Published in final edited form as:
J Child Psychol Psychiatry. 2007 October ; 48(10): 1005–1013. doi:10.1111/j.1469-7610.2007.01770.x.

Diagnostic specificity and nonspecificity in the dimensions of preschool psychopathology

Sonya Sterba[1], **Helen L. Egger**[2], and **Adrian Angold**[2]

[1] Department of Psychology, University of North Carolina at Chapel Hill, USA

[2] Center for Developmental Epidemiology, Department of Psychiatry and Behavioral Sciences at Duke University Medical Center, USA

Abstract

Background—The appropriateness of the *Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition* (DSM-IV) nosology for classifying preschool mental health disturbances continues to be debated. To inform this debate, we investigate whether preschool psychopathology shows differentiation along diagnostically specific lines when DSM-IV symptoms are aggregated statistically.

Methods—One thousand seventy-three parents of preschoolers aged 2–5 years attending a large pediatric clinic completed the Child Behavior Checklist 1.5–5. A stratified probability sample of 193 parents of high scorers and 114 parents of low scorers were interviewed with the Preschool Age Psychiatric Assessment (PAPA). Confirmatory factor analysis was performed on symptoms from seven DSM disorders.

Results—Comparison of competing models supported the differentiation of emotional syndromes into three factors: social phobia (SOC), separation anxiety (SAD), and depression/generalized anxiety (MDD/GAD), and the differentiation of disruptive syndromes into three factors: oppositional defiant/conduct syndrome (ODD/CD), hyperactivity/impulsivity, and inattention. Latent syndrome correlations were moderately high after accounting for symptom overlap and measurement error.

Conclusions—Psychopathology appears to be differentiated among preschoolers much as it is among older children, and adolescents. We conclude that it is as reasonable to apply the DSM-IV nosology to preschoolers as it is to apply it to older individuals.

Keywords

Internal validity; comorbidity; preschool children; nosology; DSM; validity; confirmatory factor analysis

---

The *Diagnostic and Statistical Manual of Mental Disorders* taxonomy (DSM-IV; American Psychiatric Association, 2000) is increasingly being used to diagnose psychopathology among preschoolers (see Angold & Egger, 2004). Several studies have shown that, when DSM diagnostic algorithms are used to aggregate symptoms from general population-based preschool samples, prevalence and comorbidity rates are within the range reported for older

---

Correspondence to: Sonya Sterba, L.L. Thurstone Psychometric Laboratory; Department of Psychology, CB# 3270; UNC-CH 27599-3270, USA; ssterba@email.unc.edu.

Conflict of interest statement: Dr Egger was the recipient of a Pfizer Faculty Scholars Award in Clinical Epidemiology. The other authors do not have financial ties with for-profit enterprises. The authors do not receive financial benefit from the instrument described in this paper.

children (Earls, 1982; Egger et al., 2006; Keenan, Shaw, Walsh, Delliquadri, & Giovannelli, 1997; Lavigne et al., 1996; see Egger & Angold, 2006 for a review). Yet, the appropriateness of the DSM-IV for preschool phenomenology continues to be debated (e.g., McClellan & Speltz, 2003; Wilens, Biederman, Spencer, & Monuteaux, 2003). Validation of the DSM-IV for preschoolers involves demonstrating that preschoolers' mental health disturbances are really differentiated along the lines of DSM-IV syndromes, rather than appearing in alternative or undifferentiated precursor forms, with DSM-IV 'disorders' being merely arbitrary impositions.

Patterns of DSM syndrome differentiation in older children

Few studies have tested the differentiability of DSMIV syndromes in preschoolers, although some studies of mostly older children have included small samples of children down to age 2 (e.g., Burns et al., 1997). DSM syndrome differentiation is conventionally tested by constructing a model that partitions DSM symptoms according to DSM syndromes and testing its fit to the data using confirmatory factor analysis. Such studies of older children and adolescents have indicated that certain areas of psychopathology are well fit by the DSM-IV criteria, but that some others are not. There are three main areas of poor or inconsistent fit (reviewed in Lahey et al., 2004): (1) lack of differentiation between generalized anxiety (GAD) and major depression (MDD); (2) lack of differentiation between oppositional defiant disorder (ODD) and conduct disorder (CD); and (3) the differentiation of attention deficit-hyperactivity disorder (ADHD) into two dimensions.

1. Generalized anxiety (GAD) and major depression (MDD) symptom dimensions have often been found undifferentiated from each other, but separable from other anxiety disorders – including obsessive compulsive disorder (OCD), separation anxiety (SAD), and social phobia (SOC) (Lahey et al., 2004; Kendler, Prescott, Meyers, & Neale, 2003; Vollebergh et al., 2001). When symptoms pertaining to various anxiety disorders are lumped together, however, the high correlation of GAD with depression tends to (a) drive the appearance of a single anxiety/depression factor, and (b) occlude the differentiability of other anxiety disorders from depression (as in Cole, Truglio, & Peeke, 1997).

2. Although ODD and CD are typically *reported* to be differentiated among older children and adolescents (e.g., Pillow, Pelham, Hoza, Molina, & Stultz, 1998), their differentiability is not beyond question. Sometimes ODD and CD have been separable (a) only when many CD symptoms are omitted (e.g., Burns et al., 1997), or (b) simply by virtue of their inclusion as separate factors in an acceptably-fitting larger model, but without an explicit test of their differentiability (e.g., Hartman et al., 2001). In this regard, it is noteworthy that ODD and CD are sub-diagnoses derived from a single set of symptoms in the *International Classification of Diseases* (ICD-10; World Health Organization, 2006). There is no doubt that the two syndromes are strongly associated. ODD is often a precursor of CD (Loeber, Keenan, Lahey, Green, & Thomas, 1993), and ODD and CD are associated with similar impairments and familial correlates (Faraone, Biederman, Keenan, & Tsuang, 1991; Frick et al., 1992).

3. Parent-reported ADHD symptoms often yield separate inattention (I) and hyperactivity/impulsivity (HI) factors (e.g., Glutting, Youngstrom, & Watkins, 2005; Willoughby, Curran, Costello, & Angold, 2000). However, Bauermeister (1992) found that ADHD symptomology was unifactorial at 4–5 years in an exploratory factor analysis, but bi-factorial (hyperactivity/impulsivity and inattention) in 6–7-year-olds. However, this was result was obtained by extracting orthogonal factors – a questionable approach given that symptoms of these disorders are known to be correlated at every age.

Patterns of DSM syndrome differentiation in preschoolers

Whereas the differentiability of a broad range of DSM symptoms according to DSM syndromes has been tested among older children and adolescents, the focus in preschoolers has mostly been on *deriving* 'empirical' syndromes (e.g., Achenbach & Rescorla, 2000). For several reasons, such investigations cannot tell us whether the DSM-IV provides reasonable working descriptions of preschool psychopathology (that has not been their goal). Although some empirically derived syndromes resemble DSMIV syndromes descriptively (see Achenbach, Dumenci, & Rescorla, 2003), the item pools employed have provided limited coverage of the scope of psychopathology, and the symptom information they represent has been insufficiently detailed to represent the approach and content of the DSM-IV. For example, an attempt to classify Child Behavior Checklist (CBCL 1.5–5; Achenbach & Rescorla, 2000) items into 'DSM-oriented syndromes' noted that there were too few anxiety symptoms assessed to permit estimation of separate GAD, separation anxiety, and social phobia syndromes (Achenbach et al., 2003, p. 333). When only a few symptoms of a particular DSM syndrome are represented on a checklist, there will often be insufficient power to recover that syndrome in a factor analysis (see MacCallum, Widaman, Zhang, & Hong, 1999). That syndrome's symptoms can instead end up loading on secondary syndromes (MacCallum et al., 1999). So, for instance, it is not surprising that the few SAD symptoms included in the CBCL 1.5–5 do not cohere as a separate factor, but cross-load on other syndromes (Achenbach et al., 2003).

Only two studies of preschoolers have tested the fit of DSM syndromes using confirmatory factor analysis of DSM symptoms, and these dealt only with anxiety. In large ($N > 700$), community samples, Eley et al. (2003) and Spence, Rapee, McDonald, and Ingram (2001) found that dimensions representing SAD, social anxiety, obsessive compulsive symptoms, fears, and generalized anxiety were differentiable.

Given these gaps in the current literature, our first aim is to examine the degree to which the DSM-IV adequately represents preschool psychiatric symptomatology using: (a) a reasonably representative preschool sample, (b) precise DSM-IV symptom measurement, and (c) a wider range of common syndromes – attention deficit hyperactivity disorder (ADHD), major depression (MDD), social phobia (SOC), oppositional defiant disorder (ODD), separation anxiety (SAD), conduct disorder (CD), and generalized anxiety disorder (GAD). Our second aim is to determine whether the three areas that are poorly or inconsistently fit by the DSM-IV criteria among older children and adolescents are similarly poorly fitting among preschoolers.

Methods

Details of the study's methods can be found in an earlier publication (Egger et al., 2006). We present a summary pertinent to the analyses conducted here.

Study design

Subjects were recruited from the Duke Children's Primary Care Clinic to take part in a one-week test–retest reliability study of the Preschool Age Psychiatric Assessment (PAPA; Egger & Angold, 2004), a structured psychiatric diagnostic interview for use with parents of preschoolers aged 2–5 years. An overview of study design is presented in Figure 1. Data from the first of the two repeated interviews were employed in the present analyses. The study used a psychopathology screen-stratified design, with oversampling of those with high screen scores, and stratification by gender, age (2-, 3-, 4- and 5-year-olds), and race (African American and non-African American). The use of sampling weights in these analyses permits unbiased pediatric clinic estimates to be computed from such a stratified sample.

Over the 18 months of data collection, 1,191 parents were approached by a screener, who explained the study and sought informed consent for completion of the Child Behavior Checklist (CBCL) 1.5–5 (Achenbach & Rescorla, 2000). Of these, 1,073 were screened: 20 refused, and 98 were excluded, either because the accompanying adult was not English speaking ($n = 48$) or could not provide legal consent ($n = 21$), or the child had autism, mental retardation, or another pervasive developmental disorder ($n = 14$), or had a sibling already enrolled ($n = 15$). Three hundred seven children 'screened high' (i.e., obtained a CBCL total symptom T-score ≥ 55). Seven hundred seventy-six 'screened low' (i.e., obtained a CBCL total symptom T-score < 55). Stratifying by age, gender, and race, 80% of screen highs were randomly selected for PAPA interviews, as well as well as 20% of 'screen lows.' We continued to request participation in the interview phase from members of each age × gender × ethnicity group until their particular cell was full. PAPA interviews took place with interviewers blind to the parent's screen status, usually in the participant's home.

Sample characteristics

Demographic characteristics of the screened sample, the interviewed sample, and surrounding Durham County where the study was conducted are presented in Table 1. Eighty-six percent of the interviews were conducted with the child's biological mother. No significant differences in gender, age, or Medicaid status emerged between screen-refusers and participants or study-refusers and participants (see Egger et al., 2006), so the sample weights were not adjusted for study-refusal.

The Preschool Age Psychiatric Assessment (PAPA)

The PAPA (Egger & Angold, 2004) is a parent-report, interviewer-based, structured psychiatric assessment involving a range of mandatory questions and probes, supplemented by further detailed exploratory probing to ensure that the ratings appropriately represent the child's problems. When symptoms (e.g., depressed mood, irritability) were reported, their frequency, duration and onset dates were also collected for a three-month primary period, in order to determine whether they met the criteria for the symptoms of various DSMIV diagnoses. Symptom algorithms implementing the DSM-IV criteria were programmed using SAS software. These SAS algorithms were applied to the raw frequency, duration, and onset PAPA data to generate DSM-IV psychiatric symptom data. As far as possible, the PAPA symptom algorithms followed the Child and Adolescent Psychiatric Assessment (CAPA; Angold & Costello, 2000) algorithms. However, (1) DSM-IV symptoms that are not applicable to young children were excluded (e.g., for CD, 5 out of the 15 possible symptoms were excluded), (2) Research Diagnostic Criteria – Preschool Age (Task Force on Research Diagnostic Criteria: Infancy and Preschool, 2003) developmentally modified DSM-IV criteria were used for depression (e.g., suicidal themes in play could serve as endorsement of the symptom of suicidality; Luby et al., 2003), and (3) the high prevalence of certain behaviors in preschoolers indicated a need to modify the CAPA's cut-points for several symptoms. For instance, because the frequency of ODD symptoms such as 'often loses temper' is higher in preschoolers than in older children, the ODD algorithm was modified so that each ODD *symptom* reflected the top 10% of frequency for preschoolers based on PAPA data. Thus, we maintained the CAPA's 90th percentile frequency cutoff conceptualization of ODD symptomatology (Angold & Costello, 1996) by modifying the criteria frequency levels. A similar approach was taken for the CD symptoms of assaults and lying. (See Egger et al., 2006 for further details about the algorithms.) The one-week test–retest symptom scale reliabilities ranged from .61 (GAD) to .81 (ADHD), comparable to those of interviews for older children and adults (Egger et al., 2006).

Analytic strategy

We employed confirmatory factor analysis (CFA) rather than exploratory factor analysis (EFA) because we were testing a pre-formed diagnostic system (DSM-IV), rather than deriving a descriptive system empirically. CFA treats observed symptoms as probabilistic indicators of latent DSM-IV syndromes and assumes that these underlying DSM-IV syndromes are continuously distributed; (empirical and theoretical justifications of this assumption are provided in van den Oord, Pickles, & Waldman, 2003).

Model specification—A series of four emotional-syndrome models and four disruptive-syndrome models were estimated separately, rather than as a series of composite models, in order to better test the dimensionality of the disorders in each domain. Such issues are hard to resolve in nested tests of large, composite models, because poor performance in one domain of the composite model can affect the validity of dimensionality testing in another domain (Hartman et al., 2001).

Each series of four models included: a '*DSM-IV model*'; two models representing differentiation patterns most commonly found in older children/adolescents ('*Child–Adolescent models*') and an '*Undifferentiated (one-factor) model*'. The four emotional-syndrome models were: (i) the *DSM-IV model* (GAD, SAD, SOC, and MDD); *Child-Adolescent models* (ii) SAD and SOC as separate factors but MDD/GAD combined and (iii) MDD as one factor and all anxiety disorders as the other; and (iv) an *Undifferentiated (1-factor) model*. The four disruptive-syndrome models were: (i) the *DSM-IV model* (ADHD, ODD, and CD); *Child–Adolescent models* (ii) hyperactivity/impulsivity [HI], inattention [I], ODD, and CD and (iii) HI and I as separate factors but ODD/CD combined; and (iv) an *Undifferentiated (one-factor) model*.

A composite model was formed by combining the preferred model from the set of emotional-syndrome models with the preferred model from the set of disruptive- syndrome models and allowing all factors to correlate. In the final model, we focused on descriptive correlations among all of the latent syndrome factors, which depict the extent of association among all syndromes accounting for measurement error and shared symptom effects.

Several rare symptoms, each belonging to the same syndrome, i.e., the *same* dimension, were 'parceled' (see Sass & Smith, 2006) prior to model estimation to prevent low variance from reducing their loadings, and thereby reducing common factor variance (see Hartman et al., 2001). Specifically, four uncommon SAD symptoms were summed to form two indicators: (1) worry about untoward events and loss or harm of attachment figures, and (2) sleep reluctance or refusal and separation nightmares. Besides improving the distributional characteristics of rare items, parceling also improves model parsimony when applied to highly correlated items. Hence, three highly-correlated hyperactivity symptoms were summed to form one indicator: leaves seat; runs and climbs; on the go. Additionally, social anxiety symptoms were combined into two indicators, (1) social or performance fear and (2) anxiety or avoidance of social contact or public performance. Two physical cruelty CD symptoms (to animals and people) were combined, as were the two property destruction CD symptoms (deliberate property damage and firesetting).

To reduce the possibility of artifactual covariation, prior to model estimation, 'specificity' terms for overlapping symptoms contributing to different disorders were correlated to account for shared method factors intrinsic to that symptom (irritability for MDD and ODD; blaming/lying for ODD and CD; fatigue, irritability, sleep, and concentration for GAD and MDD). In factor analytic terms, 'specificity' is that part of a symptom's variance not explained by the syndrome factor, nor by measurement error, and therefore is unique to that symptom. Allowing correlated specificities is preferable to deleting one symptom out of each overlapping pair and

allowing the remaining symptom to crossload, because, unless the two symptoms are perfectly interchangeable, the latter approach sacrifices syndrome-specific nuances of their measurement. In our study, overlapping symptoms' bivariate correlations never exceeded $r = .85$ because each disorder's criteria required slightly different behaviors, duration, impairment, and/or onset criteria.

Model estimation—Because the observed indicators were dichotomous, a tetrachoric correlation matrix was analyzed, with a robust estimator appropriate for non-normal data (Weighted Least Squares with Mean and Variance adjustment, WLSMV, as implemented in *Mplus* 4.1 (Muthén & Muthén, 1998–2006).

Model evaluation—Each model was evaluated according to four criteria: (1) absolute fit (mean- and variance-adjusted chi-square statistic that corrects for non-normality); (2) relative fit indices (Comparative Fit Index, CFI; Tucker-Lewis Index, TLI); (3) the Root Mean Square Error of Approximation (RMSEA), which estimates discrepancy between model-implied and population covariance matrices; and (4) residual-based fit indices (Weighted Root Mean Squared Residual, WRMR). With binary indicators and $N \geq 250$, suggested guidelines demarcating good fit are: CFI $\geq .96$, TLI $\geq .95$ RMSEA $\leq .05$; WRMR ≤ 1.0 (Yu & Muthén, 2002). Component fit was also evaluated (i.e., size and significance of standardized loadings).

Next, a sequence of inferential nested model tests was performed on the set of emotional-syndrome models, and on the set of disruptive-syndrome models, to identify the best-fitting model in each domain. We performed the minimum possible number of inferential tests that still enabled us to fulfill our study's second aim. In all, three tests were performed on the set of emotional-syndrome models, and three tests were performed on the set of disruptive-syndrome models. Specifically, for each set, first the *DSM-IV model* was compared to the more complex of the two *Child–Adolescent Models* (with more complex referring to having more factors). Second, the better-fitting model of these two was then compared to the second, less complex, *Child–Adolescent Model*. Third, the better-fitting of these two was compared to the *Undifferentiated (one-factor) model*. Model selection employed mean- and variance- adjusted χ^2 difference tests to compare the more restricted (i.e., less differentiated) model to the less restricted model within which it was nested. A significant difference in the χ^2's indicates that the more differentiated model fits the data better than the less differentiated.

The final composite model would ideally then be cross-validated in an independent sample, but no such sample was available. We, therefore, adopted the next best alternative – evaluating the composite model *descriptively* only. In theory, application of *inferential* tests to the composite model, such as the RMSEA or the chi-square test of absolute fit, could inflate Type I error due to incremental improvements in fit arising from comparing and selecting the best-fitting sub-models before fitting the composite model (capitalization on chance). Although inflated Type I error is of greatest concern when initial models are poorly fitting and model comparisons result in large improvements in fit (neither of which are the case here), some inflation of Type I error would still be likely.

Prior analyses of this dataset found no prominent differences in comorbidity, diagnostic prevalence, or scale score reliabilities across gender, race, or age (Egger et al., 2006), and so invariance testing across gender, race, and age was not conducted. Such multiple- group models, moreover, would have been infeasible because our moderate sample size and low frequency of many clinical symptoms gives rise to empty cells.

Results

Overall absolute, relative, and residual-based fit, as well as component fit, for each of the four nested emotional-syndrome models and four nested disruptive- syndrome models is presented in Table 2. All DSM symptoms in all models loaded positively and significantly on their designated DSM syndromes.

Emotional-syndrome models

Descriptive summary—The *DSM-IV model (SOC,- SAD, GAD, MDD)* and the *3-factor Child–Adolescent model (SOC, SAD, GAD/MDD)* both had good absolute fit (χ^2, $p > .05$). Good absolute fit implies (a) factor loadings fixed to *zero* – including all possible cross loadings – are evidently near-zero in the sample data, (b) high factor loadings are *not* an artifactual byproduct of high inter-factor correlations; and (c) the null hypothesis of perfect model fit cannot be rejected. Both of these models also had good relative fit (CFI ≥ .96, TLI ≥ .95) residual fit (WRMR ≤ 1.0), and low error of approximation (RMSEA < .05). The overall fit of the *2-factor Child-Adolescent model (MDD, all-anxiety-disorders)* and the *Undifferentiated* model were mixed: both showed borderline relative fit (CFI of .96), and the *Undifferentiated* model showed poor absolute fit. Residual-based fit, component fit, and RMSEA were still acceptable, however. While these indices generally preferred the *DSM-IV* or *3-factor* models over the *2-factor* or *Undifferentiated* models, we employed inferential nested chi-square difference testing to select the best fitting model.

Inferential model comparison—When the *DSM-IV model (SAD, SOC, MDD, GAD)* was compared to the *2-factor (MDD, all-anxiety-disorders)* model, the *DSM-IV model* showed significantly better fit (χ^2 (4, $N = 307$) = 19.042, $p = .0008$). This indicates that there was no support for collapsing the three anxiety disorders into a unidimensional construct. When the *DSM-IV* model was compared to the *3-factor (SOC, SAD, GAD/MDD*) model, the *DSM-IV* model did *not* show significant improvement in fit. This indicates that generalized anxiety could not be statistically differentiated from depression (χ^2 (2, $N = 307$) = .243, $p = .88$) after accounting for overlapping symptoms. This result corroborates a correlation, within rounding of 1.0, between GAD and MDD latent factors in the 4-factor model. In the preferred *3-factor* model, latent syndrome correlations were: GAD/MDD with SAD, $r = .77$; GAD/MDD with SOC, $r = .75$; and SAD with SOC, $r = .65$. All these correlations were significant ($p < .01$). Since the *Undifferentiated* model fit significantly worse than the preferred *3-factor* model (χ^2 (3, $N = 307$) = 18.18, $p = .0004$), we concluded that the *3-factor* model for emotional syndromes was preferable statistically.

Disruptive syndrome models

Descriptive summary—Good relative fit, residual-based fit, and error of approximation was found for the *DSM-IV model (ODD, CD, ADHD)*, the *4-factor model (ODD, CD, HI, I)*, and the *3-factor model (ODD/CD, HI, I*), as shown in Table 2. Yet, we could reject the null hypothesis of perfect absolute fit for all these models (χ^2 $p = .03$ or .02). Although χ^2 is adjusted for binary outcomes, strong non-normality (as found for the CD symptoms physical cruelty to animals or people) could still lower type I error and lead to an over-rejection of properly specified models (Yu & Muthén, 2002). This may explain why these models were found to be well-fitting according to all other overall fit criteria. In contrast, the *Undifferentiated* model showed poor RMSEA, poor residual-based fit, and borderline relative fit (CFI of .96).

Inferential model comparison—First, the fit of the *DSM-IV model (ODD, CD, ADHD)* was compared to the *4-factor Child–Adolescent model* (*ODD, CD, HI, I)*. The *4-factor* model showed significantly better fit than the *DSM-IV model* (χ^2 (3, $N = 307$) = 14.88, $p = .002$), indicating that ADHD is not a unitary syndrome in preschoolers. However, the *4-factor*

model did *not* show significantly better fit than the *3-factor Child-Adolescent model (ODD/CD, HI, I)*, indicating that ODD and CD could not be statistically differentiated from each other, even *after* accounting for their overlapping symptom of lying/blaming (χ^2 (2, N = 307) = 4.31, p = .11). This result is statistically unsurprising given that the ODD and CD latent syndromes from the 4-syndrome model had a correlation, within rounding, of 1.0. The *preferred 3- factor* model evidenced latent syndrome correlations of: I and HI, r = .94; ODD/CD and I, r = .71; ODD/CD and HI, r = .79 (All p < .01). Finally, the *3-factor model* fit significantly better than the *Undifferentiated* model (χ^2 (2, N = 307) = 35.11, p < .0001). Hence, a *3-factor* model for disruptive syndromes was preferable statistically.

Combined emotional and behavioral syndrome models

The preferred 3-factor model of emotional syndromes was combined with the preferred 3-factor model of disruptive syndromes. Correlations between each of the resultant six latent syndromes are shown in Table 3. We briefly present model fit statistics for descriptive purposes: relative fit (CFI = .95; TLI = .95; RMSEA = .05; free parameters = 117; χ^2 (50, N = 307) = 82.59, p = .003; all loadings significant at p < .05). Since the highest correlations between latent syndromes in the final model were between the sub-dimensions of ADHD, and in earlier analyses we showed that combining these sub-dimensions into a single factor significantly decreased fit, there was no need for exploratory comparisons to see whether other factors in the final model could be combined without decrementing fit.

Post-hoc analyses—MDD/GAD evidenced near-equivalent correlations with emotional and disruptive syndromes. Since several researchers (Luby et al., 2003; Egger et al., 2006; Lahey et al., 2004) have suggested that the observed strong relations between mood and disruptive disorders in young children are driven to a large degree by the inclusion of irritability in the criteria for both types of disorder, we reanalyzed our data without taking into account this symptom overlap. When symptom overlap was ignored, ODD and MDD appeared *unidimensional* (undifferentiated) in a bivariate analysis (χ^2 (1, N = 307) = .49, p = .48); but when symptom overlap was accounted for, they were differentiable (χ^2 (1, N = 307) = 4.62, p = .03). Furthermore, significant loadings for irritability remained on each factor after controlling for the symptom's shared method variance.

Discussion

Our first aim here was to shed light on debates about the appropriateness of classifying preschool phenomenology according to the DSM-IV nosology (McClellan & Speltz, 2003; Wilens et al., 2003). We tested whether symptom dimensions underlying seven DSM disorders were differentiated along diagnostically specific lines among preschoolers. We found no support for the idea that preschool psychopathology is essentially undifferentiated, or limited to precursor 'internalizing' and/or 'externalizing' forms. Instead, our results not only indicated that psychopathology in preschoolers is largely differentiated according to DSM syndromes, but also showed that the ways in which preschooler syndrome differentiation departs from the DSM-IV nosology are strikingly similar to those found in older children and adolescents: a lack of separation between GAD and MDD and between ODD and CD, and the splitting of ADHD into two separable (but highly correlated) sub-components – hyperactivity/impulsivity and inattention. Overall the DSM-IV provided as good a description of preschool psychopathology as it does for the mental health problems of older children.

Emotional syndromes

Paralleling factor analytic studies of older children (Lahey et al., 2004) and adults (Kendler et al., 2003; Vollebergh et al., 2001), three emotional syndromes were distinguished among preschoolers (SOC, SAD, GAD/MDD). The unidimensionality of GAD/MDD was not an

artifact of overlapping symptomology, since it persisted after controlling for shared method variance in the overlapping symptoms. Interestingly, however, if we had lacked the symptom coverage required to estimate three separate anxiety disorders (as did Achenbach et al., 2003; Cole et al., 1997; Ollendick & Yule, 1990), we might have erroneously concluded that anxiety and depression are undifferentiated as a result of the $r = .95$ correlation between the depression and the nonspecific-anxiety factor resulting from our *2-factor model*. Our more precise measurement of each anxiety syndrome shows that this high intercorrelation is the by-product of a still higher correlation between GAD and depression.

Disruptive syndromes

Paralleling ADHD and CD/ODD research on older children and adolescents (Glutting et al., 2005; Pillow et al., 1998; Willoughby et al., 2000), three disruptive syndromes were distinguished among preschoolers (hyperactivity/impulsivity, inattention, and ODD/CD). The multidimensionality of ADHD seems not to be a mere artifact of a subcluster of ADHD items that were both highly related and common in our data, because all symptoms loaded significantly and substantially on their appropriate disorders. Our undifferentiated preschool ODD/CD factor is consistent with prior research suggesting that, among older children and adolescents, these are subsets of a unitary construct (as in ICD-10), and that ODD is a developmental precursor of adolescent CD (e.g., Loeber et al., 1993). Our undifferentiated preschool ODD/CD factor appears, at first sight, to contrast with the findings of Burns et al. (1997). However, in their work, CD and ODD syndromes were found to be differentiable only after CD's symptom set was reduced to the few symptoms that did not significantly correlate with ODD or ADHD (i.e., 4 overt aggression symptoms); if they had retained the 10 DSM indicators of CD used here (encompassing overt aggression, destruction of property or objects, and deceitfulness), our results might have been quite similar. Future item analyses of conduct disorder symptoms among preschoolers are warranted to build consensus on developmentally appropriate CD items and to test whether these differentially predict outcomes above and beyond those predicted by ODD.

Comorbidity

When the emotional and disruptive syndromes were combined in our final model, six distinct syndromes were supported, that, if combined further, would have resulted in decrements to model fit. Their moderate-to- high intercorrelations affirm Lahey et al.'s (2004) assertion that 'substantial intercorrelation' is an 'inherent characteristic' of psychopathology across development (p. 377). These correlations between *latent* syndromes were higher than previous *observed*-syndrome correlations (e.g., Lavigne et al., 1996); the latter are attenuated by unreliability.

Limitations

Since we had only a moderate-sized sample, analyses were limited to common Axis I disorders that had often been used in prior CFA analyses on older children. It would have been desirable to include more anxiety disorders; however, prevalence rates of obsessive compulsive disorder and post traumatic stress disorder were extremely low in our sample (<1%) and their inclusion in analyses would have led to estimation problems. A larger sample would also have permitted us to break our sample into sub-groups and perform measurement invariance testing by age, gender, and ethnicity. Additionally, assessment of overall model fit for the composite emotional and disruptive disorders model awaits cross-validation in an independent sample. Although we have drawn qualitative parallels between our results and previously published findings on older children, statistically quantifying the degree of developmental differences in syndrome differentiation between a best-fitting CFA for preschoolers and a best-fitting CFA

for older children is another matter, requiring invariance testing on a cross-age multiple group structural equation model.

Our symptom data were obtained solely from parental report, and the children solely from a pediatric clinic. However, recruited children were seen at the clinic both for well-and sick-child visits, and our sample demographics were similar to those of the area where the clinic is located. Furthermore, the distribution of these children's CBCL scores closely matched reported general population norms (Achenbach & Rescorla, 2000).

Conclusions

Whereas our results suggest that it is as valid to apply the DSM-IV nosology to preschoolers as it is to apply it to older children or adolescents, construct validity is of course a multifaceted process. We have focused on only one component, symptom differentiation, and one set of behaviors nested within one psychiatric assessment approach. Nonetheless, this study provides initial evidence supporting the use of a common nosological system across a wide age range. This is an important point because use of a common system facilitates exploration of homotypic and heterotypic continuity more readily than would the employment of a preschool-specific classification.

Acknowledgments

This project was supported by grants from the NIMH (R01 MH-63670 (Dr Angold) and K23 MH-02016 (Dr. Egger)) and a Pfizer Faculty Scholars Award in Clinical Epidemiology (Dr. Egger). The authors thank Kristopher Preacher for helpful comments on an earlier draft.

References

Achenbach T, Dumenci L, Rescorla L. *DSM*-oriented and empirically based approaches to constructing scales from the same item pools. Journal of Clinical Child and Adolescent Psychology 2003;32:328–340. [PubMed: 12881022]

Achenbach, TM.; Rescorla, LA. Manual for the ASEBA preschool forms & profiles. Burlington, VT: University of Vermont Department of Psychiatry; 2000.

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders: Fourth Text Revision. Washington DC: American Psychiatric Press; 2000.

Angold A, Costello EJ. Toward establishing an empirical basis for the diagnosis of oppositional defiant disorder. Journal of the American Academy of Child and Adolescent Psychiatry 1996;35:1205–1212. [PubMed: 8824064]

Angold A, Costello EJ. The child and adolescent psychiatric assessment. Journal of the American Academy of Child and Adolescent Psychiatry 2000;39:39–48. [PubMed: 10638066]

Angold, A.; Egger, H. Psychiatric diagnosis in preschool children. In: DelCarmen-Wiggins, R.; Carter, A., editors. Handbook of infant, toddler, and preschool mental health assessment. New York: Oxford University Press; 2004. p. 132-139.

Bauermeister J. Factor analyses of teacher ratings of attention-deficit/hyperactivity and oppositional defiant symptoms in children aged four through thirteen years. Journal of Clinical Child Psychology 1992;21:27–34.

Burns G, Walsh J, Patterson D, Holte C, Sommers-Flanagan R, Parker C. Internal validity of the disruptive behavior disorder symptoms: Implications from parent ratings for a dimensional approach to symptom validity. Journal of Abnormal Child Psychology 1997;25:307–319. [PubMed: 9304447]

Cole D, Truglio R, Peeke L. Relation between symptoms of anxiety and depression in children: A multitrait–multimethod–multigroup assessment. Journal of Consulting and Clinical Psychology 1997;65:110–119. [PubMed: 9103740]

Earls F. Application of DSM-III in an epidemiological study of preschool children. American Journal of Psychiatry 1982;139:242–243. [PubMed: 7055303]

Egger, HL.; Angold, A. The preschool age psychiatric assessment (PAPA): A structured parent interview for diagnosing psychiatric disorders in preschool children. In: DelCarmen-Wiggins, R.; Carter, A., editors. Handbook of infant, toddler, and preschool mental health assessment. New York: Oxford University Press; 2004. p. 223-243.

Egger H, Angold A. Common etiological and behavioral disorders in preschool children: Presentation, nosology and epidemiology. Journal of Child Psychology and Psychiatry 2006;47:313–337. [PubMed: 16492262]

Egger H, Erkanli A, Keeler G, Walter B, Potts E, Angold A. The test–retest reliability of the Preschool-Age Psychiatric Assessment. Journal of the American Academy of Child and Adolescent Psychiatry 2006;45:538–549. [PubMed: 16601400]

Eley TC, Bolton D, O'Connor TG, Perrin S, Smith P, Plomin R. A twin study of anxiety-related behaviours in pre-school children. Journal of Child Psychology and Psychiatry 2003;44:945–960. [PubMed: 14531577]

Faraone S, Biederman J, Keenan K, Tsuang M. Separation of DSM-III attention deficit disorder and conduct disorder: Evidence from a family-genetic study of American child psychiatric patients. Psychological Medicine 1991;21:109–121. [PubMed: 2047486]

Frick P, Lahey B, Loeber R, Stouthamer-Loeber M, Christ M, Hanson K. Familial risk factors to oppositional defiant disorder and conduct disorder: Parental psychopathology and maternal parenting. Journal of Consulting and Clinical Psychology 1992;60:49–55. [PubMed: 1556285]

Glutting J, Youngstrom E, Watkins M. ADHD and college students: Exploratory and con- firmatory factor structures with student and parent data. Psychological Assessment 2005;17:44–55. [PubMed: 15769227]

Hartman CA, Mellenbergh GJ, Boyle MH, Offord DR, Racine Y, McNamee J, et al. DSM-IV internal construct validity: When a taxonomy meets data. Journal of Child Psychology and Psychiatry 2001;42:817–836. [PubMed: 11583254]

Keenan K, Shaw D, Walsh B, Delliquadri E, Giovannelli J. DSMR-III disorders in preschool children from low-income families. Journal of the American Academy of Child and Adolescent Psychiatry 1997;36:620–627. [PubMed: 9136496]

Kendler K, Prescott C, Meyers J, Neale M. The structure of genetic and environmental risk factors for common psychiatric and substance abuse disorders in men and women. Archives of General Psychiatry 2003;60:929–937. [PubMed: 12963675]

Lahey B, Applegate B, Waldman I, Loft J, Hankin B, Rick J. The structure of child and adolescent psychopathology: Generating new hypotheses. Journal of Abnormal Psychology 2004;113:358–385. [PubMed: 15311983]

Lavigne JV, Gibbons RD, Christoffel KK, Arend R, Rosenbaum D, Binns H, Dawson N, Sobel H, Issacs C. Prevalence rates and correlates of psychiatric disorders among preschool children. Journal of the American Academy of Child and Adolescent Psychiatry 1996;35:204–214. [PubMed: 8720630]

Loeber R, Keenan K, Lahey BB, Green SM, Thomas C. Evidence for developmentally based diagnoses of oppositional defiant disorder and conduct disorder. Journal of Abnormal Child Psychology 1993;21:377–410. [PubMed: 8408986]

Luby J, Heffelfinger A, Mrakotsky C, Brown K, Hessler M, Wallis J. The clinical picture of depression in preschool children. Journal of the American Academy of Child and Adolescent Psychiatry 2003;42:340–348. [PubMed: 12595788]

MacCallum RC, Widaman KF, Zhang S, Hong S. Sample size in factor analysis. Psychological Methods 1999;4:84–99.

McClellan J, Speltz M. Psychiatric diagnosis in preschool children. Journal of the American Academy of Child and Adolescent Psychiatry 2003;42:127–128. [PubMed: 12544170]

Muthén, LK.; Muthén, BO. Mplus User's Guide. 3. Los Angeles, CA: Múthen & Múthen; 1998–2006.

Ollendick TH, Yule W. Depression in British and American children and its relation to anxiety and fear. Journal of Consulting and Clinical Psychology 1990;58:126–129. [PubMed: 2319046]

Pillow D, Pelham W, Hoza B, Molina B, Stultz C. Confirmatory factor analyses examining attention deficit hyperactivity disorder symptoms and other childhood disruptive behaviors. Journal of Abnormal Child Psychology 1998;4:293–310. [PubMed: 9700521]

Sass DA, Smith PL. The effects of parceling unidimensional scales on structural parameter estimates in structural equation modeling. Structural Equation Modeling 2006;13:566–586.

Spence S, Rapee R, McDonald C, Ingram M. The structure of anxiety symptoms among preschoolers. Behavior Research and Therapy 2001;39:1293–1316.

Task Force on Research Diagnostic Criteria: Infancy and Preschool. Research diagnostic criteria for infants and preschool children: The process and empirical support. Journal of the Academy of Child and Adolescent Psychiatry 2003;42:1504–1512.

Van den Oord E, Pickles A, Waldman I. Normal variation and abnormality: An empirical study of the liability distributions underlying depression and delinquency. Journal of Child Psychology and Psychiatry 2003;44:180–192. [PubMed: 12587855]

Vollebergh W, Iedema J, Bijl R, de Graaf R, Smit F, Ormel J. The structure and stability of common mental disorders. Archives of General Psychiatry 2001;58:597–603. [PubMed: 11386990]

Wilens T, Biederman J, Spencer T, Monuteaux M. Psychiatric diagnosis in preschool children: Reply. Journal of the American Academy of Child and Adolescent Psychiatry 2003;42:128–129.

Willoughby M, Curran P, Costello E, Angold A. Implications of early versus late onset of attention-deficit/hyperactivity disorder symptoms. Journal of the American Academy of Child and Adolescent Psychiatry 2000;39:1512–1519. [PubMed: 11128328]

World Health Organization. The ICD-10 classification of mental and behavioral disorders: Diagnostic criteria for research. Geneva: WHO; 2006.

Yu, C.; Muthén, B. Unpublished Dissertation. University of California; Los Angeles: 2002. Evaluation of model fit indices for latent variable models with categorical and continuous outcomes.

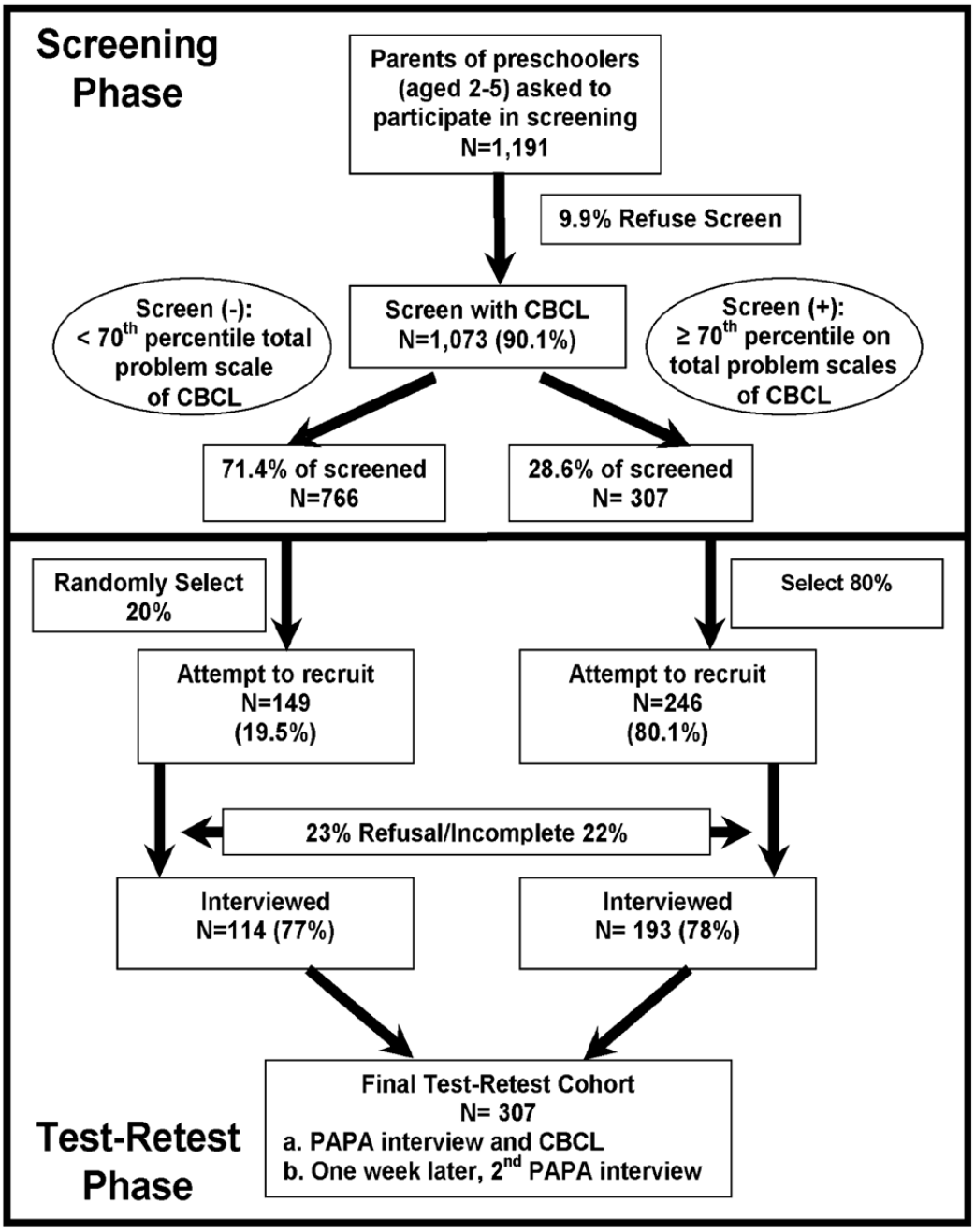

Figure 1.
Overview of study design

Table 1

Characteristics of the PTRTS participants compared to the surrounding community

	PARTS		
	Screen[a]	Interview[a]	Durham County[b]
Overall N	1,073	307	223,314
Gender			
Female	49%	46%	48%
Male	51%	54%	52%
Age			
2 year olds	51%	30%	N/A
3 year olds	21%	24%	
4 year olds	26%	24%	
5 year olds	23%	22%	
Race/ethnicity			
AA/black	58%	55%	40%
White/non-Hispanic	32%	35%	48%
Hispanic	2%	2%	8%
Asian	2%	1%	3%
Native American	0.3%	0.3%	0.3%
Other	6%	7%	6%
Medicaid/Medicare	43%	54%	33%
Headstart/Early Headstart	5%	9%	4%
Family income <$15,000/yr	25%	31 %	17%
Full time parental employment	63%	63%	61%
Parent education			
Some HS	14%	9%	22%
HS graduate	20%	30%	28%
Some college	35%	30%	27%
4 yr. college or>	32%	31%	23%

[a] unweighted percentages;

[b] Information from the 2000 Census Report (factfinder.census.gov);

AA = African American; PTRTS = PAPA test-retest study; HS = high school

Table 2

Absolute, relative, and component model fit for alternative model sets

	χ^2	DF	#free parms	*p*-value	CFI	TLI	RMSEA	WRMR	Stand. loading range	Unstand. loading Range
Emotional-syndrome models 1–4										
DSM-IV (SOC SAD MDD GAD)	45.93	37	55	0.15	0.97	0.97	0.03	0.86	.39*–.84*	.43*–1.53*
SOC SAD MDD/GAD (3 factor)	**45.53**	**37**	**52**	**0.16**	**0.97**	**0.97**	**0.03**	**0.86**	**.40*–.84***	**.44*–1.57***
SOC/SAD/GAD MDD (2 factor)	50.79	37	50	0.07	0.96	0.96	0.04	0.92	.39*–.79*	.41*–1.56*
SOC/SAD/GAD/MDD (1 factor)	50.87	37	49	.0001	0.96	0.96	0.04	0.92	..38*–.82*	.40*–1.43*
Disruptive-syndrome models 1–4										
DSM-IV (ODD CD ADHD)	51.55	33	66	0.02	0.98	0.98	0.04	0.95	.40*–.92*	.44*–2.35*
ODD CD HI I (4 factor)	48.77	32	69	0.03	0.98	0.98	0.04	0.94	.40*–.93*	.44*–2.60*
ODD/CD HI I (3 factor)	**48.91**	**32**	**66**	**0.03**	**0.98**	**0.98**	**0.04**	**0.94**	**.42*–.93***	**.46*–2.59***
ODD/CD/ADHD (1 factor)	62.34	32	63	.001	0.96	0.96	0.06	1.07	.43*–.91*	.42*–2.22*

Notes: SOC (social phobia); MDD (major depression); GAD (generalized anxiety); SAD (separation anxiety); ODD (oppositional defiant); CD (conduct); ADHD (attention deficit hyperactivity); HI (hyperactivity-impulsivity); I (inattention); #free parms = number of free parameters; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = Root Mean Squared Error of Approximation. WRMR = weighted root mean square residual.

* $p < .05$.

J Child Psychol Psychiatry. Author manuscript; available in PMC 2010 April 12.

Table 3

Estimated latent correlation matrix of final 6-disorder model

	MDD/GAD	SAD	Inattention	Hyper/Imp	SOC	ODD/CD
MDD/GAD	–					
SAD	.72*	–				
Inattention	.86*	.41*	–			
Hyper/Imp	.89*	.48*	.94*	–		
SOC	.76*	.65*	.46*	.41*	–	
ODD/CD	.80*	.59*	.71*	.80*	.59*	–

Notes. MDD/GAD = depression/generalized anxiety; SAD = separation anxiety; Hyper/Imp = Hyperactivity/Impulsivity; SOC = social phobia; ODD/CD = oppositional-defiant/conduct disorder.

*$p < .01$.

J Child Psychol Psychiatry. Author manuscript; available in PMC 2010 April 12.