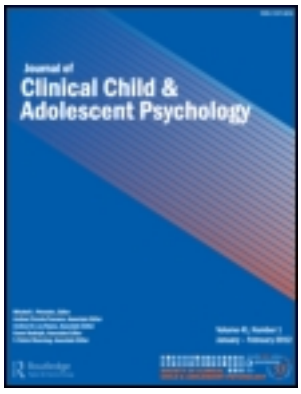

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Association of Anxiety and ODD/CD in Children With and Without ADHD

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Association of Anxiety and ODD/CD in Children With and Without ADHD

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The goal of this study is to examine levels of oppositional defiant disorder (ODD) and conduct disorder (CD) in four groups of children: attention-deficit/hyperactivity disorder (ADHD) only, anxiety only, ADHD and anxiety, and controls (i.e., non-ADHD youth). Although children with ADHD exhibit more ODD and CD than non-ADHD youth, it is unknown if anxiety is associated with increased or decreased ODD and CD in children with ADHD. We examined parent and teacher ratings of ODD and CD from the Disruptive Behavior Disorder Rating Scale in 203 school age children (ages 6–9); 70% were male, and 47% were Caucasian. Children were divided into four diagnostic groups based on ADHD and anxiety status from the Diagnostic Interview Scale for Children. According to parents, children with ADHD and anxiety had the highest levels of ODD/CD, followed by children with ADHD only (i.e., without anxiety). Children with anxiety only and controls had lowest ODD and CD scores, and these groups did not differ from each other. The same patterns were found according to teacher report, except that the anxiety only group had significantly lower levels of ODD than non-ADHD controls. Further, combined type ADHD youth with anxiety exhibited the highest levels of ODD and CD compared to all other groups. Comorbid anxiety may strengthen the association of ADHD and ODD/CD, particularly in the combined subtype. We discuss the importance of comorbid anxiety to the development of externalizing problems as well as potential explanatory factors underlying elevated ODD and CD among children with ADHD and anxiety.

Attention-deficit/hyperactivity disorder (ADHD) is defined by extreme and impairing levels of inattention and/or hyperactivity (American Psychiatric Association [APA], 1994). ADHD-related deficits are highly persistent, with as many as 40% of individuals with ADHD prematurely dropping out of school and 70% to 80% significantly underperforming at work (Barkley, 2002). ADHD is associated with elevated rates of comorbidity (Biederman et al., 2008; Frick et al., 1991), particularly with oppositional defiant disorder (ODD) and conduct disorder (CD) (Angold, Costello, & Erkanli, 1999). ODD and CD are conceptualized as falling on a developmentally sensitive spectrum, with CD typically consisting of more severe conduct problems that emerge later in development than ODD (Loeber, Lahey, & Thomas, 1991).

Although studies of comorbidity in ADHD have largely focused on ODD/CD, children with ADHD often exhibit internalizing disorders. There is meta-analytic

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evidence that ADHD probands were 3 times more likely to have an anxiety disorder than children without ADHD (Angold et al., 1999). Point estimates of ADHD and anxiety comorbidity (ADHD+Anx) ranged from 25% to 33% (Biederman, Newcorn, & Sprich, 1991; Jensen, Martin, & Cantwell, 1997; March et al., 2000). Although rates of comorbid anxiety in children with ADHD are well characterized, the behavioral and clinical correlates in ADHD+Anx youth relative to nonanxious ADHD youth are not well known. Children with ADHD+Anx exhibited more mood disorders, school fears, and less social competence than children with ADHD only or anxiety only (Bowen, Chavira, Bailey, Stein, & Stein, 2008; Mikami, Ransone, & Calhoun, 2011); the ADHD+Anx group also showed worse school functioning and received more mental health services than ADHD only and anxiety only youth (Hammerness et al., 2010). Beyond impairment, children with ADHD+Anx exhibited more sluggish cognitive tempo and working memory deficits than children with ADHD only (Pliszka, 1989). Given the fact that comorbidity in ADHD influences outcome and treatment response, some have argued that comorbidity should be used to subtype ADHD (Biederman et al., 1991; Jensen et al., 1997).

Of interest, there is evidence that anxiety may inhibit aggression. One study of 177 seven- to 12-year-old children found that individuals with CD and comorbid anxiety were rated by peers as less mean and aggressive, and these children had fewer school suspensions and police contacts than nonanxious CD youth (Walker, Lahey, Russo, & Frick, 1991). Similarly, social anxiety predicted reduced aggression during an experimental task in which college students administered prolonged noise blasts to a factitious opponent (DeWall, Buckner, Lambert, Cohen, & Fincham, 2010). Theories have proposed that fearful inhibition or the absence of anxiety is necessary to the development of externalizing problems (Cleckley, 1941/1982) and that anxiety may *inhibit* ODD/CD. However, the relationship between anxiety and ODD/CD may mask more complex associations. For example, whereas ODD/CD were positively associated with trait anxiety, callous-unemotional traits demonstrated a negatively association (Frick, Lilienfield, Ellis, Loney, & Silverthorn, 1999). Finally, children with ADHD+Anx had superior inhibitory control compared to children with ADHD only (Epstein, Goldberg, Conners, & March, 1997). Considering the potential mitigating effects of anxiety on ODD/CD (DeWall et al., 2010; McIntyre & Wolf, 1973; Walker et al., 1991) and the suppressive role anxiety played on impulsivity/hyperactivity and response inhibition among ADHD youth (Epstein et al., 1997; Pliszka, 1989, 1992), comorbid anxiety may be associated with lower levels of ODD/CD among children with ADHD.

To characterize the nature of ADHD, with and without comorbid anxiety, on multi-informant measures of ODD and CD scores, we examined four diagnostic groups of 6- to 9-year-old children: (a) anxiety disorder only, (b) ADHD only, (c) ADHD+Anx, and (d) controls (i.e., neither ADHD nor anxiety). We aimed to examine early manifestations of ADHD, anxiety, and externalizing problems, given that early identification of these behaviors is important for identifying groups at risk for further problems and potential targets for intervention and/or prevention. We examined formal diagnoses of ADHD and anxiety given that impairment was required, thus transcending simple individual differences in traits. Recent work on the possible mitigating or exacerbating effects of anxiety on externalizing problems suggests that additional comorbid disorders, including ADHD, may share common risk processes (Drabick, Ollendick, & Bubier, 2010). Accordingly, we examined four distinct groups of children to determine patterns of ODD/CD based on anxiety, ADHD, and their co-occurrence. Furthermore, given previous evidence that ODD/CD varied significantly by ADHD subtype (Eiraldi, Power, & Nezu, 1997), we included secondary analyses to test whether ADHD subtypes were differentially associated with patterns of ODD and CD, for children with and without anxiety.

METHOD

Participants

Participants were 203 (70% male) 6- to 9-year-old children ($M = 7.36$, $SD = 1.07$) with ($n = 102$) or without ($n = 101$) ADHD (see Table 1). Forty-seven percent of the sample was Caucasian, 8% African American, 9% Hispanic, 3% Asian, 21% mixed, and 12% as Other or missing. Participants were recruited using presentations to self-help groups for ADHD, advertisements mailed to local elementary schools, pediatric offices, clinical service providers, and some referrals from mental health clinics. English fluency was required for parents and children. Exclusion criteria for all participants consisted of a Full Scale IQ less than 70 or pervasive developmental, seizure, or neurological disorder that prevented full participation in the study.

Diagnostic status (i.e., ADHD vs. control) was based on the Diagnostic Interview Schedule for Children, 4th edition (DISC–IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), a fully structured diagnostic interview with the parent keyed to the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed. [*DSM–IV*]; APA, 1994) criteria for ADHD. Anxiety disorder status was similarly ascertained by a positive diagnosis on the DISC. To improve the external validity of the ADHD

TABLE 1
Demographics by ADHD and Anxiety Disorder Status

Variable	*Control (A)*	*Anx-Only (B)*	*ADHD Only (C)*	*ADHD+Anx (D)*	*ANOVA F or* χ^2	*p*
N	75	26	60	42		
Age	7.97 (0.13)	7.87 (0.23)	7.80 (0.15)	7.67 (0.18)	0.67	.57
Gender (% Male)	65%	69%	73%	81%	3.40	.33
Race/Ethnicity (% White)[a]	54%	50%	54%	46%	0.75	.86
Maternal Education (% College Graduates)	81%	81%	72%	67%	4.00	.26
Family Income (% earned $75,000 or higher)	68%	65%	66%	63%	0.28	.96

Note: Mean (*SE*) unless indicated as percentage. ADHD = attention-deficit/hyperactivity disorder; ANOVA = analysis of variance.
[a]Percentages based on those that provided a response.

probands, participants with comorbid disorders (e.g., depression) were not excluded from participating. Similarly, to avoid recruiting an improbably high-functioning control group, which could exaggerate diagnostic group differences, control children who met criteria for any disorder other than ADHD were allowed to participate. Thirty-one percent of the sample met criteria for oppositional defiant disorder, 4% for conduct disorder, and 0.5% for depression. To ascertain the association of ADHD, anxiety, and their comorbidity on dimensional ODD and CD scores, we created four groups of children: (a) no ADHD or anxiety (controls; $n = 75$); (b) at least one anxiety disorder, but no ADHD (Anx-only; $n = 26$); (c) ADHD, but no anxiety (ADHD only; $n = 60$); and (d) ADHD and anxiety (ADHD+Anx; $n = 42$).

Procedures

Study eligibility was determined through an initial telephone screening. After eligibility was established, parents completed behavior rating scales and families visited our research laboratory for in-person assessments of child behavior and family interaction. Each child's teacher was invited to complete rating scales with 126 (62%) children having complete parent and teacher data. No significant differences were found for demographic variables as well as independent or dependent variables among children with versus without teacher data. Whenever possible, children were assessed in our lab without psychotropic medication (e.g., stimulants). If a child was normally medicated, we asked that parents and teachers provide ratings based on the child's unmedicated behavior. Similar procedures have been used in other ADHD studies, including the Multimodal Treatment Study of ADHD (Hinshaw et al., 1997; Lee, Lahey, Owens, & Hinshaw, 2008). Prior to the assessment, all interviewers were blind to the child's diagnostic status. Assessors obtained written consent from all parents and written assent from all children. Children were reminded that participation was optional, and that they could choose to stop at any time. These procedures were approved by the UCLA Institutional Review Board.

Measures

DISC–IV (Shaffer et al., 2000). To ascertain whether children met *DSM–IV* criteria for ADHD and/or for an anxiety disorder, we administered the computerized DISC–IV to each participant's parent using graduate students and advanced undergraduates who underwent 2 days of assessment training. This fully structured interview probes required symptom levels, duration/persistence, age of onset, and functional impairment. The distribution of anxiety disorders was as follows: specific phobia ($n = 69$), separation anxiety disorder ($n = 15$), generalized anxiety disorder ($n = 8$), social phobia ($n = 7$), obsessive-compulsive disorder ($n = 6$), posttraumatic stress disorder ($n = 3$), agoraphobia ($n = 1$), and panic disorder ($n = 1$). Sixteen children met criteria for two or more anxiety disorders. Test–retest reliability for ADHD from the DISC ranged from .51 and .64 in the *DSM–IV* Field Trials (Lahey et al., 1994) and diagnostic designations from the DISC showed predictive validity in other studies of children with versus without ADHD (Lee et al., 2008).

Disruptive behavior disorder rating scale (DBD; Pelham, Gnagy, Greenslade, & Milich, 1992). This is 45-item rating scale of child ADHD, ODD, and CD *DSM–IV* symptoms was completed by parents and teachers. Ratings ranged from 0 (*not at all*) to 3 (*very much*), resulting in separate total scores for ODD and CD. The M was 6.18 ($SD = 4.93$) for ODD and 1.55 ($SD = 2.21$) for CD for parent ratings and $M = 5.30$ ($SD = 5.83$) for ODD and $M = 1.78$ ($SD = 3.28$) for CD for teacher ratings. Teacher and parent ratings were significantly correlated ($r = .46$ for ODD and $r = .50$ for CD ($ps < .001$). The Cronbach's alpha was .93 and .75 for teacher ratings and .86 and .67 for parent ratings of ODD and CD, respectively. This measure was valid

in previous studies of school-age children with ADHD (Owens & Hoza, 2003).

Data Analysis

To accommodate the skewed distribution of the outcomes, we evaluated differences using a generalized linear model and specified Poisson regression. Controlling for the child's age and sex, family income, and maternal education (see Table 1), we constructed separate models for ODD and CD in relation to a dummy coded group variable, followed by pairwise comparisons on each group's estimated means using Fisher's least significant difference (LSD) post hoc test.

RESULTS

Parent-Reported ODD and CD

Poisson regression suggested significant group differences in levels of ODD (Wald $\chi^2 = 188.07$, $p < .001$). Pairwise comparisons revealed that the ADHD+Anx group had the highest ODD scores relative to all other groups. The ADHD only group had significantly greater levels of ODD than the Anx-only and Control group, which did not differ from another (see Figure 1A). The omnibus test was also significant for CD (Wald $\chi^2 = 87.94$, $p < .001$). Pairwise comparisons yielded identical group differences to ODD: the ADHD+Anx group exhibited the highest levels of CD, followed by the ADHD only group. Each of these two groups had higher levels of CD than both of the Anx-only and control groups, which did not differ from each other (see Figure 1B). We then reanalyzed the model including the number of ADHD symptoms as an additional covariate to determine whether ADHD symptom severity accounted for the differences in levels of ODD and CD between the ADHD and ADHD+Anx groups. The ADHD+Anx group continued to demonstrate significantly higher levels of ODD and CD compared to the ADHD only group (both $ps < .001$).

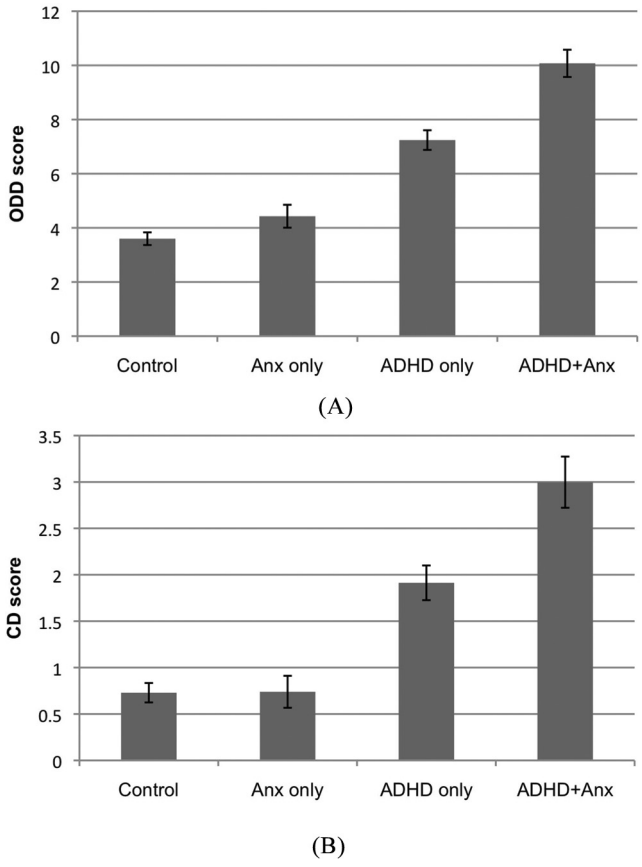

FIGURE 1 Parent-reported oppositional defiant disorder (ODD) (A) and conduct disorder (CD) scores (B) by attention-deficit/hyperactivity disorder (ADHD) and anxiety disorder status. *Note*: Models control for child age, gender, maternal education, and family income.

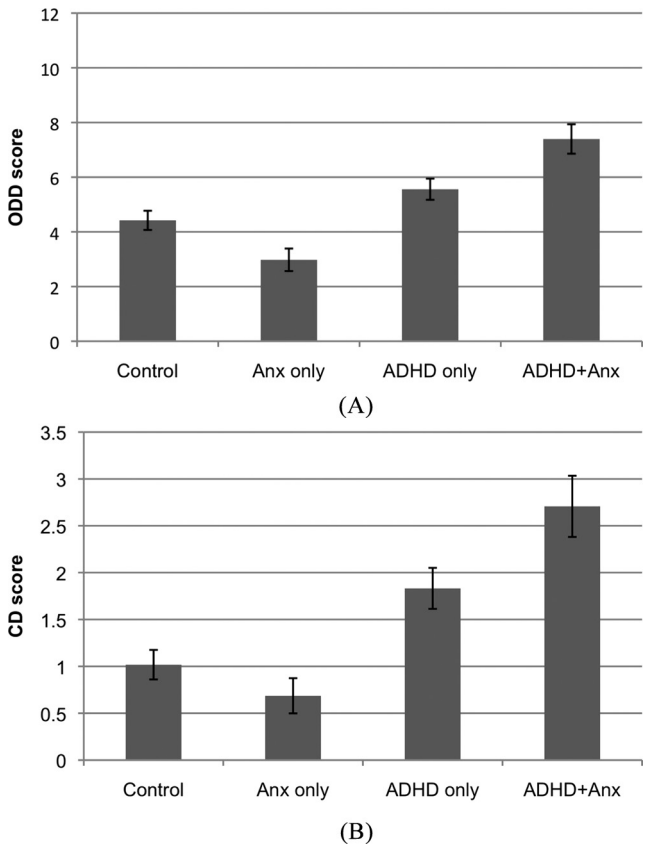

FIGURE 2 Teacher-reported oppositional defiant disorder (ODD) (A) and conduct disorder (CD) scores (B) by attention-deficit/hyperactivity disorder (ADHD) and anxiety disorder status. *Note*: Models control for child age, gender, maternal education, and family income.

Teacher-Reported ODD and CD

Given the importance of multiple informants, we analyzed the same ODD and CD data from the Teacher DBD rating scale. Consistent with findings from the Parent DBD, the omnibus test for the four group variable for ODD was significant, Wald $\chi^2 = 45.73$, $p < .001$. Post hoc comparisons again revealed that the ADHD+Anx group had the highest levels of ODD, followed by the ADHD only group. Unlike parent-reported ODD, however, the control group had the next highest levels of ODD, and the Anx-only group had significantly lower teacher-rated ODD than all other groups (see Figure 2A). For teacher-rated CD, there was a significant omnibus association for diagnostic group, Wald $\chi^2 = 41.22$, $p < .001$, with pairwise comparisons showing that ADHD+Anx had the highest levels of CD, followed by the ADHD only group. The control group and Anx-only group did not differ from each other (see Figure 2B). When the number of ADHD symptoms was controlled, the ADHD+Anx group continued to demonstrate more ODD and CD according to parents and teachers than the ADHD only group (both $ps < .05$).

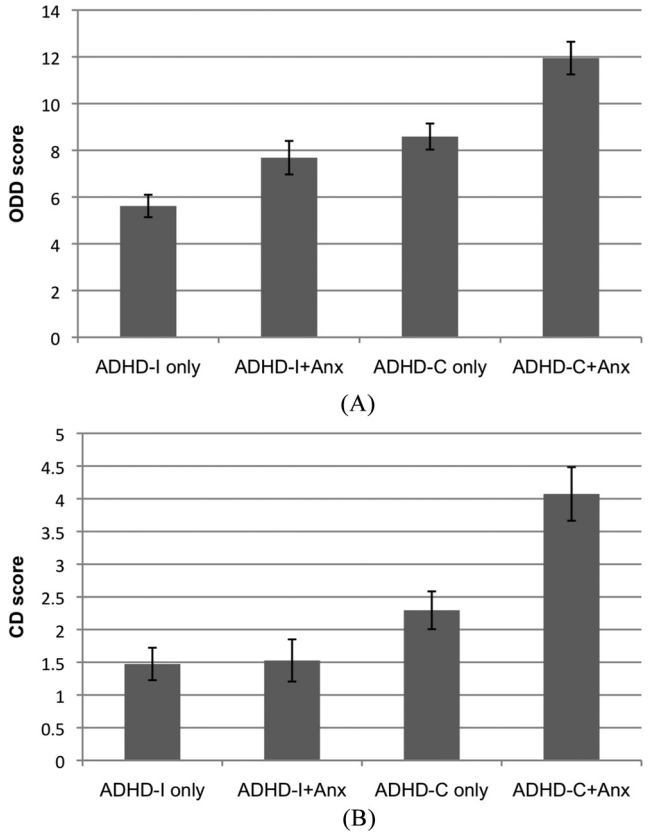

FIGURE 3 Parent-reported oppositional defiant disorder (ODD) (A) and conduct disorder (CD) scores (B) by attention-deficit/hyperactivity disorder (ADHD) subtype and anxiety disorder status. *Note*: Models control for child age, gender, maternal education, and family income.

Analyses Based on ADHD Subtype

To improve the specificity of ADHD and comorbid anxiety with ODD and CD, we compared ADHD Inattentive Type (ADHD-I) versus ADHD Combined Type (ADHD-C) and ADHD Hyperactive-Impulsive Type (ADHD-H), based on evidence that ADHD-H is a frequent precursor to ADHD-C (Lahey, Pelham, Loney, Lee, & Willcutt, 2005). Because of limited teacher data, we focused exclusively on the parent DBD for measures of ODD/CD. The sample size was 26 ADHD-I only, 16 ADHD-I+Anx, 33 ADHD-C only, and 26 ADHD-C+Anx according to subtypes derived from the DISC. The omnibus diagnostic group tests were again significant for ODD (Wald $\chi^2 = 58.37$, $p < .001$) and CD (Wald $\chi^2 = 39.34$, $p < .001$). The LSD post hoc tests demonstrated that the ADHD-C+Anx group had significantly higher levels of ODD than the three other groups (see Figure 3A). This was followed by the ADHD-C only and ADHD-I+Anx groups, which did not differ from each other. The ADHD-I only group had significantly lower levels of ODD than all other groups. For CD, the ADHD-C+Anx group had a significantly higher score than all other groups (see Figure 3B). The ADHD-C only had the next highest score and significantly differed from ADHD-I only.

DISCUSSION

Based on parent and teacher ratings, children with ADHD+Anx clearly demonstrated the highest levels of ODD and CD relative to ADHD only, controls, and Anx-only children. That is, comorbid anxiety was associated with increased ODD and CD in children with ADHD, which is divergent from other studies that found no effect of anxiety (Abikoff et al., 2002), or that anxiety was associated with reduced aggression and CD (Plizka, 1992). Our results suggested that anxiety was associated with increased levels of ODD/CD for children with ADHD, and for children without ADHD, anxiety alone did not affect levels of parent-rated ODD/CD. According to teachers, those children with anxiety-only had lower levels of ODD than controls. Thus, although causal associations cannot be made, it is possible that anxiety may be protective in some contexts and potentially exacerbating in others. The present findings also provide partial support for the theory on the inhibiting role of anxiety on ODD/CD, but only for those children without comorbid ADHD. In addition, the findings of increased levels of ODD/CD in children with both anxiety and ADHD should be

considered in light of previous evidence that children with two or more disorders had more behavior problems than children with ADHD only (Crawford, Kaplan, & Dewey, 2006).

Given important differences by ADHD subtype, including patterns of comorbidity, we examined whether differences in ODD/CD scores were related to ADHD subtype. Dimensions beyond anxiety have yielded consistent sensitivity to ADHD subtypes, including evidence that children with ADHD-C had greater deficits in planning (Klorman et al., 1999), selective memory (Castel, Lee, Humphreys, & Moore, 2011), and increased comorbidity with ODD/CD (e.g., Eraldi et al., 1997) relative to children with ADHD-I. Findings from the current study that levels of ODD/CD were highest among children specifically with ADHD-C and anxiety are consistent with previous work documenting higher levels of problems in children with the combined type of ADHD compared to children with ADHD-I.

If these findings are replicated, future research must identify the explanatory factors underlying increased ODD/CD in the ADHD+Anx group. One potential factor is heightened negative affect, which underlies anxiety (King, Ollendick, & Gullone, 1991) and CD (Rothbart, Ahadi, & Hershey, 1994), including evidence that early affective lability prospectively increases vulnerability to later CD (McKay & Halperin, 2001). Indeed, rates of anxiety and disruptive behavior disorders occur above chance (e.g., Ford, Goodman, & Meltzer, 2003). Social information-processing deficits have been consistently linked to reactive CD (Dodge & Coie, 1987; Lansford, Malone, Dodge, Pettit, & Bates, 2010), and one theory suggests that reactive CD is a precursor to co-occurring anxiety, ADHD, and disruptive behavior (Bubier & Drabrick, 2009). Given that social information-processing deficits may contribute to ODD/CD for ADHD and anxiety, future research should incorporate measures of hostile attribution bias in developmentally sensitive studies of ADHD, anxiety, and ODD/CD. Finally, biological factors may also contribute to ODD/CD in children with ADHD and comorbid anxiety. Among 2- to 4-year-old twins, the phenotypic correlation between anxiety and ODD/CD was mostly accounted by shared environmental factors (65% and 94% of variance for male and female participants, respectively; Gregory, Eley, & Plomin, 2004). However, genetic variation may also be relevant, given that a functional polymorphism of the serotonin transporter gene has been linked to anxiety (Lesch et al., 1996) and aggression (Beitchman et al., 2006). In addition, trait anger, a correlate of ODD/CD, was found to positively correlate with bilateral dorsal amygdala reactivity, but only in men with elevated trait anxiety (Carré, Fisher, Manuch, & Hariri, 2010).

In addition to exploring bottom-up processes related to the associations observed herein, contextual factors may also be relevant. Multiple informants of child behavior from different settings evaluate the consistency of behavior across reporter and context. This is particularly relevant for parents and teachers who observe children in different settings, and who may utilize different standards with respect to appraising children's behavior and their development overall (see De Los Reyes & Kazdin, 2005, for review). Although agreement between parent and teacher ratings of childhood ODD/CD is generally superior to internalizing problems, associations are still modest. Nevertheless, we observed that our findings were quite consistent across reporter/setting: that children with ADHD+Anx had the highest levels of ODD/CD relative to children with ADHD only. Thus, this significant degree of consistency provides compelling evidence that children with ADHD+Anx are more likely to exhibit higher rates of ODD/CD relative to children with ADHD only, anxiety only, or neither disorder.

We conclude with a discussion of study limitations. All eight anxiety disorders were weighted equally, potentially betraying important differences with respect to social functioning or other factors (Kendall et al., 2010). A second limitation is the cross-sectional design, which precluded temporal ordering of constructs, a necessary condition to establish potential causal sequencing (i.e., successive comorbidity, Angold et al., 1999; dynamic comorbidity, Lahey, Loeber, Burke, Rathouz, & McBurnett, 2002). In addition, given that the data from a portion of the children were based only on parent ratings, it is possible that informant differences are partially attributable to unmeasured differences in patterns of data collection. Our findings should be considered in the context of studies of anxiety in children with ADHD+ODD/CD (Gadow & Nolan, 2002). Future research must integrate differentiated measures of anxiety within the context of prospective longitudinal designs to adequately characterize the dynamic and temporal relations among ADHD, anxiety, and ODD/CD, as well as obtain ratings from youth self-report and neutral observers.

Based on a large and ethnically diverse sample of school-age children, we found that children with ADHD+Anx had the highest levels of ODD and CD. This specific group of comorbid children may constitute a uniquely high-risk clinical population that may benefit from early identification, prevention, and intervention. Among this group, those with ADHD-C appear to be at particular risk for externalizing problems. Although internalizing and externalizing problems are frequently conceptualized orthogonally, these findings strongly suggest that ADHD children with clinically significant anxiety are at elevated risk for increased levels of ODD and CD.

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