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Impact of ODD Dimensions on the Temporal Ordering of Conduct Problems and Depression across Childhood and Adolescence in Girls

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Abstract

Background—Little is known about the role of ODD dimensions on the temporal unfolding of CD and depression in girls between childhood and adolescence.

Method—The year-to-year associations between CD and depressive symptomatology were examined using nine waves of annually collected data (ages 8 through 16 years) from 1215 participants of the Pittsburgh Girls Study. A series of autoregressive path models were tested that included ODD-Emotion Dysregulation (ODD-ED) and ODD-Defiance, as time varying covariates on CD predicting depression severity in the following year, and vice versa.

Results—Conduct problems, depression, and ODD dimensions were relatively stable throughout childhood and adolescence, and a moderate degree of covariance was observed between these variables. Path analyses showed that CD often preceded depression across this developmental period, although the effect sizes were small. There was less consistent prediction from depression to CD. The overlap between ODD-ED and CD partially explained the prospective relations from CD to depression, whereas these paths were fully explained by the overlap between ODD-ED and depression. The overlap between ODD-Defiance and CD did not account for the prospective relations from CD to depression. In contrast, the overlap between ODD-Defiance and depression accounted for virtually all paths from CD to depression. Accounting for the overlap between ODD dimensions and *both* CD and depression eliminated all significant predictive paths.

Conclusions—Symptoms of CD tend to precede depression in girls during childhood and adolescence. However, covariance between depression and both ODD-ED and ODD-Defiance accounts for these prospective relations. ODD dimensions should be assessed when evaluating risk for comorbid depression in girls with conduct problems, and emotion dysregulation and defiance aspects of ODD should be identified as targets for treatment in order to prevent depression in the future.

Keywords

Conduct Disorder; Depression; Oppositional Defiant Disorder; Comorbidity; Girls; Longitudinal

Research has shown that conduct problems frequently co-occur with depressive disorders at greater than chance levels (Wolff & Ollendick, 2006), and that the prognosis for adolescents with these comorbid conditions is typically poor (e.g. Ezpeleta, Domènech & Angold, 2006; Marmorstein & Iacono, 2001). Despite much research documenting the co-occurrence of conduct problems and depression and their shared genetic and environmental risks (e.g. Lilienfeld, 2003; Patterson & Capaldi, 1990; Subbarao et al., 2008), the developmental unfolding of these problems is not well understood. In clinic-referred samples, conduct problems have been shown to both predate (e.g. Biederman, Faraone, Mick & Lelon, 1995) and to covary with depressive symptomatology (e.g. Lahey, Loeber, Burke, Rathouz & McBurnett, 2002). In community and epidemiological samples, conduct problems have also been shown to precede depression (Moffitt, Caspi, Rutter & Silva, 2001), but there is also evidence for reciprocal and circular patterns of association with depression (Capaldi, 1992; Wiesner, 2003). These mixed findings are likely due to differences across studies in the base rates of disorder (i.e. clinic vs. community samples), the gender composition of the sample, the developmental period examined, and the ways in which the constructs are measured and defined.

Most research thus far has focused on male samples. It is possible that the temporal relationship between conduct problems and depression varies in gender-specific ways. First, there is evidence that the symptom and risk profiles of conduct problems differs for girls and boys, even in community samples (Côté, Tremblay, Nagin, Zoccolillo & Vitaro, 2002; Maughan, Pickles, Rowe, Costello & Angold, 2000) which are not confounded by gender-specific referral biases. Girls, for example, tend to show less physically aggressive behavior, but higher rates of status violations and authority conflict compared with boys (Maughan et al., 2000). Although it remains unclear whether the age of onset of conduct problems differs by gender (e.g. Moffitt & Caspi, 2001; Keenan, Wroblewski, Hipwell, Loeber, Stouthamer-Loeber, 2010), girls appear to show less developmental continuity than boys (Tremblay et al., 1992). Finally, and particularly pertinent for the current study, is evidence that non-referred girls with conduct problems are at higher risk than their male counterparts for developing a range of comorbid conditions (Moffitt et al., 2001). The prevalence and course of depression is also known to vary by gender. For example, first episodes of depression have been shown to be more severe and longer in duration for girls than for boys, and beginning in adolescence, girls show a disproportionate increase in symptoms and rate of disorder relative to boys (Keenan & Hipwell, 2005). These gender differences in the nature and course of both conduct problems and depression, highlight the need for a within-female approach to understanding the temporal unfolding of these disorders in girls.

Although a variety of models have been proposed to explain gender differences in the presentation and course of these disorders (e.g. Silverthorn & Frick, 1999; Alloy & Abramson, 2007; Garber & Flynn, 2001), there have been few female-specific hypotheses about the nature of the temporal ordering of conduct problems and depression. Gender Socialization and Gender Intensification theories are, however, informative. Socialization theories posit that girls tend to be socialized in ways that actively discourage them from behaving against societal norms (Chesney-Lind & Sheldon, 1992; Maccoby, 1986; Zahn-Waxler, 1993), and increase the likelihood that feelings of guilt will be elicited following a misdemeanor (e.g. Bettencourt & Miller, 1996). Gender Intensification theory (Hill & Lynch, 1983) posits that these socialization pressures to behave in gender-appropriate ways accelerate in adolescence, especially for girls. The societal pressure and social sanctions that result against even minor conduct problems may heighten girls' risk for subsequent depression (Keenan & Shaw, 1997). It has also been proposed that, for females, depression may have a protective function by reducing the persistence of conduct problems over time (Zahn-Waxler, Klimes-Dougan & Slarrety, 2000). Thus, one might expect that experienced social sanctions and increasing levels of depressive symptoms would lead to a reduction in

behavior problems. Wiesner (2003) provided some support for this female-specific pattern of circularity across four assessment waves in a community sample of adolescents. The results showed that high levels of delinquent activity led to higher levels of depressed mood 6 months later, which then predicted less delinquency in the following 6 month period.

Longitudinal multi-wave community studies examining the development of female conduct disorder (CD) symptomatology, as opposed to delinquency or antisocial behavior, and depression across childhood and adolescence are rare, and it remains unclear whether the comorbidity of these disorders changes with age. Data from the Dunedin Longitudinal Study, for example, indicate that among adolescent girls, depression typically emerges after the onset of CD (Moffitt et al., 2001). However, the correlations between continuous symptom scores of depression and CD appeared relatively constant from ages 11 to 21, and that by age 11, girls with a history of conduct problems already showed higher rates of depressive symptoms than girls without such a history. These results suggest that the examination of prospective relations between CD and depression needs to begin prior to the adolescent period before comorbid conditions become established.

Mixed findings are also likely due to different ways in which conduct problems are operationalized. In particular, symptoms of CD and Oppositional Defiant Disorder (ODD) have often been combined, obscuring potentially important developmental and phenotypic distinctions. For example, among boys, ODD typically precedes CD (Loeber, Burke, Lahey, Winters & Zera, 2000). For girls however, the evidence is equivocal and may depend on whether dimensional or categorical methods are used. Results from the Great Smoky Mountains Study (GSMS) for example have shown that ODD diagnosis did not predict subsequent CD diagnosis in girls, unlike for boys (Rowe, Costello, Angold, Copeland & Maughan, 2010). In contrast, symptom counts of ODD did predict later CD symptom counts, over and above the effect of concurrent CD symptoms. Gorman-Smith and Loeber (2005) also reported some support for the role of ODD symptoms as stepping-stones to CD among adolescent girls.

Making the distinction between CD and ODD is also critical for examining the temporal relations between CD and depression given that data from large community-based and epidemiological samples show significant relationships between ODD and depression, although again, the results are somewhat mixed for girls. ODD and depression were significantly comorbid among girls in the GSMS (Costello, Mustillo, Erkanli, Keeler & Angold, 2003), and ODD was also significantly predictive of later depression in both adolescence (Rowe, Maughan, Pickles, Costello & Angold, 2002), and adulthood (Copeland Shanahan, Costello, & Angold, 2009) among girls. In contrast, ODD was not found to be contemporaneously associated with depression among girls in a large national sample of British children between 5 and 15 years of age (Maughan, Rowe, Messer, Goodman & Meltzer, 2004).

Some evidence suggests that ODD is more closely associated with depression than is CD (Burke, Loeber, Lahey & Rathouz, 2005; Rowe, Maughan & Eley, 2006). This relationship may be best understood by consideration of ODD at the symptom-level. ODD symptoms have been shown to tap at least two related but distinct dimensions: emotion dysregulation and defiance (Keenan & Shaw, 2003). In turn, dysregulated or negative emotionality has long been proposed as one explanation for the co-occurrence of CD and depression (e.g. Goodyer, Cooper, Vize, & Ashby 1993; Lilienfeld, 2003; Oland & Shaw, 2005). The empirical differentiation of dimensions among ODD symptoms and their association with subsequent CD and depressive disorders have only recently been examined. In our own work with a longitudinal community study of girls, Burke, Hipwell & Loeber (2010) conducted factor analyses in each of the first five assessment waves showing that 'loses

temper, argues and defies' loaded consistently onto a behaviorally oriented factor, while 'being touchy, angry and spiteful' loaded onto a separate affectively oriented factor. These factors were then tested as predictors of depression symptoms over one year intervals, using transitional marginal models, controlling for the contemporaneous level of depression symptoms. The results revealed that the affectively oriented factor predicted increasing depression symptoms. Results from other studies generate slightly different results with regard to which items fall on which dimensions (e.g., Rowe et al., 2010; Stringaris & Goodman 2009). In general, however, affective and behavioral dimensions can be meaningfully extracted from ODD symptoms and typically demonstrate differential patterns of association with CD and MDD. Thus, any study of the temporal unfolding of disruptive behavior and depressive disorders that include ODD, would benefit from differentiating the affective from behavioral symptoms

The goal of the current study is to examine the temporal ordering of conduct problems and depressive symptomatology across 9 years spanning childhood and adolescence in a community sample of girls. In addition, we test hypotheses about the impact that ODD dimensions of emotion dysregulation and defiance will have on this unfolding relationship over time. Based on prior research, we hypothesized that symptoms of CD would predict symptoms of depression, but there would be evidence of bidirectionality in this relationship during adolescence. We further hypothesized that these bidirectional pathways would be attenuated after accounting for shared variance with the emotion dysregulation dimension of ODD. In contrast, we expected that the defiance dimension of ODD would have little impact on the developing association between conduct problems and depression across time.

Method

Sample

The current analyses are based on data from the prospective Pittsburgh Girls Study (PGS), a longitudinal study of the development of CD and depression in young girls. The PGS comprises 2,451 girls recruited at ages 5-8 years following the enumeration of 103,238 city households in 1999. In the enumeration process, all households in the poorest third of city neighborhoods, and 50% of the households in the remaining neighborhoods were sampled (see Hipwell et al., 2002; Keenan et al., 2010 for further details). Nine waves of data from the two oldest PGS cohorts (N=1232 in wave 1) were aligned by age to span the developmental period from 8 to 16 years (i.e., assessment waves 1-9 for age cohort 8, and waves 2-10 for age cohort 7). At age 16, 529/622 (85%) of cohort 8 and 524/610 (85.9%) of cohort 7 were retained in the sample. Attrition analyses revealed that, compared to girls who remained in the study at age 16, girls lost to follow-up were less depressed at age 8 ($F[1,1215]=4.07, p=.05$), and were more likely to be European American (16.4%) than of minority race (11.9%, $\chi^2=5.14, df=1, p<.05$). There were no differences on any of the other study variables.

The mean age of the girls in the first wave was 8.2 years ($SD=.66$), increasing in one year increments until age 16.3 years ($SD=.68$). By caregiver report, 42% girls were identified as European American, 52.4% as African American, 5% as African American and another race and .6% as Asian American. For the current analyses, a variable was created to contrast minority racial status from European American. At age 8, 419 girls (34.4%) were living in a family which received public assistance (e.g. food stamps, Medicaid), 49.4% of parents had received 12 or fewer years of education, and 42.8% lived in a single parent household.

Measures

Symptoms of CD, depression and ODD were assessed using caregiver reports on the Child Symptom Inventory (CSI-4, Gadow & Sprafkin, 1994) transitioning into the Adolescent Symptom Inventory (ASI-4, Gadow & Sprafkin, 1997) from age 13 onwards.

Thirteen DSM-IV symptoms of CD were scored on 4-point scales ranging from 0 (*never*) to 3 (*very often*). The symptoms, 'running away' and 'truancy', were not administered in the PGS until assessment wave 4 and so were excluded from the current analyses to ensure measurement continuity. In the current analyses continuous severity scores were used as they provided greatest variability. The CD subscale of the CSI/ASI has shown good concurrent validity, and good sensitivity and specificity in distinguishing youth with clinical diagnoses from healthy controls (Gadow & Sprafkin, 1994; 1997). The internal consistency coefficients for CD scores in the current sample ranged from .69 (in wave 6) to .80 (in wave 10).

DSM-IV symptoms of depression were also assessed by parent report using seven items rated on the same 4-point scales, as well as four items referring to changes in appetite, sleep, activity, and concentration, scored as either 0.5 (*no*) or 2.5 (*yes*). As previously, severity scores (i.e. the sum of 11 items) were used. The depression subscale has good psychometric properties (Gadow & Sprafkin, 1994; 1997), and was also reliable in the current sample with α ranging from .68 (wave 1) to .85 (wave 10).

The eight DSM-IV symptoms of ODD were also assessed using parent report on the CSI/ASI. As for the CD and depression subscales, the ODD subscale has good psychometric properties. Prior exploratory factor analysis of ODD symptoms in our sample (Burke et al., 2010) revealed dimensions of 1) emotion dysregulation (being angry, touchy and spiteful); 2) defiance (losing temper, arguing and defying); and 3) antagonistic behavior (annoying and blaming others). In the current analyses, we created severity scores of the two dimensions of interest: emotion dysregulation (ODD-ED) and defiance (ODD-Defiance). Reliability of the subscales was consistently good across assessment waves: Cronbach's α for ODD-ED ranged from .74 (in wave 2) to .82 (in wave 9), and α for ODD-Defiance ranged from .70 (in wave 1) to .83 (in waves 9 and 10).

Procedure

Approval for all study procedures was obtained from the University of Pittsburgh Institutional Review Board. Written informed consent from the caregiver and verbal assent from the child were obtained prior to data collection. Interviews were conducted in the home by trained interviewers using a laptop computer. All the participants were financially reimbursed for their help with the study.

Analysis plan

First, several path models were used to examine the cross-lagged associations between CD and depression between ages 8-16, while controlling for the stability of each construct and for correlations within and across each time point. Scaled difference chi-square tests were used to compare the nested models (Satorra & Bentler, 2001). Second, ODD-ED and ODD-Defiance were included as time-varying covariates in this cross-lagged model to examine whether the relationships between CD and depression severity were changed by their inclusion. In each set of path analyses, the cross-lagged associations were estimated (e.g., age 8 CD with age 9 depression, and age 8 depression with age 9 CD), while simultaneously accounting for the autoregressive relations between temporally later symptoms on earlier ones within each repeated measure (e.g., depression at age 10 was regressed upon depression at age 9). In all path models, we also correlated a) the residuals of CD and

depression scores measured at the same time-points in order to account for shared method variance, and b) the residuals of all non-adjacent time-points of the same construct. Paths from CD to depression were estimated at each assessment wave, and vice versa. Analyses were conducted using Mplus version 6.1 (Muthén & Muthén, 2008).

To allow for the non-normal distributions of CD and depression scores, all models were specified using maximum likelihood estimation with robust standard errors. We evaluated the absolute fit of the models using global fit indices following standard convention (McDonald & Ho, 2002). Thus we regarded RMSEA values $<.05$ as indicative of a 'good' fit (and $.05$ – $.08$ as 'acceptable'). For the CFI and TLI, cutoff values $\geq .95$ were interpreted as indicating a 'good' model fit ($\geq .9$ as 'acceptable').

In handling the missing data, Mplus provides full information maximum likelihood estimation under the assumption of missing at random (Muthén & Muthén, 2008). In addition, we examined whether there were any systematic missing data patterns across the 9 assessment waves. Nine waves of data were obtained for 79.6% of the sample. Of the girls with data missing at any time, 6.7% had missing data in one wave, 3.3% in two waves, 1.9% in three waves, and less than 2% in 4 through 9 waves. We compared girls with none versus any missing data on SES (minority race, household poverty, single parent and low parental education), CD, depression, and ODD severity. There were no differences between the groups in terms of any of the SES variables, depression or ODD scores. At ages 11, 12 and 14 however, girls with some missing data had higher scores on CD severity than girls with complete data ($F[1,1145]=5.97$, $p<.05$ at age 11, $F[1,1139]=4.61$, $p<.05$ at age 12 and $F[1,1097]=7.05$, $p<.01$ at age 14).

Results

Descriptive statistics are shown in Table 1, and bivariate correlations between CD and depression severity across all data points in Table 2. ANOVA revealed that at age 8, girls living in household poverty had higher CD and depression scores than non-poverty girls ($F[1,1215]=40.41$, $p<.001$, and $F[1,1215]=13.33$, $p<.001$ respectively). In addition, higher levels of both CD and depression were reported for girls of minority race compared with European American girls ($F[1,1213]=18.98$, $p<.001$, and $F[1,1213]=7.33$, $p<.01$ respectively). As a result, household poverty and race were entered as time-invariant covariates and regressed on CD at age 8, depression at age 8, and dimensions of ODD at age 8 (when applicable) in all subsequent analyses. Cohort was also included as a time-invariant covariate to account for any possible cohort effects.

Auto-regressive and cross-lagged models

In the first step examining the autoregressive relations within each repeated measure, the model fit was good (see Table 3). The CD and the depression paths were moderately stable between ages 8–16 years. Stability coefficients (β s) ranged from $.38$ to $.60$ ($ps <.001$) for CD, and from $.39$ to $.52$ ($ps <.001$) for depression severity. At age 8, there were higher levels of CD among girls living in poverty ($\beta=.08$, $p<.01$), but no effect of race or cohort was revealed. Depression severity at age 8 was unrelated to the covariates.

The model fit improved when the lagged paths from depression to CD, and from CD to depression were added to the autoregressive model (Table 3). Further model improvement was achieved by the cross-lagged model relative to both the model with only the lagged paths from depression to CD ($\Delta\chi^2(8)=91.27$, $p<.001$) and the model with only the lagged paths from CD to depression ($\Delta\chi^2(8)=23.96$, $p<.001$). Examination of individual paths in the cross-lagged model revealed the same pattern as found in the prior separate lagged path models: there were two significant paths from depression to CD, whereas six of the eight

tested paths from CD to depression were significant (Figure 1). Statistically significant effect sizes ranged from .06 to .14. Specifically, depression severity at ages 11 and 13 predicted CD severity at ages 12 ($\beta=.06, p<.05$) and 14 ($\beta=.07, p<.05$) respectively. In addition, CD at ages 8, 9, 10, 13, 14 and 15 predicted depression at ages 9 ($\beta=.10, p<.02$), 10 ($\beta=.07, p<.05$), 11 ($\beta=.14, p<.001$), 14 ($\beta=.07, p<.02$), 15 ($\beta=.12, p<.001$) and age 16 ($\beta=.13, p<.01$) respectively. CD severity at ages 11 and 12 did not predict depression severity in the subsequent year.

Cross-lagged models with ODD dimensions covaried on CD and depression severity

The models were then examined with the addition of ODD-ED and ODD-Defiance as time-varying covariates, first of CD, then of depression, and then of both CD and depression. Model fit was acceptable-to-good in every case.

Emotion dysregulation

First, the cross-lagged associations between CD and depression were estimated after accounting for the effects of concurrent ODD-ED on CD. The ODD-ED dimension was significantly associated with CD at all ages between 8 and 16 years ($\beta s=.33-.54, ps<.001$). After accounting for the overlap between ODD-ED and CD, none of the paths from depression to CD remained, and only three paths from CD to depression, at ages 10, 14 and 15 to depression at 11 ($\beta=.13, p<.001$), 15 ($\beta=.10, p<.01$) and 16 ($\beta=.09, p<.05$), remained significant (Figure 2A). When ODD-ED was covaried on depression, ODD-ED was also associated with depression at all ages ($\beta s=.25-.41, p<.001$). In this model, one path from depression at 11 to CD at 12 remained significant ($\beta=.06, p<.05$), but all paths from CD to depression disappeared. Finally, when concurrent ODD-ED was covaried on *both* CD and depressive symptomatology, none of the paths from CD to depression, or from depression to CD, remained significant.

Defiance

As with ODD-ED, ODD-Defiance was moderately associated with both CD ($\beta s=.30-.51, ps<.001$) and depression ($\beta s=.20-.34, ps<.001$) at all ages. When ODD-Defiance was covaried on CD however, the paths from CD to depression remained virtually unchanged from the full cross-lagged model without time-varying covariates (Figure 2B). As previously, the paths from depression to CD became non-significant. When ODD-Defiance was covaried on depression, only a marginal path from CD at age 10 to depression at age 11 remained in the model ($\beta=.08, p=.048$). Again as previously, none of the paths from depression to CD remained significant. When ODD-Defiance was covaried on *both* CD and depression simultaneously, only one path between CD at age 10 and depression at age 11 was significant ($\beta=.10, p<.01$).

Discussion

The current study adds to knowledge of the temporal relationships between CD and depression severity, and the role played by affective and behavioral dimensions of ODD, in an urban community sample of girls followed from 8 to 16 years. The model-building analytic approach revealed that the bidirectional, cross-lagged paths between CD and depression fit the data better than models specifying only unidirectional relationships. Without accounting for shared variance with ODD dimensions, the pattern of results showed asymmetry in these bidirectional relationships across this developmental period: paths from CD to depression one year later were more consistent than the paths in the reverse direction. This pattern of asymmetric bidirectionality is consistent with prior research on clinic-referred adolescent boys (e.g. Lahey et al., 2002). There was no evidence in the current

study for circularity, such that that depressed mood reduced the persistence of conduct problems over time, as all the parameter estimates were in the positive direction.

In contrast to our first hypothesis, the results did not support the notion that a pattern of co-dependence between CD and depression begins to emerge during adolescence. Instead, the results showed that CD predicted depression severity in late childhood and again in adolescence, whereas depression showed some prediction to CD in early adolescence. Although the detected effects were generally small, the results do suggest that a developmental transition such as moving from middle- to high-school, or sociobiological factors associated with pubertal maturation for example, could have presented behavior disordered girls with new social and academic opportunities that resulted in some discontinuity in the CD to depression paths at this time. However, the results are consistent with a previous finding of discontinuity in prediction from externalizing to internalizing symptoms (depression and anxiety) in the same developmental period using the full PGS sample even after controlling for pubertal status and family life stress (Obradović & Hipwell, 2010). This pattern of results may also reflect different developmental trajectories within the sample, with one subgroup characterized by early onset conduct problems which 'mature out', and another subgroup characterized by increasing symptoms of CD beginning in early adolescence (an 'adolescent-onset' group c.f. Silverthorn & Frick, 1999). This notion is partially supported by the decreasing mean CD scores between ages 11 and 13 when there may also be reduced statistical power to detect an influence on depressed mood.

Our hypothesis that ODD-Emotion Dysregulation would attenuate the temporal link between CD and depression was supported. Our hypothesis that there would be no attenuation when overlap with ODD-Defiance was accounted for however, was not supported by the results. For both dimensions, differentiated results were obtained depending on whether they were covaried on CD or depression. Thus the results showed that when the overlap between ODD-ED and CD was statistically controlled, some, but not all, of the paths from CD to depression were explained. To some extent, the results also suggested a developmental effect whereby ODD-ED accounted for CD to depression paths in childhood, but not in adolescence. In contrast, when the overlap between ODD-ED and depression was controlled, all CD to depression paths were accounted for, indicating that this relationship was entirely accounted for by commonality between depression and ODD-ED. A slightly different pattern was revealed when covarying ODD-Defiance on CD. In this case, there was a negligible effect of ODD-Defiance on the CD to depression paths indicating that the overlap between ODD-Defiance and CD does not account for the prediction from CD to depression. However, accounting for the overlap between ODD-Defiance and depression again explained virtually all the CD to depression paths. This pattern of results demonstrates consistently that CD predicts the aspects of depression that overlap with ODD – both emotion dysregulation *and* defiance.

The results from the current have implications for the changes to ODD criteria proposed by the DSM-V Workgroup, namely the incorporation of distinct dimensions among the symptoms. Although the current results are consistent with the notion that affective symptoms of ODD predict mood disorders, the item assignment and the dimensional structure derived by factor analysis differs from the results and/or methods used in other studies (Rowe et al., 2010; Stringaris & Goodman, 2009). The current DSM-V proposition is for three ODD categories: 1) 'Angry/Irritable Mood' (consisting of the symptoms loses temper, is touchy, and is angry and resentful); 2) 'Defiant/Headstrong Behavior' (consisting of argues, actively defies, deliberately annoys, blames others); and 3) 'Vindictiveness' (consisting of the single symptom of spiteful or vindictive) based on the findings of Stringaris & Goodman (2009) with dimensions derived on *a priori* theoretical grounds. However, it seems evident that further investigation of whether separate dimensions

pertaining to vindictiveness, or to antagonism, are warranted, and whether there are relevant distinctions to be made between temper tantrums or temper outbursts versus losing one's temper, before valid and specific indicators of an affective ODD dimension can be determined.

Taken together the findings indicate that for the current sample of urban-living girls, apparent comorbid relationships between CD and depression are in fact spurious, as they are fully accounted for by emotion dysregulation and defiance dimensions of ODD. These dimensions covary primarily with depression, but also show some overlap with CD. Clearly further research is needed to replicate these findings, especially given ongoing discussion about item assignment and structure of the ODD dimensions. The current results also highlight the need for caution in interpreting moderately sized bivariate correlations between CD and depression as indicative of comorbidity. As shown in the current study, once construct stability and measurement error are modeled across multiple data waves, the strength of these relationships is likely to be small.

Limitations

The current findings should be considered in the light of certain limitations. First, we used only parental reports of girls' CD, depression and ODD symptoms. We recognize that caregiver reports are probably more optimal in childhood than adolescence, and that depressed mood may be best assessed using self-report, although this may not be the case for CD or ODD. We elected to use parent report throughout in order to avoid the possibility that 'informant' would be a significant confound in explaining differential stability coefficients and directional effects across time. In addition, all the constructs of interest could be assessed with this informant; symptoms of ODD were not assessed using child report in the current study. Second, the base rates of clinically significant CD and depression in our community sample are low (e.g. 3.8% of the sample met DSM-IV criteria for CD, and less than 1% met criteria for major depressive disorder at age 8). In addition, girls with some missing data had higher CD severity scores at ages 11, 12 and 14 years compared with girls with complete data. The low prevalence of disorder in the current study prevented examination of the temporal relations between CD and depression for a subgroup of more impaired girls who met diagnostic thresholds. Work by Rowe et al (2010) however, suggests that for girls, a dimensional approach may detect temporal relationships that are not evident using categorical methods. Nevertheless, it remains to be seen whether the results found here will be replicated in clinic-referred samples with more severe levels of psychopathology. Third, the current analyses used a variable-centered approach to test hypotheses about the temporal relationships between CD and depression in the sample as a whole. It is recognized however, that there will be heterogeneity among girls showing different patterns of associations between the symptoms over time. Elucidating these subgroups of girls within a person-centered approach will be an important next step in future work. Fourth, it was beyond the scope of the study to examine the additional contribution of other disorders such as anxiety, attention-deficit/hyperactivity disorder, or substance use. However, it is known that among females in particular, depression interacts significantly with substance use disorders and conduct problems to increase risk for suicidal behaviors (Wannan & Fombonne, 1998). Examination of the effects of these additional disorders is clearly warranted.

Despite these limitations, the current study adds to a growing body of work examining the developmental course of conduct problems in girls from childhood into adolescence. Our findings suggest that there may be critical opportunities for prevention of depression by intervening to reduce the severity of girls' conduct problems in late childhood and in early adolescence. However, our results also showed that dimensions of ODD, reflecting emotion dysregulation and defiance, largely accounted for the predictive relationships from CD to

depression severity and vice versa. Clearly there is a need for systematic screening of ODD symptoms among vulnerable youth from a young age. Furthermore, by targeting ODD symptoms in treatments for girls with CD, the risks for subsequent depressive disorders may be significantly reduced.

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Abbreviations

ODD	Oppositional Defiant Disorder
CD	Conduct Disorder
GSMS	Great Smoky Mountains Study
PGS	Pittsburgh Girls Study
CSI	Child Symptom Inventory
ASI	Adolescent Symptom Inventory

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- Among girls, CD predicts depressive symptomatology more consistently than the reverse across childhood and adolescence. The size of these effects however is small.
- Defiance and emotion dysregulation dimensions of ODD are linked to both CD and depressive symptoms.
- The links between ODD dimensions and depressive symptoms better explain why CD precedes depression, than links between ODD dimensions and CD symptoms.
- Early intervention to reduce ODD emotion dysregulation and defiance among girls with conduct problems may also protect them from later depression.

Note. CD = Conduct disorder symptom severity; DEP = Depression severity. For ease of presentation, within (e.g., CD8 and DEP8) and across (e.g., CD8 with CD10 through CD16) time-point correlations were omitted from figure. Additionally, CD8 and DEP8 were regressed on cohort, public assistance at age 8, and minority racial status. See text for these parameter estimates and for stability coefficients for CD and DEP. Gray, dashed lines indicate non-significant paths. * $p < .05$; ** $p < .01$; *** $p < .001$.

Figure 1.

Full cross-lagged model including paths from CD to depression severity and from depression severity to CD from age 8 through 16 years

Note. CD = Conduct disorder symptom severity; DEP = Depression severity, ODD-ED = Emotion Dysregulation, ODD-Def = Defiance. For ease of

presentation, within (e.g., CD8 and DEP8; CD8 and ODD-ED8) and across (e.g., CD8 with CD10 through CD16) time-point correlations were omitted

from figure. Additionally, CD8, DEP8, ODD-ED8 and ODD-Def8 were regressed on cohort, public assistance at age 8, and minority racial status. See

text for these parameter estimates and for coefficients for paths from ODD-ED to CD and for ODD-Def to CD. Gray, dashed lines indicate non-

significant paths. * $p < .05$; ** $p < .01$; *** $p < .001$.

Figure 2.

Full, cross-lagged model with ODD-Emotion dysregulation (A) and ODD-Defiance (B) as time-varying covariates of CD

Table 1

Mean severity (SD) of conduct problems, depression and ODD dimensions between ages 8 and 16 years.

	Age								
	8	9	10	11	12	13	14	15	16
CD severity	1.24 (1.93)	1.21 (1.88)	1.07 (1.92)	1.06 (1.86)	0.97 (1.69)	1.03 (1.87)	1.17 (2.01)	1.34 (2.42)	1.32 (2.48)
Dep severity	4.39 (2.76)	4.42 (2.84)	4.64 (2.95)	4.91 (3.24)	5.02 (3.49)	4.86 (3.33)	5.14 (3.66)	5.31 (3.88)	5.19 (3.95)
ODD-ED	1.80 (1.39)	1.68 (1.49)	1.74 (1.55)	1.78 (1.61)	1.84 (1.62)	1.75 (1.56)	1.78 (1.61)	1.88 (1.71)	1.77 (1.64)
ODD-Defiance	2.18 (1.54)	2.08 (1.63)	2.06 (1.70)	2.09 (1.74)	2.15 (1.78)	2.20 (1.75)	2.25 (1.79)	2.39 (1.88)	2.26 (1.83)

Note. CD=conduct disorder, Dep=depression, ODD-ED=emotion dysregulation dimension of ODD, ODD-Defiance=defiance dimension of ODD.

Table 2

Bivariate correlations between conduct problems and depression severity between 8 and 16 years.

<i>Study variables</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. CD age 8	---																
2. CD age 9	.62	---															
3. CD age 10	.64	.68	---														
4. CD age 11	.55	.61	.64	---													
5. CD age 12	.48	.51	.59	.60	---												
6. CD age 13	.51	.57	.60	.58	.55	---											
7. CD age 14	.45	.53	.50	.48	.54	.66	---										
8. CD age 15	.38	.43	.46	.47	.48	.62	.64	---									
9. CD age 16	.36	.43	.42	.45	.46	.55	.61	.71	---								
10. Dep age 8	.32	.23	.23	.17	.17	.16	.18	.14	.13	---							
11. Dep age 9	.28	.36	.29	.26	.27	.23	.20	.16	.18	.53	---						
12. Dep age 10	.26	.28	.36	.27	.30	.22	.22	.21	.19	.50	.60	---					
13. Dep age 11	.31	.31	.34	.44	.35	.27	.21	.25	.24	.43	.49	.55	---				
14. Dep age 12	.23	.25	.33	.30	.41	.27	.27	.23	.15	.36	.44	.45	.55	---			
15. Dep age 13	.20	.28	.25	.21	.27	.27	.27	.22	.15	.30	.39	.42	.45	.59	---		
16. Dep age 14	.21	.24	.22	.21	.24	.21	.40	.26	.23	.29	.33	.37	.39	.47	.52	---	
17. Dep age 15	.15	.20	.21	.25	.25	.20	.32	.41	.30	.25	.32	.37	.37	.44	.44	.52	---
18. Dep age 16	.17	.21	.24	.26	.32	.21	.28	.32	.38	.23	.31	.34	.38	.41	.42	.46	.50

Note. CD age 8 denotes conduct disorder symptom severity at age 8; Dep age 8 denotes depression severity at age 8.

All correlations significant at $p < 0.01$.

Table 3

Model fit statistics for the path models.

Model	(df) χ^2	CFI/TLI	RMSEA	Model comparison	(df) $\Delta\chi^2$
1. Autoregressive model	(120) 412.37 ***	.951/.915	.045	-	-
2. Dep to CD	(112) 393.48 ***	.953/.912	.045	2 vs. 1	(8) 29.22***
3. CD to Dep	(112) 353.19 ***	.959/.925	.042	3 vs. 1	(8) 96.53***
4. Full, cross-lagged model	(104) 338.52 ***	.960/.921	.043	4 vs. 2	(8) 91.27***
				4 vs. 3	(8) 23.96***
5. Full, cross-lagged model, ODD-ED with CD	(272) 870.72 ***	.948/.918	.043	-	-
6. Full, cross-lagged model, ODD-ED with Dep	(272) 923.03 ***	.944/.911	.044	-	-
7. Full, cross-lagged model, ODD-ED with CD & Dep	(254) 585.19 ***	.971/.951	.033	7 vs. 5	(18) 385.71***
				7 vs. 6	(18) 473.01***
8. Full, cross-lagged model, ODD-Def with CD	(272) 880.32 ***	.951/.922	.043	-	-
9. Full, cross-lagged model, ODD-Def with Dep	(272) 1005.47 ***	.941/.907	.047	-	-
10. Full, cross-lagged model, ODD-Def with CD & Dep	(254) 641.93 ***	.969/.947	.035	10 vs. 8	(18) 320.06***
				10 vs. 9	(18) 494.44***

Note. CD denotes conduct disorder symptom severity, Dep denotes depression severity.

 $p < .001$.