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Identifying comorbid depression and disruptive behavior disorders: Comparison of two approaches used in adolescent studies

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Abstract

Interest in commonly co-occurring depression and disruptive behavior disorders in children has yielded a small body of research that estimates the prevalence of this comorbid condition and compares children with the comorbid condition and children with depression or disruptive behavior disorders alone with respect to antecedents and outcomes. Prior studies have used one of two different approaches to measure comorbid disorders: 1) meeting criteria for two DSM or ICD diagnoses or 2) scoring .5 *SD* above the mean or higher on two dimensional scales. This study compares two snapshots of comorbidity taken simultaneously in the same sample with each of the measurement approaches. The Developmental Pathways Project administered structured diagnostic interviews as well as dimensional scales to a community-based sample of 521 11-12 year olds to assess depression and disruptive behavior disorders. Clinical caseness indicators of children identified as "comorbid" by each method were examined concurrently and 3-years later. Cross-classification of adolescents via the two approaches revealed low agreement. When other indicators of caseness, including functional impairment, need for services, and clinical elevations on other symptom scales were examined, adolescents identified as comorbid via dimensional scales only were similar to those who were identified as comorbid via DSM-IV diagnostic criteria. Findings suggest that when relying solely on DSM diagnostic criteria for comorbid depression and

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disruptive behavior disorders, many adolescents with significant impairment will be overlooked. Findings also suggest that lower dimensional scale thresholds can be set when comorbid conditions, rather than single forms of psychopathology, are being identified.

Keywords

classification; comorbid conditions; depression; disruptive behavior disorders; adolescent

Co-occurring depression and disruptive behavior problems are common in children and adolescents. Both categorical and dimensional measurement approaches have been used to classify comorbid depression and disruptive behavior disorders in child populations (Angold & Costello, 1993; Angold et al., 1999a). One group of well-designed research studies defines comorbidity on the basis of a child meeting diagnostic criteria for depression and a disruptive behavior disorder (Cohen et al., 1993; Costello et al., 2003; Marmorstein & Iacono, 2003; Zoccolillo, 1992). Another group of well-designed studies defines comorbidity on the basis of having elevated depression and disruptive behavior problem dimensional scale scores (Capaldi, 1991; Ingoldsby et al., 2006; Miller-Johnson et al., 1998; Rockhill et al., 2009). Research based on both traditions has demonstrated epidemiological comorbidity (Kraemer, 1995), insofar as comorbid depression and disruptive behavior disorders occur more frequently than would be expected on the basis of chance alone (Zoccolillo, 1992), as well as clinical comorbidity, in that adolescents with comorbid disorders suffer from greater functional impairment than adolescents with only one disorder (Capaldi, 1991; Ingoldsby et al., 2006; Rockhill et al., 2009). Under consideration in the DSM-5 is a recommendation to use both approaches in making psychiatric diagnoses. Research that contributes to our understanding of the comparability between structured diagnostic interviews and dimensional scales for identifying individuals with comorbid conditions is notably absent. Currently, DSM-5 field trials are underway to evaluate the performance of a new system with added features of syndrome-specific dimensional measures and cross-cutting indicators of general mental health status (Kraemer et al., 2010). A better understanding of the degree of complementarity of different approaches for identifying psychopathology is needed to inform revisions to psychiatric nomenclature.

Efforts to establish the validity of screening tools has yielded an extensive literature that evaluates the sensitivity and specificity of questionnaire-based dimensional measures with regard to interviewer-obtained categorical diagnoses (e.g., Jensen et al., 1993, 1999; Kasius, Ferdinand et al., 1997; Rhew, Simpson et al, 2010; Richardson et al, 2010). However, few studies have examined sources of discrepancy between dimensional and categorical approaches or focused on comorbid conditions. Two papers from large cohort studies have compared methods of classifying childhood psychopathology. The Great Smoky Mountains Study showed that children with functional impairment related to life at home and school who did not meet DSM-III-R diagnostic criteria for a disorder demonstrated equivalent indicators of clinical caseness (e.g., receipt of mental health services, child and parent perceptions of child's need for help) as those who met DSM diagnostic criteria. Children who did not meet diagnostic criteria but who had high symptomatic impairment scores had significantly higher likelihood of clinical caseness (i.e., received specialty and school-based mental health services, parent perceived burden due to child's symptoms, parent perception that child had a problem of needed help) than children with no diagnosis and low impairment scores (Angold et al., 1999b). In the Children in Community Study, a simple count of symptoms was equivalent to a psychiatric diagnosis in identifying adolescents who as young adults failed to complete high school or had criminal involvement (Vander Stoep et al., 2002). These findings might suggest that using strict diagnostic criteria alone has low sensitivity for identifying youth experiencing psychiatric problems and sequelae.

To date only one study has conducted a “head to head” comparison of clinical caseness of children assessed by both diagnostic and dimensional approaches of classifying psychopathology. Jensen and Watanabe (1999) compared psychopathology identified via categorical, dimensional, or both approaches on measures of service use, life stress, and parental depression. Among 201 children from military families those meeting DSM diagnostic criteria for a psychiatric disorder and CBCL total score above a *T* score of 60 differed significantly from those who were negative on both measures, whereas children meeting either the categorical or dimensional criteria only demonstrated intermediate levels on most risk and outcome indicators. This study provided important empirical information regarding comparability of the two classification systems but was limited by the use of a small sample and a broad age range of children.

While prior studies suggest that when it comes to identifying adolescents with non-comorbid conditions, similar results can be derived from different measurement methods, none have compared classification systems with respect to identification of children with comorbid conditions. The current study extends the literature by taking simultaneous “snapshots” of comorbid depression and disruptive behavior disorders in one sample using the two approaches that have been used extensively in prior comorbidity research. The objectives of the study are to compare DSM-IV criteria and dimensional scale score classification approaches 1) in their estimation of the prevalence of comorbid depression and disruptive behavior disorders, 2) in the degree of concordance with regard to the adolescents they identify as comorbid, and 3) in the clinical severity of the adolescents so identified.

Materials and Methods

The current research is based on the Developmental Pathways Project (DPP), a community-based cohort study designed to examine the antecedents, phenomenology, and outcomes of comorbid depression and disruptive behavior disorders in early adolescence. The investigation was carried out in accordance with the latest version of the Declaration of Helsinki and was approved by the University of Washington Human Subjects Division. Informed assent of the participants and informed consent from a parent or guardian was obtained after the nature of the procedures had been fully explained.

Sampling Procedures and Sample

Sampling was conducted in two stages (Vander Stoep et al, 2011). Stage 1 involved universal classroom-based screening of 6th grade students for depression and disruptive behavior problems. Stage 1 procedures have been detailed previously (Vander Stoep et al., 2005). Stage 2 was a longitudinal study in which six in-home assessments were conducted with a stratified random sample of children screened in Stage 1 and a parent/guardian. Data analyzed for the current paper were derived from the Stage 1 screening, Stage 2 baseline and three-year follow-up assessments.

For the purpose of selecting a stratified random sample for longitudinal study, all screened students were assigned to one of four groups: high depression and high disruptive behavior score (CM), high depression and low disruptive behavior score (DP), low depression and high disruptive behavior disorder score (DB), and low depression and low disruptive behavior disorder score (NE), using .5 SD above the screening sample mean as a cutoff for a high score for the two screening scales. To enhance the likelihood of observing psychopathology and related outcomes over the course of early adolescence, students whose screening scores were high on either or both depression or disruptive behavior dimensions were over-sampled for participation. Each year a target number of students who had been randomly selected from the four cells in a ratio of approximately 1 CM : 1 DP : 1 DB : 2 NE were recruited. In the screening sample the distribution is approximately 1 CM: 1 DP: 1 DB:

6 NE. A total of 521 subjects (64.6% of eligibles selected) were recruited into the longitudinal study. Among eligible adolescents selected for recruitment, participants did not differ significantly from non-participants on the basis of gender or screening depression or disruptive behavior problem scores. Participation rates did, however, differ on the basis of race, with the participant group comprised of a disproportionately lower number of Asian American children. In study analyses 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 of students enrolled in participating schools.

The Developmental Pathways longitudinal study sample comprised 249 (47.8%) girls and 272 (52.2%) boys. Participants included 148 (28.4%) African Americans, 97 (18.6%) Asian Americans and Pacific Islanders, 21 (4.0%) Native Americans, and 255 (48.9%) European Americans. Across racial groups, 10.2% of children were of Hispanic ethnicity. The mean age at the baseline interview was 12.02 years ($SD=.43$). Families spanned a range of income levels, with 26.7% of families having an annual household income of under \$25,000, and 31.1% with an income over \$75,000.

Measures

Baseline interviews were conducted within three months of screening. Parent/caregiver and child interviews were conducted separately; 75.6% of parent/caregiver interviewees were mothers. Both child and parent received a monetary incentive after completing the interview. Five follow-up interviews were conducted over the course of the subsequent three years.

Dimensional measures—Classification of depression via dimensional assessment was carried out using the baseline child and parent-reported *Mood and Feelings Questionnaire* (MFQ) score (Angold & Costello, 1987)ⁱ. The average of the child and parent scores was utilized for analyses. Disruptive behavior disorder status was classified using the screening child reported externalizing scale of the *Youth Self Report* and baseline parent-reported externalizing scale score from the *Child Behavior Checklist* (CBCL: Achenbach, 2001)ⁱⁱ. Because the YSR and CBCL externalizing scales had different numbers of items (30 and 35, respectively), the total score of each scale was divided by their respective number of items in order to keep the scale scores on the same metric and then the two item-average scores were averaged. For ease of presentation, this average of the YSR and CBCL item-level score was multiplied by 30. The internal consistency (Cronbach's alpha) for the MFQ items in our sample was .91. for child report and .89 for parent report. For the CBCL externalizing scale, alpha was .88. and the YSR externalizing scale was .90. Combined child and parent report was utilized for dimensional scales to render them comparable to the method used in the diagnostic interview which incorporated both parent and child report.

Consistent with that prior dimensional scale-based research on comorbid depression and disruptive behavior disorders (Capaldi, 1991; Ingoldsby et al., 2006; Miller-Johnson et al., 1998), we used a cutoff of .5 SD above the mean to identify adolescents as comorbid. In the DPP sample we applied the .5 SD above the mean cutoffs to the weighted average of parent

ⁱAt baseline participants completed the 33-item long form of the MFQ, except for the first 20 participants who completed only the 13-item Short MFQ. The correlation between the SMFQ and the MFQ is .96. An additional 14 children were missing 1 MFQ item, and 1 student was missing 2 items. For the 35 participants who completed fewer than 33 MFQ items, we assigned the missing items the mean item score for their own 13-32 completed items.

ⁱⁱFor baseline parent-report scales, 8 parents did not complete the baseline CBCL. Unstandardized predicted scores based on gender, SES, 6-month CBCL externalizing scale, and baseline Teacher Report Form externalizing scales were used to impute missing baseline CBCL scale scores.

plus child baseline MFQ scores (mean + .5SD = 11.7) and externalizing scale (mean + .5SD = 10.0) scores to assign participants into high and low psychopathology categories. We refer to the dimensional score-based diagnosis as DIM_DX.

Diagnostic measures—The lay interviewer-administered computerized *Diagnostic Interview Schedule for Children-IV* (DISC-IV; Columbia University DISC Development Group, 1998) was administered to the child and parent/caregiver at the baseline interview to determine the occurrence of depression, oppositional/defiant disorder (ODD), and conduct disorder (CD) diagnoses, as specified in the DSM-IV (American Psychiatric Association, 1994) in the past 12 months. Test-retest reliability of the DISC-IV modules have been assessed in a clinical sample, with intraclass kappas for past year, combined parent and youth diagnoses of 0.65 (MDD), 0.59 (ODD), and 0.55 (CD) (Shaffer et al., 2000). Positive diagnoses were assigned by combining child and caregiver reports at the criterion level using the “either/or rule” (Piacentini et al., 1992). Children who met criteria for either oppositional defiant disorder

Children meeting criteria for major or minor depression were classified as having a depression diagnosis. We refer to the DSM-based categorical diagnosis as CAT_DX. Child and parent DISC-IV interviews were available for 508 of the 521 longitudinal study participants. An additional 16 participants who were administered a DISC-IV were missing either the child-parent baseline MFQ or child-parent externalizing score. Thus, the results presented are based on 492 adolescents with complete case analysis.

Functional status—The *Columbia Impairment Scale* is a 13-item measure of global functional impairment that includes both parent- and child-report formats (Bird et al., 1993). The CIS assesses the child’s functioning in interpersonal relations, broad psychopathological domains, functioning in job or schoolwork, and use of leisure time. The parent and child versions have good internal consistency (alpha range: .84-.86) in the DPP sample. CIS scores from the baseline and 3-year follow-up interview are used in this study. To measure the prevalence of functional impairment, a CIS cutoff score of 15 was applied (Bird et al., 1996).

Service use—Parents were queried about their child’s use of services for emotional and behavioral problems in the prior six months using the *People I Talk To About My Child* questionnaire (PITT; Wu et al., 1999). The PITT taps 1) the parent’s perception of the child’s need for services, 2) general utilization of outpatient mental health services, 3) utilization of services provided by a psychologist, and 4) utilization of services provided by a psychiatrist. Each of the four service use indicators is coded dichotomously (any need/utilization, no need/utilization).

Other psychological symptoms—Four empirically-derived syndrome scales, other than depression or externalizing problems, from the parent and teacher reports of psychological symptom elevations were obtained from the *Child Behavior Checklist* and *Teacher Report Form* (CBCL and TRF; Achenbach & Rescorla, 2001): somatic complaints, social problems, thought problems, and attention problems. For each reporter, the number of clinical elevations defined as a T-score of 65 or higher was summed (0 to 4).

Statistical Procedures

The weighted prevalence and associated 95% confidence interval (95% CI) of comorbid depression and disruptive behavior disorder were calculated on the basis of the two approaches. To assess the degree of “epidemiologic comorbidity” found with each approach (Kraemer, 1995), observed weighted prevalence estimates of comorbid disorders were

compared to the expected prevalence of comorbidity based on the cross product of the independent weighted prevalence of each condition and tested for statistical significance using the χ^2 test.

To highlight the correspondence between adolescent depression and disruptive behavior disorder status, a Spearman correlation coefficient was calculated for the correlation between the averaged YSR-CBCL externalizing score and the averaged child-parent MFQ score (the bases for the two DIM_DX classifications), and a Phi coefficient was calculated for the correlation between the two dichotomous CAT_DX classifications. A grid was constructed to locate the adolescents with respect to their depression (x-axis) and disruptive behavior (y-axis) dimensional scores. Then, the adolescents who met criteria for CAT_DX comorbid depression and disruptive behavior disorder diagnoses were superimposed on this grid. Weighted sensitivity and specificity values and area under the Receiver Operating Characteristics Curve (AUC) were calculated for DIM_DX comorbidity status using CAT_DX comorbidity status as the standard.

Cross-classification of comorbidity via DIM_DX and CAT_DX approaches was used to highlight four subgroups of adolescents: 1) those who met CAT_DX and DIM_DX criteria for depression and disruptive behavior disorder (BOTH_CM), 2) those who met criteria for CAT_DX, but did not meet DIM_DX criteria for comorbidity (CAT_CM), 3) those who did not meet CAT_DX criteria but did meet DIM_DX criteria for comorbidity (DIM_CM), and 4) those who met neither CAT_DX nor DIM_DX criteria for comorbid depression and disruptive behavior disorder diagnoses (NO_CM). To determine the extent to which meeting CAT_DX and/or DIM_DX criteria for comorbid depression and disruptive behavior disorder diagnoses was associated with independent evidence of psychopathology, we compared the four subgroups on external validators or “clinical caseness” measures. Fisher’s exact tests were used to identify overall differences across the four classification groups with respect to binary indicators of functional impairment and service utilization. To test differences in the number of clinical elevations across groups, the non-parametric Kruskal-Wallis test of ranks was used. Pairwise comparisons were made, and p-values were adjusted using a Bonferroni correction to account for multiple comparisons.

Results

The observed weighted prevalence of CAT_DX comorbid disorders was 2.1/100 (95% CI: 1.1/100-3.1/100). This was 1.83 times higher than the expected weighted prevalence, calculated as the cross-product of the two marginal prevalence estimates for depression and ODD/CD diagnoses ($\chi^2 (1) = 4.9, p = .023$). The observed weighted prevalence of comorbid depression and disruptive behavior disorders according to DIM_DX criteria was 11.7/100 (95% CI: 8.8/100-14.6/100), which was 2.03 times higher than the prevalence of comorbidity that would be expected based on the cross-product of the two marginal prevalence estimates ($\chi^2 (1) = 53.1, p < .0001$).

The Spearman correlation coefficient between scores on the externalizing scale (the basis for DIM_DX disruptive behavior disorder) and scores on the MFQ scale (the basis for DIM_DX depression) was .53, $p < .001$. The Phi coefficient between DISC-IV CAT_DX disruptive behavior disorder and CAT_DX depression diagnoses was .10, $p = .02$. Figure 2 shows the grid cross-classifying 492 adolescents on sixth grade depression and disruptive behavior scale scores and depicts the location on the dimensional grid of the children who met CAT_DX criteria for comorbid depression and disruptive behavior disorder diagnoses. Of the 19 adolescents who were identified as CAT_DX comorbid, 13 were also classified as DIM_DX comorbid at the cutoff used in prior studies (and 9 at the 1.0 *sd* above the mean cutoff). Of the remaining 6 children who met CAT_DX criteria for comorbidity, 2 were

classified as high on the disruptive behavior dimension only; 1 was elevated on the depression dimension only, and 3 were classified as low on both dimensions. An additional 64 adolescents met DIM_DX criteria but not CAT_DX criteria for comorbid disorders. Twenty eight of these 64 adolescents identified as DIM_DX had either a depression or a disruptive behavior disorder diagnosis, with 8 meeting criteria for a depression disorder diagnosis (N=2 MDD, N=6 for Minor Depression) and 20 meeting criteria for a disruptive behavior disorder diagnosis (N=20 for ODD, N=6 for CD). The weighted sensitivity of DIM_DX comorbid depression and disruptive behavior disorders (at $.5 SD$ above the mean cutoffs) vis a vis CAT_DX comorbid depression and disruptive behavior disorders was .66, and the weighted specificity was .89. The AUC was .79. The weighted Cohen's kappa reflecting chance-corrected agreement between diagnosis and dimensional scale classifications was .18. When the cutoffs for comorbid disorders were set at $1.5 SD$ above the mean on each measure, a level that would be nearer to a "clinical cutoff" on a *single* dimension, the weighted sensitivity dropped to .27, the AUC was .63, and the weighted Cohen's kappa was .22. When the MFQ and externalizing score cutoffs were lowered to $.25 SD$ above the mean, these cutoffs resulted in a sensitivity of .71, a specificity of .85, and an AUC of .79 vis a vis CAT_DX comorbidity, and kappa was .14 (See Figure 1).

Overall differences in student- and parent-reported functional impairment at 6th grade and 9th grade were observed across the CAT_DX, DIM_DX, BOTH_DX and NO_DX groups ($p < .001$ for each). Pairwise comparisons revealed that adolescents classified as comorbid by CAT_DX, DIM_DX, or BOTH_DX demonstrated a significantly higher likelihood of self- and parent-reported functional impairment concurrently (sixth grade) and prospectively (ninth grade) when compared to those without elevations (Figure 2). No statistically significant differences in functional impairment were observed when comparing among the CAT_DX, DIM_DX, or BOTH_DX groups.

Similarly, although overall differences were observed for parent perception of child needing help ($p = .006$), receipt of any outpatient mental health services ($p = .012$), and of outpatient psychiatric treatment ($p = .012$); pairwise comparisons indicated that most of these differences, except for outpatient psychiatric treatment, were restricted to comparisons of those with comorbid disorders compared to those without comorbid disorders (Figure 3). Specifically, compared to those without comorbid disorders, adolescents in the BOTH_DX group had a greater likelihood of parents' perception of needing services ($p = .012$), and those in the CAT_DX group were more likely to receive mental health outpatient services ($p = .024$). In comparisons of psychiatric treatment, youth in the BOTH_DX group had a higher likelihood of treatment compared to those in the NO_DX group ($p < .001$) as well as to those in the DIM_DX group ($p = .048$). There were no statistically significant differences detected between adolescents who met comorbidity criteria via dimensional scale, diagnostic interview-identified, or both approaches in parent perception that the child needed help, receipt of any outpatient mental health services, or receipt of outpatient psychological treatment.

Group differences were observed with respect to the number of clinical elevations on four parent-reported syndrome scales ($p < .001$). Specifically, compared to those who were not identified as comorbid via either criteria, a significantly higher number of clinical elevations were found among adolescents identified as comorbid via both ($p < .001$) or via the dimensional scale score ($p < .001$). Further, the BOTH_CM and DIM_CM groups did not differ in number of clinical elevations. An overall difference with respect to the number of teacher-reported clinical elevations was also observed ($p = .002$) which was restricted to a significantly higher number of elevations among youth in the DIM_CM compared to the NO_DM group ($p = .002$).

Discussion

In light of differences in measurement approaches used in prior research on comorbid depression and disruptive behavior disorders and proposed changes in the DSM nomenclature, the purpose of this study was to examine the correspondence between classification of these comorbid conditions via DSM diagnostic criteria and dimensional scale scores. Results reveal that when the two measurement approaches are applied simultaneously to the same adolescents, there are clear differences in the prevalence of comorbidity and in the specific individuals identified as comorbid, but there are few differences in the impairment related to psychopathology for those who are classified as “positive” for comorbidity by either approach. Applying the prior research standard of $.5 SD$ above the mean cutoffs to two dimensional scores clearly yields a higher prevalence of co-occurring depression and disruptive behavior disorders than identification via DSM-IV diagnostic criteria for two disorders (11.7/100 vs. 2.1/100). Overall, with weights applied to account for overrepresentation of at-risk adolescents, only 1.4% of the study sample was identified as comorbid by both approaches. Evaluating the methods simultaneously, of those who scored $.5 SD$ above the mean or higher on both depression and disruptive behavior disorders, only 11.6% also met criteria for comorbidity via the diagnostic interview. Of the adolescents who met diagnostic criteria for both disruptive behavior disorders (ODD or CD) and depression disorders (major and minor), 66.1% were at or above the $.5 SD$ above the mean cut-off on both dimensional measures. Although there is overlap in adolescents identified as comorbid by the two approaches, the number of discrepant cases is larger than the number of concordant ones,

It could be argued that the mismatch simply reflects the use of an inappropriate dimensional scale cutoff value and that using a higher cutoff value would yield better correspondence between the dimensional score and DSM diagnosis. It is informative to reexamine Figure 1 in an attempt to identify dimensional scale scores that might yield better sensitivity and specificity. To attain 100% sensitivity, the dimensional scale cutoff scores would have to drop very low, with a corresponding drop to 10% specificity. To attain 100% specificity, dimensional scale cutoffs would be so high that sensitivity would fall to 0%. Our results showed cutoffs higher than $.5 SD$ to yield extremely low sensitivity and to reduce AUC markedly.

The question arises as to whether discrepancies in adolescents identified by the two methods might be due to differences in the symptoms being evaluated by dimensional scales and diagnostic interviews. We took two post-hoc steps towards addressing this question, first, by investigating the content covered by MFQ scale, the CBCL/YSR scales and the DISC diagnosis; and second, by determining the proportion of adolescents in the DIM and CAT subgroups who endorsed each depression and disruptive behavior scale item. We found high correspondence between MFQ items and diagnostic criteria for depression. The general difference was that diagnostic criteria were represented by multiple MFQ items (e.g., depression diagnostic criterion psychomotor agitation or retardation reflected through four MFQ items “moving and walking more slowly,” “restless,” “felt like talking less,” talking more slowly than usual”). The CBCL/YSR disruptive behavior scale coverage did not align as well with diagnostic criteria for ODD and CD. Appendices A-C show the item content of the dimensional scales and display the proportion of youth who endorsed each depression and disruptive behavior item (sometimes true or very true) by disorder classification group. As expected, for each item those identified as CM, whether by DIM or CAT, exhibited higher percent endorsement compared with those who were not classified as comorbid. Less anticipated was the finding that proportions of youth who endorsed each item were remarkably similar in the larger DIM_CM and smaller CAT_CM subgroups. This item analysis does not support the interpretation that the differences in estimates of the

prevalence of comorbidity or the discrepancies in adolescents identified as comorbid via the two approaches can be attributed to differences in how psychopathology is manifest in the comorbid groups or in differences in symptom content within the measurement approaches. Additionally, re-examination of concordance and discordance between DSM-IV and dimensional scale comorbidity classifications in Figure 1 shows little variation with regard to whether an adolescent classified as comorbid met criteria for ODD, CD, or both.

Why does a lower cutoff work better for classifying comorbid conditions when a higher cutoff works better for classifying depression or disruptive behavior disorders alone? While having an elevation of $.5 SD$ above the mean could be considered a fairly low cutoff criterion on *one* dimension, having elevations of this magnitude on *two* dimensional scales, particularly two with minimal symptom overlap, is actually quite a high “load” of psychopathology. A child with elevations this high on two heterotypic dimensions is exhibiting many different symptoms. For example, when examined in the DPP sample, adolescents classified as comorbid according to $.5 SD$ cutoffs on MFQ and YSR-CBCL_{ext} scales demonstrated a significantly higher level of total combined symptomatology (MFQ + YSR-CBCL_{ext} Combined $M = 34.42$) than adolescents with elevated depression symptoms only even when the MFQ cutoff for the depression, only group was raised to a clinical threshold of $1.5 SD$ above the mean (Combined $M = 32.10$; $t(89.9) = -2.00$; $p = .049$) and compared to adolescents with disruptive behavior problems only when the YSR-CBCL_{ext} cutoff was raised to a $1.5 SD$ cutoff (Combined $M = 30.75$; $t(116.52) = -3.52$; $p < .001$). Thus, while a $.5 SD$ above the mean cutoff on a single dimension would arguably be too low for establishing need for clinical intervention, having elevations of $.5 SD$ above the mean on multiple heterotypic dimensions signals a need for attention, and requiring that an adolescent meet full diagnostic criteria for one, let alone two, heterotypic disorders would miss many individuals with significant comorbid psychopathology.

Assigning a DSM diagnosis requires lengthy interviewing of multiple informants followed by the application of complex algorithms to multiple sets of responses. Unlike many other health conditions where the more intensive and expensive approach is more valid, in the case of comorbid mental health conditions appearing in adolescence, application of strict diagnostic algorithms may *not* yield a superior indicator of disorder. In this study adolescents who were identified as comorbid via a simpler-to-implement dimensional approach that applied moderately high cutoffs to scale scores demonstrated considerable concurrent and future functional impairment, a high prevalence of mental health service use, and more elevations on clinical syndrome scales, compared to adolescents who were not identified as comorbid using either categorical or dimensional approaches. Furthermore, these adolescents had equivalent independent indications of caseness compared to those who met criteria for both DSM depression and disruptive behavior disorder diagnoses. Thus, a large proportion of adolescents who did not meet criteria for comorbid diagnoses had dimensional scale scores that, by examining other indicators of disorder, would be inappropriate to ignore. Study findings help to validate recommendations that dimensional scale approaches be used to contribute information to guide clinical decision-making (Kraemer, 2007).

Study results must be interpreted in light of several limitations. Our findings of low concordance between diagnostic and dimensional measurement strategies may not generalize to other types of comorbid psychopathology. Application of multiple measurement approaches to homotypic comorbid conditions would likely yield higher concordance. While combining ODD and CD into a single disruptive behavior disorder category was consistent with prior studies and provided good correspondence with the items comprising the CBCL externalizing scale, this approach has its drawbacks. When we examined the contribution of the two disruptive behavior disorders to the classification of

CAT_CM, we found the majority (70%) met criteria for ODD and depression; 20% met criteria for ODD, CD and depression diagnosis; and 10% met criteria for CD and depression. An emerging body of evidence reveals that, while the two disruptive behavior disorders are related, their trajectories diverge at critical developmental junctures (Frick et al., 1993) and that ODD may have multiple meanings. While CD has been shown to portend future antisocial behavior, ODD has been implicated as a non-specific precursor to multiple forms of later internalizing and externalizing disorders (Boylan et al., 2007). Although comparisons in our study were limited by the small number of youth meeting criteria for either ODD or CD diagnosis, future research should explore how depression comorbid with ODD differs in etiology, phenomenology and outcome from depression comorbid with CD.

Characteristics of our sample may also limit generalizability. The study examined a brief period in the lifespan, and findings may not generalize beyond early adolescence. Further, this sample was recruited from a single geographic area. However, the study population was diverse in gender, socioeconomic status, and race/ethnicity. A limitation relating to the measurement tools used must also be acknowledged. While our measurement tools are well-validated and commonly used, they vary with respect to how information from multiple reporters was combined and the duration of symptoms queried. These differences likely affect their comparability. At any given time a small proportion of adolescents in a community who report high levels of symptoms on dimensional scales would be expected to simultaneously meet the extensive duration and severity criteria to attain full diagnoses. That said, the current study demonstrated that dimensional scores based on validated measures completed by two reporters, as well as diagnoses based on validated structured interviews completed by two reporters, predicted impaired functional status three years later, indicating that both reflect mental health problems that are more than transitory.

In conclusion, our “snapshot” of simultaneously administered diagnostic interview and dimensional scale measures showed that prior studies of co-occurring depression and disruptive behavior disorders using different measurement approaches were likely making inferences about different adolescents with similar levels of clinical need. Study findings confirm a small literature showing that when relying on DSM diagnostic criteria only, many adolescents with significant impairment will be overlooked and lend support to suggestions to incorporate dimensional scale scores in the diagnosis of childhood psychopathology. Findings also suggest that lower dimensional scale thresholds can be set when identifying comorbid conditions, rather than single forms of psychopathology. Future research that applies similar analytic methods to larger samples of children and can address remaining questions about specific disruptive behavior disorders or comparability of parent or child reports are warranted.

Appendix A.1

Proportion of adolescents who endorsed MFQ depression items in each depressed and non-depressed and comorbid and non-comorbid classification group by MDD diagnostic criteria

MDD Criteria	Item	- DIM_DP (n =368)	+ DIM_DP (n = 142)	-DIM_CM (n=425)	+ DIM_CM (n=78)	-CAT_DP
Depressed Mood	1. Miserable/unhappy	.65	.96	.69	.95	.73
	14. cried a lot	.17	.53	.21	.58	.20
	11. grumpy	.74	.92	.76	.96	.77
Anhedonia	2. Didn't enjoy anything	.21	.64	.25	.65	.30

MDD Criteria	Item	- DIM_DP (n =368)	+ DIM_DP (n = 142)	-DIM_CM (n=425)	+ DIM_CM (n=78)	-CAT_DP
	20. didn't want to see my friends	.19	.42	.21	.45	.22
	29. didn't have any fun at school	.44	.80	.49	.76	.51
Either Depressed Mood or Anhedonia		.70	.99	.74	.97	.77
Weight/Appetite Disturbance	3. Less hungry	.45	.76	.49	.74	.53
	4. Ate more	.42	.73	.45	.77	.49
Sleep problems	32. didn't sleep well	.43	.71	.45	.86	.48
	33. slept more	.44	.60	.46	.64	.48
Psychomotor agitation/retardation	5. Moving and walking more slowly	.27	.66	.32	.66	.36
	7. Restless	.45	.80	.48	.84	.53
	12. felt like talking less	.37	.81	.43	.80	.48
	13. talking more slowly than usual	.09	.40	.14	.39	.16
Fatigue/energy loss	1. Felt so tired	.53	.89	.58	.91	.66
Worthlessness/guilt	8. no good anymore	.14	.64	.21	.64	.22
	9. blamed myself	.25	.68	.31	.67	.33
	31. did everything wrong	.20	.63	.25	.65	.29
	30. never be as good	.29	.73	.35	.73	.44
	28. nobody loved me	.11	.57	.16	.63	.22
	23. hated myself	.09	.55	.15	.55	.19
	24. bad person	.14	.53	.19	.56	.22
	25. looked ugly	.24	.66	.27	.74	.33
Inattention/concentration/indisiveness	21. hard to concentrate	.49	.92	.56	.88	.59
	10. hard to make up mind	.66	.92	.70	.93	.77
Thoughts of death/SI	16. life not worth living	.03	.37	.07	.41	.16
	17. death and dying	.14	.47	.17	.55	.22
	19. kill self	.02	.19	.03	.26	.08
	15. nothing good for me in future	.09	.52	.15	.50	.19
	18. family better off without me	.07	.46	.10	.57	.19
	22. thought bad things would happen to me	.23	.75	.30	.77	.33
	26. worried about aches and pains	.49	.73	.52	.74	.53
	27. felt lonely	.36	.85	.43	.87	.48

Abbr. -Dim_dep: depression scale score < .5SD above mean, + Dim_dep: depression scale score > .5 SD above mean, - Dim_CM depression and/or externalizing scale score < .5SD above mean, + Dim_CM depression and externalizing scale score > .5 SD above mean, -CAT_DP: Did not meet diagnostic criteria for depression diagnosis, +CAT_DBD: Met criteria

for a depression diagnosis, -CAT_CM: did not meet diagnostic criteria for depression and disruptive behavior disorder diagnosis, +CAT_CM: Met diagnostic criteria for depression and disruptive behavior disorder diagnosis.

Appendix B

Proportion of adolescents who endorsed disruptive behavior items in each disruptive behavior disorder and non-disruptive behavior disorder and comorbid and non-comorbid classification group on the YSR/CBCL ODD DSM-oriented scale by ODD diagnostic criteria

ODD items	Item	- DIM_EXT (N=344)	+ DIM_EXT (N=170)	- DIM_CM (N=425)	+ DIM_CM (N=78)	- CAT_DBD
Argues	3. Argues	.82	.99	.86	1.00	.85
Defies adults or refuses to comply	23. Disobeys	.18	.61	.27	.54	.29
	86. Stubborn	.64	.93	.70	.92	.69
Lose temper, angry, resentful	95. Temper	.46	.93	.55	.96	.55
Deliberately annoys	--	--	--	--	--	--
Blames others for mistakes	--	--	--	--	--	--
Touchy or easily annoyed	--	--	--	--	--	--
Spiteful/vindictive	--	--	--	--	--	--

Abbr. -Dim_ext: externalizing score < .5SD above mean, + Dim_ext: externalizing score .5 SD above mean, -Dim_CM depression and/or externalizing score < .5SD above mean, + Dim_CM depression and externalizing score .5 SD above mean, -CAT_DBD: Did not meet diagnostic criteria for a disruptive behavior disorder, +CAT_DBD: Met criteria for a disruptive behavior disorder, -CAT_CM: did not meet diagnostic criteria for depression and disruptive behavior disorder, +CAT_CM: Met diagnostic criteria for depression and disruptive behavior disorder. -- indicates that the diagnostic criteria is not assessed via the ODD DSM-oriented subscale.

Appendix C

Proportion of disruptive behavior symptom endorsement in each disruptive behavior disorder and non-disruptive behavior disorder and comorbid and non-comorbid classification group on the CBCL/YSR CD DSM-oriented scale by CD diagnostic criteria

CD Criteria	CD items	- DIM_EXT (N=344)	+ DIM_EXT (N=170)	- DIM_CM (N=425)	+ DIM_CM (N=78)	-
Aggression to people						
Bullies/ threatens	Mean 16	.26	.74	.36	.71	
	Threaten 97	.06	.42	.13	.40	
Physical fights	Fights 37	.13	.59	.21	.64	
Weapon	--	--	--	--	--	
Cruel physically	Attacks 57	.07	.34	.12	.32	
Cruel to animals	Cruel animal 15*	.02	.02	.02	.01	
Stolen while confronting a victim	--	--	--	--	--	
Forced sexual activity	--	--	--	--	--	
Destruction of property						
Fire setting	Sets fires 72	.02	.18	.06	.17	
Destroyed others property	Destroys other 21	.04	.49	.13	.51	
	Vandalism 106*	.01	.05	.01	.09	

CD Criteria	CD items	- DIM_EXT (N=344)	+ DIM_EXT (N=170)	- DIM_CM (N=425)	+ DIM_CM (N=78)
Deceitfulness or theft					
Broken in	--	--	--	--	--
Lies to obtain goods	Lie cheat 43	.34	.84	.44	.78
Stolen	Steals home 81	.04	.27	.09	.24
	Steals other 82	.03	.26	.07	.29
Serious violation of rules					
Stays out before 13	Breaks rules 28	.26	.63	.32	.68
Run away twice	Run away 67	.02	.13	.03	.18
Truant from school	Truant 101	.01	.09	.02	.08
	Not guilty	.38	.80	.31	.73
	Bad friends 39	.23	.70	.32	.69
	Swears 90	.35	.82	.45	.78

Note.

* Only on cbcl. Abbr. -Dim_ext: externalizing score < .5SD above mean, + Dim_ext: externalizing score .5 SD above mean, -Dim_CM depression and/or externalizing score < .5SD above mean, + Dim_CM depression and externalizing score .5 SD above mean, -CAT_DBD: Did not meet diagnostic criteria for a disruptive behavior disorder, +CAT_DBD: Met criteria for a disruptive behavior disorder, -CAT_CM: did not meet diagnostic criteria for depression and disruptive behavior disorder, +CAT_CM: Met diagnostic criteria for depression and disruptive behavior disorder. – indicates that the diagnostic criteria is not assessed via the CD DSM-oriented scale.

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Figure 1.

Location of adolescents with comorbid DSM-IV diagnoses (BOTH_CM and CAT_CM) on the dimensional depression and disruptive behavior disorder score grid

* CBCL: Child Behavioral Checklist; YSR: Youth Self Report

** MFQ: Mood and Feelings Questionnaire

Gray solid line is Mean cutoff

Black dotted line is +.25 SD cutoff

Black solid line is +.5 SD cutoff

Black dash line is +1.0 SD cutoff

◇ not classified as comorbid according to categorical diagnoses

■ classified as comorbid according to categorical diagnoses with ODD

▲ classified as comorbid according to categorical diagnoses with CD

◆ classified as comorbid according to categorical diagnoses with both ODD and CD

Figure 2.

Prevalence (%) of child and parent reported clinically-significant impairment in 6th and 9th grade by comorbidity status.

Note. Numbers inside bars indicate the groups with significantly ($p < .05$) lower rates than the group represented by that bar. Abbr. NO_CM= no comorbidity, DIM_CM= classified as comorbid by dimensional diagnosis only, CAT_CM= classified as comorbid by categorical diagnosis only, BOTH_CM= classified as comorbid by both dimensional and categorical diagnosis.

Figure 3.

Prevalence (%) of service need and use by comorbidity status.

Note. Numbers inside bars indicate the groups with significantly ($p < .05$) lower rates than the group represented by that bar. Abbr. NO_CM= no comorbidity, DIM_CM= classified as comorbid by dimensional diagnosis only, CAT_CM= classified as comorbid by categorical diagnosis only, BOTH_CM= classified as comorbid by both dimensional and categorical diagnosis.