

## Atypical Behaviors and Comorbid Externalizing Symptoms Equally Predict Children with Attention-Deficit/Hyperactivity Disorder's Social Functioning

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**Abstract** The goal of the current study was to determine within a clinical sample what differentiates children with ADHD who experience social functioning difficulties from those who appear to have healthy social functioning. Participants for this study included 62 children (mean age = 11.3 years) with a DSM-IV diagnosis of ADHD confirmed by a comprehensive clinical diagnostic assessment. Multiple indicators of children's social functioning were collected via parent report including: social skills, social adaptability, peer difficulties, and social quality of life. Parent reports of children's externalizing, internalizing, and atypical behaviors were also collected. Results indicated that both externalizing symptoms and atypical behaviors predicted children with ADHD's social functioning, even after controlling for ADHD symptoms severity. No association was found between internalizing symptoms and social functioning. The current study provides initial data suggesting that atypical behaviors found in children with ADHD are as powerful as comorbid externalizing symptoms in predicting social functioning difficulties. Due to the shared variance from relying solely on parent report, it will be critical for future research to replicate our findings using multi-informant data such as peer and teacher reports which provide unique information on children's social functioning.

**Keywords** ADHD · Social functioning · Atypical behaviors · Externalizing · Internalizing

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## Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common childhood psychiatric disorders with prevalence rates ranging from 3 to 7% worldwide [1, 2]. The core symptoms of ADHD, consisting of inattention, hyperactivity, and impulsivity, are associated with significant impairment across children's social functioning [3]. For example, peer rejection rates are significantly higher in children with ADHD relative to their peers [4]. Children with ADHD also report having fewer close friends and are reported as having worse social skills compared to their peers [5]. The social difficulties encountered by children with ADHD occur rapidly (e.g., rejected by a peer group within hours or days of entering a new group) and remain relatively stable until adolescence and early adulthood [6, 7]. Despite the strong link between ADHD symptoms and social dysfunction, a significant group of children with ADHD have a healthy social life [8]. In fact, differentiating children with ADHD with and without social dysfunction is of utmost importance given that social dysfunction has been found to be among the strongest predictors of children with ADHD's short and long-term prognosis [9].

The effects of ADHD symptoms on social functioning have been hypothesized to be a function of self-regulation deficits that interfere with reciprocal social interactions and/or due to comorbid behavioral problems such as Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD [10, 11]). Within the self-regulation domain, current theoretical and neurobiological notions suggest that the etiology of ADHD may involve behavioral disinhibition/executive function deficits involving the prefrontal cortex and its connections, including striatal regions and associated dopaminergic and norepinephrine systems [10, 12]. The executive functioning deficits seen in children with ADHD are also most readily associated with the inattention symptoms rather than the hyperactivity/impulsivity [13, 14]. These inattention symptoms have been shown to independently predict social difficulties in children with and without ADHD [15, 16].

Several mechanisms may explain the link between inattention and social difficulties in children with ADHD. First, inattention would likely interfere with a child's ability to consistently attend to social cues during an interaction. A pattern of such inattentive interactions may contribute to a child missing valuable opportunities to learn social norms as well as missing opportunities to engage in typical social reciprocity [15]. Second, inattention may also affect a child's ability to provide verbal and non-verbal feedback to their peers during interactions [16]. A lack of reciprocal feedback during interactions may be perceived as a sign that the child is not interested in his/her peers which may result in a decrease in social interactions with that child [17]. Lastly, children with the predominantly inattentive ADHD subtype are also more likely to exhibit internalizing symptoms (e.g., anxiety, shyness, withdrawal) which may also have a negative impact on social functioning via a decrease in social interactions [18].

In addition to having difficulty regulating one's attention during social interactions, the executive functioning deficits present in children with ADHD also make them have more difficulty regulating their emotions and behavior. Extensive evidence suggests that social competence requires optimal levels of emotion and behavioral regulation [19]. Children who experience intense levels of negative emotions and who are unable to manage them in an adaptive manner are more likely to engage in impulsive and negative social behaviors (e.g., aggression) and are less likely to engage in prosocial behaviors such as show empathy [20, 21]. These behavioral and emotion regulation deficits often seen in children with ADHD may contribute to the high comorbidity rates, ranging from 30 to 50%, of ODD and CD [22, 23]. These additional comorbid diagnoses have also

been shown to exacerbate any social problems [8]. For example, children with ADHD and comorbid ODD or CD have more peer problems than children with ADHD alone [24, 25].

More recently, researchers have also indicated that some of the social difficulties expressed by children with ADHD may be partially due to atypical behaviors that they display. First, it is important to recognize that many behaviors that are reported by parents and classified as atypical on behavior rating scales (e.g., BASC) can be attributed to inattention symptoms such as “seeming out of touch with reality” and “stares blankly”. However, other atypical behaviors such as “says things that make no sense,” “acts strangely,” “seems unaware of others,” are behaviors that are more independent of inattention symptoms and commonly seen in children with pervasive developmental disorders (PDD). While diagnostic issues have restricted the combined diagnosis of PDD and ADHD [1], children with ADHD have been shown to score higher scores on measures of PDD behaviors compared to both healthy controls and other psychiatric disorders [8]. Other evidence for the overlap in these two disorders includes similar lower performance on emotion recognition and theory of mind tasks [26]. As with ADHD, executive functioning deficits have also been considered core features of PDD [27]. Lastly, there is also preliminary data from genetic linkage studies indicating an overlap in genetic regions of interest in both ADHD and autism [28].

In summary, children with ADHD may take multiple pathways that lead to the development of social difficulties. ADHD symptoms on their own can have a direct impact on social functioning via self-regulation/executive functioning deficits which make it more difficult to successfully interact with peers during social situations. Children with ADHD may also experience social difficulties via comorbid conditions such as ODD/CD as well as internalizing symptoms. Lastly, more recent research has also suggested that children with ADHD display atypical social behaviors commonly found in children with PDD which may also contribute to social dysfunction. While these different contributing factors have been established in the ADHD literature, no study to date has examined all three factors in a single study. In fact, most studies have primarily focused on how ADHD symptoms and/or executive functioning deficits and/or comorbid externalizing difficulties contribute to social dysfunction, while the role of comorbid internalizing and atypical behaviors in social functioning remain largely unexplored [8, 18]. Given the recent interest in the etiological overlap between PDD and ADHD, it is particularly important to determine whether these atypical behaviors exhibited by children with ADHD contribute to social dysfunction independent of comorbid conditions such as ODD and CD as well as internalizing difficulties.

Hence, the goal of the current study was to determine within a clinical sample what differentiates children with ADHD who experience social functioning difficulties from those who appear to have healthy social functioning. Given the heterogeneity of what defines social impairment or social competence [19, 29], we included multiple indicators of children’s social functioning that have been used in past research including: social skills, social adaptability, peer difficulties, and social quality of life. We also wanted to make sure that our sample included a sufficient number of girls with ADHD as this group has historically been understudied [30]. We were also interested in examining concurrent associations between comorbid difficulties (i.e., externalizing, internalizing, atypical behaviors) and social functioning to determine whether one symptom cluster exerts a stronger influence on children with ADHD’s social functioning. While past literature has found that children with ADHD’s comorbid externalizing, internalizing, and atypical behaviors symptoms contribute to social

impairment, no study to date had examined all three symptom clusters within the same model. Given the similar self-regulation and/or executive functioning deficit profiles found in children with externalizing problems and children with atypical behaviors, we expected both of these symptom clusters to predict social dysfunction, above and beyond the effects of ADHD symptoms severity. We did not expect that internalizing symptoms would predict social dysfunction above and beyond the effects of ADHD symptoms and the other comorbid conditions as past studies have suggested that the link between internalizing symptoms and social dysfunction are mediated by earlier comorbid externalizing symptoms [31].

## Method

### Participants

Participants for this study included 62 children (15 girls) with a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) whose parents provided consent to participate in the study. The mean age of the participating children was 11 years, 3 months (range: 6–18 years of age). These children were primarily referred from psychiatrists (68%), self-referred (13%), and pediatricians (12%). All participants had a previous DSM-IV diagnosis of ADHD ( $n = 37$  for combined type,  $n = 23$  for predominantly inattentive type, and  $n = 2$  for ADHD not otherwise specified) confirmed by a licensed psychologist via a comprehensive clinical diagnostic assessment including the use of a semi-structure interview (e.g., diagnostic interview schedule for children) and Conners Parenting Rating Scales. Exclusionary criteria included a diagnosis of Mental Retardation or a psychotic disorder. The sample was primarily Caucasian (74%) with an additional 15% of children being classified as African American, 10% Hispanic, and 1% as biracial. Forty-five percent of children were from an intact biological family, 22% were from a single biological parent household, 12% were from a remarried household, and the 21% were in an adoptive/foster family placement. In terms of treatment history, 64% of the children in our sample were currently taking medications to address their symptoms.

### Measures

#### *ADHD Symptoms*

To assess children's current severity level of ADHD symptoms, the Conners' Parent Rating Scale, 3rd edition was administered [32]. The Conners-3 is a widely used questionnaire that covers core symptoms of ADHD as well as comorbid problems such as Oppositional Defiant Disorder symptoms. The parent version used for children ages 6–18 contains 108 items. Each item on the Conners-3 is rated on a four-point scale with respect to the frequency of occurrence (never, occasionally, often, and very often). The measure yields  $t$  scores on internalizing, hyperactivity/impulsivity, learning problems, executive functioning, defiance/aggression, and peer relations as well as DSM-IV-TR symptom scales. The Conners-3 has well-established internal consistency, reliability and validity [32]. For the purpose of the present study, the *inattention* and *hyperactivity/impulsivity*  $t$  scores were used as indicators of ADHD symptoms severity.

### *Behavioral/Emotional Functioning*

To assess children's behavioral functioning, parents completed the Behavior Assessment System for Children, 2nd Edition (BASC-2 [33]). The BASC-2 is a widely used behavior checklist that taps emotional and behavioral domains of children's functioning. The parent version used for children ages 6–21 contains 148 items. Each item on the BASC-2 is rated on a four-point scale with respect to the frequency of occurrence (never, sometimes, often, and almost always). The measure yields scores on broad internalizing, externalizing, and behavior symptom domains as well as specific adaptive/social functioning skills scales. The BASC-2 has well-established internal consistency, reliability and validity [33]. For the purpose of the present study, the aggression and conduct problems subscale *t* scores were averaged into an *externalizing symptoms composite* due to their high correlation ( $r = .69$ ,  $p < .001$ ). Similarly, the depression and anxiety subscale *t* scores were averaged into an *internalizing symptoms composite* due to their moderately high correlation ( $r = .51$ ,  $p < .001$ ). The *atypicality* subscale *t* score was also examined.

### *Social Functioning*

To assess children's social functioning, parents completed the Pediatric Quality of Life (PedsQL [34]). The PedsQL is a widely used 23 item questionnaire that yields information on children's quality of life across four domains: physical, emotional, social, and school functioning. Mean scores are calculated based on a 5-point response scale (never, almost never, sometimes, often, and almost always) for each item and transformed to a 0–100 scale with a higher score representing better quality of life. The PedsQL has well-established internal consistency, reliability and validity and has been extensively tested in both healthy children and children with chronic disease [35, 36]. The current study examined the *social functioning* subscale. The *t* scores for the *peer difficulties* subscale from the Conners-3 as well as the *social adaptability* and *social skills* subscales from the BASC-2 were also used as measures of children's social functioning.

### Data analytic Strategy

Descriptive statistics for the study variables, which were all normally distributed, are presented in Table 1. All analyses were conducted using SPSS 17.0. First, preliminary analyses focused on determining whether there were any associations between demographic variables or severity of ADHD symptoms with the behavioral, emotional, and social functioning measures. Second, a factor analysis was conducted to determine the viability of combining all of the social functioning measures into a single composite. Third, hierarchical regressions were used to examine concurrent associations between comorbid difficulties (i.e., externalizing, internalizing, atypical behaviors) and children with ADHD's social functioning.

## Results

### Preliminary Analyses and Data Reduction

No significant associations were found between any demographic variable (age, maternal education, income, marital status, race, sex) and severity of ADHD symptoms or any other

**Table 1** Descriptive statistics for all variables

|  | <i>M</i> | <i>SD</i> | <i>Min</i> | <i>Max</i> | <i>N</i> |
|--|----------|-----------|------------|------------|----------|
| ADHD symptoms severity                   |          |           |            |            |          |
| Inattention T-score (Conners-3)          | 77.66    | 13.39     | 18         | 100        | 62       |
| Hyper/impulsivity T-score (Conners-3)    | 76.26    | 17.68     | 43         | 113        | 62       |
| Behavioral and emotional functioning     |          |           |            |            |          |
| Externalizing composite T-score (BASC-2) | 57.44    | 13.37     | 33         | 101.5      | 62       |
| Internalizing composite T-score (BASC-2) | 60.70    | 13.72     | 37.5       | 94.5       | 62       |
| Atypical behavior T-score (BASC-2)       | 64.34    | 16.89     | 41         | 115        | 62       |
| Social functioning                       |          |           |            |            |          |
| Social adaptability T-score (BASC-2)     | 40.24    | 10.34     | 13         | 65         | 62       |
| Social skills T-score (BASC-2)           | 43.90    | 11.05     | 21         | 69         | 62       |
| Peer difficulties T-score (Conners-3)    | 70.32    | 25.96     | 41         | 142        | 62       |
| Social quality of life (PedsQL)          | 63.06    | 28.26     | 5          | 100        | 62       |

**Table 2** Factor loadings from the principal components factor analysis

|   | Social functioning factor |
|---|---------------------------|
| Quality of social life (PedsQL)         | .87                       |
| Peer relations difficulties (Conners-3) | -.87                      |
| Social skills (BASC-2)                  | .72                       |
| Adaptability (BASC-2)                   | .83                       |

behavioral, emotional, or social functioning measure. A principal component factor analysis was subsequently conducted with a promax rotation method to determine the feasibility of having a single social functioning factor based on our 4 indicator variables: peer relations difficulties (Conners-3), social skills and adaptability subscales (BASC-2), and social functioning quality of life (PedsQL). From this analysis, one factor emerged with an eigenvalue above one. This social functioning factor ( $\lambda = 2.70$ ) explained 68% of the total variance across measures for this sample. Table 2 depicts the results of the factor analysis and the loadings of our indicator variables on this social functioning factor. All indicator variables were retained given their high loadings ( $>.70$ ) and the overall factor score was used in subsequent analyses.

### Associations Between ADHD Symptoms and Behavioral, Emotional, and Social Functioning

As seen in Table 3, correlational analyses indicated that ADHD symptoms severity was positively associated with externalizing symptoms, internalizing symptoms, and atypical behaviors. Hence, not surprising, children with higher levels of inattention and hyperactivity/impulsivity were also reported as having higher levels of externalizing symptoms, internalizing symptoms, and atypical behaviors. ADHD symptoms severity was also negatively associated with the social functioning composite such that children with higher levels of inattention and hyperactivity/impulsivity were reported as having worse social functioning. Externalizing, internalizing, and atypical behaviors were also significantly associated with worse social functioning. Externalizing symptoms were also associated

**Table 3** Associations between ADHD symptoms, behavioral, emotional, and social functioning

| Variable                  | 1      | 2       | 3       | 4       | 5       | 6 |
|---------------------------|--------|---------|---------|---------|---------|---|
| 1. ADHD-inattention       | –      |         |         |         |         |   |
| 2. ADHD-hyper/impuls.     | .52*** | –       |         |         |         |   |
| 3. Externalizing symptoms | .42**  | .44***  | –       |         |         |   |
| 4. Internalizing symptoms | .33**  | .46***  | .27*    | –       |         |   |
| 5. Atypical behaviors     | .49*** | .57***  | .42***  | .67***  | –       |   |
| 6. Social functioning     | –.39** | –.44*** | –.47*** | –.49*** | –.67*** | – |

\*  $p < .05$ ; \*\*  $p < .01$ , \*\*\*  $p < .001$

**Table 4** Regression analyses examining predictors of social functioning

|   | $\beta$ | $R^2$ | $R^2$ change | $F$     |
|---|---------|-------|--------------|---------|
| Step 1                                    | –       | .23   | .23          | 8.71*** |
| ADHD inattention $t$ score                | .01     |       |              |         |
| ADHD hyperactivity/impulsivity $t$ score  | –.02    |       |              |         |
| Step 2                                    | –       | .49   | .26          | 9.80*** |
| Externalizing symptom composite $t$ score | –.23*   |       |              |         |
| Internalizing symptom composite $t$ score | –.09    |       |              |         |
| Atypicality subscale $t$ score            | –.51**  |       |              |         |

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

with higher levels of atypical behaviors and internalizing symptoms. Lastly, a positive association between internalizing symptoms and atypical behaviors also emerged.

### Predicting Social Functioning

The primary aspect of the current study involved examining concurrent associations between comorbid difficulties (i.e., externalizing, internalizing, atypical behaviors) to determine whether one symptom cluster exerts a stronger influence on children with ADHD's social functioning. To address this research question, hierarchical regression analyses were conducted and are depicted in Table 4. To control for ADHD symptoms severity, the inattention and hyperactivity/impulsivity  $t$  scores were entered in the first step. The comorbid behavioral/emotional difficulties (i.e., externalizing, internalizing, atypical behaviors) were placed in the second step. The dependent variable for the regression analysis was the social functioning composite, derived from the earlier factor analysis. As seen in Table 4, both the externalizing symptom composite  $t$  score and the atypicality subscale  $t$  score were significant predictors of social functioning, even after controlling for ADHD symptoms severity. Thus as expected, children with ADHD who exhibited higher levels of externalizing symptoms and atypical behaviors, as reported by parents, were reported as having lower levels of social functioning. Fischer's  $r$ -to- $z$  transformation analyses [37] also indicated that the strength of the associations between externalizing symptoms and atypical behaviors with social functioning was not significantly different ( $z = .93$ ,  $p > .05$ ). Lastly, no associations were found between the internalizing symptom composite or ADHD symptoms severity with social functioning.

## Discussion

The aim of this study was to examine what differentiates children with ADHD who experience social functioning difficulties from those who appear to have healthy social functioning. Prior research indicated multiple ways in which children with ADHD can experience social functioning difficulties [4, 8]. In this study, we explored whether ADHD symptoms severity, comorbid externalizing and internalizing difficulties, and atypical behaviors were associated with such social difficulties. Our rationale for including these factors come from previous studies establishing such factors as independent predictors of social dysfunction, although no study to date had included all of them in a single model [8, 18]. In addition, given the heterogeneity of what defines social competence, we also included multiple indicators of children's social functioning (i.e., social skills, social adaptability, peer difficulties, social quality of life). Finally, we examined these issues in a clinical sample of children with a current DSM-IV diagnosis of ADHD.

First, our results indicated that the severity of ADHD symptoms were significantly associated with social functioning. Not surprisingly, children with more severe ADHD symptoms, both inattentive and hyperactive/impulsive symptoms, were more likely to have low social functioning as reported by parents. This finding is consistent with previous work showing how symptom severity can significantly affect children's social functioning [18, 25]. Our finding that this association occurs similarly for boys and girls adds to the growing body of research finding little sex differences in social functioning among clinically referred children with ADHD [38]. However, it is important to note that our sample only included 15 girls which may limit our ability to generalize our findings to both sexes. It also remains unclear whether the mechanisms by which ADHD symptoms affect social functioning are similar for boys and girls. Developmental research has identified different behavioral profiles for boys and girls in terms of what is socially accepted by peers [39]. For example, girls tend to engage in more covert or relational aggression acts (e.g., spread rumors, sneaky) compared to boys who engage in more overt acts of aggression (e.g., hitting), although both behaviors are negatively related to social competence [40, 41]. Given these different behavioral profiles, it will be important for future research to determine whether the link between ADHD symptoms and social competence is mediated differently for boys and girls as this would potentially lead to more specific interventions.

The second and main aspect of our study was to examine the extent to which comorbid externalizing and internalizing difficulties, and atypical behaviors uniquely contribute to children with ADHD's social functioning. Consistent with our hypotheses, we found that children with ADHD who had greater comorbid externalizing symptoms and atypical behaviors had worse social functioning according to parents, even after controlling for ADHD symptoms severity. No association was found between internalizing symptoms and social functioning. While there is a well established comorbidity between ADHD and internalizing symptoms, the role of comorbid internalizing symptoms in children with ADHD's social functioning has been understudied [18]. Developmental research has examined the role of internalizing symptoms and/or a shy temperament in social functioning and found that such children tend to be neglected/excluded by their peers [42]. However, within the ADHD population, internalizing symptoms have been conceptualized as a reaction to chronic social difficulties as evidenced by a temporal lag in such diagnoses [18]. In addition, past research has also suggested that the link between internalizing symptoms and social dysfunction is mediated by earlier comorbid externalizing symptoms [31]. Our null finding adds to this literature by demonstrating that internalizing symptoms were not associated with children's social functioning, especially when other concurrent comorbid difficulties are considered.



However, as past researchers have pointed out, it may also be the case that internalizing symptoms have a more subtle social functioning effect in terms of being neglected by peers rather than overtly rejected [42]. Given that our social functioning indicators were collected from parents, we would not be able to pick up on such subtle peer dynamics. The use of sociometric procedures should be considered for future work to determine how comorbid internalizing symptoms in children with ADHD are received by peers.

It is also important to point out that parents' perceptions of their children's quality of life in the social domain may differ from the children's own perceptions. For example, a recent study showed only moderate levels of agreement between children with ADHD and their parents regarding their quality of life across several psychosocial domains with children generally reporting higher levels of satisfaction compared to parents [43]. As children get older, their perceptions regarding their social functioning also become increasingly important and may interact with their actual social status to influence their behavioral functioning [44]. Hence, future research should include children's self-report of their social functioning.

Our findings also replicate previous work showing that comorbid externalizing problems such as ODD and CD symptoms are strongly associated with social functioning impairment seen in children with ADHD [8]. Previous work had examined various aspects of children with ADHD's social functioning including social preference/peer popularity [4], social skills [45], friendships [6] and global measures of social competence [38]. Our study extends such work by finding similar findings while using multiple indicators of children's social functioning (i.e., social skills, social adaptability, peer difficulties, and social quality of life). Children with ADHD who are experiencing externalizing symptoms have been shown to have not only executive functioning deficits but also emotion regulation difficulties [46]. Difficulties across several self-regulation/executive functioning domains likely affect multiple aspects of social functioning. For example, while attentional regulation difficulties may contribute to poor social skills in terms of not attending to social cues properly, additional deficits in the regulation of impulsive/aggressive behaviors and emotions are likely to affect a child's ability to adapt to social situations. Higher order executive functioning deficits may also affect a child's more advanced social skills which include the ability to plan and make social decisions, problem solve, and get others to work together. It will be important for future research to continue to examine various aspects of social competence to determine whether there are specific executive functioning/self-regulation deficits in children with ADHD and comorbid externalizing symptoms that are associated with different facets of social competence.

Researchers have recently suggested that some of the social difficulties experienced by children with ADHD appear to be due to atypical behaviors (e.g., inability to conceive other people's feelings and thoughts) generally associated with children diagnosed with pervasive developmental disorders (PDD). In fact, children with ADHD have been shown to have higher scores on measures of PDD behaviors compared to both healthy controls and other psychiatric disorders [8]. While our study did not use a specific PDD measure, it adds to the literature by demonstrating heterogeneity in the occurrence of atypical behaviors within the ADHD population as such behaviors were associated with children's social functioning. It is important to note that both externalizing symptoms and atypical behaviors uniquely and similarly predicted social functioning difficulties. This provides further evidence for the importance of examining atypical behaviors in children with ADHD, especially given the importance of social functioning in the prognosis of children with ADHD [9]. While a multiple pathway model for ADHD and comorbid externalizing symptoms have been suggested within a temperament framework [11], atypical behaviors

have largely been ignored in such models and have tended to be included only as a social consequence of ADHD symptoms [8]. Neuropsychological theories of ADHD that focus on executive functioning/behavioral inhibition [10, 47] have also failed to account for atypical behaviors and have mainly focused on understanding DSM-IV subtypes of ADHD, of which mixed results have been obtained [14, 48–50].

Our findings highlight the need for future longitudinal work to focus on the role of early atypical behaviors in children with ADHD's social development. In addition, most current intervention efforts have centered on treating ADHD symptoms and comorbid externalizing symptoms that are disruptive and known to cause impairment in school and at home. While gold standard pharmacological treatments (i.e., stimulant medications) have been shown to be efficacious in the reduction of ADHD symptoms and aggressive behaviors [51, 52], they have not been as effective in terms of improving children with ADHD's social functioning [4]. Consistent with our findings, this highlights the unique and strong role that atypical behaviors play in disrupting the social functioning of children with ADHD. Hence, while a child on pharmacological treatment is calmer and more attentive during social interactions, he or she may still engage in "odd" behaviors that are negatively perceived by peers. Consequently, it will be important for behavioral treatment interventions to target these atypical behaviors to determine whether that changes children with ADHD's social functioning and/or status.

In terms of this study's limitations, the cross-sectional aspect of our study prevents us from determining the directionality of the association between externalizing, atypical behaviors, and children with ADHD's social functioning. Past research has documented a bidirectional association between externalizing symptoms and social functioning in children with ADHD such that externalizing symptoms can not only contribute to social functioning difficulties [6, 25] but can also worsen as a reaction of chronic social functioning difficulties [53]. Examining atypical behaviors in children with ADHD is an emerging area of research [8]. It remains unclear whether atypical behaviors displayed by children with ADHD precede social dysfunction as measured by social skills, social adaptability, and peer acceptance. Another limitation to our study was not having a separate PDD measure which may have contributed to some shared method variance in our findings. While the atypicality subscale of the BASC has been used successfully in prior research within the PDD population [54], it will be important for future research to use a separate PDD measure to confirm the association between atypical behavior and traditional social functioning measures. It will also be important to replicate these findings using multiple reporters (e.g., peer and teacher report) as our study relied solely on parent report. Obtaining peer and teacher report is especially important for assessing children's social functioning as both reports can measure distinct aspects of peer status [55]. Lastly, although all parents in our study reported during the clinical interview that their children's impairment was evident across settings, we were not able to collect corroborating teacher reports to substantiate children's ADHD status. Given the importance of teacher reports in the diagnosis of ADHD [56], it may be that our sample was not as impaired as if we had included teacher reports in making diagnostic decisions. The relatively normal levels of comorbid externalizing symptoms reported by parents also provide evidence to the less impaired and healthy nature of our ADHD sample.

## Summary

The current study provides initial data supporting the importance of examining atypical behaviors when examining children with ADHD's social functioning. It also suggests that

atypical behaviors found in children with ADHD are equally as powerful as comorbid externalizing symptoms in predicting social functioning difficulties. It is important to acknowledge that due to the shared variance from relying solely on parent report, it will be critical for future research to replicate our findings using multi-informant data. Given initial neuropsychological and genetic data suggesting an overlap between ADHD and PDD symptoms [26–28], it will be important for future research to examine whether children with ADHD who display atypical behaviors, but who do not have necessarily a PDD diagnosis, differ in terms of executive functioning/self-regulation lab measures compared to children with ADHD who do not display atypical behaviors. If such differences are confirmed, it may have significant implication for clinical practice. For example, as part of an ADHD evaluation, it may be crucial to ascertain the presence of atypical behaviors that are distinct from social functioning difficulties as this may aid pharmacological or non-pharmacological treatment choice.

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