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The Internalizing Pathway to Adolescent Substance Use Disorders: Mediation by Ruminative Reflection and Ruminative Brooding

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Abstract

Two subtypes of rumination were examined in relationship to substance use and substance use disorders in adolescents. In the 8th and 9th grade, 521 adolescents completed measures assessing depressive symptoms, conduct problems, and reflective and brooding subtypes of rumination. In 12th grade, adolescents reported substance use and were administered the substance use disorders modules from the DISC. Path analyses conducted with data from 428 participants indicated that neither depression nor rumination variables significantly affected the presence of substance use. However, indirect effects of depression through reflection and brooding were differentially related to risk of developing substance use disorders, with brooding positively associated with Marijuana Use Disorders, and reflection negatively related to both Marijuana and Alcohol Use Disorders. Pathways did not differ by sex. These findings suggest that promoting self-reflection may be an effective strategy to prevent and intervene with the development of problematic substance use.

Keywords

rumination; brooding; reflection; substance abuse; adolescence

Alcohol and marijuana are the most widely used and abused substances among America's youth (CDC, 2011). Use of these substances escalates during adolescence, such that by 12th grade, 71% of adolescents have initiated drinking, 42% have used marijuana, and between 8% and 20% meet lifetime criteria for a substance use disorder (CDC, 2011 Johnson et al., 2011; Young et al., 2002). Substance abuse among adolescents results in serious immediate and long-term social, economic, and personal costs (CASA; 2011; Odgers et al., 2008). The widespread occurrence of substance abuse and the significant personal and social toll underscore our need to better understand the etiological factors that place adolescents at risk for substance abuse.

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Prospective research suggests that the developmental trajectories toward adolescent substance use and disorders frequently begin with childhood psychopathology, predominantly conduct disorder, and to a lesser degree, depressive disorders (Clark, 2004). Conduct problems are an established prospective risk factor for substance abuse (Fergusson, Horwood, & Ridder, 2007; Hawkins et al., 1992; King & Chassin, 2008). Moreover, a strong concurrent association between substance use and depressive symptoms has also been consistently documented (e.g., Armstrong & Costello, 2002; Rohde et al., 1996).

One of the commonly accepted etiological theories connecting depressive symptoms and substance use maintains that individuals with depressive symptoms consume psychoactive substances because they have the effect of temporarily improving mood and providing distraction from negative emotions (Cooper et al., 2001). This “negative affect pathway of vulnerability,” in which individuals might turn to alcohol or other drugs to alleviate psychological distress is commonly described as the internalizing pathway to substance use disorders. Under this theory, the core function of substance use is to serve as a negative reinforcement strategy to regulate distress and negative affect (Hussong et al., 2011; Sher, 1991). Although this theory is compelling and consistent with clinical lore, the findings on the prospective connection between depressive symptoms and substance abuse remain mixed. Support comes from investigations that have found that early depressive symptoms double the odds of early alcohol use (King et al., 2004); however, other data do not support this association (Hussong et al., 1998; Mason et al., 2008). Specifically, in a recent literature review of longitudinal studies of adolescent depression and substance use, just over half (52% $n = 26$) reported at least one positive prospective association between depression in childhood or adolescence and later substance use, while 8% reported at least one significant negative association. The remaining 40% had null findings (C. McCarty, personal communication, February 18th, 2014). The inconsistency of these findings and the lack of research to support the hypothesis that youth use substances to regulate negative affect suggest the need for more research into possible pathways from depressive symptoms to substance use disorders.

The role of core emotion regulation mechanisms that could increase an adolescent’s risk for a substance use diagnosis is currently receiving attention (Aldao et al., 2010; Cole et al., 1994). One mechanism suggested as a potential mediator of the association of depressive symptoms to problematic substance use is rumination: the tendency to repetitively focus on symptoms of distress and their causes/consequences without engaging in active problem solving (Nolen-Hoeksema & Watkins, 2011). Since its original description in the literature, rumination has been examined more in depth to identify potentially adaptive and maladaptive types of rumination. *Brooding* rumination (passively stewing on symptoms and consequences) was suggested to be distinct from *reflective* rumination, cognitively processing the causes and consequences of one’s problems (Nolen-Hoeksema & Watkins, 2011). Previous examinations indicate bidirectional relationships between brooding rumination and depression. Brooding rumination has been observed to exacerbate negative mood and increase negative thinking, while depressive symptoms can also exacerbate brooding (Nolen-Hoeksema et al., 2007). According to response styles theory, brooding exacerbates distress by using negative thoughts to explain current circumstances as

overwhelming and unsolvable and by interfering with effective problem solving and instrumental behavior (Nolen-Hoeksema et al., 2007). Brooding rumination may increase risk for maladaptive behaviors, especially if substance use behaviors serve to avoid aversive, self-directed ruminations (i.e., escape from the self; Abramson, Bardone-Cone, Vohns, Joiner & Heatherton, 2006; Heatherton & Baumeister, 1991; Nolen-Hoeksema et al., 2008).

Direct testing of the mechanisms that underlie the risk of depressive symptoms resulting in substance use problems may elucidate etiological pathways and suggest intervention strategies. In Nolen-Hoeksema & Harrell's (2002) research among adults, overall rumination was associated with alcohol-related problems for women one year later, but the association was not significant for men (Nolen-Hoeksema & Harrell, 2002). In addition, adult studies that have accounted for depressive symptoms have found that overall rumination predicted level of alcohol use and problem drinking above and beyond the contribution of depression (Casilli, 2008, 2010). Studies with adolescent samples have found that ruminative brooding predicted increases in alcohol abuse symptoms and diagnoses in girls over a 4-year period (Nolen-Hoeksema et al., 2008), as well as substance abuse (including alcohol, marijuana, and other illicit drugs) in boys and girls (Skitch & Abela, 2008). Depressive symptoms, however, were not accounted for in analyses for either of these studies. Finally, a cross-sectional study found that rumination subtypes, controlling for level of depression, were associated with problematic substance use in adolescence, with lower reflective rumination associated with higher frequency of use and higher brooding rumination associated with substance abuse (Willem, Bijttebier, Claes, & Raes, 2011). Consequently, the extant literature suggests that rumination in relation to substance abuse is an important area of investigation. However, the exact nature of the association between depressive symptoms, rumination, and substance use and disorders is unclear.

The current study had two objectives. The first objective was to examine ruminative brooding and ruminative reflection as mediators of the association between depressive symptoms and two outcomes: substance use and substance use disorders. Examining these two outcomes allows us to understand the extent to which rumination styles are associated with substance use, versus being linked more specifically to problematic use. Based on the literature, we hypothesized that depressive symptoms would predict rumination style, and that only ruminative brooding would be associated with alcohol and marijuana use disorders. Because the literature supports differential pathways leading from depressive symptoms to alcohol abuse and marijuana abuse (Kosterman et al., 2000), alcohol and marijuana abuse are examined separately as outcomes. Second, we examined whether gender moderated the models. We hypothesized that due to emotion socialization pressures (Crick & Zahn-Waxler, 2003), girls may be more likely to develop ruminative response styles, but we did not expect sex differences in mediation of rumination variables in the association between depressive symptoms and substance use.

Method

Participants

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 representative of the Seattle public middle school population. These schools are located in four distinct geographic and demographic 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 four consecutive years (2001–2004); details of the screening procedure have been described elsewhere (Vander Stoep, McCauley, Thompson, Kuo, & Herting, 2005). All study procedures were reviewed and approved by the University of Washington Human Subjects Review Board.

Students eligible for screening included sixth-graders who had a third-grade reading comprehension level or higher (for more details see Vander Stoep et al., 2005). A stratified random sample of 807 students was selected for longitudinal follow-up with students scoring high on depressive and/or conduct problem scores over-sampled according to a ratio of 1:1:1:2 from four psychopathology risk groups (comorbid depression and conduct problems: CM, depressive problems: DP, conduct problems: CP, neither conduct nor depressive problems: 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. Oversampling of children in psychopathology risk groups was carried out to increase the likelihood of observing depressive and conduct disorders over the course of the longitudinal study. Between 62–66% of youth randomly selected from each group consented to participate for a total of 521 participants. At baseline, participants in the DPP sample 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. Participating families spanned a wide range of income levels, with 26.7% of families having a total household annual income of under \$25,000, and 30.9% of families having a household income of over \$75,000. Mean socioeconomic status (Hollingshead, 1975) for the full sample was 39.13 ($SD = 14.13$).

In-home interviews were administered to participating students and parents/guardians (76% biological mothers, 15% biological fathers, 9% other relatives) by two trained research interviewers who were blind to the psychopathology risk group status. Baseline interviews were conducted within 3 months of screening (fall of 6th Grade), and in-person follow-up interviews were conducted in 6th, 7th, 8th, 9th and 12th grades. Of the participants originally enrolled in DPP, between 86% and 92% were retained in each of the first four follow-up interviews, including over 80% in each psychopathology risk. The participants included in this study did not differ significantly from those without follow-up data on any demographic or predictor variable (Cohen's d range = .00–.26). Rumination and alcohol data were obtained from interviews in Grades 8, 9 and 12; thus data analyses were restricted to those time points. Two-component weights were applied to each participant to account for the oversampling of youth with elevated psychopathology scores enrolled in the longitudinal study and to render the longitudinal study cohort representative by gender, race, ethnicity, and school program of students enrolled in participating schools.

Measures

Depressive symptoms—The Mood and Feelings Questionnaire (MFQ) is a self-report measure designed to assess depressive symptoms in epidemiological studies of children ages 8 to 18. The MFQ has 33 items rated on a 3-point scale (0 = *not true*, 2 = *true*) that comprise both the full range of DSM-IV diagnostic criteria for depressive disorders, as well as additional items reflecting common affective, cognitive, and vegetative features of childhood depression (e.g., “I felt miserable or unhappy”; Costello & Angold, 1988). Scores can range from 0–66. Previous validation studies have demonstrated high content and criterion validity and moderate to high discriminant validity (e.g., Daviss et al., 2006). The 8th and 9th grade MFQ scores were used in these analyses and Cronbach’s alpha coefficients for the MFQ in this sample were good, exceeding .85 at each timepoint.

Conduct Problems—At the 8th grade timepoint, parents completed the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). The CBCL is a well-validated parent-report measure with good psychometric properties (alphas range from .78–.97). Designed to assess children’s psychological symptomatology, the CBCL has 113-items rated on a 3-point scale (0 = *not true*, 2 = *very true*) and yields broad- and narrow-band symptomatology categories. For this study, thirty items characterizing undercontrol of emotions (e.g., “I physically attack people) comprising the entire externalizing problems scale were used.

Rumination—Rumination was assessed using the brooding and reflection subscales of the Ruminative Responses Scale (RRS; Nolen-Hoeksema & Marrow; 1991; Treynor et al., 2003), using the 10 items that have been deemed to be unconfounded with depression content (Treynor et al., 2003). The brooding subscale includes 5 items assessing moody pondering such as thinking “Why can’t I handle things better?” The reflection subscale includes 5 items assessing neutral pondering, such as “Go away by yourself and think about why you feel this way.” Participants rated each item according to how much they engaged in the ruminative response when feeling sad, down, or low on a scale from 1 = *never* to 4 = *always*. Cronbach’s alphas for both scales were good (ruminative brooding = .75 and ruminative reflection = .72). Previous studies have established the psychometric properties of these scales, including high internal consistency, good test-retest reliability, and differential predictive associations with depression, with brooding but not reflection associated with depressive symptoms over time (Treynor et al., 2003). The RRS was administered at the 8th and 9th grade assessments.

Substance Use and Substance Use Disorder—Engagement of substance use over the past 6 months was assessed by one item (“*During the past 6 months, did you use alcohol (beer, wine, hard liquor) or marijuana or both?*”) on the Rutgers Alcohol Problem Inventory (RAPI; White & Labouvie, 1989). The computerized Diagnostic Interview Schedule for Children (DISC-IV) (Columbia University DISC Development Group, 1998) was administered to the child at the 12th grade assessment to determine the presence of alcohol abuse, alcohol dependence, marijuana abuse, and marijuana dependence, as specified in the DSM-IV (American Psychiatric Association, 1994) in the past 12 months. Interviewers were trained by one of the study’s Principal Investigators (EM), who was certified by the Columbia University DISC Development Group. The DISC has well-

established psychometrics, including good test-retest agreement ($\kappa=.66$) and concurrent validity ($\kappa=.70$; Schwab-Stone et al., 1996) Child DISC-IV interviews were conducted for 467 of the 521 longitudinal study participants. For each of these cases, available DISC diagnoses were examined, and dichotomized into a binary variable indicating whether any of the four substance use diagnoses were present, or all were absent.

Analytic Plan

The Mplus statistical package (Version 6.0; Muthén & Muthén, 2010) was used to estimate all models. Mplus uses the expectation-maximization algorithm (Allison, 2002) to obtain maximum likelihood estimates with robust standard errors (FIML) and weighted least squares estimation (WLSMV) for categorical data. These are accepted approaches to handling missing data when data are missing at random (Asparouhov & Muthén, 2010; Little & Rubin, 2002). Model fit was assessed using chi-square as an indicator of exact fit. Where exact fit was not achieved (as chi-square is sensitive to violations of normality and sample size; Hu & Bentler, 1999), we used relative fit indices, specifically the Tucker-Lewis Index (TLI), comparative fit index (CFI) and root-mean square error of approximation (RMSEA). Using these indices, we judged model fit with reference to standards provided by Hu and Bentler (1999), Kenny and McCoach (2003) and the cautions of Marsh, Hau, and Wen (2004).

To test the hypotheses for the current study, path analysis was used to examine whether 9th grade ruminative reflection and ruminative brooding mediated the association between 8th grade depressive symptoms and subsequent substance use, alcohol use disorders and marijuana use disorders in the 12th grade. Indirect effects were estimated in MPlus using the INDIRECT command, which uses Sobel (1982) standard errors. Significant indirect effects were also estimated with bootstrapped confidence intervals consistent with MacKinnon's (2002) recommendations. Analyses included sex and 8th grade externalizing symptoms as covariates in the model, and all covariances among exogenous variables were allowed to correlate.

Results

Preliminary Analyses

Data were collected for 455 participants at the 8th grade assessment, 424 at the 9th grade assessment, and 477 at the 12th grade assessment, with 372 participants providing data at all assessments. Final models included 428 participants. Attrition analyses verified that participants who were missing data at follow-up periods did not differ significantly on the variables examined, suggesting that the attrition did not introduce bias. Consequently, data were assumed to be missing at random and missing data were estimated by procedures described above for the path analyses. Regarding substance use diagnoses, there were 330 adolescents with no disorder and 137 who had a substance use disorder. Sixty-seven youth met criteria for alcohol abuse, 27 met criteria for alcohol dependence, 53 met criteria for marijuana abuse, and 47 met criteria for marijuana dependence. Fifty-five youth had more than one substance use disorder.

Descriptive statistics and intercorrelations for depressive symptoms, rumination components, and substance use measures for females and males are presented in Table 1. *T* tests indicated that adolescent females reported more depressive symptoms and greater rumination; whereas adolescent males more frequently met criteria for alcohol and marijuana use disorders. Differences based on gender were not observed with respect to conduct problems (Table 1).

Path Analysis

We used MPlus to obtain a maximum likelihood estimation of the path coefficients in the recursive path model. We began with the just identified model, allowing all regression paths to be estimated. We then tested a model where non-significant paths in the model were constrained to zero, to allow for an over-identified model, and tested whether this more parsimonious model still provided good fit to the data. The overall model provided an excellent fit to the data, with Chi-square square $\chi^2(4) = 5.36, p = .25$, CFI = .996, TLI = .97, RMSEA = .03. Finally, we tested for gender moderation by estimating a multi-group path model (allowing the thresholds of the outcomes to be free across groups), and testing whether constraining the main effects across gender produced a significantly worse fitting model than a fully freed model. The fully constrained model fit the data well, $\chi^2(14) = 17.84, p = .21$, CFI = .99, TLI = .97, RMSEA = .04, while freeing all paths across gender did not improve model fit, $\chi^2(12) = 16.22, p = .18$.

Substance Use—Depressive symptoms, ruminative reflection, ruminative brooding, sex, and conduct problems did not significantly predict substance use. Table 2 and Figure 1 present the unstandardized, standardized path coefficients, and standard errors for the model estimates.

Alcohol Use Disorders—Ruminative reflection and conduct problems had direct effects on 12th grade alcohol use diagnoses. Contrary to hypotheses, depressive symptoms in 8th grade did not have direct effects on subsequent alcohol use disorder; however, an indirect effect of depressive symptoms, through 9th grade ruminative reflection was detected. Specifically, the indirect effect of ruminative reflection was $-.007 (p = .05)$ with higher levels of depressive symptoms predicting increased ruminative reflection. Increased ruminative reflection, in turn, predicted absence of alcohol use diagnoses.

Marijuana Use Disorders—Ruminative reflection, ruminative brooding, and conduct problems had direct effects on 12th grade marijuana use diagnoses. Contrary to hypotheses, depressive symptoms in 8th grade did not have direct effects on subsequent marijuana use disorders; however, an indirect effect of depressive symptoms, through 9th grade ruminative brooding, was detected. Specifically, the indirect effect of ruminative reflection was $-.006 (p = .04)$ with higher levels of depressive symptoms predicting increased ruminative reflection. Increased ruminative reflection, in turn, predicted absence of marijuana use diagnoses. In addition, the indirect effect of ruminative brooding was $.01 (p = .05)$ with high levels of depressive symptoms predicting increased ruminative brooding processes. Increased ruminative brooding, in turn, predicted the presence of marijuana use diagnoses.

Discussion

The aim of this research was to test a more nuanced application of the theorized internalizing pathway to substance use, in which brooding and reflection rumination styles may mediate pathways between depressive symptoms and substance use outcomes. Three substance use outcomes, including the presence of any substance use, the presence of alcohol use disorders, and the presence of marijuana use disorders were examined in a community sample during mid to late adolescence. Substance use alone was not associated with rumination. Although no direct path between depressive symptoms and substance use disorders was detected, analyses supported indirect pathways for depressive symptoms affecting substance use disorders through distinctive rumination subtypes. Overall, the results suggest that different dimensions of rumination are associated prospectively with the development of substance use disorders.

The results of this study support the hypothesis that the tendency to brood in response to depressed mood serves as a vulnerability factor for marijuana use diagnoses in adolescents. This is consistent with Nolen-Hoeksema and colleagues' (2007) investigation where elevated ruminative brooding at initial evaluation was associated with increased substance abuse symptoms for adolescent girls one year later (Nolen-Hoeksema, et al., 2007). Similarly, Skitch and Abela (2008) reported that ruminative brooding predicted substance abuse following negative events in an 18-week follow-up period, particularly for older adolescents. In a study with adult men and women, ruminative brooding was associated cross-sectionally with drinking to cope with distress across gender (Nolen-Hoeksema & Harrell, 2002). Our study confirms these findings as well as extends prior research by demonstrating the indirect effects of depressive symptoms through ruminative brooding. Additionally, these prior studies examined rumination as a vulnerability factor for both depressive symptoms and substance use problems, but did not examine mediation or control for other symptomatology such as conduct problems, which are known to influence the development of substance use disorders. Taken together, these studies support the notion that depressive symptoms increase a tendency toward a negative, perseverative self-focused cognitive style in response to distress, which in turn influences problematic substance use. Finding that brooding mediates the association between depression and marijuana use is consistent with the literature linking experiential avoidance coping motives for marijuana use (e.g., Buckner et al., 2013). Consequently, the results partially support Hussong's "negative affect pathway of vulnerability" for marijuana use disorders; however, results support reflecting upon one's problems (ruminative reflection) as a protective factor in the development of subsequent alcohol use disorders. The specification of specific mechanisms influencing developmental pathways helps to clarify mixed findings between depression and substance use. Therefore, although depression appears to promote both types of rumination, these ruminative responses have differential associations with the development of substance use disorders.

Our findings also add to the growing body of literature that specific mechanisms associated with depressive symptoms that place youth at risk for substance use disorders are not necessarily associated with substance use, which may be more normative. Substance use is a common behavior during adolescence, particularly by the 12th grade (Armstrong and

Costello, 2002; CDC, 2011). Based on our data, depressive symptoms appear to be indirectly associated with substance use disorders prospectively via rumination. However, neither depression nor rumination predict the presence of substance use. These findings converge with a recent review of the literature we conducted that indicated the association between substance use disorders or problematic use, as opposed to substance use frequency, were more likely to be associated with later depression (C. McCarty, personal communication, February 18, 2014).

The current study also elaborates on extant literature by examining both self-reflective and brooding styles of rumination, as only one cross-sectional study examined the associations of rumination subtypes with respect to substance use in previous studies with adolescents (Williem et al., 2011). Previous investigation of the association between ruminative reflection and depressive symptoms has resulted in mixed findings of positive relations, negative relations, and no relations (Nolen-Hoeksema et al., 2008). In our study, increased depressive symptoms in 8th grade were associated with greater tendency for adolescents to endorse reflective, thoughtful style of processing the causes and consequences of distress in the 9th grade, which predicted reduced risk for substance use disorder in the 12th grade. Direct effects of ruminative reflection were negatively associated with substance use disorders, and depressive symptoms indirectly reduced risk for alcohol use diagnoses through their impact on ruminative reflection. The positive associations between depressive symptoms and subsequent ruminative reflection and ruminative brooding suggests experience of depressive symptoms fosters these coping styles, and these reciprocal processes of rumination and depressive symptoms continue to propel a vicious cycle (Nolen-Hoeksema, 2004; Nolen-Hoeksema et al., 2007). Moreover, the finding that ruminative reflection is associated with reduced risk for substance use disorder suggests that what is a “maladaptive” emotion regulation strategy for one problem (e.g., depressive symptoms) may be adaptive for another (i.e., substance use). Moreover, it is quite possible that youth who do more reflective processing are better able to evaluate the short and long-term consequences of substance use, and consequently are at reduced risk for problematic substance use. Consistent with a functional perspective of emotion regulation (Cole, Michel, & Teti, 2004), use of this strategy may be simultaneously associated with symptom maintenance in one domain and recovery in another. Clearly, understanding emotion dynamics and their association with the temporal course of psychopathology and substance use remains an important area for future investigation.

Finally, a core aim of this research was to examine gender differences in the associations between depressive symptoms, rumination, and substance use outcomes. Given that response style theory was developed to help understand the gender differences observed between males and females in the experience of depressive symptoms, clarifying if the associations between rumination and substance use vary by gender is an important area of inquiry. Gender differences were observed with girls reporting greater levels of depressive symptoms and both aspects of rumination, and boys reporting more substance use and substance use disorders. However, contrary to hypotheses, when accounting for these mean level differences, the associations we observed were similar for boys and girls.

Several limitations of the current study should be acknowledged when considering these results. First, depressive symptoms, rumination, and substance use/abuse were assessed using self-report measures. Although our measures possess good psychometric properties, the contribution of shared-method variance must be considered. With respect to the measurement of rumination, the RRS was employed and is worded to elicit emotion regulation responses to depressed mood. Consequently, the results cannot be generalized to ruminative responses to all negative emotions. Additionally, over the six years of the study, some youth were lost to follow-up despite rigorous efforts for retention. While we believe the use of full information maximum likelihood estimates was an appropriate strategy for our small amount of missing data, the assumptions of missing at random are difficult to fully evaluate. Despite the longitudinal and high methodological rigor of the study design, we did not manipulate rumination variables and therefore only correlational, not causal, interpretations are warranted. Furthermore, our sampling population, though roughly representative of those attending the Seattle Public Schools, may not represent youth from other geographic areas. Finally, it is important to note that the effect sizes of the model were in the small to medium range, and while this is common for social sciences (Rosenthal, 1984), it suggests that there are other factors important in the pathway to substance use disorders.

Despite these limitations, the current study contributes important findings to the literature and supports a pathway from depressive symptoms to marijuana use disorders that functions through ruminative brooding. Ruminative reflection, on the other hand, was found to decrease later substance abuse disorders. Importantly, we used measurements of rumination that removed items overlapping with measurement of depressive symptoms. The underlying processes by which depressive symptoms and rumination affected substance use disorders were similar for girls and boys. These findings highlight the importance of interventions that reduce youths' focus on despondent mood states as a way to impact substance use disorders during this developmental period. Instead, establishing strategies to increase self-awareness and cognitively process problems may mitigate the path from depressive symptoms to substance use disorders.

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Figure 1.

Standardized (and Unstandardized) Parameter Estimates Illustrating Reflection and Brooding as Mediators of the Association Between Depressive Symptoms and Substance Use.

Note. *indicates significance at $p < .05$; brooding and reflection were significantly correlated ($r = .48, p < .001$), as were sex, depressive symptoms and conduct problems ($r = .18$, sex and depressive symptoms, $r = -.12$ for sex and conduct problems, $r = .14$ for conduct problems and depressive symptoms).

Figure 2.

Standardized (and Unstandardized) Parameter Estimates Illustrating Reflection and Brooding as Mediators of the Association Between Depressive Symptoms and Alcohol Use Disorder.

Note. *indicates significance at $p < .05$; brooding and reflection were significantly correlated ($r = .48, p < .001$), as were sex, depressive symptoms and conduct problems ($r = .18$, sex and depressive symptoms, $r = -.12$ for sex and conduct problems, $r = .14$ for conduct problems and depressive symptoms).

Figure 3. Standardized (and Unstandardized) Parameter Estimates Illustrating Reflection and Brooding as Mediators of the Association Between Depressive Symptoms and Marijuana Use Disorder.

Note. *indicates significance at $p \leq .05$; brooding and reflection were significantly correlated ($r=.48, p < .001$), as were sex, depressive symptoms and conduct problems ($r=.18$, sex and depressive symptoms, $r=-.12$ for sex and conduct problems, $r=.14$ for conduct problems and depressive symptoms).

Table 1

Means, standard deviations, and correlation matrix by gender.

Variable	Depressive Symptoms	Conduct Problems	Reflection	Brooding	Alcohol Use Disorder	Marijuana Use Disorder	M(SD) or % for girls
N	448	448	404	404	468	468	
Depressive Symptoms	--	.30**	.19*	.30**	.23**	.20*	9.29 (7.63)
Externalizing Symptoms	.01	--	.04	.19**	.14	.18*	6.08 (6.71)
Reflection	.15*	-.07	--	.47**	-.08	.04	11.37 (3.34)
Brooding	.19*	-.07	.50**	--	.01	.28*	11.00 (3.09)
Alcohol Use Disorder	-.09	.17*	-.14	-.07	--	.42**	16.14%
Marijuana Use Disorder	-.06	.08	.09	.01	.46**	--	15.25%
M (SD) or % for boys	6.60 (6.09)	7.08 (7.61)	9.5 (3.20)	9.65 (2.86)	23.27%	26.12%	--
t-test/ χ^2 differences by gender	$t(446) = -4.14^{**}$	$t(446) = .69$	$t(402) = -5.77^{**}$	$t(402) = -4.56^{**}$	$\chi^2(1) = 3.72^*$	$\chi^2(1) = 8.34^{**}$	

Note. Correlations for girls are given above the diagonal, and for boys are given below the diagonal.

* $p < .05$,

** $p < .01$.

Table 2

Parameter Estimates for Rumination Variables as a Mediator of the Association between Depressive Symptoms and Substance Use and Substance Use Outcomes.

Parameter	Substance use (N=428)			Alcohol Use Disorder (N=428)			Marijuana Use Disorder (N=428)		
	Standardized	Unstandardized	SE	Standardized	Unstandardized	SE	Standardized	Unstandardized	SE
Direct effects									
Depressive symptoms	-.00	.00	.01	.08	.01	.01	.06	.01	.01
Reflection	.04	.01	.03	-.21	-.06*	.03	-.18	-.05*	.03
Brooding	.13	.04	.03	.08	.03	.03	.32	.11*	.03
Conduct problems	.02	.00	.01	.20	.03*	.01	.14	.02*	.01
Sex	-.11	-.21	.18	-.11	-.24	.18	-.13	-.27	.18
Indirect effects									
Depressive symptoms → reflection	.01	.00	.00	-.04	-.007*	.00	-.04	-.006*	.00
Depressive symptoms → brooding	.03	.01	.00	.02	.003	.00	.08	.01*	.00
Total indirect effects	.04	.01	.00		.004	.00		.007	.01

Note.

* $p < .05$;

Abbreviations: SE=standard error.