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To cite this article: Rosmary Ros & Paulo A. Graziano (2018) Social Functioning in Children With or At Risk for Attention Deficit/Hyperactivity Disorder: A Meta-Analytic Review, *Journal of Clinical Child & Adolescent Psychology*, 47:2, 213-235, DOI: [10.1080/15374416.2016.1266644](https://doi.org/10.1080/15374416.2016.1266644)

To link to this article: <https://doi.org/10.1080/15374416.2016.1266644>



Published online: 27 Jan 2017.



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Social Functioning in Children With or At Risk for Attention Deficit/Hyperactivity Disorder: A Meta-Analytic Review

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Considerable work has demonstrated significant impairment in social functioning for children with attention deficit/hyperactivity disorder (ADHD). The social functioning profiles of children with ADHD are marked by impairments across diverse domains as they tend to experience greater rates of peer rejection, have lower levels of social skills, and have impaired social cognitions. The purpose of this study was to (a) quantitatively examine the association between ADHD and deficits across several domains of social functioning (peer functioning, social skills, social information processing), (b) examine differences in the magnitude of such associations, and (c) examine the effect of potential moderators. A meta-analysis of 109 studies ($n = 104,813$) revealed that children with ADHD have the most impairment within the peer functioning domain (weighted effect size [ES] $r = .33$) followed by significantly smaller effects within the social skills (weighted ES $r = .27$) and social information-processing domains (weighted ES $r = .27$). When examining potential moderators, results revealed that the association between ADHD and deficits within the social skills domain was weaker among studies that controlled for co-occurring conduct problems (CP). Studies that utilized sociometric and teacher reports of peer status reported the largest effects within the peer functioning domain. In addition, studies that utilized the “gold standard” approach to diagnosing ADHD documented the largest effects within both the social skills and peer functioning domains. Last, studies utilizing younger samples revealed the largest effects for deficits within the peer functioning domain. Theoretical and clinical implications are discussed.

Attention deficit/hyperactivity disorder (ADHD), marked by symptoms of hyperactivity, impulsivity, and inattention, is prevalent in 5% to 7% of children worldwide (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). Children with ADHD typically experience impairment across a host of functional domains including academic achievement, behavioral functioning, and cognitive functioning (Barkley, 2006). Impairment in social functioning is especially evident in children with ADHD (Hoza, 2007; McQuade & Hoza, 2008; Nixon, 2001). Not only is social functioning important for predicting long-term outcomes in normative samples (Jones, Greenberg, & Crowley, 2015), but it is among the strongest predictors of long-term outcomes for children with ADHD (Greene, Biederman, Faraone, Sienna,

& Garcia-Jetton, 1997). For instance, the social functioning deficits of children with ADHD are predictive of later impairments such as school difficulties, criminality (Nixon, 2001), risky behavior taking, and heightened levels of anxiety (Mrug et al., 2012). Thus, substantial research has aimed to examine the nature of social functioning deficits for this clinical population.

Gresham and Elliott (1987) proposed a conceptual model of social functioning that characterizes social deficits as social skill acquisition deficits and/or performance deficits. According to this model, deficits are characterized by either the child's inability to behave in a socially skilled manner because he or she lacks the skills to do so (skill deficit) or the child's inability to perform the behavior despite knowing how to do so because of alternate factors (performance deficit). In addition to the controversy over whether children with ADHD have a “skill” deficit or a “performance” deficit (King et al., 2009), the social functioning deficits of children

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with ADHD may not fit well within the predictions of the “skill versus performance deficit” model. The social problems of children with ADHD may not only arise from a lack of skill or presence of symptoms that affect performance (e.g., impulsivity), but may also be impacted by less overt factors such as cognitive biases (discussed in detail next). Given the disruptive behaviors of children with ADHD and their effect on peer perceptions, other more contextual factors such as external perceptions may also be important to consider.

More recent conceptualizations of social functioning focus not only on the acquisition and performance of socially appropriate behaviors but also on the appropriateness of behaviors as perceived by external judges (Dirks, Treat, & Weersing, 2007). According to Dirks and colleagues (2007), an important aspect of social functioning also involves the concordance between behavior and contextual factors, which often relies heavily on an individual’s cognitive ability to interpret social situations and respond appropriately. Thus, according to this multidimensional view, markers of social functioning range from (a) overt behaviors including social skills, to (b) more cognitive factors that equip individuals with the ability to process information and modulate social responses according to contextual factors, and lastly to (c) external individual’s—namely, peer’s—perceptions and evaluations of behavior. These additional components (i.e., peer and cognitive factors) may be especially important to consider as children with ADHD tend to experience not only significant limitations in overt social skills but also impairments within peer functioning along with impaired social information processing. **Figure 1**

illustrates our conceptual framework for examining the link between ADHD symptoms and deficits across domains of social functioning.

DOMAINS OF SOCIAL FUNCTIONING

Peer Functioning

As highlighted by Dirks et al. (2007), an important component of social functioning involves the evaluation of social behaviors from external judges, which may be captured by indices of peer functioning. Peer functioning has been conceptualized as a complex and dynamic system of interactions often characterized by variables encompassing judgment of same-age peers such as peer rejection, peer acceptance, and quality of relationships (Masten, 2005). Impairments within the peer functioning domain are especially evident in children with ADHD (Hoza, 2007). Specifically, about 80% of children with ADHD experience high rates of peer rejection (Hoza et al., 2005) even after very brief encounters with typically developing peers (Erhardt & Hinshaw, 1994; Pelham & Bender, 1982). Children with ADHD also tend to have fewer friends (Bagwell, Molina, Pelham, & Hoza, 2001; Hoza et al., 2005) and are less likely to be selected as friends by peers with higher sociometric status (Hoza et al., 2005).

Symptoms of ADHD contribute to the development of maladaptive peer functioning and are associated with bossy/unfriendly, aggressive, and impulsive interpersonal styles (Mrug, Hoza, & Gerdes, 2001). Others have concluded

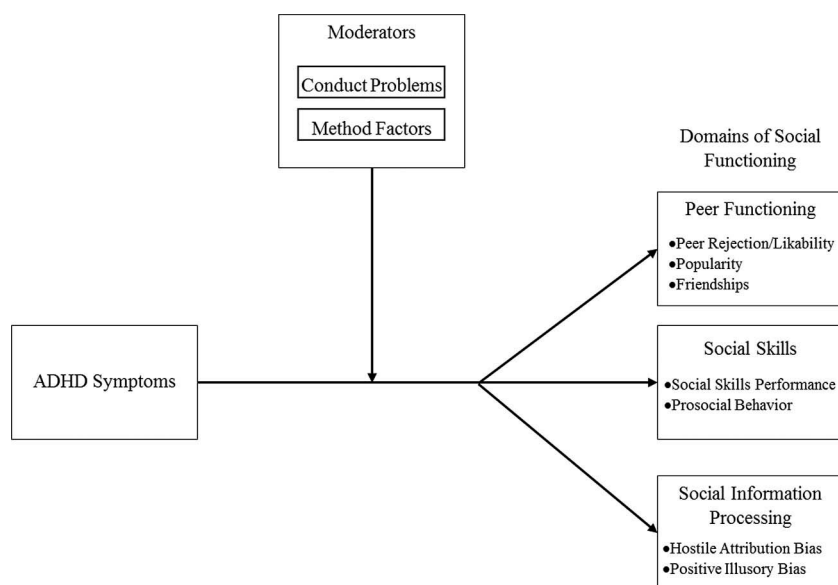


FIGURE 1 Attention deficit/hyperactivity disorder (ADHD) social functioning conceptual framework. *Note:* Current meta-analysis focuses only on the pathways from ADHD to social skills, social information processing, and peer domains (solid black lines) while examining the moderating effect of co-occurring conduct problems and method factors.

that deficits in peer functioning arise from an inability to modulate habitual behavior patterns associated with perspective taking (Marton, Wiener, Rogers, Moore, & Tannock, 2009). More recently, work has shown that children with ADHD tend to not only have fewer mutual friendships (Blachman & Hinshaw, 2002) but more importantly have poorer quality friendships (Normand et al., 2013).

Social Skills

The enactment of social skills is also a basic component underlying social functioning (Dirks et al., 2007). Social skills have often been operationally defined as effective and appropriate verbal or nonverbal behaviors that are either initiative or responsive in nature and are intended to elicit socially desirable outcomes (Merrell & Gimpel, 2014). Social skills often include behaviors such as sharing, helping, and engaging in reciprocity during interactions.

Social functioning problems in children with ADHD have been conceptualized to arise from an inability to engage in sharing, cooperating, and turn taking (Barkley, 2006). Children with ADHD are not only less socially effective during lab simulation situations involving the use of social skills (Hoza, Waschbusch, Pelham, Molina, & Milich, 2000) but also rated by teachers as having poorer social skills in the classroom (DuPaul, McGoey, Eckert, & VanBrakle, 2001). Specifically, social interactions in the classroom are often marked by low levels of cooperation, turn taking, and reciprocity in conversation (DuPaul et al., 2001).

Behavioral factors that may serve to explain social skills deficits are symptoms of ADHD themselves, particularly hyperactivity and impulsivity. Although children with ADHD do tend to display engagement and interest in social interaction with same-age peers (Nixon, 2001), they tend to be more intrusive and disruptive during interactions (Nijmeijer et al., 2008). Symptoms of inattention are also associated with problems maintaining conversation and engaging in role switching (Nijmeijer et al., 2008).

Social Information Processing

Social functioning is indexed not only by the enactment of social skills but also by the appropriateness of behavioral responses to situations (Dirks et al., 2007). As defined by Crick and Dodge (1994; Dodge, Pettit, McClaskey, & Brown, 1986), social information processing includes various cognitive processes including the detection and interpretation of social cues, as well as the emergence and maintenance of cognitive biases, and self-perceptions of social functioning. The social information functioning profiles of children with ADHD are marked by difficulties in encoding social cues, identifying problems, and generating responses to problem-solving tasks (Zentall, Cassady, & Javorsky, 2001).

Hostile Attribution Bias

A key cognitive distortion found among children with clinical or at-risk levels of aggression is the hostile attribution bias, which involves attributing aggressive intent to neutral situations (Dodge, 1980). Children with ADHD and aggression are more likely to not only interpret social cues with a hostile attribution bias (Milich & Dodge, 1984) but also use a more hostile responding style during peer provocation (King et al., 2009) and problem-solving activities (Bloomquist, August, Cohen, Doyle, & Everhart, 1997). Although much is known about the hostile attribution bias within children with aggression, the role of ADHD in the absence of aggression is relatively understudied.

Positive Illusory Bias

Despite the aforementioned social functioning deficits, another cognitive distortion among children and adolescents with ADHD is the positive illusory bias. The positive illusory bias is defined as a positive evaluation of one's own competence that is disparate of actual competence (Hoza et al., 2000). Children with ADHD tend to overestimate their competence particularly in domains where the most impairment is present, such as social functioning (Hoza et al., 2004; Hoza, Pelham, Dobbs, Owens, & Pillow, 2002). Theoretical explanations for the presence of a positive illusory bias in children with ADHD include cognitive immaturity, neuropsychological deficits, and unawareness of incompetence (Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007).

Potential Moderators

Co-occurring Conduct Problems

Although CP are not a defining feature of ADHD, meta-analytic reviews have revealed that ADHD and CP tend to co-occur at a significant rate (Waschbusch, 2002). Some studies suggest that social functioning deficits are heightened for children with ADHD and comorbid CP such as oppositional defiant disorder (ODD; Wehmeier, Schacht, & Barkley, 2010). For instance, children with ADHD and co-occurring CP tend to respond more aggressively to peer provocation (Bloomquist et al., 1997; Matthys, Cuperus, & Van Engeland, 1999) and are more likely to have negative peer status than typically developing peers (Hinshaw & Melnick, 1995). However, there is mixed evidence on the moderating role of CP on the association between ADHD and social functioning. For example, some studies find that regardless of level of CP, ADHD is associated with significant peer problems (Hoza et al., 2005; Waschbusch, 2002). Conversely, others find that in the absence of CP, children with ADHD are comparable to typically developing children on measures of social preference (Melnick & Hinshaw, 2000). Given the inconsistencies in the literature,

quantitative approaches are needed to more conclusively determine the moderating role of CP in the association between ADHD within social functioning.

Methodological Factors

The multidimensional nature of social functioning contributes to the existing diversity of measurement approaches. Several modalities have been utilized to measure social functioning. Often parent and/or teacher reports of social functioning such as the Social Skills Rating System (Gresham & Elliott, 1990) are utilized as a measure of social functioning. However, the validity of teacher and parent reports remains unclear as the greatest social impairment occurs within the peer context where parents and teachers may have the least insight. Self-report measures of social functioning are also typically used but may be influenced by the positive illusory bias inherent in ADHD. Although observational methods including laboratory tasks and observations within naturalistic settings may be valuable, they often represent limited samples of behavior (Hoza, 2007). Peer reports, primarily sociometric ratings, tend to be the best predictor of later social adjustment (Lee & Hinshaw, 2006) but have poor concordance rates with parent and teacher reports of social functioning (Hoza et al., 2005). Given the multitude of assessment tools for social functioning along with the low concordance between such measures, it may be important to quantify which methods of assessment yield the largest associations with ADHD in an effort to further understand the specific contexts of impairment in social functioning. Understanding which methodology better captures social impairment among children with ADHD is of significant clinical utility, as it would provide researchers and clinicians alike with important information on how to best assess treatment response within the social functioning domain.

The Current Meta-Analysis

The goals of the current meta-analysis are to (a) determine the magnitude of the association between ADHD and social functioning deficits, (b) examine whether there are differences in the magnitude of association for the different domains of social functioning (peer functioning, social skills, social information processing), and (c) examine whether the associations between ADHD and social functioning deficits are moderated by co-occurring CP and method of assessment. Despite the lack of previous evidence to suggest that there are differences in the magnitudes of association between ADHD and each social functioning domain, we hypothesized that the peer functioning and social skills domains would be most impaired, as these domains seem to be the most overtly impacted by the symptoms of ADHD. Although there are several theoretical reviews examining social functioning in ADHD (de Boo & Prins, 2007; Frederick & Olmi, 1994; Hoza, 2007; Landau, Milich,

& Diener, 1998; McQuade & Hoza, 2008; Nixon, 2001), all have either focused on only one domain of social functioning (e.g., peer domain; Hoza, 2007) or discussed social functioning more broadly without comparing deficits across domains. However, a more recent review (Gardner & Gerdes, 2015) discussed social functioning deficits in children with ADHD across domains similar in nature to those examined in the current study (i.e., social skills and sociocognitive factors). In particular, the review discussed the clinical implications for current treatments aiming to improve social outcomes for children with ADHD. Although previous reviews provide rich theoretical conceptualizations of social functioning and qualitative reviews of the literature, a meta-analytic review would provide a more thorough and quantitative approach toward understanding which domains of social functioning are most impaired for children with ADHD. Such understanding would provide empirical evidence toward quantifying previous theoretical conceptualizations of social functioning that implicate social skills; contextual appropriateness, which may be implicated by social information-processing factors; and evaluation from peers (Dirks et al., 2007). Of note, one meta-analytic review examining the comorbidity between ADHD and CP included peer difficulties in its examination of outcomes (Waschbusch, 2002). Although this study made notable strides within the social functioning literature by demonstrating greater peer problems in children with ADHD and co-occurring CP, social functioning was not the central focus of the study, as only 11 studies were included within the peer domain. Thus, the current study would not only provide quantitative support for previous theoretical reviews but also build on earlier meta-analytic reviews by expanding outcomes across social functioning domains. Lastly, given the lack of success of current treatment approaches toward remediating social difficulties among children with ADHD, information gathered from the current meta-analysis may aid in determining which domains of social functioning are of the highest priority when considering treatment targets.

METHOD

Literature Search

We conducted a comprehensive literature search regarding the association between ADHD and social functioning over the last 40 years (1975–2015) using PsycINFO, PubMed, MEDLINE, ERIC, and Google Scholar. Keyword search terms included *ADHD*, *AD/HD*, *ADD*, *Attention Deficit/Hyperactivity Disorder*, *Attention Deficit Disorder*, and *attention problems*. These search terms were crossed with terms related to social functioning, including *social functioning*, *social competence*, *social skills*, *social skill performance*, *social skill knowledge*, *prosocial behavior*, *social interaction*, *social relationships*, *friendship*, *peer rejection*, *peer problems*, *peer conflict*, *peer likability*, *peer status*,

sociometrics, social status, peer provocation, problem solving, social information processing, social cognition, hostile attribution bias, and positive illusory bias. In addition, references of selected studies and review articles were used to search for relevant studies. Due to the large number of studies identified, only published data were used in the current study.

Inclusionary and Exclusionary Criteria

More than 200 articles were identified in the initial literature search. After scanning abstracts, 152 studies were examined further, 109 of which met inclusion criteria for the current study. To satisfy inclusion criteria, studies had to identify children as having an ADHD diagnosis ($k = 73$) or having elevated symptoms of ADHD ($k = 36$). Studies that compared social functioning between children with ADHD (or elevated levels of ADHD symptoms) and a control group (e.g., children with normative levels of ADHD symptoms) were included ($k = 81$). However, studies that compared children with ADHD exclusively with children meeting criteria for other clinical disorders were not included (e.g., studies comparing social functioning of children with ADHD vs. depression). Studies examining associations between ADHD symptoms and social functioning factors through correlational methods were also included ($k = 28$). Studies also had to report sufficient statistical data to allow for the calculation of ESs (e.g., means, standard deviations, correlations, regression, test-statistics, analysis of variance). Only articles written in English were included. Studies that more broadly examined general externalizing behavior problems were not included ($k = 31$).

Studies focusing on the change in social functioning as a function of treatment (e.g., Pfiffner & McBurnett, 1997; $k = 11$) were excluded unless baseline data were available comparing ADHD samples with a control group. In addition, one child follow-up study with a mean age older than 18 was excluded (i.e., Barkley, Fischer, Smallish, & Fletcher, 2006).

Study Coding

Two coders (first and second authors) independently coded studies for demographic and methodological factors. Coders also categorized study outcomes into social functioning categories (peer functioning, social skills, social information processing). To code outcomes into social functioning categories, coders examined measure descriptions of selected studies and categorized based on operational definitions of each respective domain. A list of applicable measures (e.g., questionnaires, tasks) was also created for coders to reference for each social functioning domain. If studies contained outcome measures across categories coders coded for each separately. In the case of discrepant codes, coders recoded the study independently. If further discrepancy was identified, coders discussed and came to a consensus.

Intraclass correlation coefficients for continuous codes and kappas (κ) for categorical codes were calculated for inter-coder reliability. Reliability statistics were averaged across studies for each variable and then averaged across variables. The reliability between coders was excellent (intraclass correlation coefficient $> .90$, $\kappa = .95$). In the case of missing data, study authors were contacted for further information on missing demographic or methodological data (e.g., mean age, gender composition, ethnic composition, covariates included).

Demographic Variables

Studies were coded for average age of the sample, gender composition (i.e., percentage male), ethnicity (i.e., percentage Caucasian), time lag (time in years between ADHD symptoms and social functioning outcome), type of sample (between-group comparison of ADHD and comparison group, $k = 82$; or within-group comparison of ADHD symptoms and social functioning among clinical/at-risk groups, $k = 28$). The method for diagnosing ADHD was also coded. Thirty-three studies utilized a “gold standard” approach (i.e., used a diagnostic interview along with parent and teacher reports), 40 studies used only parent and/or teacher reports, 19 studies used a diagnostic interview with or without parent or teacher reports, 12 studies used medical records of previous diagnosis with or without parent report, and four studies used parent-reported history of ADHD. The majority of studies identified were cross-sectional in nature ($k = 97$), which precluded us from examining the time lag between diagnosis and social functioning outcome as a moderator. Studies were also coded for whether samples were community based ($k = 41$), only clinical ($k = 2$), or a comparison of clinical to community samples ($k = 65$).

Conduct Problems

As discussed in the introduction, the association between ADHD and social functioning outcomes remains confounded by the comorbidity between ADHD and CP (aggression and/or ODD/conduct disorder diagnoses). Studies were coded for whether analyses between ADHD and social functioning outcomes controlled for CP ($k = 33$) or not ($k = 76$). Studies were coded as controlling for CP if analyses statistically controlled for the effect of CP by including it as a covariate. Studies were also coded as controlling for CP if analyses were conducted separately for groups with and without concurrent CP. In that case, ESs were calculated from results of the groups without CP and coded as controlling for such. Studies were coded as not controlling for CP if CP were not measured or if the effect of CP and ADHD on social functioning was examined jointly.

Methodological Factors

Also noted in the introduction, great variability exists in how social functioning outcomes are measured across

studies. Hence, studies were coded for whether social functioning outcomes were measured via exclusively parent and/or teacher reports ($k = 40$), included observational lab tasks or other observational paradigms ($k = 30$), included sociometric ratings ($k = 27$), or used discrepancy scores calculated from multiple reporters (e.g., discrepancy between self and parent reported outcomes to assess positive illusory bias; $k = 7$).

Calculation of Effect Sizes

One hundred nine studies were identified, for a total of 61 ESs for the peer-functioning domain (61 studies, $N = 24,571$), 68 ESs for the social skills domain (68 studies, $N = 148,778$), and 23 ESs for the social information-processing domain (23 studies, $N = 3,752$). Pearson's r correlations between ADHD status and/or symptom severity and social functioning outcomes served as estimates of ES. When correlations were not available, r was estimated from other values such as group comparisons (t tests), analysis of variance, regression coefficients (β), or means and standard deviations for groups (e.g., children with ADHD vs. control groups). Transformations from other statistics to r were calculated according to Lipsey and Wilson's (2001) guidelines. When multiple estimates of ES for a single domain were available (e.g., two measures or two raters) in a study, each estimate was transformed to an r value and then averaged to create a single ES per domain for each study.

Within the peer-functioning domain 35 estimates of ES were calculated using means and standard deviations, 13 using regression coefficients (β), five using correlation coefficients (r), three using t values, one using a chi-square statistic, two using an F statistic, and two using a combination of statistics. Within the social skills domain, 40 estimates of ES were calculated using means and standard deviations, 10 using regression coefficients (β), seven using correlation coefficients (r), three using t values, one using a chi-square statistic, and seven using a combination of statistics. Within the social information-processing domain 16 estimates of ES were calculated using means and standard deviations, two using regression coefficients (β), two using correlation coefficients (r), one using t values, two using an F statistic, and two using a combination of statistics.

Further information about all studies appears in the Appendix.

Data Analysis

Primary analyses were conducted using a random effects model approach (Hughes, 1998) using Microsoft Excel (Neyeloff, Fuchs, & Moreira, 2012). The random effects model attempts to estimate the mean ES from a distribution of "true" effects, whereby each study is estimating a different ES as different samples are assumed to have a different "true" effects (Borenstein, Hedges, & Rothstein, 2007). Given the wide array of age distributions, sample demographics, sample sizes, and

methodologies employed in the studies included, we chose to use a random effects model in order to assign more balanced weights to ESs and ensure that larger studies were less likely to dominate analyses. All ESs were transformed to z scores using Fisher's r -to- z transformation. ESs were transformed again to rs for comparison. Cohen's criteria of small = .10, medium = .30, large = .50 was used to interpret ES sizes (Cohen, 1988). As a result of the large number of studies included, we used a minimum alpha level of .01 (two-tailed tests).

Heterogeneity analyses were also conducted to determine whether ESs were more heterogeneous than would be expected due to sampling error alone. The measure I^2 is a modification of Cochrane's Q test (Cochran, 1954), which measures whether the ratio of variation exceeds chance, thereby accounting for the number of studies utilized in meta-analysis with more accuracy (Higgins & Thompson, 2002). Values for I^2 range from 0 to 1; an I^2 of 0% indicates no heterogeneity, whereas I^2 s of 25%, 50%, and 75% represent low, moderate, and high heterogeneity, respectively (Higgins, Thompson, Deeks, & Altman, 2003). For variables with moderate to high heterogeneity, potential moderators to the ES were identified using weighted least squares regression or analysis of variance procedures (Hedges & Cooper, 1994). All moderation analyses were conducted in SPSS v20. Finally, file drawer analyses were conducted following Rosenberg's (2005) weighted approach to determine the number of studies that would be necessary to reduce the mean effect to a negligible level. The Fail Safe Number Calculator software was used for the weighted file drawer analyses (Rosenberg, 2005). Additional tests for publication bias were conducted with comprehensive meta-analysis software including the rank correlation test (Begg & Mazumdar, 1994) for publication bias, as well as the Trim and Fill procedures (Duval & Tweedie, 2000).

RESULTS

Primary Analyses

See Table 1 for study identification information, coded categories, and ESs representing the association between ADHD and social functioning outcomes. The association between ADHD and deficits within the peer-functioning domain had a weighted ES of $r = .33$, 95% confidence interval (CI) [.31, .34], $p < .001$, indicating a moderate effect. However, the association between ADHD and deficits within the social skills domain had a weighted ES of $r = .27$, 95% CI [.26, .27], $p < .001$, indicating a small effect. A small effect was also found for the association between ADHD and deficits within the social information-processing domain, weighted ES of $r = .27$, 95% CI [.24, .30], $p < .001$. The association between ADHD and deficits within the peer-functioning domain was significantly greater than the ES for the social skills domain ($z = 3.25$, $p < .001$).

TABLE 1
Effect Sizes (ES) Across Domains of Social Functioning

	Social Functioning Domain		
	Peer Functioning	Social Skills	Social Information Processing
Weighted <i>M</i> ES	.33	.27	.27
Cohen's Criteria	Medium	Small	Small
95% CI	.31, .34	.26, .27	.24, .30
No. of ESs	61	68	23
<i>N</i> Across Studies	24,571	148,778	3,752
Range of ESs	-.16 to 1.27	.08 to 1.21	-.15 to .67
<i>t</i>	50.99***	103.39***	16.42***
Weighted File Drawer Analysis	1,327.73	3,174.57	80.73
<i>I</i> ²	93%	97%	78%
Cochrane's <i>Q</i> Test	899.38, <i>p</i> = .02	2068.02, <i>p</i> = .01	98.15, <i>p</i> = .04
Nature of Moderation	a, b, c, e	b, c, d, e	—

Note: a. Age: stronger association between attention deficit/hyperactivity disorder (ADHD) and social functioning among studies with younger children. b. Sample type: stronger association between ADHD and social functioning among studies comparing clinical samples with community samples. c. Diagnostic approach: stronger association between ADHD and social functioning among studies using the "gold standard" approach to diagnosis. d. Conduct problems: weaker association between ADHD and social functioning for studies controlling for conduct problems. e. Assessment method: differing effect size for ADHD based on method used to assess social functioning.

****p* < .001.

and the social information-processing domain ($z = 2.55$, $p < .001$). The ESs for the social skills and social information-processing domains were not significantly different from one another ($z = 0.00$, $p = .50$).

Heterogeneity and Moderation Analyses

Results of heterogeneity and moderator analyses are presented in Table 1. The I^2 values for the association between ADHD and social functioning outcomes indicated high heterogeneity for the peer functioning, social skills, and social information-processing domains (93%, 97%, and 78% respectively).

Demographic moderators included average age, gender (% male), ethnicity of sample (% Caucasian), type of sample (comparison of clinical and community subjects vs. community samples), and method of ADHD diagnosis. Regression analyses indicated that age of sample was significantly associated with the average strength of the association between ADHD and deficits in the peer-functioning domain ($\beta = -.28$, $p = .03$). This indicates that the association between ADHD and deficits within the peer-functioning domain was weaker among studies with older children. Age did not have an effect on the association between ADHD and deficits in either the social skills ($\beta = .12$, $p = .32$) or social information-processing ($\beta = .03$, $p = .89$) domains. Associations between ADHD and difficulties within the social skills domain were marginally stronger for studies with larger proportions of male participants ($\beta = .24$, $p = .06$). Gender did not have an effect on the association between ADHD and deficits in either the peer-functioning ($\beta = .01$, $p = .96$) or social information-processing ($\beta = -.16$, $p = .45$) domains. Sample ethnic

composition did not have an effect on the association between ADHD and deficits in any social-functioning domains. Studies comparing clinical samples with community samples obtained higher ESs for the association between ADHD and difficulties within the peer-functioning ($\beta = .53$, $p < .001$) and social skills domains ($\beta = .52$, $p < .001$) than studies using only community samples. This effect was not present for the social information-processing domain ($\beta = .14$, $p = .55$).

In addition, the method of diagnosing ADHD was a significant moderator of the association between ADHD and social functioning within the peer-functioning, $F(9, 49) = 4.52$, $p < .001$, and social skills, $F(8, 58) = 5.52$, $p < .001$, but not social information-processing, $F(6, 16) = 1.99$, $p = .13$, domains. Specifically, studies utilizing the "gold standard" (i.e., parent and teacher reports plus a diagnostic interview) obtained higher ESs for the association between ADHD and deficits within the peer-functioning domain than studies utilizing only parent ($p = .002$) or teacher ($p = .01$) reports. Similarly, ESs for the social skills domain were larger for studies utilizing the "gold standard" than those utilizing parent and teacher reports without diagnostic interviews ($p = .006$).

Comorbid Conduct Problems

To examine the influence of co-occurring CP, separate regressions using weighted least squares (accounting for sample size) were performed for each domain of social functioning. First, we examined potential differences in any demographic factors among studies that did or did not control for CP. These analyses found that studies that controlled for CP had significantly greater numbers of

Caucasian children ($\beta = .56, p < .001$) and younger children ($\beta = -.54, p < .001$) compared to studies that did not control for CP. No other demographic differences were found. In addition, there were no differences in the method used to diagnose ADHD or sample type among studies that did or did not control for CP. Hence, only sample percentage of Caucasian subjects and subject age were included as covariates. Covarying CP did have a significant effect on the strength of the association between ADHD and deficits within the social skills domain ($\beta = -.58, p < .001$). As seen in Figure 2, studies that covaried CP reported weaker associations between ADHD and deficits within the social skills domain of social functioning ($M = .15, SE = .04$), compared to studies that did not covary CP ($M = .41, SE = .05$). However, covarying CP had no effect on the strength of the association between ADHD and deficits in either the peer-functioning ($\beta = .20, p = .21$) or social information processing ($\beta = -.21, p = .47$) domains.

Methodological Factors

To determine whether different methods of assessing peer functioning had an influence on the strength of the association between ADHD and social functioning, separate regressions using weighted least squares (accounting for sample size) were performed for each domain of social functioning. No demographic differences were found among studies that used different method of assessing social functioning within the peer-functioning domain. Thus, no covariates were included in the analyses for the peer-functioning domain. Within the peer-functioning domain, there was a significant effect of methodology on the association between ADHD and deficits in the peer-functioning domain, $F(3, 41) = 10.31, p < .001$, such that studies that utilized sociometric procedures ($M = .27, SE = .04$) had larger ESs than studies relying solely on parent report ($M = .14, SE = .02, p = .03$). However,

studies using sociometric procedures did not differ from studies relying on teacher reports ($M = .33, SE = .04, p = .99$) in the strength of the association between ADHD and deficits in peer functioning. In addition, studies relying solely on parent reports found lower effects than those using teacher reports and those using combined teacher and parent reports ($M = .55, SE = .10, p = .002$). Due to a low number of studies relying solely on self-report ($k = 11$), we did not examine it across all domains.

Within the social skills domain, average sample age and proportion of Caucasian subjects were significantly associated with the method of assessing social functioning, $F(3, 54) = 35.27$ and $F(3, 45) = 8.46$, respectively ($ps < .001$); thus, they were controlled for in the subsequent analyses. There was a significant effect of methodology on the association between ADHD and deficits in the social skills domain of social functioning, $F(3, 39) = 3.81, p < .05$, such that studies that utilized observational methods ($M = .44, SE = .10$) had marginally larger ESs than those that relied on combined parent and teacher reports ($M = .13, SE = .05, p = .07$). In addition, studies relying solely on parent reports ($M = .39, SE = .07$) had larger ESs than those utilizing combined parent and teacher reports ($p = .04$).

Within the social information processing domain there were no demographic differences for studies utilizing different methods for assessing social functioning; thus no covariates were entered for these analyses. There were no significant differences in the magnitude of the association between ADHD and deficits within the social information processing domain for studies using different methods of assessment, $F(1, 18) = 3.51, p = .09$. In addition, there were no differences within the social information processing domain when examining the strength of the association for studies that examined differing cognitive biases (e.g., positive illusory bias, hostile attribution bias, general problem solving), $F(3, 19) = .70, p = .56$.

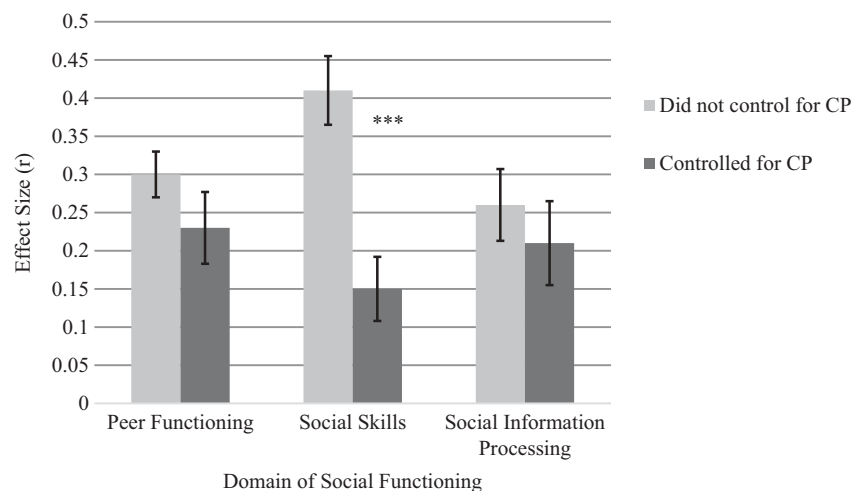


FIGURE 2 Association between attention deficit/hyperactivity disorder and social functioning moderated by conduct problems (CP). *** $p < .001$.

File Drawer Analysis and Publication Bias

We conducted a file drawer analysis to account for publication biases, specifically, the lack of published nonsignificant findings. The file drawer analysis examines the number of studies with nonsignificant findings needed to bring the ESs to a negligible level. Rosenberg's (2005) approach was utilized to identify the number of studies with null results needed to change the significant level of findings weighted by the sample sizes across studies. Results of the weighted file drawer analyses are provided in Table 1. The weighted file drawer analysis also indicated a high number of studies needed to overturn significant findings for the peer functioning domain (more than 1,327 studies), social skills domain (more than 3,174 studies), and social information processing domain (more than 80 studies). In conjunction with the file drawer analyses, additional analyses were run to test for publication bias. The rank correlation test (Begg & Mazumdar, 1994) for publication bias was nonsignificant for effects within the peer domain (Kendall's tau $b = 0.03$, $p = .76$) and social information processing domain (Kendall's tau $b = 0.11$, $p = .46$). In addition, the Trim and Fill procedure suggested that no studies were missing from both the peer and social information processing domains, therefore no publication bias correction was conducted for analyses within either domain (Duval & Tweedie, 2000). Within the social skills domain, the rank correlation test was significant (Kendall's tau $b = 0.21$, $p = .01$). However, results of the Trim and Fill procedure suggested that no studies were missing, and the file drawer analyses indicated a high number of null studies needed. Thus, collectively analyses pointed toward a lack of publication bias within the social skills domain as well.

DISCUSSION

Given the multidimensional nature of theoretical conceptualizations of social functioning (Dirks et al., 2007; Ronk, Hund, & Landau, 2011), the current study examined the magnitude of social functioning deficits across domains. Results indicated small to moderate associations between ADHD and social functioning domains. Effects for social functioning deficits within the social skills and peer functioning domains were moderated by methodological factors. In addition, CP moderated effects within the social skills domain. Findings are discussed in more detail next.

In regards to the first and second study aims, and consistent with our hypothesis, results of the current meta-analysis indicated a moderate association between ADHD and children's social functioning difficulties within the peer functioning domain. On the other hand, and contrary to our predictions, we found significantly smaller associations between ADHD and deficits within the social skills and social information processing domains of social functioning. These findings appear to provide support for the Dirks et al.

(2007) conceptualization of social functioning, suggesting an integral component is external evaluation of social behaviors, which may be characterized by peer perceptions. These findings highlight the complexity of peer status beyond simply displaying good social skills. For instance, children rated by peers as controversial are often high in indices of sociability as well as relational aggression (Nelson, Robinson, & Hart, 2005), suggesting that a distinct construct is indexed by peer status. In addition, non-skill-based constructs such as attractiveness and gender/ethnic concordance with peer groups are also linked to peer status (Fishbein & Imai, 1993). The importance of peer relationships for children with ADHD is further supported by the stability of peer status across development and its prediction of long-term outcomes (Mrug et al., 2012). In addition, smaller effects for the associations between ADHD and the social skills and social information processing domains may be due to the difficulty in quantifying abstract social abilities and cognitions, whereas peer relationships present more concrete and readily observable dynamics. Of note, although statistically significant, differences between ESs across social functioning categories were small. Thus, it remains unclear the extent to which these differences in social functioning categories are clinically significant. Nonetheless, impairments within the peer domain were within the medium range and the lower bound confidence interval did not overlap with confidence intervals of other social functioning domains.

In regards to our final study aim (i.e., examination of moderators) the examination of CP was the most central to moderation analysis. Results demonstrated that the association between ADHD and social functioning deficits within the social skills domain were moderated by CP. Given the strong associations between aggression and social adjustment (Campbell, Spieker, Burchinal, & Poe, 2006; Crick, 1996), it is not surprising that studies examining the role of ADHD in the absence of comorbid CP, find lower levels of social skills deficits. This finding suggests that to some extent, CP may exacerbate deficits in behavioral indicators of social functioning in children with ADHD. Given that overt aggression is an important defining feature of early CP (Okado & Bierman, 2015) it is likely that this more concrete factor may affect observable measures that are captured by ratings and observations within the social skills domain. However, given that a small yet significant association remained between ADHD and peer functioning (even for studies that controlled for CP), it appears that some of the attentional and regulatory deficits more uniquely associated with ADHD (e.g., intrusive, off-topic, and annoying during interactions; Landau et al., 1998) may still contribute to social rejection in the absence of CP.

Similarly, ADHD continued to be associated with deficits within the social information processing domain independent of CP. Of note, the association between ADHD and deficits within the social information processing domain

was not moderated by any factors included in the study. These findings highlight a relatively stable association between ADHD and social information processing deficits. Perhaps the stability of this association may be driven by executive functioning deficits in children with ADHD (Nigg, Blaskey, Huang-Pollock, & Rappley, 2002; Sergeant, Geurts, & Oosterlaan, 2002). Of note, many tasks used to measure the cognitive biases and social problem solving skills of children with ADHD require the use of working memory abilities and cognitively flexibility to remember appropriate details about social situations and adjust perceptions accordingly. Studies have concluded that executive functioning problems are primarily associated with symptoms of ADHD and not ODD, suggesting that CP may not play an additive role in executive dysfunction (Thorell & Wählstedt, 2006). The lack of moderation by CP within the social information processing domain may be partially explained by the unique nature of executive functioning deficits in children with ADHD independent of CP. Regarding the lack of moderation for methodological factors, a similar explanation may be plausible. Given the relative validity of parent and teacher reports in measuring executive functioning (Gioia, Isquith, Guy, & Kenworthy, 2000), perhaps parents and teachers may be attune to picking up on executive functioning skills often necessary for and indicative of performance on social problem solving tasks.

Additional moderation analyses revealed methodological factors as a significant moderator. Within the peer functioning domain, studies utilizing sociometric ratings had larger ESs than those using only parent reports. However, studies using sociometric ratings were not significantly different from studies exclusively relying on teacher reports of social preference. This finding was surprising as the validity of peer reports for establishing social functioning has been well-established (Lee & Hinshaw, 2006). A large proportion of studies that examined peer status via teacher reports utilized the Dishion Social Preference Scale (Dishion, 1990) or variations. Results suggest that when presented with standardized questions regarding social status, teachers may provide insight into the peer relationships of children, particularly by estimating popularity and rejection. The utility of teacher reports in measuring other domains of functioning for children with ADHD has also been widely documented (Biederman, Faraone, Milberger, & Doyle, 1993; McCandless & O'Laughlin, 2007). Although sociometric procedures present unique information, the utility of more cost effective teacher reports should be considered. More work is needed examining the relative contribution of teacher reports above that of sociometric procedures.

Additional analysis revealed demographic factors as moderators. For instance, associations between ADHD and social dysfunction were weakest for studies utilizing older samples. More advanced self-regulatory abilities, which may play an important role in social functioning

(Eisenberg, Fabes, Guthrie, & Reiser, 2000; Eisenberg et al., 1995), typically develop as children age (Kopp, 1982). Self-regulation has been deemed an important precursor for the development of adequate social responding (Vohs & Ciarocco, 2004). In addition, work examining social functioning becomes increasingly difficult to conduct with older samples, as secondary school teachers are much less aware of peer problems. Sociometric evaluations are also less commonly used with older samples. Nonetheless, future work is needed to examine social functioning deficits within younger children with ADHD, as this group seems to be experiencing the most impairment. Diagnostic method for assessing ADHD was also a significant moderator. Studies utilizing the gold standard approach for diagnosing ADHD documented the largest associations between ADHD and social functioning deficits. Although it has been argued that diagnostic interviews do not provide incremental validity beyond parent and teacher ratings for the diagnosis of ADHD (Pelham, Fabiano, & Massetti, 2005), it seems that studies that utilize all three sources of information are identifying children at risk for greater social dysfunction. Our results provide support for the gold standard approach of diagnosis for ADHD, as it not only provides better predictive utility for later impairments (Sibley et al., 2012) but may be more sensitive to children experiencing greater functional impairment within the social domain.

There are certain limitations to the current study that should be noted. Given that a large proportion of studies were cross-sectional in nature, we were unable to examine the longitudinal associations between ADHD and social functioning deficits. Individual studies have documented long-term effects of ADHD symptoms impacting social functioning 6 months to 8 years later (Andrade & Tannock, 2014; Becker, 2014; Campbell, 1994; Greene et al., 1997; Milich & Dodge, 1984; Miller & Hinshaw, 2010; Owens, Hinshaw, Lee, & Lahey, 2009; Young, Heptinstall, Sonuga-Barke, Chadwick, & Taylor, 2005). However, limited studies have examined the effect of changes in ADHD symptoms on social functioning over time. As studies have documented changes in ADHD symptoms with age (e.g., decreases in hyperactivity symptoms; Galéra et al., 2011), it would be of interest to examine how such changes impact social impairments over time.

An additional limitation of the current study involves the directionality of paths from ADHD to separate social functioning domains. For instance, deficits within social skills and social information processing may serve as mechanisms by which ADHD symptoms influence peer functioning (Hoza, 2007). However, quantitatively examining such indirect pathways was not possible given the small number of studies examining the link between social skills and cognitive factors and peer functioning. In addition, it is important to note that impairments in peer domains may not be entirely affected by deficits within social skills and social information processing. Peer functioning deficits may

in fact be attributable to symptoms of ADHD themselves as symptoms of ADHD have been largely documented to predict peer rejection in longitudinal studies (Andrade & Tannock, 2014; Becker, 2014). In addition, given the complexity of peer functioning described earlier, a multitude of factors beyond social skills and cognitive biases may affect peer functioning. Nonetheless, more studies examining these mediational pathways are warranted.

Of note, our inclusionary criteria specified that studies identified children as having either an ADHD diagnosis or elevated symptoms of ADHD. However, numerous studies examine externalizing behavior problems or disruptive behavior disorders more broadly in relation to social functioning outcomes (Calkins, Gill, & Williford, 1999; Henricsson & Rydell, 2006; Webster-Stratton & Hammond, 1998). Considering that high comorbidity exists between ADHD and other disruptive behavior disorders (Waschbusch, 2002), it is important to consider the role of general behavioral problems in social functioning outcomes. However, this limitation may serve as a strength, as effects reported were all deemed to be specific to ADHD and not general externalizing behavior problems more broadly.

In summary, social functioning deficits present a fundamental problem for children with ADHD. In fact, ESs yielded from the current study are comparable to ESs documented by other meta-analytic studies examining academic impairments and ADHD ($r = .32$; Frazier, Youngstrom, Glutting, & Watkins, 2007). Considering the attention given to efforts that address and remediate academic impairments in youth with ADHD (Evans, Serpell, Schultz, & Pastor, 2007; Sibley, Altszuler, Morrow, & Merrill, 2014), similar efforts are needed for social impairments, as this area of functioning seems to be comparably compromised. Given the critical impairment in peer functioning for children with ADHD and small yet significant effects independent of CP within the social skills and social information processing domains, clinical and theoretical implications must be considered. From a theoretical standpoint, the social deficits of children with ADHD seem to highlight the importance of external evaluations when examining social functioning as peer functioning seemed to be the most implicated domain. The results of this meta-analysis provide quantitative support for previously proposed theoretical models of social functioning (Dirks et al., 2007).

Clinical implications of the current study include the need for different efforts to address social deficits within psychosocial treatments for children with ADHD. Despite significant impairments, current treatments remain limited in remediating social problems for children and adolescents with ADHD (Abikoff et al., 2004; Evans, Owens, & Bunford, 2014). Results of this meta-analysis suggest that children with ADHD are not simply experiencing poorer social skills and cognitions but, more importantly, experience great peer impairment. Recent reviews have

highlighted that traditional conceptualizations of social functioning have largely ignored peer group factors, solely focusing on overt social behaviors, which has limited the efficacy of interventions to improve the social problems of children with ADHD (Mikami & Normand, 2015). Hence, rather than focusing on didactic efforts to improve social skills, which encompasses the majority of treatments aimed to reduce social impairments (Pelham & Fabiano, 2008), the field should shift toward helping children with ADHD implement such skills in ecologically valid settings. For example, peer-mediated interventions carried out in schools may provide better targets for future treatment of social problems in youth with ADHD. For instance, the MOSAIC intervention, which aims to train peers to be socially inclusive, is associated with larger effects on peer status for children with ADHD than more traditional approaches (Mikami et al., 2013). More work is needed in the development and dissemination of such treatment approaches that aim to improve interactions with typical peers (not simply other children with ADHD, as most social skills groups implement). Other reviews on the social functioning of children with ADHD have suggested the need for interventions that not only include dyadic friendship components but also include parental involvement to foster said relationships (Gardner & Gerdes, 2015; Mikami, Jia, & Na, 2014). Given the potential role that parents may have to impact peer functioning, which may be more feasible for parents to foster than social skills and cognitive factors, these suggestions provide relevant targets to remediate children's social functioning deficits long term.

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APPENDIX

TABLE A1
Coded Qualities and Weighted Effect Sizes for Studies of ADHD and Children's Social Functioning Outcomes

<i>Study</i>	<i>Demographic Variables</i>					<i>Social Functioning Factors</i>			
	<i>M Age in Years</i>	<i>% of Sample Male</i>	<i>% of Sample Caucasian</i>	<i>Design (Between vs. Within Subject)</i>	<i>How Was ADHD Diagnosed?</i>	<i>Controlled for CP?</i>	<i>Social Functioning Domain Measured</i>	<i>Effect Size (r)</i>	<i>N</i>
Abikoff et al., 2004	8.45	NA	NA	Between	NA	No	Peer (O)	.0912	206
Airaksinen et al., 2004	7	49	100	Between	Parent report	No	SS (O)		
Alessandri, 1992	4.44	43	10	Between	Parent & teacher report, diagnostic interview	No	SS (P)	.59	471
Andrade et al., 2009	8.68	79	NA	Within	Parent & teacher report	No	SS (O)	.40	40
Andrade & Tannock, 2013	7.6	49	86	Within	Parent & teacher report	No	SS (T)	.50	202
					Parent report	Yes	Peer (T)	.13	500
Andrade & Tannock, 2014	8.6	51	86	Within	Parent report	Yes	SS (T)	.34	
							Peer (T)	.20	492
Babb et al., 2010	9.55	63	64	Between	Previous diagnosis confirmed with parent report	No	SS (T)	.32	
Baumeister et al., 2005	8.32	59	0	Between	Parent & teacher report, diagnostic interview	No	SIP (O)	.35	80
							SS (P, T)	.67	98
Becker, 2014	9.17	47	93	Within	Teacher report	Yes	Peer (T)	.45	176
Becker & Langberg, 2013	11.9	77	70	Within	Teacher report, diagnostic interview	Yes	SS (P)	.33	57
Biederman et al., 2004	13.12	46	NA	Between	Previous diagnosis confirmed with parent report & diagnostic interview	No	SS (P)	.42	484
Blachman & Hinshaw, 2002	9.6	0	53	Between	Parent & teacher report, diagnostic interview	No	Peer (SM, S)	.21	228
Blackman et al., 2005	9.18	79	95	Between	Diagnostic interview	No	SS (P, S)	.63	453
Bloomquist et al., 1997	9.15	79	100	Between	Parent & teacher report	No	SIP (O)	.22	110
Bunford et al., 2015	9.64	55	94	Within	Parent & teacher report, diagnostic interview	No	Peer (P, T)	.53	64

Buhrmester et al., 1992	9.21	100	66	Between	Parent reported history	No	Peer (SM)	.33	32
Campbell, 1994	3.83	100	98	Between	Parent & teacher report	No	SS (O)	.09	112
Cardoos & Hinshaw, 2011	9	0	53	Between	Parent report, diagnostic interview	No	Peer (SM)	.24.51	228
Carlson et al., 1987	8	76	NA	Between	Parent & teacher report, diagnostic interview	Yes	SS (P)	.47	101
Carlson et al., 1997	7.82	71	7	Between	Teacher report	No	Peer (T)	.35	508
Clark et al., 2002	13.98	83	100	Between	Parent & teacher report	Yes	SS (T)	.40	
Demaray & Elliot, 2001	10	100	55	Between	Teacher report	No	SS (P)	.79	110
De Wolfe et al., 2000	4.84	80	NA	Between	Parent report, diagnostic interview	No	SS (T, S)	.34	94
Diamantopoulou et al., 2005	12.08	50	100	Within	Teacher report	Yes	Peer (S)	.17	50
							SS (P, S)	.31	
Diamantopoulou et al., 2007	8.5	45	100	Within	Parent & teacher report	No	Peer (SM, S)	.19	635
							SS (PR, T)	.48	
DuPaul et al., 2001	4	74	88	Between	Parent & teacher report	No	Peer (SM)	.30	112
DuPaul et al., 2004	8.5	77	67	Between	Parent report, diagnostic interview	No	SS (PR)	.26	
Emeh & Mikami, 2014	8.52	73	82	Between	Parent & teacher report, diagnostic interview	No	SS (P, O)	.51	94
						Yes	SS (T)	.84	189
							SS (T, S)	.42	56
Erhardt & Hinshaw, 1994	9	100	NA	Between	Previous diagnosis confirmed with parent report & diagnostic interview	No	SIP (D)	.39	
							Peer (SM)	.52.21	45
Evangelista et al., 2008	9.42	56	93	Between	Parent & teacher report	No	SS (O)	.52	107
							Peer (P, T, S)		
Evans et al., 2015	16	52	NA	Within	Teacher report	Yes	SIP (D)	.32	
Flanagan et al., 1996	5.25	49	0	Within	Parent & teacher report	No	Peer (T)	.10	200
Flieck, 1992	9.5	100	100	Between	Teacher report	No	SS (P, T)	.18	53
							Peer (SM)	.24	339
Gadow & Nolan, 2002	4.11	58	47	Between	Parent & teacher report	Yes	SS (T)	.49	
Gaub & Carlson, 1997	7.6	66	8	Between	Teacher report	No	SS (P, T)	.31	595
							Peer (T)	.56	442
							SS (O)	.66	
Glass et al., 2012	13.87	42	73	Within	NA	No	Peer (P, T, S)	.19	82

(Continued)

Demographic Variables

Demographic Variables							Social Functioning Factors		
M Age in Years	% of Sample Male	% of Sample Caucasian	Design (Between vs. Within Subject)	How Was ADHD Diagnosed?	Controlled for CP?	Social Functioning Domain Measured	Effect Size (<i>r</i>)	N	
Graziano et al., 2011	76	74	Within	Previous diagnosis confirmed with parent report & diagnostic interview	No	SS (P)	.44	62	
Greene et al., 1997	100	100	Between	Diagnostic interview	No	SS (P)	.32	226	
Grenell et al., 1987	100	NA	Between	Previous diagnosis confirmed with parent & teacher report	No	Peer (SM)	.07	30	
Griggs & Mikami, 2011	72	85	Between	Parent & teacher report	Yes	SS (O)	.27		
						Peer (SM)	.13	103	
						SS (P, T, O)	.63		
Hanć & Brzezińska, 2009	48	100	Between	Parent report	No	SS (S)	.10	62	
Hay et al., 2010	46	100	Within	Parent & teacher report, diagnostic interview	Yes	SS (T)	.30	61	
Heiman, 2005	77	0	Between	Teacher report, diagnostic interview	No	SS (P, T, S)	.21	56	
Hinshaw, 2002	0	53	Between	Parent & teacher report, diagnostic interview	Yes	Peer (SM)	.40	228	
Hinshaw et al., 1997	100	56	Between	Parent report, diagnostic interview	Yes	SS (T, O)	.32		
						Peer (SM)	.29	133	
						Peer (SM)	.45	45	
Hodgens et al., 2000	100	56	Between	Parent & teacher report, diagnostic interview	Yes	Peer (S)	.12	52	
Hoza et al., 1993	100	NA	Between	Parent & teacher report, diagnostic interview	No	SIP (S)	.31		
Hoza et al., 2000	100	NA	Between	Parent report, diagnostic interview	No	SS (O)	.22	185	
						Cognitive (S)	.15		
						SIP (D)	.30	268	
Hoza et al., 2002	100	NA	Between	Parent report, diagnostic interview	Yes	SIP (D)	.19	774	
Hoza et al., 2004	80	61	Between	Parent & teacher report, diagnostic interview	Yes	Peer (SM)	.23	330	
Hoza et al., 2005	79	66	Between	Parent & teacher report, diagnostic interview	Yes	SS (P)	.40	143	
Kaiser et al., 2011	80	80	Within	Parent & teacher report, diagnostic interview	Yes	Peer (SM)	.52	152	
Kats-Gold & Priel, 2009	100	0	Within	Teacher report	No				
Kawabata et al., 2012	52	0	Within	Teacher report	No	SS (T)	.64		
						Peer (P)	.11	2,463	
						SS (P)	.31		
Kellner et al., 2003	64	NA	Between	Diagnostic interview	No	SS (S)	.23	291	
Keown & Woodward, 2006	100	72	Between	Parent & teacher report, diagnostic interview	No	Peer (T)	.42	67	
						SS (T, O)	.14		

King et al., 2009	9.15	75	92	Between	Parent & teacher report, diagnostic interview	Yes	SIP (O)	.10	75
Kofler et al., 2011	9.7	100	62	Between	Parent & teacher report, diagnostic interview	No	SS (P, T)	.34	39
Larson et al., 2011	11.5	NA	NA	Between	Parent reported history	No	SS (P)	.17	61,779
Lee et al., 2008	4.9	82	64	Between	Parent & teacher report, diagnostic interview	No	Peer (T)	.20	222
Lee et al., 2012	7.4	70	56	Between	Diagnostic Interview	No	Peer (P, T)	.85	223
Lee & Hinshaw, 2006	9.6	0	53	Between	Parent & teacher report, diagnostic interview	No	SS (P, T)	.48	
Lin et al., 2012	11.78	95	0	Between	Previous diagnostic history	Yes	Peer (SM, T)	.44	228
Linnea et al., 2012	8.69	79	85	Between	Parent & teacher report, diagnostic interview	No	Peer (P, S)	.41	120
Marton et al., 2009	10.14	72	NA	Between	Previous diagnosis confirmed with parent & teacher report	Yes	SS (O)	.20	125
							SIP (O)	.45	92
McConaughy et al., 2011	8.1	70	68	Between	Teacher report, diagnostic interview	No	SS (P, T)	.65	178
McQuade et al., 2011	9.2	77	81	Between	Parent & teacher report, diagnostic interview	No	Peer (T, S)	.38	272
Melnick & Hinshaw, 2000	9.11	100	55	Between	Parent & teacher report, diagnostic interview	Yes	SIP (D)	.43	
							Peer (SM)	.23	82
Merrell & Boelter, 2001 (study 1)	9	73	59	Between	Parent reported history	No	SIP (O)	.13	
Merrell & Boelter, 2001 (study 2)	13	45	55	Within	Parent report	No	SS (P)	.73	164
Merrell & Wolfe, 1998	5.5	76	64	Between	Teacher report	No	SS (P)	.66	148
Mikami et al., 2007	9.74	70	55	Between	Parent & teacher report, diagnostic interview	Yes	SS (T)	.62	190
							Peer (T)	.64	116
							SS (P,O)	.43	
							SIP (O)	.40	
Mikami et al., 2008	9.5	0	53	Between	Parent & teacher report, diagnostic interview	No	Peer (SM)	.43	228
							SIP (O)	.09	
Mikami et al., 2011	8.25	68	86	Between	Parent & teacher report, diagnostic interview	No	Peer (SM, T)	.29	124
							SS (P,T, O)	.52	
Mikami & Hinshaw, 2003	9.55	0	50	Between	Teacher report, diagnostic interview	No	Peer (SM)	.43	149
Mikami & Hinshaw, 2006	9.5	0	53	Between	Parent & teacher report, diagnostic interview	No	Peer (SM)	.56	228
Milich & Dodge, 1984	11.9	100	NA	Between	Parent report	Yes	SIP (O)	.15	135
Milich et al., 1982	5	100	NA	Within	Teacher report	No	Peer (SM, T)	.21	86
Miller & Hinshaw, 2010	9.6	0	53	Between	Parent & teacher report, diagnostic interview	No	Peer (P, T)	.35	228

(Continued)

TABLE A1
(Continued)

<i>Study</i>	<i>Demographic Variables</i>				<i>How Was ADHD Diagnosed?</i>	<i>Controlled for CP?</i>	<i>Social Functioning Factors</i>		
	<i>M Age in Years</i>	<i>% of Sample Male</i>	<i>% of Sample Caucasian</i>	<i>Design (Between vs. Within Subject)</i>			<i>Social Functioning Domain Measured</i>	<i>Effect Size (f)</i>	<i>N</i>
Nelson et al., 1999	9	48	81	Within	Teacher report	No	SS (P)	.46	75
Normand et al., 2013	7.6	76	91	Between	Previous diagnosis confirmed with parent & teacher report	No	SS (T)	.43	133
							Peer (SM, S)	.20	
							SS (O)	.17	
Ohan & Johnston, 2011	10.58	0	87	Between	Previous diagnosis confirmed with parent & teacher report	Yes	SS (P, T, S, O)	.38	82
Ostrander et al., 2006	9.18	79	95	Between	teacher report		SIP (D)	.58	
Owens et al., 2009	14.2	0	53	Between	Parent & teacher report, diagnostic interview	Yes	SS (P, T, S)	.49	246
					Diagnostic interview	No	Peer (T)	.31	207
							SS (T)	.39	
Owens & Hoza, 2003	10.87	76	96	Between	Parent & teacher report	No	Peer (S)	.07	180
							SIP (D)	.28	
Paap et al., 2013	8.5	50	100	Within	Parent & teacher report	Yes	SS (P, T)	.10	9,430
Piumatti et al., 2014	8.25	53	NA	Within	Teacher report	Yes	Peer (S)	.05	103
							SS (S)	.08	
Ronk et al., 2011	9.7	100	100	Between	Previous diagnosis confirmed with parent report	No	Peer (SM)	.28	147
							SS (O)	.23	
Scholten et al., 2012	9.96	86	100	Within	Parent & teacher report	Yes	Peer (P, T)	.28	86
							SIP (D)	.19	
Semrud-Clikeman, 2010	10.4	65	78	Between	Parent report, diagnostic interview	No	SS (P, T)	.50	270
Semrud-Clikeman et al., 2010	10.56	70	82	Between	Parent report, diagnostic interview	No	SS (P, T, S)	.46	342
Sibley et al., 2010	12.29	53	71	Between	Parent & teacher report, diagnostic interview	No	Peer (SM, P)	.52	45
							SIP (O)	.30	
Solanto et al., 2009	9.13	53	NA	Between	Parent & teacher report, diagnostic interview	Yes	SS (P, T)	.79	80
Staikova et al., 2013	8.88	75	60	Between	Parent & teacher report, diagnostic interview	No	SS (P)	.63	63
Strine et al., 2006	10.5	NA	NA	Between	Parent reported history	No	Peer (P)	.14	8,681
Swanson et al., 2012	9.1	0	53	Between	Diagnostic Interview	No	SIP (D)	.22	228
Thorell & Rydell, 2008	6.5	51	100	Within	Parent report	No	Peer (P)	.31	559
							SS (P)	.14	

Thurber et al., 2002	9.5	0	58	Between	Parent & teacher report, diagnostic interview	No	Peer (SM)	.37	79
Tseng et al., 2012	10.06	52	0	Within	Parent report	No	SIP (O)	.54	739
Tseng & Gau, 2013	12.94	81	0	Between	Parent & teacher report, diagnostic interview	No	SS (PR, T)	.16	452
Van der Oord et al., 2005	9.99	82	100	Between	Previous diagnosis confirmed with diagnostic interview	No	SS (P, S)	.50	362
Van Eck et al., 2013	6.5	50	51	Within	Teacher report	No	SS (P, T, S)	.48	387
Wiener & Mak, 2009	11.54	77	NA	Between & Within	Previous diagnosis confirmed with parent & teacher report	No	SIP (O)	.16	104
Willcutt et al., 1999	5.2	82	64	Within	Parent & teacher report	Yes	Peer (P, T)	.73	252
Wu & Gau, 2013	12.37	71	0	Between	Diagnostic interview	No	Peer (T, S)	.31	765
Young et al., 2005	15	0	100	Between	Parent & teacher report	Yes	SS (T)	.39	78
Zentall et al., 2001	10.81	53	NA	Between	Teacher report	No	Peer (P,S)	.43	34
Zoromski et al., 2015	10.15	50	75	Within	Teacher report	No	Peer (S)	.28	788
Zucchetti et al., 2015	9.38	48	NA	Within	Teacher report	No	SIP (O)	.28	334
							Peer (T)	.37	
							Peer (S)	.15	

Note: NA = information not available in article; SS = social skills; SIP = social information processing; (P) = parent report; (T) = teacher report; (S) = self-report; (SM) = sociometrics; (O) = observational; (PR) = peer report; (D) = discrepancy score between self-report and other reporters for cognitive domain.