Association of comorbid anxiety with social functioning in school-age children with and without attention-deficit/hyperactivity disorder (ADHD)

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ABSTRACT

Although attention-deficit/hyperactivity disorder (ADHD) is frequently comorbid with disruptive behavior disorders, less is known about ADHD and comorbid anxiety. To improve understanding about the association of anxiety and social functioning, we studied 223 6 to 9 year-old ethnically diverse boys and girls (M = 7.4 years) with and without ADHD. According to parents, children with ADHD and anxiety (n = 46) and ADHD only (n = 71) were consistently less socially competent than comparison children (i.e., no anxiety and ADHD: n = 80) and children with anxiety only (n = 26), who did not differ from one another. A similar pattern emerged for teacher ratings where youth with ADHD only and ADHD with anxiety exhibited the most social problems, but they did not differ from each other. These data suggest that comorbid anxiety does not exacerbate social dysfunction among 6 to 9 year-old children with ADHD. We consider findings within a developmental psychopathology framework to further understand social development in children with ADHD and anxiety.

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1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is characterized by an early onset of developmentally aberrant and impairing levels of inattentive-disorganized behavior and/or hyperactivity–impulsivity. ADHD prospectively predicts substandard academic achievement, neuropsychological dysfunction, occupational instability, and substance problems (Biederman et al., 2006; Lee et al., 2008; Owens et al., 2009; Lee et al., 2011). Even children who were intensively treated for 14 months (i.e., careful medication evaluation, integrated parent- and school-based interventions) and whose ADHD symptoms improved significantly, showed continued impairment into adolescence (Molina et al., 2008). That is, the clinical significance of ADHD transcends inattention/hyperactivity because ADHD persistently compromises socio-emotional and behavioral functioning over time.

Children with ADHD consistently have higher rates of comorbidity than typically developing children. The meta-analysis of Angold et al. (1999) estimated that children with ADHD were 11 times more likely to have oppositional defiant disorder (ODD) or conduct disorder (CD) than non-ADHD youth and girls with ADHD had more comorbidity with ODD and CD in childhood and in adolescence than girls without ADHD (Hinshaw, 2002; Hinshaw et al., 2006). Although comorbid ODD/CD has been integrated into models of ADHD, there is a gap in knowledge with respect to the nature of ADHD and comorbid anxiety, despite the fact that anxiety frequently co-occurs with ADHD (Biederman et al., 1991; Schatz and Rostain, 2006). ADHD probands were three times more likely to have an anxiety disorder than children without ADHD (Angold et al., 1999) and 33% of the 579 children with combined type ADHD had an anxiety disorder in the Multimodal Treatment Study (MTA) of ADHD (MTA Cooperative Group, 1999). In pediatric samples, ADHD probands were more frequently diagnosed with anxiety than non-ADHD youth (Bowen et al., 2008) and the proportion of ADHD probands (27%) exceeded non-ADHD youth (5%) in the prevalence of multiple anxiety disorders (Spencer et al., 1999). Children with ADHD and anxiety also show divergent patterns of association, including sluggish cognitive tempo and response inhibition than children with ADHD only (Pliszka, 1989, 1992). In the MTA study, children with ADHD and comorbid anxiety responded more favorably to behavioral treatment than ADHD children without anxiety (Jensen et al., 2001). Thus, by virtue of its prevalence and evidence that this group of children is empirically distinct, further research on children with ADHD and comorbid anxiety is warranted.

Social dysfunction in children with ADHD is highly intractable to intervention and it independently predicts and partially mediates long-term negative outcomes, including later CD and substance problems (Greene et al., 1997; Pelham et al., 2005). There is consistent evidence that children with ADHD are not only more rejected by peers (Blachman and Hinshaw, 2002; Hoza et al., 2005), they are perceived by teachers and peers as being less socially competent (DuPaul et al., 2004), they are prone to positively biased self-perceptions (Hoza et al., 2002), and they have fewer friendships (i.e., reciprocal dyadic relationship) (Parker and Asher, 1987; Gresham et al., 1998). Further underscoring its intractability, social dysfunction among children with

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ADHD often persists into adolescence, even if ADHD symptoms improve (Lee et al., 2008; Owens et al., 2009). Thus, early ADHD catalyzes social dysfunction that is often more chronic than the constituent symptoms of ADHD.

Despite evidence that social functioning in children with ADHD and comorbid aggression is significantly worse than children with ADHD only, relatively little is known about whether comorbid anxiety similarly exacerbates social functioning in children with ADHD (Nijmeijer et al., 2008, Hoza et al. (2005)) observed that studies of social functioning in "children with both ADHD and anxiety have [not] often (if ever) been studied" (p. 11). Similarly, the review of Nijmeijer et al. (2008) on ADHD and social dysfunction prioritized comorbid ODD/CD and pervasive developmental disorders rather than anxiety. In a recent study of boys and girls with and without ADHD, child anxiety inversely predicted parent- and teacher-ratings of peer acceptance and social skills beyond ADHD and ODD, but not according to sociometric nominations (Milami et al., 2011). Karustis et al. (2000) found that child- and parent-rated anxiety significantly predicted multi-informant ratings of social problems in a study of school-age children with ADHD. An investigation of 190 children with ADHD and anxiety, anxiety only, ADHD only, or controls found that comorbid ADHD and anxiety children were less socially competent according to parent and youth self-report than each of the other three groups (Bowen et al., 2008). However, this study utilized a very large age range of participants (8–17) and limited comorbid anxiety to panic disorder, generalized anxiety disorder, and separation anxiety disorder, in addition to social and school phobia. Further, potential age effects were not accommodated (e.g., covariate, age × predictor interactions), a particularly important consideration given reliable changes in ADHD over time (Lee et al., 2008). Moreover, important fear-based anxiety disorders (i.e., obsessive compulsive disorder (OCD) and post-traumatic stress disorder (PTSD)) were not analyzed. Among a subgroup of children with ADHD from the MTA study, comorbid anxiety did not predict social functioning estimated from sociometric interviews (Hoza et al., 2005). Overall, despite an emerging literature, methodological differences demand that additional approaches are required to fully discern critical associations among ADHD, anxiety, and social functioning. For example, designs that utilize a more narrow age range of participants would provide an important advance by circumscribing significant age-related changes in ADHD, anxiety, and social functioning. Similarly, rather than use variable-based approaches (Karustis et al., 2000; Milami et al., 2011), where clinical significance is not readily discerned, studies that utilize diagnostic groups (to complement variable-based approaches) would ensure the clinical relevance of key constructs (e.g., elevated symptoms vs impairment).

In sum, there is a modest literature on the anxiety and social functioning in children with ADHD with studies to date characterized by important methodological differences (e.g., age range of participants, type of anxiety disorders ascertained, use of clinical groups versus dimensional variables). To characterize the precise contribution of anxiety, ADHD, and their comorbidity on identical measures of social functioning (e.g., social problems, negative social preference, social skills) across multiple informants (i.e., parent and teacher), we rigorously ascertained a large and ethnically diverse sample of school-age boys and girls with and without ADHD: (1) ADHD and anxiety (ADHD + Anx) (n = 46); (2) ADHD only (n = 71), (3) anxiety only (n = 26); and (4) comparison youth without ADHD and anxiety (n = 80). We hypothesized that the ADHD + Anx and ADHD only groups would be more socially compromised than children with anxiety only and comparison youth. In light of the modest literature, we did not make any directional hypotheses about differences between ADHD + Anx youth versus children with ADHD only.

2. Methods

2.1. Participants

Two hundred twenty-three ethnically diverse [n = 124 Caucasian; n = 18 African-American; n = 22 Hispanic; n = 8 Asian; n = 44 Mixed; n = 7 Other] 6 to 9 year-old children (M = 7.4, S.D. = 1.1) with (n = 117) and without ADHD (n = 106) were recruited through presentations to ADHD self-help groups, referrals from mental health clinics, and advertisements sent to clinical service providers, pediatric offices, and local elementary schools (Table 1). To be eligible for the study, all participants were required to have a full scale intelligence quotient (IQ) greater than 70, to live with one biological parent at least half of the time, and to be fluent in English. Exclusion criteria for all participants included a previous diagnosis of an autism spectrum disorder, seizure disorder, or neurological disorder that prevented full participation in the study.

ADHD diagnostic status (i.e., ADHD versus non-ADHD) was ascertained according to the Diagnostic Interview Schedule for Children, fourth edition (DISC-IV) (Shaffer et al., 2000), a fully structured interview with parents keyed to all Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) criteria (i.e., age of onset, symptom persistence, cross-situational presence). Families of children with and without ADHD completed identical screening and testing procedures. To avoid recruiting a non-ADHD comparison group that may have exaggerated the severity of psychopathology in ADHD probands, children who met diagnostic criteria for any disorder other than ADHD were placed in the non-ADHD group. This conservative approach, which is fairly stringent given that it would likely increase the similarity between the ADHD and non-ADHD comparison group, has been used in similar studies of childhood ADHD (Lalhey et al., 1998; Hinshaw, 2002).

2.2. Procedures

To determine eligibility, parents completed a telephone screening and eligible families who were interested in participating were mailed rating scales. After obtaining parental consent, we mailed the child’s primary teacher parallel rating scales. Families were then invited to our laboratory for in-person assessments. Approximately 85% of children were unmedicated during the lab visit. Following parental consent and child assent, parents completed a structured diagnostic interview and rating scales while children completed tests of cognitive ability, academic achievement, and neuropsychological functioning. Whenever possible, children were assessed without medication. Similarly, parents and teachers were asked to complete rating scales based on the child’s unmedicated behavior. Interviewers consulted mostly of Ph.D. students in clinical psychology who had completed graduate coursework in psychological assessment as well as several BA-level students. All interviewers underwent 2 days of intensive training, led by the first author, to standardize administration of measures and interviews. All interviewers were also blind to the child’s diagnostic status and the Institutional Review Board approved all study procedures.

2.3. Measures

2.3.1. Diagnostic Interview Schedule for Children — fourth edition (DISC-IV; Shaffer et al., 2000)

This computer-administered, fully structured parent interview ascertained the presence of DSM-IV childhood mental disorders. All DSM-IV criteria (e.g., persistence, age of onset, impairment) were evaluated for each disorder (e.g., anxiety, ADHD). The DISC-IV is widely used, extensively validated, and psychometrically sound. Test-retest reliability for ADHD from the DISC ranged from 0.51 to 0.64 in the DSM-IV field trials (Lalhey et al., 1994). A recent review also provided evidence of the DISC-IV’s strong psychometric properties including predictive validity and sensitivity to treatment effects (Pelham et al., 2005). We ascertained eight anxiety disorders with the DISC-IV: social phobia (n = 6, 2.7%), obsessive compulsive disorder (OCD) (n = 6, 2.7%), generalized anxiety disorder (GAD) (n = 7; 3.1%), post-traumatic stress disorder (PTSD) (n = 3; 1.3%), separation anxiety disorder (SAD) (n = 14; 6.3%), specific phobia (n = 55; 16.1%), agoraphobia (n = 1; 0.3%), and panic disorder (0.0%). Children were considered to have an anxiety disorder if they met full diagnostic criteria for at least one of the eight anxiety disorders we assessed for using the DISC.

2.3.2. Child Behavior Checklist (CBCL) and Teacher Report Form (TRF) for ages 6–18 (Achenbach and Rescorla, 2001)

The CBCL and TRF are both 113-item rating scales of child psychopathology, competence, and impairment. Each item is scored on a 0–2 metric. Based on normative data

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-ADHD</th>
<th>Anxiety only</th>
<th>ADHD only</th>
<th>Anxiety and ADHD</th>
<th>F/Wald</th>
</tr>
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<tr>
<td></td>
<td>(n = 80)</td>
<td>(n = 26)</td>
<td>(n = 71)</td>
<td>(n = 46)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>7.41 (1.02)</td>
<td>7.62 (1.02)</td>
<td>7.30 (1.13)</td>
<td>7.20 (1.09)</td>
<td>3.07</td>
</tr>
<tr>
<td>Male (%)</td>
<td>65</td>
<td>65</td>
<td>70</td>
<td>78</td>
<td>2.63</td>
</tr>
<tr>
<td>Caucasion</td>
<td>59</td>
<td>57</td>
<td>48</td>
<td>62</td>
<td>2.11</td>
</tr>
<tr>
<td>WISC$^a$</td>
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<td>108.83</td>
<td>103.53</td>
<td>103.74 (13.53)</td>
<td>1.43</td>
</tr>
<tr>
<td>FSIQ$^a$</td>
<td>15.32</td>
<td>14.75</td>
<td>14.06</td>
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</tbody>
</table>

$^a$ WISC-IV = Wechsler Intelligence Scale for Children, fourth edition.

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from 3210 6–18 year-old children, the CBCL and TRF yield developmentally sensitive scales of externalizing and internalizing problems as well as competence and impairment. We specifically focused on the social problems narrow band scale (alpha = 0.82 and 0.79 for the CBCL and TRF, respectively), which consists of 11 items including “Complaints of loneliness” and “Doesn’t get along with other kids.”

2.3.3. Dishion Social Preference Scale (Dishion, 1990)

This is a three-item (five-point metric) measure of peer acceptance, rejection, and being ignored with parallel parent and teacher forms. Social preference was predicted from initial sociometric ratings and was significantly correlated with antisocial behavior (ASB), depression, and deviant peer association (r = 0.60, 0.30, and 0.51, respectively) (Dishion, 1990). We subtracted the reject from the accept rating and then reverse scored the difference to estimate negative social preference and to approximate Poisson distributions for statistical analyses (alpha = 0.78). This method has been sensitive to group differences in other studies of ADHD and social preference (e.g., Lahey et al., 2004).

2.3.4. Impairment Rating Scale (IRS; Fabiano et al., 2006)

A total of five items were completed by parents and teachers to assess children’s need for treatment due to problems in relationships with playmates, siblings, academic progress, self-esteem, and family using a seven point metric ranging from “No problem/definitely does not need treatment or special services” to “Extreme problem/definitely needs treatment or special services.” We utilized a single item evaluating how the child’s problems affected his/her relationship with peers. Previous studies reported adequate 1 year test-retest stability with different teachers rating the same child (r = 0.39 to 0.63) and acceptable concurrent validity with other impairment scales (Fabiano et al., 2006).

2.3.5. Social Skills Rating System—Total Social Skills Scale (SSRS; Gresham and Elliott, 1990)

Across 20 items, parents and teachers rated children’s cooperation, self-control, assertiveness, and responsibility. Based on the normative sample, we analyzed designations of social skill as being: below average, average, or above average. The SSRS total score has been used in similar ADHD samples (Lee et al., 2008; Owens et al., 2009) and it demonstrated good discriminant validity (i.e., children with versus without behavior problems) (Antshel and Rener, 2003).

2.4. Data analytic procedures

To review, our goal was to evaluate social functioning in four groups of children based on their ADHD and anxiety diagnostic status. To supplement the frequent use of “variable-centered” strategies in clinical research, our approach reflected an increasing recognition on the value of person-centered methods in developmental psychopathology (Bergman et al., 2006). We examined the following four groups (note that some children had more than one anxiety disorder): (1) ADHD plus anxiety (n = 46; 13.0% OCD, 6.5% PTSD, 19.0% ODD, 8.7% social phobia, 15.2% GAD, 78.3% specific phobia), (2) ADHD only (n = 71), (3) anxiety only (n = 26; 38.8% agoraphobia, 19.2% SAD, 7.7% social phobia, 73.3% specific phobia), and (4) comparison youth (n = 80). Eleven percent (n = 9) and 1% (n = 1) of comparison youth (i.e., neither anxiety nor ADHD) met diagnostic criteria for ODD and major depression, respectively, according to the DISC. No other diagnoses were made in this group. First, age and sex, but not race-ethnicity, were correlated significantly with antisocial behavior. Previous studies reported adequate main effects (Wald $\chi^2 = 102.06$, d.f. = 3, p < 0.001). Pairwise comparisons among the four diagnostic groups suggested that comparison youth ($B = -0.98$, SE = 0.11, p < 0.001) and children with anxiety only ($B = -0.82$, SE = 0.14, p < 0.001) had significantly fewer social problems than children with ADHD and comorbid anxiety. Both comparison youth and children with anxiety only had fewer social problems than children with ADHD only ($B = -0.73$, SE = 0.10, p < 0.001 and $B = -0.58$, SE = 0.14, p < 0.001, respectively). The ADHD + Anx group had significantly more social problems than children with ADHD only ($B = -0.25$, SE = 0.09, p < 0.01) (see Table 3).

TRF social problems were also sensitive to diagnostic group differences (Wald $\chi^2 = 11.76$, d.f. = 3, p < 0.01) whereby children with ADHD only had significantly more social problems than children with anxiety only ($B = 0.40$, SE = 0.16, p = 0.01) and children with ADHD and comorbid anxiety had more social problems than comparisons and anxiety only children ($B = -0.27$, SE = 0.12, p < 0.05 and $B = 0.53$, SE = 0.17, p < 0.01, respectively) (Table 3). No other significant pairwise comparisons were observed among the four diagnostic groups.

3.2. Negative social preference

We observed a significant main effect of diagnostic group for parent rated negative social preference (Wald $\chi^2 = 43.62$, d.f. = 3, p < 0.001). Post-hoc tests revealed that comparison youth ($B = -1.04$, SE = 0.19, p < 0.001) and children with anxiety only ($B = -1.17$, SE = 0.29, p < 0.001) were less negatively regarded than the ADHD + Anx group and less negatively regarded than ADHD only youth ($B = -0.61$, SE = 0.13, p < 0.001 and $B = -0.57$, SE = 0.21, p < 0.01, respectively). Children with ADHD only were similarly negatively regarded by peers as ADHD + Anx youth ($B = 0.11$, SE = 0.14, p = 0.42) (Table 2).

Table 2

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Race</th>
<th>ADHD status</th>
<th>Anxiety status</th>
<th>CBCL social problems</th>
<th>Neg. social pref.</th>
<th>SSRS (P)</th>
<th>IRS</th>
<th>TRF social problems</th>
<th>Neg. social pref. (T)</th>
<th>SSRS (T)</th>
<th>IRS (T)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.06</td>
<td>0.01</td>
<td>0.00</td>
<td>-0.35</td>
<td>0.49</td>
<td>0.26</td>
<td>0.00</td>
<td>0.04</td>
<td>0.08</td>
<td>0.01</td>
<td>0.05</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0.16</td>
<td>0.12</td>
<td>0.02</td>
<td>0.36</td>
<td>0.09</td>
<td>0.50</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0.04</td>
<td>0.16</td>
<td>0.02</td>
<td>0.36</td>
<td>0.20</td>
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<tr>
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<td>-0.11</td>
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</tbody>
</table>

Note: ADHD = attention-deficit/hyperactivity disorder. CBCL = Child Behavior Checklist. SSRS = Social Skills Rating System. Neg. social pref. = negative social preference. TRF = Teacher Report Form. (T) denotes teacher version of indicated measure. ADHD status indicates presence or absence of ADHD diagnosis. Anxiety status indicated presence or absence of an anxiety disorder.

⁎ p < 0.05.

⁎⁎ p < 0.01.
Teacher rated negative social preference was also sensitive to diagnostic group differences (Wald χ² = 8.00, d.f. = 3, p < 0.05). Interestingly, children with ADHD only and ADHD and comorbid anxiety were each more negatively regarded by peers, but only relative to children with anxiety only (B = −0.45, SE = 0.21, p < 0.05 and B = −0.57, SE = 0.22, p < 0.01), although a marginal association was also observed for children with ADHD and anxiety relative to comparison youth (B = 0.28, SE = 0.16, p = 0.08). No other significant pairwise comparisons were observed for teacher rated negative social preference (Table 4).

3.3. Social impairment

Parent ratings of children’s social impairment showed significant variability as a function of diagnostic group (Wald χ² = 24.81, d.f. = 3, p < 0.001). Once again, comparison youth and children with anxiety only had less impaired peer relationships than children with ADHD and anxiety (B = −0.50, SE = 0.15, p < 0.001 and B = −0.46, SE = 0.22, p < 0.05, respectively). A similar pattern was observed relative to children with ADHD only (B = −0.61, SE = 0.13, p < 0.001 and B = −0.57, SE = 0.21, p < 0.01, respectively). However, no significant differences were observed for the comorbid group versus children with ADHD only (Table 2). There was no significant association between diagnostic group and teacher ratings of social impairment (Wald χ² = 6.30, d.f. = 3, p = 0.10). To avoid type I error, we did not conduct post-hoc comparisons among the four groups.

3.4. Social skills

Finally, we evaluated the association of diagnostic group on social skills using ordinal designations (low, average, high) derived from the SSRS normative sample. There was a significant main effect for diagnostic group (Wald χ² = 23.8, d.f. = 3, p < 0.001) where comparison youth and children with anxiety only (B = 1.73, SE = 0.41, p < 0.001 and B = 1.65, SE = 0.50, p < 0.001, respectively) were more likely to have average or high social skills than children with ADHD and anxiety. Comparison youth and children with anxiety only were also more likely to be socially competent (i.e., average or high) than children with ADHD only (B = 1.24, SE = 0.35, p < 0.001 and B = 1.17, SE = 0.45, p < 0.01, respectively). No significant differences were observed between children with ADHD only and the comorbid group, however (B = 0.49, SE = 0.39, p = 0.21). No significant association between diagnostic group and teacher ratings of social skills was observed (Wald χ² = 6.16, d.f. = 3, p = 0.10) and no post-hoc comparisons were made.

4. Discussion

Although children with ADHD exhibit significant anxiety problems, anxiety has yet to be integrated into theoretical/empirical models of ADHD to an extent that is commensurate with ODD/CD (see Schatz and Rostain, 2006 for an exception). We rigorously ascertained 223 ethnically diverse 6 to 9 year-old children using structured diagnostic interviews and multi-informant ratings of social functioning. Across all parent ratings of social functioning, children with ADHD + anxiety and children with ADHD only were less socially competent and more socially impaired than comparison youth and children with anxiety only, who did not differ from each other. Findings were less uniform according to teacher ratings, although children with ADHD and ADHD + anxiety were the most consistently socially impaired and there was no difference between the two groups.
These results further substantiate that early ADHD strongly predicts social dysfunction such as peer rejection (Blachman and Hinshaw, 2002) and fewer social skills (Mikami et al., 2007). However, unlike some previous studies which reported comorbid anxiety negatively affected social functioning in children with ADHD (Karustis et al., 2000; Bowen et al., 2008; Mikami et al., 2011), Hoza et al. (2005) did not find this association.

Several reasons may have explained the primacy of ADHD versus the incremental contribution of comorbid anxiety on social functioning. First, unlike previous studies where anxiety mitigated aggressive behavior and improved inhibitory control among children with ADHD (Walker et al., 1991; Epstein et al., 1997), our study found that anxiety did not meaningfully affect social functioning in children with ADHD. That is, anxiety neither exacerbated nor improved social functioning in children with ADHD. Second, ADHD may have explained substantial variance and thus limited the putative role of anxiety. Similar effects were observed in two independent samples where ASB and social information processing deficits predicted delinquency severity and aggression, respectively, more robustly in controls than in children with ADHD (Lee and Hinshaw, 2004; Mikami et al., 2008).

This pattern was also suggested by Mikami et al. (2011) where anxiety negatively affected social functioning more robustly in controls than in ADHD youth. Third, although we employed a reasonably large sample, we were unable to adopt more refined distinctions among anxiety disorders. For example, all eight anxiety disorders were analyzed equivalently, although this approach may betray important differences overall and with respect to social functioning specifically (Kendall et al., 2010). Whereas specific phobia is typically characterized by onset in early childhood, social phobia is associated with a post-pubertal onset (Albano et al., 2003), suggesting that different factors may be implicated in the onset of each disorder. Recent evidence also identified important structural differences between social phobia, which was optimally characterized by a single factor, and GAD, which consisted of two factors (i.e., worry and somatic complaints) (Higa-McMillan et al., 2008). Finally, Hinshaw and Lee (2003) reviewed inconsistent evidence on the role of anxiety in the development of serious ASB (i.e., exacerbating versus protective role). Beyond diagnostic differences among anxiety disorders, important dimensions of anxiety, including withdrawn/isolated behavior may exacerbate aggression whereas inhibition/fear may diminish aggression. Overall, the multi-dimensional and developmentally sensitive nature of anxiety necessitates that future studies adopt more refined approaches to its measurement in studies of childhood ADHD (Nigg, 2001).

Given relatively few studies on ADHD and anxiety, methodological influences may be salient. First, to prioritize clinical significance and person-centered approaches, we evaluated ADHD and anxiety based on a structured diagnostic interview whereas previous studies used a variable-centered approach (i.e., incremental contribution of anxiety beyond ADHD) (Mikami et al., 2011). Although diagnostic ascertainment of anxiety is based on evidence of functional impairment, they can sacrifice statistical power whereas variable-based methods estimate associations across the entire sample for the average child. Second, Bowen et al. (2008) utilized a wide age-range of participants (8 to 17 years), but they did not control for age. Prospective longitudinal studies of ADHD show aggregate stability, but reliable age-related decreases in ADHD in adolescence as well as important individual differences in outcome among ADHD youth. Indeed, recent studies of ADHD have distinguished persistent ADHD from remitters based on neuropsychological differences (Halperin et al., 2008). That is, as ADHD is a disorder of development, differences from cross-sectional studies, particularly those with wide age ranges, must be done cautiously. Nevertheless, using variable-based approaches, Mikami et al. (2011) did find a significant association of anxiety with social dysfunction in children with ADHD at a similar age in development with the participants in this study. Similarly, childhood OCD has a mean age of onset of 10 years and it is chronic as evidenced by the fact that 40% of youth still met diagnostic criteria for OCD in a 9 year prospective follow-up (Micali et al., 2010). However, the median age of onset for specific phobia is 7 years (Kessler et al., 2005) and SAD is noted for its early onset (Albano et al., 2003). Thus, the age of children may influence the pattern of anxiety relative to comorbidity, prognosis, and etiology (Chabane et al., 2005).

Developmental influences must also be considered when appraising potential patterns of association for ADHD, anxiety, and social functioning. This is particularly true given recent work on the role of developmental cascades for competence and psychopathology (Masten and Cicchetti, 2010). Defined as the accumulation of interactions and transactions resulting in dispersed effects across multiple systems, anxiety may interact with childhood ADHD in distinct ways across development. Lahey et al. (2002a, 2002b) found that increases in CD prospectively predicted growth in ADHD, ODD, anxiety, and depression. Therefore, prospective longitudinal designs are necessary to rigorously discern the timing of effects of anxiety on social dysfunction, including interactive effects with ADHD. This is particularly true given that the negative, cumulative effects of significant anxiety may not have been realized at the early stage in development in this study. That is, children with ADHD and anxiety may exhibit more social dysfunction than children with ADHD as the burden of comorbidity increases over time. Coupled with evidence that ADHD and ODD/CD may be more consequential in girls than in boys (Loeber and Keenan, 1994), the role of ADHD and anxiety on social functioning may differ according to sex and developmental period.

We emphasize several important limitations of our study. First, our limited sample size precluded theoretically relevant tests of interactions with gender and did not allow for alternative methods to grouping children with anxiety, an important limitation given the heterogeneity of the latent factor structure of common child anxiety disorders (Higa-McMillan et al., 2008; Kendall et al., 2010). Second, although we incorporated a broad array of social functioning measures, our approach may have lacked sufficient specificity for children with ADHD and anxiety at this stage in development. Future studies should consider using sociometric interviews and structured interaction tasks between the target child and peers that may provide additional insight into the nature of peer interactions. Third, our study was unable to assess whether anxiety differentially affected social functioning in children with combined versus inattentive type ADHD. Solanto et al. (2009) found that ADHD combined type children exhibited specific dysfunction in cooperation and self-control (relative to inattentive type youth and controls) whereas inattentive type children lacked assertiveness relative to combined type youth and controls. Thus, future studies must consider that the different aspects of social dysfunction may be differentially distributed among ADHD subtypes. Fourth, medication effects on the variables of interest could not be rigorously discerned given the non-experimental nature of this study design. For example, potential biases secondary to our instructions to parents and teachers to rate the children’s unmedicated behavior could have influenced our results. Indeed, given that interventions in non-experimental designs often correlate positively with psychopathology due to the intervention selection bias (Larzelere et al., 2004), strong inferences about treatment effects in this study cannot be made. Finally, some of the psychometric properties of our instruments were only in the acceptable range, thus necessitating that future studies consider alternative methods as well, and our data analytic procedures did not yield estimates of effect size, potentially limiting the clinical interpretability of our findings.

Results from this large and ethnically diverse sample of children with and without ADHD revealed evidence that children with ADHD only and children with ADHD and comorbid anxiety, who did not differ from one another, were consistently more socially impaired than children with anxiety only and comparison youth (who also did not differ from one another). Future research must utilize more refined approaches to phenotypic classification including ADHD and anxiety disorder subtypes as well as prospective longitudinal designs to uncover...
the timing of potential effects. Clinically, these findings underscore the powerful contribution that ADHD makes on social dysfunction, even relative to other children with clinically significant psychopathology (i.e., anxiety disorder). Given the independent and interactive effect of social dysfunction to negative outcome, particularly among children with existing psychopathology, interventions must be developed and delivered that target specific deficits in social competence.

References


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