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Influence of Anxiety on the Social Functioning of Children With and Without ADHD

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Abstract

Objective: This investigation examined the contribution of anxiety to the social functioning of children with and without ADHD. **Method:** Participants were 62 children with ADHD (ages 6-10 years and 68% boys) and 62 age- and sex-matched comparison children. Children's social functioning was measured through parent and teacher reports, observations of social behaviors during a lab-based playgroup with previously unacquainted peers, and peer nominations during that lab-based playgroup. **Results:** Anxiety symptoms incrementally predicted adult-informant reports of poorer social functioning after controlling for demographic covariates, ADHD status, and oppositional-defiant disorder (ODD) status. However, anxiety was not associated with peer nominations received at the playgroup. There were some indications that anxiety may have greater influence on the functioning of comparison children relative to children with ADHD or ODD. **Conclusion:** Anxiety may contribute to the peer problems of children both with and without ADHD. *(J. of Att. Dis. 2010; XX(X) 1-XX)*

Keywords

ADHD, anxiety, peer relationships

Children with ADHD are well known to experience serious peer difficulties. Relative to typically developing youth, children with ADHD are more disliked by peers and are rated by parents and teachers as having poorer social skills (Hoza, Mrug, et al., 2005). Poor peer relationships warrant concern, as they may predict adolescent and adult adjustment problems (Parker & Asher, 1987). Collectively, findings suggest the importance of investigating factors—such as comorbid disorders—which may contribute to peer problems among children with ADHD. Relative to extensive research documenting the increased social impairment conferred by comorbid oppositional-defiant disorder (ODD) and conduct disorder (CD) to youth with ADHD, the influence of comorbid anxiety has been understudied (Pfiffner, Calzada, & McBurnett, 2000; Schatz & Rostain, 2006). This is surprising, given the estimate that approximately 25% of children with ADHD meet criteria for comorbid anxiety disorder (Jensen, Martin, & Cantwell, 1997) and that the high comorbidity between anxiety and ADHD cannot be simply explained by artifactual or methodological reasons (Angold, Costello, & Erkanli, 1999).

Additive Influences of Anxiety and ADHD on Social Functioning

There are theoretical reasons to believe that comorbid anxiety may incrementally predict poorer social functioning among children with ADHD. First, it has been suggested that youth with ADHD and comorbid anxiety experience poorer relationships with parents and siblings (Mikami & Pfiffner, 2007; Pfiffner & McBurnett, 2006), and more working memory problems and sluggish cognitive tempo (Carlson & Mann, 2002; Tannock & Schachar, 1995), than do youth with ADHD and no comorbid anxiety. Because poor family relationships, working memory problems, and sluggish cognitive tempo may all be independent risk factors for peer difficulties in ADHD populations (Hinshaw, Zupan, Simmel, Nigg, & Melnick, 1997; Mikami, Huang-Pollock, Pfiffner, McBurnett, & Hangai, 2007), it raises the possibility that comorbid anxiety may predict increased social impairment among youth with ADHD.

Existing work supports these hypotheses. In a clinic-referred sample of youth with ADHD, parent ratings of child anxiety symptoms positively predicted teacher report of social problems, even after controlling for depression (Karustis, Power, Rescorla, Eiraldi, & Gallagher, 2000). Similarly, for children participating in the Multimodal Treatment Study

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of Children with ADHD (MTA; MTA Cooperative Group, 1999), children's self-reported anxiety symptoms were associated with parent report of poorer social skills (March et al., 2000). A recent investigation also found that youth with ADHD and a comorbid anxiety disorder had lower social competence (assessed via self- and parent-reports) than did either youth with ADHD alone or youth with anxiety alone (Bowen, Chavira, Bailey, Stein, & Stein, 2008).

However, we note that the aforementioned research relies on adult-informant reports of children's social competence. It is also important to investigate peer sociometric ratings of children's social functioning, as well as objective observations of children's behaviors with peers, as these measures may have greater validity in predicting subsequent adjustment than do adult-informant reports (Parker & Asher, 1987). Of note, multiple facets of peer sociometric status exist. Peer acceptance, or the extent to which peers like the child, is typically assessed by nominations from peers as someone they "like most." Peer rejection, or the extent to which peers actively dislike the child, is assessed by peer nominations as being "liked least." Social impact indicates the extent to which a child is noticed, the combination of liked and disliked, and can be considered the opposite of peer neglect (Coie, Dodge, & Coppotelli, 1982).

Studies of the effect of comorbid anxiety on peer-rated sociometric status are rare. Strauss, Frame, and Forehand (1987) reported that, in a sample of youth with anxiety, fewer peers liked anxious children who also had clinically significant attention problems than they did anxious children below thresholds for attention problems. However, the use of inattention symptom scales in this study precludes generalizing this finding to youth with clinically diagnosed ADHD. We are only aware of one study, conducted by Hoza and colleagues (2005), which examined the influence of anxiety on the peer sociometric status of youth with ADHD. In a subsample of 165 youth from the MTA study, there was a trend for comorbid anxiety to predict poorer peer-rated status relative to youth with ADHD and no anxiety, but no relationship was statistically significant after adjusting for the multiple comparisons tested.

Differential Effects of Anxiety on ADHD Versus Comparison Youth

In the earlier section, we have argued that why anxiety may have damaging effects on the social functioning of children with ADHD. Yet it is possible that anxiety may differentially affect the peer relationships of comparison youth relative to those of youth with ADHD. Whereas the peer problems experienced by youth with anxiety (and not ADHD) may arise due to shyness and withdrawal (Strauss et al., 1987), the peer problems of youth with ADHD are probably better attributed to intrusiveness and aggression (Erhardt & Hinshaw, 1994). In fact, the different social behaviors associated with anxiety versus ADHD may explain why children with anxiety tend to have low social impact, that is, to be neglected by peers (Strauss, Lahey, Frick, Frame, & Hynd, 1988), whereas children with ADHD tend to be actively peer rejected (Hoza, Mrug, et al., 2005).

In concordance with the suggestion that anxiety confers an inhibitory effect on social behavior, it has been theorized that the presence of comorbid anxiety is associated with less aggression and impulsivity among children with ADHD (see Quay, 1997; Tannock, 2000). Children with ADHD and comorbid anxiety, though more impaired than typically developing youth, have been found to display less impulsiveness and off-task behavior on a laboratory measure relative to children with ADHD and no anxiety (Pliszka, 1989, 1992). In the MTA sample, Newcorn and colleagues (2001) found the presence of comorbid anxiety to predict lower impulsivity according to teacher ratings and in the computerized Continuous Performance Test. Similar reductions in impulsivity have been reported for children with ADHD and anxiety on stop-signal reaction-time tests, relative to children with ADHD and no anxiety (Tannock, 2000). On the other hand, another study using the MTA sample found that aggression, observed in children's regular classrooms, did not differ based on comorbid anxiety (Abikoff et al., 2002).

Given that anxiety may mute disruptive behaviors that would otherwise be present in youth with ADHD, the potential detrimental influence of anxiety on social functioning may be tempered in an ADHD sample. Specifically, because aggression and impulsivity are arguably the most damaging behaviors to the peer relationships of children with ADHD (Pfiffner et al., 2000), anxiety may actually benefit peer status by reducing these noxious behaviors. However, anxiety may do more harm to the peer relationships of youth without ADHD, to the extent that it makes such youth overly withdrawn. Research to date has not assessed whether associations between anxiety and social functioning may differ in ADHD versus comparison samples.

Limitations of Existing Research

The existing research about the contribution of comorbid anxiety to the social functioning of children with ADHD has several limitations, as noted in recent reviews (Jarrett & Ollendick, 2008; Karustis et al., 2000; Schatz & Rostain, 2006). First, previous studies have been inconsistent in controlling for the contribution of comorbid ODD or CD. Considering comorbid ODD/CD is important, as it co-occurs with anxiety in ADHD samples at rates more than chance (Jensen et al., 1997), it may predict poorer social functioning independent of the effects of ADHD alone (Pfiffner et al., 2000). Furthermore, in the MTA sample, comorbid anxiety and ODD/CD were additively associated with parent report

of lower social skills (March et al., 2000), and the combination of anxiety plus ODD/CD predicted a differential treatment response relative to children with ADHD and either comorbid anxiety or ODD/CD, but not both (Jensen et al., 2001). Yet Abikoff et al. (2002), also using the MTA sample, failed to find interactions between comorbid anxiety and ODD/CD in predicting observed behaviors in the classroom.

Another limitation is that existing research has not examined children's peer status and social behaviors in a group of previously unacquainted peers and instead measured these constructs in children's classrooms. Assessing peer sociometric status and social behaviors in the regular classroom has ecological validity; however, these variables may be influenced by the child's previously established reputation or teacher–student relationships (Harris, Milich, Corbitt, Hoover, & Brady, 1992). It is unknown how the effects of anxiety might manifest themselves differently in a lab-based interaction with previously unacquainted peers.

Study Aims and Hypotheses

We used a multimethod and multiinformant design to assess the influence of anxiety symptoms on the social functioning of youth with ADHD and age- and sex-matched comparison youth. We hypothesized that, after statistical control of demographic covariates and ADHD and ODD status, anxiety symptoms would be associated with lower social skills and more social problems as reported by parents and teachers, and less acceptance, more rejection, and lower social impact with peers as reported by teachers and by previously unacquainted peers in a lab-based playgroup. Because of theorizing that anxiety confers an inhibitory effect on behavior, we hypothesized that anxiety would not only predict less aggression but also less prosocial behavior observed at the playgroup. We also hypothesized interaction effects, such that the relationship between anxiety and poor social functioning, as well as between anxiety and reduced aggression or prosocial behavior, would be stronger for comparison youth than for youth with ADHD. Finally, we conducted exploratory analyses of potential interactions between ODD and anxiety symptoms.

Method

Participants

Participants were 62 children (68% boys, age range: 6-10 years) with ADHD, and 62 age- and sex-matched comparison children. Children were 83% White, 9% mixed, 5% African American, 2% Asian American, and 1% Latino. Children with ADHD were recruited from pediatricians, schools, and clinics. To confirm diagnosis of ADHD, children needed to surpass clinical cutoffs as reported by parent and teacher on the Child Symptom Inventory (CSI; Gadow & Sprafkin, 1994). In accordance with *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.) (*DSM-IV*) field trials, a symptom was counted when endorsed by either parent or teacher as "often" or "very often" on the CSI. Diagnosis of ADHD was then confirmed via a semistructured *DSM-IV-TR*-based parent interview (Kaufman et al., 1997). On the basis of the CSI ratings and the parent interview, children with ADHD were classified as combined type (ADHD-C; $n = 46$) or inattentive type (ADHD-I; $n = 16$). Because the hyperactive-impulsive form of ADHD is most salient for preschoolers (Lahey et al., 1998), we did not include children with this subtype.

Children in the comparison group were recruited from local schools and from a database of families who had previously participated in research at the university. Comparison youth could not meet criteria for ADHD on the parent or teacher ratings and could not receive a diagnosis of ADHD on the parent interview. Exclusion criteria for all children were pervasive developmental disorder, Full-Scale IQ below 70, or Verbal IQ below 75. ODD, CD, and other comorbidities were permitted in both groups because of the high prevalence of these conditions in children with ADHD and because of a desire to have a "normal" but not "supernormal" comparison sample (see Hinshaw, 2002 for a similar rationale). ODD required a diagnosis on the parent interview and teachers endorsing elevated symptoms ($t > 60$) on the oppositional-behavior scale of the Conners Teacher Rating Scale–Revised (Conners, 2001). No child met criteria for CD on the parent interview. Because of evidence that many children with ADHD who take medications remain impaired in their peer relationships (Hoza, Gerdes, et al., 2005), medication users were not excluded from participation. However, medicated participants ($n = 40$, all with ADHD) must have been on the same regimen for at least 3 months before the study.

All children provided assent and parents provided written, informed consent. Study procedures were approved by a university review board. As shown in Table 1, the ADHD and comparison samples did not differ on most demographic variables. However, parents' self-reports of parental education and child IQ scores as assessed by the Wechsler Intelligence Scale—Fourth Edition (WISC-IV; Wechsler, 2003) were higher in the comparison sample.

Procedure

Intake. Interested parents completed a brief telephone screen during which they provided ratings on the CSI. Teachers completed the CSI by fax. If children with ADHD surpassed clinical cutoffs and children in the comparison group were below clinical cutoffs on parent and teacher CSI versions then they attended an intake session. At intake,

Table 1. Descriptive Statistics for ADHD and Comparison Samples

	ADHD[a]	Comparison[a]	Difference
	M (*SD*)	*M* (*SD*)	(*p*)
Child age	8.26 (1.21)	8.23 (1.19)	.88
Child race, White (*n*)	50	55	.38
Child sex, male (*n*)	42	42	.99
Full scale IQ	107.06 (14.49)	116.77 (11.69)	<.01
Parent education[b]	4.72 (1.04)	5.32 (0.83)	<.01
Household income	US$66,913(19,103)	US$76,723 (14,665)	.07
Adults in household	2.02 (0.43)	2.02 (0.34)	.99
Anxiety symptoms	59.00 (6.67)	51.87 (2.85)	<.01
Social skills (parent)	84.10 (14.43)	110.22 (12.54)	<.01
Social skills (teacher)	86.94 (11.15)	108.97 (12.44)	<.01
Social problems (parent)	61.63 (7.98)	51.18 (1.89)	<.01
Social problems (teacher)	61.45 (7.53)	51.77 (3.86)	<.01
"Like/accept" (teacher)	3.08 (1.35)	4.58 (0.85)	<.01
"Dislike/reject" (teacher)	1.87 (1.01)	1.10 (0.48)	<.01
"Ignore/neutral" (teacher)	2.24 (1.15)	1.38 (0.85)	<.01
"Like most" (peer)	0.63 (0.29)	0.72 (0.25)	.04
"Like least" (peer)	0.10 (0.20)	0.07 (0.14)	.45
Social impact (peer)	0.73 (0.29)	0.78 (0.26)	.12
Aggression (observed)	0.53 (0.81)	0.25 (0.57)	<.01
Prosocial (observed)	0.52 (0.72)	0.40 (0.67)	.18

Note: Two-tailed *t* tests were used for questionnaire items and HLM for playgroup variables.
a. *N* = 62.
b. Reported on the following scale: 1 = *eighth grade or less*, 2 = *some high school*, 3 = *high school graduate*, 4 = *some college*, 5 = *college graduate*, 6 = *graduate degree*.

children were administered the WISC-IV (Wechsler, 2003), whereas the parents were administered the clinical interview. Parents reported demographic information and completed questionnaires about the child's social functioning. Teachers provided ratings of children's social functioning by mail.

Playgroups. Children who met the study inclusion criteria after intake were assigned to lab-based playgroups. Each group included four previously unacquainted children (two ADHD children and two comparison-group children) of the same age and sex. The parent who completed the questionnaires about the child was present during the playgroup. For the first 10 minutes of the playgroup, children participated in a structured game. For the next 35 minutes (the focus of the current investigation), children engaged in unstructured free play during which they were provided with a variety of toys and were told to play with whomever or whatever they wished. Parents were free to do what they chose. At the end of the playgroup, each child was privately interviewed using a standard sociometric procedure (Coie et al., 1982). Children were shown pictures of the other three children at their playgroup and were asked to nominate the peer(s) whom they most liked and least liked. Unlimited nominations were accepted. For a complete description of the playgroup assignment and procedures, please see (Mikami, Jack, Emeh, & Stephens, in press).

We note that, after the intake and playgroups were completed, some parents received an intervention designed to provide them with strategies to improve their children's peer relationships (for details, see Mikami, Lerner, Griggs, McGrath, & Calhoun, in press). Because parental behaviors were central to the treatment, parents were present for playgroup observations. However, all measures in the current study focus on baseline assessments before treatment began.

Measures

Social skills. Parents and teachers reported children's social skills using the Social Skills Rating System (SSRS; Gresham & Elliott, 1990). The total social skills score, converted into norms on the basis of age and sex, was used. Items are rated on a 3-point metric (*never*, *sometimes*, and *very often*). The parent version includes 38 items related to social skills at home (e.g., "invites others home"), and the teacher version includes 30 items related social skills in the classroom (e.g., "volunteers to help peers with classroom tasks"). The SSRS has good reliability and criterion-related validity and is widely used (Gresham & Elliott, 1990).

Social problems. The social problems subscale on the Child Behavior Checklist (CBCL; Achenbach, 1991a) and Teacher Report Form (TRF; Achenbach, 1991b) index parent and

teacher perceptions of children's peer problems. The parent version has 8 items and the teacher version 13 items that pertain to difficulty getting along with peers and social immaturity. Items are measured on a 3-point scale (*not true*, *somewhat true*, and *very true*). Scales have strong psychometric properties and have been used in previous studies to assess the contribution of comorbid anxiety to social problems among youth with ADHD (Karustis et al., 2000).

Peer status: Teacher report. Teachers reported the proportion of classmates that "like and accept," "dislike and reject," and "ignore or are neutral to" the child on the Dishion Social Acceptance Scale (DSAS; Dishion, 1990). Teachers chose from one of five responses: less than 25% (*almost none*), 25% to 50% (*a few*), 50% (*about half*), 50% to 70% (*most*), or more than 75% (*nearly all*). This measure has been used in the ADHD literature (Hinshaw, 2002), and Dishion (1990) reports moderate correlations with peer-reported sociometric measures.

Peer status: Playgroup peer nominations. Proportion scores were created for peer liking and disliking by dividing the total number of "most liked" or "least liked" nominations, which a child received by the number of peers in the playgroup providing nominations. Proportion scores for "most liked" and "least liked" nominations were also summed to create a total social impact score (intended to be the inverse of ignoring or neglect).

Observed aggression. Trained coders, unaware of children's diagnostic status, used a standardized coding system to assess children's behaviors with peers during the free play period in the playgroup. A random sample of 25% of videotapes was double-coded and the interrater reliability for aggression was adequate (ICC = .66). Examples of aggression include criticizing a peer, name calling, pushing, taking another's possessions without asking, rule breaking, refusing to take turns, not listening to others' suggestions, and complaining after losing or gloating after winning a game. The construct of aggression was scored on a 0-3 metric (0 = *no evidence of behavior*; 1 = *one minor incidence of behavior, but behavior is not pervasive*; 2 = *more than one minor incident of behavior such that it was pervasive or one major incident*; and 3 = *more than one severe incident or only one major incident but at least one minor incident*).

Observed prosocial behavior. Also observed during the playgroup, prosocial behavior was operationalized as the extent to which a child displayed helping behavior or good sportsmanship through cooperating, complementing, or assisting peers. Examples include a child saying to a peer, "I like your idea, let's try that"; saying "good game," or "You're good at that"; or offering to help a peer put away a game. Interrater reliability for this variable was acceptable (ICC = .61). Prosocial behavior was scored using the same 0 to 3 metric as was aggression.

Anxiety symptoms. The anxiety problems subscales on the CBCL and TRF were used to assess anxiety symptoms reported by parents and teachers, respectively. Items are rated on a 3-point scale ("*not true*, *somewhat/sometimes true*, and *very true/often true*) and include descriptions such as "worries," "fearful," "nervous," and "dependent." The scale assesses *DSM-IV-TR* symptoms of generalized anxiety disorder, separation anxiety disorder, and specific phobias. Evidence supports the test–retest reliability, internal consistency, and discriminative and convergent validity of this scale (Nakamura, Ebesutani, Bernstein, & Chorpita, 2009). *T* scores were calculated for each child on the basis of national age and sex norms (Achenbach, 1991a, 1991b).

We used youth's continuous anxiety symptoms in this study because we thought this would be the most sensitive measure to assess of the effects of anxiety on social functioning in ADHD versus comparison youth, as anxiety was lower in the comparison sample (see Table 1). We note that other research has found that subclinical anxiety symptoms still predict parent- and teacher-reported social problems among youth with ADHD (March et al., 2000). The correlation between parent and teacher reports of anxiety was significant ($r = .43$, $p < .01$). To form a more comprehensive index, we averaged together the *t* scores from parent and teacher scales, weighted equally, to form a single, continuous, composite score of anxiety symptoms.

Data Analytic Plan

We first examined the distributions of all study measures. "Dislike and reject" on the DSAS, "least like" peer nominations, and observed aggression were skewed such that few children received high scores. We did not transform variables because we considered elevations on these scales to be clinically meaningful. However, to prevent a few extreme outliers from driving results, scores more than 3.5 deviations above the mean were replaced by a value that was 3.5 standard deviations from the mean. This procedure was necessary for the variables of "least like" nominations ($n = 1$), observed aggression ($n = 3$), and DSAS "dislike and reject" ($n = 4$).

Hierarchical multiple regressions were used to test our hypotheses that (a) after control of covariates (child age, sex, and parental education), ADHD status, and ODD status, anxiety symptoms would incrementally predict adult reports of child social skills, social problems, and peer status, and (b) ADHD status would moderate these associations. Given evidence that age and sex may influence a child's social functioning and that parental education levels were higher in the comparison sample and significantly correlated with most of the criterion measures, we controlled for child age, sex, and parental education at Step 1. We placed ADHD diagnostic status on Step 2 and ODD status on Step 3; both were

dichotomous and dummy coded. We then placed the continuous measure of anxiety symptoms at Step 4 to test the independent effect of anxiety on social functioning. Finally, we tested the potential for ADHD diagnostic status to moderate associations between anxiety symptoms and the criterion measures by placing the interaction between ADHD status and anxiety symptoms at Step 5. Significant interactions were probed in the manner recommended by Holmbeck (2002).

As children were nested within playgroups for the observational and sociometric measures, hierarchical linear modeling analytic procedures (HLM; Raudenbush & Bryk, 2002) were necessary to control for the possibility that the playgroup variables of one child would be nonindependent from those of the other children in the same playgroup. Thus, we used HLM to examine the associations between anxiety and the playgroup criterion variables ("most liked" nominations, "least liked" nominations, social impact, observed aggression, and observed prosocial behavior). The predictors at Level 1 were ADHD status, ODD status, and anxiety symptoms, whereas child age, sex, and parental education were the covariates. We also tested the interaction between anxiety symptoms and ADHD status. We did not include predictors at the playgroup level (Level 2) but simply included this nesting to control for shared variance. Thus

$$\begin{aligned}\text{Level 1: } Y = {} & \beta 00 + \beta 01\ (\text{age}) + \beta 02\ (\text{sex}) \\ & + \beta 03\ (\text{parental education}) \\ & + \beta 04\ (\text{ADHD status}) + 05\ (\text{ODD status}) \\ & + \beta 06\ (\text{anxiety symptoms}) + \beta 06 \\ & \quad (\text{ADHD x anxiety}) + r0\end{aligned}$$

$$\begin{aligned}\text{Level 2: } \beta 00 &= G00 + u00 \\ \beta 01 &= G01 \\ \beta 02 &= G02 \\ \beta 03 &= G03 \\ \beta 04 &= G04 \\ \beta 05 &= G05 \\ \beta 06 &= G06 \\ \beta 07 &= G07\end{aligned}$$

We examined the significance associated with the addition of each predictor by adding each one in the same order in which they were placed in the hierarchical multiple regressions: covariates first, followed by ADHD status, ODD status, anxiety symptoms, and the interaction between ADHD status and anxiety symptoms last.

If after controlling for covariates and ADHD and ODD status, anxiety symptoms were associated with lower social skills and more social problems as reported by parents and teachers, less acceptance, more rejection, and lower social impact as reported by teachers and playgroup peers, as well as less observed aggression and prosocial behavior in the playgroup, then our first hypothesis would be confirmed. If ADHD status moderated the influence of anxiety symptoms, such that the effects of anxiety were stronger for the comparison sample relative to the ADHD sample, then our second hypothesis would be confirmed. In exploratory analyses, we next examined potential interactions between ODD status and anxiety symptoms by keeping all the aforementioned predictors and adding the interaction between ODD and anxiety to models.

Finally, we note that we reconducted analyses with children's medication status as well as IQ as additional covariates. Because results were largely unchanged, we have not included these predictors in models. In addition, there is conflicting research regarding whether anxiety is more common among children with ADHD-I relative to ADHD-C (Milich, Balentine, & Lynam, 2001; Power, Costigan, Eiraldi, & Leff, 2004). In our sample, anxiety symptoms did not significantly differ across the ADHD-C and ADHD-I subtypes. We also reconducted analyses substituting ADHD subtype (e.g., combined, inattentive, comparison) for ADHD versus comparison status. Results were unchanged, so we have collapsed ADHD subtypes herein.

Results

Descriptive Statistics

Table 1 presents group differences on the primary dependent measures. Relative to comparison children, children with ADHD had more anxiety symptoms, poorer social skills, and more social problems as rated by both parents and teachers and were rated by teachers as less "liked and accepted," more "disliked and rejected," and more "ignored" by classmates. At the playgroup, children with ADHD also received fewer "like most" nominations and displayed more aggression than did comparison peers. However, the two groups did not differ on "least liked" nominations, social impact scores, or prosocial behavior displayed at the playgroup.

Anxiety and ADHD as Predictors of Adult-Rated Social Functioning

As displayed in Table 2, after controlling for demographic covariates and ADHD and ODD status, anxiety symptoms were significantly and consistently associated with both parent and teacher report of poorer social skills and more social problems. Effect sizes were small for both parent and teacher reports of social skills ($R^2\Delta = .03$) and for teacher report of social problems ($R^2\Delta = .06$) and large for parent report of social problems ($R^2\Delta = .15$). In addition, the interaction between ADHD status and anxiety symptoms was significant for parent report of social skills. Probing revealed that the detrimental influence of anxiety symptoms on children's social skills was stronger for comparison children

Table 2. The Effect of Anxiety on Parent and Teacher Reported Social Functioning

Predictors	B	*SEB*	β	ΔR^2	B	*SEB*	β	ΔR^2	B	*SEB*	β	ΔR^2	B	*SEB*	β	ΔR^2
	Social skills (parent)				Social skills (teacher)				Social problems (parent)				Social problems (teacher)			
1. Covariates		.12**				.04				.11**				.09**		
2. ADHD	−24.64	2.54	−.66	.39**	−22.27	2.26	−.69	.44**	9.79	1.09	.63	.36**	9.12	1.14	.59	.32**
3. ODD	5.97	3.69	−.12	.01*	−7.75	3.18	−.18	.03**	6.09	1.48	.29	.07**	6.87	1.52	.33	.09**
4. Anxiety	−0.61	0.24	−.20	.03*	−0.59	0.21	−.23	.03**	0.61	0.08	.49	.15**	0.38	0.10	.30	.06**
5. ADHD × Anxiety	1.29	0.63	.35	.02*	0.33	0.56	.62	.00	1.45	0.22	.39	.01	−0.04	0.26	−.16	.00
	Like/accept (teacher)				Ignore (teacher)				Dislike/reject (teacher)							
1. Covariates		.02				.03				.02						
2 ADHD	−1.56	0.21	−.58	.31**	0.90	0.19	.41	.16**	0.79	0.16	.42	.16**				
3. ODD	−0.93	0.30	−.25	.05**	0.19	0.28	.06	.00	0.88	0.22	.35	.10**				
4. Anxiety	−0.07	0.02	−.30	.06**	0.04	0.02	.22	.03*	0.04	0.01	.28	.06**				
5. ADHD × Anxiety	0.02	0.05	.51	.00	−0.02	0.05	−.49	.00	0.02	0.04	.53	.00				

Note: Child age, sex, and parental education were included together as covariates at Step 1. ADHD status (*comparison* = 0; *ADHD* = 1); ODD status (*No ODD* = 0; *ODD* = 1). ΔR^2 represents the percentage change in the residual variance at each step of the regression.
*$p < .05$. **$p < .01$.

(β = –.56; $p < .01$) than it was for children with ADHD (β = –.13; $p = .12$). The interaction between ADHD and anxiety was not significant for social skills reported by the teacher, or for social problems reported by either informant.

Regarding teacher report of peer status, after statistical control of covariates and ADHD and ODD status, the main effect of anxiety symptoms was significant for all subscales. Higher levels of anxiety were associated with teacher report of fewer peers who "like and accept" the child, as well as more peers who "dislike and reject" and more peers who "ignore or are neutral to" the child. Effect sizes were small ($R^2\Delta$ = .03-.06). For the peer status dimensions reported by teachers, none of the interactions between ADHD status and anxiety symptoms was significant.

Anxiety and ADHD as Predictors of Social Functioning in Playgroup Observations

As shown in Table 3, after accounting for covariates, and the sequential contributions of ADHD and ODD status to the hierarchical model, anxiety symptoms were not associated with either observed aggression or prosocial behavior as a main effect. However, there was a significant interaction between anxiety and ADHD status in predicting aggression. Probing suggested that there may be a negative relationship between anxiety and aggression for the comparison children (β = –.32, $p = .23$), but not for children with ADHD (β = –.01, $p = .91$). In addition, the interaction between ADHD status and anxiety almost reached significance for the criterion variable of prosocial behavior, $t(116) = 1.71$, $p<.09$. Because of the intriguing findings for aggression and suggestions that statistical interactions are underpowered in nonexperimental research (McClelland & Judd, 1993), we also probed this interaction. Results also suggested that there may also be a negative relationship between anxiety and prosocial behavior for comparison children (β = –.35, $p = .23$) but not for children with ADHD (β = .09, $p = .50$).

However, anxiety symptoms were not incrementally associated with the proportion of "most liked" or "least liked" nominations children received at the playgroup, or with total social impact scores at the playgroup. Moreover, none of the interactions between ADHD and anxiety was significant for sociometric status as reported by playgroup peers (see Table 3).

Interactive Effects of ODD and Anxiety in Predicting Social Functioning

When the interaction between anxiety and ODD was added to the model in exploratory analyses, this interaction was significant in predicting parent report of social problems on the CBCL. Probing suggested that the positive relationship between anxiety- and parent-reported social problems may be stronger for children without ODD (β = .55, $p < .01$), relative for children with ODD (β = .27, $p = .04$). In addition, the interaction between anxiety and ODD was significant in predicting teacher reports of peers who "ignore or are neutral" to the child. Probing suggested a positive relationship between anxiety and teacher reports that peers ignore that child for youth without ODD (β = .34, $p = .03$) and not for youth with ODD (β = –.20, $p = .34$). None of the other interactions between anxiety and ODD were significant.

Discussion

In a sample of children with ADHD and age- and sex-matched comparison children, we found that anxiety symptoms were associated with lower social skills, more social problems, less acceptance, more rejection, and more ignoring by peers as reported by both parents and teachers. More important, these effects held after controlling for children's age, sex, parental education, ADHD status, and comorbid ODD. However, anxiety symptoms were not associated with peer nominations, aggression, or prosocial behavior observed during the lab-based playgroup.

As hypothesized, our results suggest a consistent association between continuous anxiety symptoms and poor social functioning as rated by adult informants across multiple measures. It is possible that the presence of anxiety may additively impede children's abilities to connect positively with peers, both among youth with ADHD and comparison youth. Nonetheless, it may be that the link between social problems and anxiety is bidirectional. Indeed, youth with poor social functioning may develop symptoms of anxiety specifically because of their difficulties in peer situations (Parker & Asher, 1987), which may further restrict opportunities to make friends and learn essential social skills.

It is notable that anxiety was associated with poorer social functioning on all adult-reported measures but failed to influence peer nominations received at the playgroup or observations of playgroup social behaviors. Our findings parallel those obtained in the MTA sample, where comorbid anxiety was associated with parent ratings of lower social skills (March et al., 2000) and teacher ratings of lower impulsivity (Newcorn et al., 2001), but not with classroom peer nominations (Hoza, Mrug, et al., 2005) or classroom observations of aggression (Abikoff et al., 2002). Our results confirm those obtained in the MTA when using a lab-based playgroup of previously unacquainted peers, as we also found that youth with ADHD received significantly fewer "most liked" nominations and displayed more aggression than did comparison youth at the playgroup; however, anxiety did not incrementally predict these variables.

Why might anxiety have a negative influence on adult informant ratings of social functioning but not on peer ratings? It may be that adults are more sensitive in noticing reticent and nervous behaviors when assessing children's

Table 3. The Effect of Anxiety on Playgroup Behaviors and Peer Status

		"Like Most"			"Like Least"			Social Impact			Aggression			Prosocial		
Fixed effects		B	SE	t ($\sigma^2\Delta$)	B	SE	t ($\sigma^2\Delta$)	B	SE	t ($\sigma^2\Delta$)	B	SE	t ($\sigma^2\Delta$)	B	SE	t ($\sigma^2\Delta$)
Intercept	β_{00}	.68	.10	6.74**	.13	.05	2.68	.80	.11	7.42**	.99	.20	5.23**	.39	.21	1.84
Age	β_{01}	.00	.02	−0.06	−.02	.01	−1.51	−.03	.03	−0.93	.03	.05	0.56	−.04	.06	−0.63
Sex	β_{02}	.00	.07	−0.04	−.03	.03	−0.93	−.03	.08	−0.48	−.48	.10	−4.83**	.05	.17	0.30
Parent education	β_{03}	.03	.02	1.47	−.02	.02	−1.20	.01	.02	0.31	−.09	.07	−1.34	−.04	.06	−0.61
ADHD	β_{04}	−.08	.05	−1.73 (.02)	.01	.03	0.40 (.00)	−.08	.05	−1.48 (.01)	.24	.09	2.77**(.05)	.11	.10	1.05 (.00)
ODD	β_{05}	−.03	.07	−0.50 (.00)	.07	.07	1.03 (.01)	.06	.08	0.74 (.00)	.23	.19	1.24 (.01)	.36	.18	2.01* (.04)
Anxiety	β_{06}	.00	.00	1.09 (.01)	.00	.00	−0.50 (.00)	.00	.00	0.50 (.00)	.00	.01	−0.41 (.00)	.00	.01	0.36 (.00)
ADHD × Anxiety	β_{07}	.00	.01	0.16 (.00)	.00	.00	0.83 (.00)	.00	.01	0.34 (.00)	.03	.01	2.16* (.01)	.04	.02	1.71 (.01)
Random effects		σ^2	τ	χ^2	σ^2	τ	χ^2	σ^2	τ	χ^2	σ^2	τ	χ^2	σ^2	τ	χ^2
Conditional model		.05	.03	84.57**	.03	.00	35.41	.05	.03	84.00**	.39	.05	41.18	.44	.05	39.28
Covariates only		.05	.03	83.48**	.03	.00	33.81	.05	.03	85.33**	.41	.05	40.45	.45	.05	39.11

Note: The symbol $\sigma^2\Delta$ is the proportion of reduction of within-group (child-level) variance when the given variable was added to the model. Each variable was added to the model in the following order: covariates of child age, sex (*boy* = 1; *girl* = 2), and parental education; ADHD status (*comparison* = 0; *ADHD* = 1); ODD status (*No ODD* = 0; *ODD* = 1); anxiety symptoms; and the interaction between ADHD status and anxiety symptoms. Coefficients, standard errors, and *T*-ratios represent the value associated with the addition of the given variable to the model.
*$p < .05$. **$p < .01$.

social skills, but peers do not find such behaviors as bothersome as they would disruptive problems. Therefore, adults may consider anxious children to have poorer social functioning than their peers perceive those children to have. Nonetheless, it is also possible that the effects of anxiety on adult (but not peer) reports of social functioning can be attributed to shared method variance, given that our anxiety composite was derived from parent and teacher ratings of anxiety. It may be that, if peers had reported participants' anxiety, we would also have seen a detrimental effect of anxiety on peers' sociometric ratings. Finally, it is also possible that the short period of time in the playgroup did not allow the effects of anxiety to be shown as they would in the classroom. However, it is notable that Abikoff and colleagues (2002) also did not find effects for anxiety on observed aggression in the classrooms of children with ADHD.

We were intrigued to find some interactions between anxiety symptoms and ADHD diagnostic status. The correlation between anxiety symptoms and parent report of lower social skills was stronger for comparison youth than for youth with ADHD. Anxiety also appeared to predict less aggression and less prosocial behavior observed at the playgroup for the comparison sample, but not for the ADHD sample. Collectively, these results suggest that the effect of anxiety on social functioning may be stronger for children without ADHD than for children with ADHD. Although anxiety mainly had a dampening effect on aggression for comparison youth, the similar dampening effect on prosocial behavior among comparison youth suggests that anxiety may be associated with an overall style of withdrawn, timid behavior for comparison children and not for children with ADHD. If anxiety confers social withdrawal for comparison youth specifically, this may explain the greater detrimental effects of anxiety on parent-rated social functioning for comparison youth relative to youth with ADHD.

Another interpretation is that youth with ADHD, but not comparison youth, have reached a ceiling in their social problems, such that the presence of anxiety may not additionally affect them. A third possibility is that the anxiety experienced by youth with ADHD may be "qualitatively different" than that experienced by typically developing youth (Jensen et al., 2001) and, therefore, associated with divergent outcomes. In the MTA sample of children with ADHD, anxiety was more marked by negative affect and disruptive behavior than by fearfulness, as it is presumed to occur in typically developing samples (Jensen et al., 2001). Given that the current study is, to our knowledge, the first to investigate interactions between ADHD status and anxiety on peer functioning, replication of our results is needed.

Comorbid ODD was also suggested to moderate relationships, such that the detrimental effects of anxiety on parent-reported social problems and teacher reports of peers ignoring the child were strongest for the children without ODD relative to the children with ODD. Again, this suggests a similar pattern as reported earlier, that anxiety may have the most negative effect on children without comorbid disruptive-behavior disorders. However, because the current sample was selected for ADHD (and not for ODD), this finding bears replication in a sample of children with ODD and no ADHD comorbidity, relative to comparison youth.

Strengths of this study include the use of multiple informants (parents, teachers, peers, and objective observations in a lab-based playgroup). In addition, our inclusion of children with ADHD who were matched with comparison peers of the same age and sex enhanced our ability to examine potential differential relationships between anxiety and social functioning depending on ADHD versus comparison status. Third, our use of both clinic- and community-based methods to recruit participants with ADHD may have increased the generalizability of results.

A limitation of this study is its cross-sectional design, as it prevents determining the directionality of relationships. The duration of the playgroup may have also been a limitation, as a longer period of play may have permitted the more subtle effects of anxiety to emerge. In addition, no child had CD. Because CD may be associated with more socially aversive behaviors among youth with ADHD than ODD (Kuhne, Schachar, & Tannock, 1997), it is possible that CD may have additional interactions with anxiety on children's peer relationships. Moreover, given evidence that self-reported anxiety among youth with ADHD may be associated with more peer problems than parent report of child anxiety (March et al., 2000), our results may have differed when we obtained child self-reports of anxiety.

In conclusion, we found that anxiety symptoms had additive effects on children's social impairment, as rated by parents and teachers. There was also some support for the hypothesis that anxiety may be associated with greater social impairment among comparison youth relative to youth with ADHD or ODD. This investigation may have implications for understanding the ways in which both externalizing and internalizing psychopathology contribute to peer problems.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interests with respect to their authorship or the publication of this article.

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