol Problem Inventory total score.

^a
n = 517.

^b
n = 438.

^c
n = 442.

^d
n = 403.

Table 2

Inter-correlations among MDD and CD symptoms across 6th–9th grade and substance use impairment in 12th grade

	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	–											
2. Ethnicity	.05	–										
3. Income	.08	.40**	–									
4. RAPI-6th	–.02	–.02	.00	–								
5. MDD-6th	.06	.01	–.04	.07	–							
6. MDD-7th	.04	.01	–.09	.00	.63**	–						
7. MDD-8th	.03	–.01	–.10*	.01	.54**	.65**	–					
8. MDD-9th	.02	.04	–.04	.01	.52**	.60**	.65**	–				
9. CD-6th	.12**	–.10*	–.13**	–.01	.34**	.29**	.26**	.31**	–			
10. CD-7th	.11*	–.07	–.15**	.00	.29**	.42**	.31**	.36**	.74**	–		
11. CD-8th	.15**	–.12*	–.20**	.05	.28**	.33**	.35**	.29**	.71**	.68**	–	
12. CD-9th	.16*	–.02	–.18**	.00	.24**	.34**	.29**	.37**	.63**	.65**	.71**	–
13. RAPI-12th	.10*	.10*	.06	.00	.03	.09	.09	.13*	.08	.09	.12*	.18**

Note: Sample sizes range from 375 to 521, depending on what grades were correlated. Gender (0 = Female, 1 = Male); Ethnicity (1 = Native American, 2 = Black, 3 = Asian, 4 = White, 5 = Hispanic); Income (1 = < \$25,000, 2 = \$25–50,000, 3 = \$50–75,000, 4 = \$75–100,000, 5 = > \$100,000); RAPI = Summary score for adolescent ratings on Rutgers Alcohol Problem Inventory; MDD = Symptom count for parent-rated adolescent major depressive disorder generated by DISC; CD = Symptom count for parent-rated adolescent conduct disorder generated by DISC.

* $p < .05$;

** $p < .01$