The Extent to which Inference-Making Ability Predicts Social Competence in Children

with Varying Symptoms of ADHD

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Abstract

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Children with attention-deficit/hyperactivity disorder (ADHD) often experience higher rates of social difficulties than their typically-developing peers. Because interventions for social difficulties are generally ineffective, research must examine new malleable targets for intervention. The ability to make social inferences is one such target. This study used Social Information Processing theory as a foundation for examining two primary aims: (1) to determine the extent to which ADHD symptomatology, inference-making abilities, and/or their interaction predict social competence, and (2) to determine what level of ADHD symptoms and inference-abilities best predicts dichotomous social impairment. Participants were 233, 8- to 10-year-old children (68% male). ADHD symptoms and impairment were assessed by both parents and teachers using multiple rating scales. Different types of social competence were measured using sociometric methods from peers and adults, as well as observational methods. Regression analyses showed that ADHD symptoms predicted social competence, accounting for 5% to 11% of the variance, depending on the model. However, most inference types were not significant predictors of social competence. One significant interaction suggested that the relationship between parent-rated hyperactivity/impulsivity and social competence may be moderated by explanatory

implausible inferences. Receiver Operating Characteristic (ROC) curves indicated cutoff scores for both parent-rated inattention and number of explanatory implausible inferences that best identify children experiencing rejection and low peer liking. Implications for screening tools and future studies are discussed.

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Overview

Peer relationships are an important part of child development, and social skills acquired through interactions with peers during early childhood create the foundation for an individual's social success as they grow up. Poor social competence leads to negative outcomes that persist in adolescence and adulthood, such as drug use, delinquency, anxiety, and poor school performance (Bagwell, Schmidt, Newcomb, & Bukowski, 2001; Mrug et al., 2012). One population that is prone to experiencing social difficulties is children with attention-deficit/hyperactivity disorder (ADHD); indeed, about 50 to 80% of children with ADHD experience significant social impairment (e.g., Staikova et al., 2013; Tseng, Kawabata, Gau, & Crick, 2014). Given that negative social status develops quickly (e.g., Bagwell, Molina, Pelham, & Hoza, 2001) and becomes more difficult to change over time (Mrug et al., 2007), it is important to address social impairment for children with ADHD through early intervention.

Current social interventions for children with ADHD are largely ineffective. They do not produce clinically significant improvements in social functioning, and few, if any, improvements seen in training are generalizable across settings (e.g., Antshel & Remer, 2003; Pfiffner & McBurnett, 1997). One potential explanation for this lack of efficacy is that current interventions likely target the wrong mechanisms. The current study uses Social Information Processing (SIP; Crick & Dodge, 1994) research to provide a theoretical basis for understanding the processes involved in social interactions. Based on SIP research, one malleable mechanism that may underlie social impairment in children with ADHD is the ability to make inferences (i.e., the ability to draw conclusions based

on implicit information from a text, story, or situation). Poor inference-making abilities can lead to difficulties in social interactions, such as misinterpreting social cues (Rieffe, Villanueva, & Terwogt, 2005). There is some evidence that children with ADHD have difficulties making inferences in academic and social situations (Berthiaume, Lorch, & Milich, 2010; Milch-Reich et al., 1999); however, there are limitations to this body of literature. First, our understanding of the role of inferences in social functioning in children with ADHD is largely theoretical and requires more empirical support. Second, most inference research uses academic rather than social outcomes. Third, peers have been underutilized as informants despite findings suggesting that social data from peers and adult informants (e.g., parents and teachers) are mildly correlated at best (Hoza, Gerdes et al., 2005). Fourth, studies have primarily focused on one type of inference even though different inference types (i.e., coherence/elaborative and plausible/implausible) are likely related to different outcomes.

The goals of this study are to (a) determine the extent to which symptoms of ADHD, inference-making abilities, and/or their interaction predict social impairment as measured by multiple informants, and (b) attempt to create a benchmark for identifying children at risk for social impairment based on specific levels of ADHD symptomatology and/or inference-making abilities. These data could then be used to identify whether inferences are viable targets of social interventions and, if so, which children could benefit most from such an intervention.

Social Impairment in Children with ADHD

Although not all children with ADHD have social difficulties, social impairment, such as rejection and low social status, is prominent among 50 to 80% of children with the disorder (e.g., Hoza, Mrug et al., 2005; Staikova et al., 2013). Studies suggest that rejection occurs early in social interactions with novel peers (e.g., Bagwell, Molina, Pelham, & Hoza, 2001; Sibley, Evans, & Serpell, 2010), and negative reputations are persistent and difficult to change, even with improvements in positive behaviors (Mrug et al., 2007). A longitudinal study by Bagwell, Molina et al. (2001) found that social rejection in children with ADHD persisted into adolescence, even if they no longer had enough ADHD symptoms for a diagnosis. Even subclinical ADHD can be socially impairing (e.g., Geryk, 2013). This emphasizes the importance of examining ADHD symptoms as a continuum and of examining impairment in addition to symptom presence or absence.

Negative social outcomes seem to be related to all three symptom categories of ADHD: inattention, hyperactivity, and impulsivity. Although one study found that greater symptoms of ADHD were associated with higher peer liking for boys (Diamantopoulou et al., 2005), most studies have found the opposite relationship. For example, children with hyperactive/impulsive symptoms tend to show disruptive behaviors that annoy their peers, and children with hyperactive/impulsive symptoms tend to engage in more negative social interactions during group play than do their typically developing peers (Hay, Payne, & Chadwick, 2004; Wheeler & Carlson, 1994). Moreover, children with inattentive symptoms often have difficulty attending to social cues (for a review see

McQuade & Hoza, 2008) and difficulty understanding more covert and implicit rules of positive social interactions (Caillies et al., 2014; Tseng et al., 2014). Because each dimension of ADHD may differentially contribute to social impairment, it is important to examine each dimension's relationship to impairment individually. It is also important to examine different types of social impairment (e.g., rejection and dislike) because children may experience different social difficulties depending on their symptom profiles.

Children with ADHD who do have social difficulties likely demonstrate problems with a particular mechanism underlying social interactions that children without social difficulties are able to execute. Social cognitive theory offers insight into mechanisms underlying successful social interactions that might be deficient in children with ADHD and social impairment.

Social Information Processing (SIP) Theory

Crick and Dodge's SIP theory (Crick & Dodge, 1994) provides a six-step model to explain the mechanisms behind how children interact with peers. Knowledge of these processes and the problems resulting from dysregulated steps of the model has informed social interventions for other populations of children, such as those with conduct problems and aggression (Akhtar & Bradley, 1991; Dodge, Godwin, & The Conduct Problems Prevention Research Group, 2013; Lochman & Lenhart, 1993). Thus, using this model to inform interventions for children with ADHD may have merit as well. This study focuses on Step 1 (Cue Encoding) and Step 2 (Cue Interpretation) because they may be particularly implicated in poor social outcomes when dysfunctional, and they affect all other steps in the model (See Figure B1 in Appendix B).

Children use Steps 1 and 2 to form a mental representation of each social interaction (Crick & Dodge, 1994). In Step 1, children attend to verbal and nonverbal cues from their peers, and they store ("encode") the cues for later use. Then, in Step 2, children interpret the encoded cues in order make sense of events in the interaction, largely through the use of inferences. Children use inferences to make connections between encoded cues or draw conclusions about the relevance and meaning of each cue. Children use their interpretations to decide how they will respond to the cues based on their desired outcome of the social interaction.

Children with ADHD likely have deficits in multiple steps of the SIP model, all of which could contribute to poor social skills. Appropriate targets for social interventions are mechanisms that are both deficient and malleable. Social knowledge deficits and cue

encoding, two of the SIP steps, have both been examined as possible mechanisms underlying social dysfunction, but neither has been shown to be consistently deficient in children with ADHD or effective when targeted in interventions (e.g., Hall et al., 1999; Wheeler & Carson, 1994). However, evidence suggests that children with ADHD have difficulties making inferences for cue interpretation (SIP Step 2; e.g., Milch-Reich et al., 1999) and that inference skills can be improved with intervention (e.g., Brooks, Hanauer, & Frye, 2001; Van Neste, Hayden, Lorch, & Milich, 2014).

The Importance of Inference-Making Abilities

Making inferences is important for interpreting cues. Typically, inferences are divided into two main categories: elaborative and explanatory (Thurlow & van den Broek, 1997). Elaborative inferences add information to enrich a story but are not central to story comprehension. Explanatory inferences are integral for comprehending a story or situation (Crick & Dodge, 1994; Kosloski, 2012; Thurlow & van den Broek, 1997; Trabasso & Magliano, 1996). Explanatory inferences that involve cause-and-effect connections are particularly important for linking an event to its preceding and succeeding events (i.e., making causal connections). The more causal connections an event has, the more important it is to the story (Trabasso & van den Broek, 1985). Inferences can be further categorized as either plausible or implausible. Plausible inferences are those that are "…reasonable explanations or elaborations of story events" (Van Neste et al., 2015, p. 264), and implausible inferences are those that are incorrect or do not make sense. Implausible inferences are often based on irrelevant cues and are

illogical based on previously provided information. Theoretically, implausible or incorrect inferences can be detrimental to story comprehension and social interactions.

Children's ability to make inferences has mostly been studied in the context of story comprehension. Such studies suggest that difficulties making inferences (particularly explanatory plausible inferences) contribute to children's story comprehension problems, which in turn contribute to children's academic difficulties (Berthiaume et al., 2010) because such a large portion of schoolwork relies on reading comprehension. Research suggests that children who make more explanatory inferences have better story comprehension than readers who make fewer or less accurate inferences (Bower-Crane & Snowling, 2005; Laing & Kamhi, 2002). Further, less skilled readers who receive interventions targeting two different types of text-specific explanatory plausible inference skills show significantly improved reading comprehension that is maintained over time (e.g., Cain & Oakhill, 1999; Mih, 2011).

SIP theory postulates that children need to make explanatory inferences in order to identify the most important elements of an interaction. Explanatory inferences are likely also used to identify causal connections, such as peer intentions (i.e., why their peer exhibited a certain behavior) and identify the connections between their own behaviors and subsequent social consequences (e.g., peer responses). Failing to attend to the most important and relevant cues in a social interaction could cause a child to overlook or misinterpret important causal connections, thereby leading to a dysfunctional interaction. For example, misinterpreting peer intent could lead the child to respond inappropriately (e.g., responding negatively due to misinterpreting a neutral reaction as

hostile) or generate solutions to the wrong problem because they do not understand the reasons behind a peer's actions.

Research has shown that there is variability in SIP skills in typically-developing children; children who have difficulties with inferences experience rejection and lower social status (Rieffe et al., 2005), thus reducing the chance of opportunities to improve their social skills through future interactions (e.g., Murray-Close et al., 2010). Similarly, Denham et al. (1990) found that typically-developing preschool children who misinterpreted emotions displayed by characters in a vignette (e.g., confused happy and sad) were less liked by peers regardless of their prosocial behaviors. In order to be successful at this task, children had to use cues from the vignette to determine how the character was feeling (i.e., they had to make inferences). As described below, children with ADHD may experience particular difficulty with inferences which may partially explain why they experience greater social difficulties than other children.

Inference Difficulties in Children with ADHD

Inferences in Academic Contexts

Only a few studies document the relationship between inferences and academic skills in children with ADHD. Results of these studies indicate that compared to typically-developing peers, children with ADHD have more difficulty interpreting ambiguous sentences and making connections between different pieces of textual information (Berthiaume et al., 2010). They form disjointed story conceptualizations, likely due to poor inference skills, and draw conclusions about texts based on single clues rather than synthesizing multiple pieces of information (Berthiaume et al., 2010; Trabasso & Magliano, 1996). Some researchers have found that, overall, children with ADHD make fewer inferences than children without ADHD (Renz et al., 2003), but others have found that children with ADHD make a comparable number of plausible inferences but significantly more implausible inferences by drawing conclusions using irrelevant or inaccurate story information (Berthiaume et al., 2010). Because these deficits in inference making may also affect interpretation of social information, research on inferences in children with ADHD in social contexts has emerged in recent years.

Inferences in Social Contexts

To date, only two studies have examined the relationship between ADHD and inferences in a social context (Milch-Reich et al., 1999; Sibley et al., 2010). Sibley et al. (2010) sought to demonstrate the relationship between ADHD and social inferences in adolescents. The authors measured social comprehension by showing adolescents with and without ADHD a television show and asking questions that were either factual or

required knowledge of cause-and-effect relationships to answer correctly. They also measured social problem solving by asking adolescents to generate solutions for the problems presented in the hypothetical social situations. Compared to adolescents without ADHD, adolescents with ADHD provided significantly fewer correct answers to the social comprehension questions (ADHD $M = 9.80$, Control $M = 14.61$; $d = 1.24$) and generated significantly fewer solutions, on average, for each problem (ADHD $M = 1.01$, Control $M = 1.56$; $d = .91$). Therefore, the researchers concluded that children with ADHD have more deficits in social cognitive functioning than their peers. However, multiple study design issues warrant caution in the interpretation of the findings.

First, although the study concluded that adolescents with ADHD had more difficulty detecting cause-and-effect relationships (i.e., explanatory inferences) than did their peers, their measure of social comprehension combined inferences with factual questions. Their results do not indicate whether adolescents with ADHD had trouble with inferences, facts, or both. Therefore, if the true deficit was in factual responses, memory could have been a confounding factor. In the present study, memory is considered as a covariate so that differences can be more confidently attributed to inferences. Second, their social problem-solving outcome variable was the number of appropriate solutions offered and did not include whether the adolescents identified the correct problems; the latter would have directly accessed the inference construct while the former does not. The fact that adolescents with ADHD generated fewer correct solutions could have been due to identifying the wrong problem (inferences) or it could have been a problem with a later

SIP step (generating solutions). The present study measures inferences directly so that deficits can be linked to that specific SIP step.

Using a narrative method to assess inferences could help combat the problems from the Sibley et al. (2010) study by accessing the inference construct more directly. Narratives are widely used in studies of other populations (e.g., children with Autism Spectrum Disorder [ASD]) to evaluate children's social comprehension. In narrative methods, children are asked to retell a story that they have read, requiring them to remember the most relevant story events and organize the story events so that the causal connections are preserved (Diehl, Bennetto, & Young, 2006). Researchers can then analyze and interpret various aspects of their responses, including each type of inference. Studies have shown that children with ASD who produce narratives containing fewer and less diverse inferences (such as causal statements, narrator beliefs or perspectives, and references to characters' internal states) have less successful conversational interactions (Capps et al., 2000).

Research has shown that children with ADHD form poorer narratives than children without ADHD. Narrative studies have found that children with ADHD make more errors related to sequencing, linking events in the story, and misinterpreting information, which jointly indicate disorganized mental representations of the story (Flory et al., 2006; Tannock, Purvis, & Schachar, 1993). Although these studies did not directly study social outcomes, their findings and those from previously mentioned studies suggest that children with ADHD who produce inference-poor narratives may demonstrate the most severe social impairment; i.e., worse than those without ADHD

and/or without inference making difficulties. The present study sought to advance the literature on narrative methods and inferences in children with ADHD by examining this hypothesis.

The second study to examine inferences in a social context among children with ADHD was Milch-Reich et al., 1999. Similar to Flory et al. (2006) and Tannock et al. (1993), Milch-Reich et al., 1999 found that children with ADHD have more difficulty using inferences to create organized mental representations of their interactions than their typically-developing peers. Without this properly constructed representation, children with ADHD likely cannot readily access cues that are necessary to make inferences that are crucial for successful interactions. They also likely use the wrong cues to make inferences because their disorganized representations make it difficult to decide which cues are relevant to the situation. Milch-Reich et al. (1999, p. 427) uses an analogy of "slides versus movies" in which the representations of children with ADHD are analogous to a presentation of disorganized slides, while the representations of typical children are like an "unfolding film." In order to create the "film," children must integrate cues by drawing inferences to connect the various "slides" which represent events or cues in the social situation. Similar to the difficulties found with reading comprehension, children with ADHD tend to make social inferences based on the most recent social cues rather than cues from multiple points throughout the interactions (Milch-Reich et al., 1999), resulting in less complete and less accurate social reasoning than children without ADHD. Although this study provides important information about

specific SIP processes that are dysfunctional in children with ADHD, they do not relate inferences to social outcomes.

To this author's knowledge, no study has examined the relationship between ADHD and inferences in relation to actual social outcome measures (i.e., measures of the child's actual social functioning as opposed to hypothetical social functioning). Also, despite evidence that poor inference abilities and greater ADHD symptoms are both generally associated with worse social outcomes, as well as evidence that children with greater symptoms of ADHD have worse inference abilities, inferences have never been examined as a moderator of the relationship between ADHD and social outcomes. The previous two studies provide the first step for examining this relationship by showing that compared to typically-developing peers, children with ADHD have particular deficits in inference-making abilities and social competence. The present study will take the next step by examining how the three variables relate to each other while addressing the limitations of the previous studies.

Current Study

The present study addresses the aforementioned limitations by (a) examining multiple types of inferences (i.e., explanatory and elaborative; plausible and implausible), (b) assessing social competence as perceived by adult observers and peer sociometrics (rejection and liking), (c) using narratives to elicit inferences as a skill separate from cue identification or solution generation, and (d) examining the predictive and interactive effect of inferences and ADHD symptoms on social competence.

The primary research aim (Aim 1) was to determine the extent to which ADHD symptomatology, inference-making abilities, and/or their interaction predict social impairment. It was hypothesized that, (1) there would be a significant negative relationship between ADHD symptoms and social competence, and (2) children with poor inference abilities would have worse social competence, regardless of ADHD symptom level. It was also predicted that children with high symptoms of ADHD and low inference abilities would have the worst social competence, and children with low symptoms of ADHD and high inference abilities would have the highest social competence. Due to the limited research related to the interaction between ADHD symptoms and inference abilities, we directional hypotheses were not made. The second aim (Aim 2) was to determine the level of ADHD symptoms and inference abilities that best predicts different types of social impairment.

Method

Participants

Participants were 174 children (31.6% female; 51.1% Caucasian) who participated in a multi-site study (Ohio and South Carolina) examining academic and social functioning in children with and without ADHD. See Table 1 for demographic information. Participants were included in the current analyses if they had complete data on the measures described below. Those included (n=174) and those excluded (n=198) were not statistically different from each other on most key demographic variables, such as age, learning disability status, race, ADHD symptoms, and oppositionality as rated by parents and teachers. However, the excluded sample was significantly more likely to report lower parental yearly income than the included sample (low vs. middle income: χ^2 (1) = 15.80, p < .001; low vs. high income: χ^2 (1) = 10.11, p < .01). The included sample also scored higher on Wechsler Abbreviated Scale of Intelligence, second edition (WASI-II; Wechsler, 2011) (M = 104.60; SD = 14.28) than did the excluded sample (M = 96.50; SD = 16.05), t (367) = -5.09, p < .001, d = 0.53.

Table 1

Demographic Characteristics of the Total Sample and by ADHD Status

Variable	Total (N = 174) M (SD)	ADHD (*n*=84) M(SD)	No ADHD (*n*=90) M(SD)
Age (years)	8.89 (0.83)	8.96 (.83)	8.83 (.83)
*FSIQ-2[1]	104.6 (14.3)	102.24 (13.7)	106.8 (14.56)

	N (%)		
ADHD Status			
No ADHD	90 (51.7)		
ADHD-I	27 (15.5)		
ADHD-HI	4 (2.3)		
ADHD-C	53 (30.5)		
Gender			
Female	55 (31.6)	29 (34.5)	26 (28.9)
Male	119 (68.4)	55 (65.5)	64 (71.1)
Race			
White	89 (51.1)	41 (48.8)	48 (53.3)
Black or African American	65 (37.4)	33 (39.3)	32 (35.6)
Biracial/Multicultural	19 (10.9)	10 (11.9)	9 (10)
American Indian/ Alaskan	1 (0.6)	0	1 (1.1)
Grade			
1	2 (1.1)	1 (1.2)	1 (1.1)
2	35 (20.1)	14 (16.7)	21 (23.3)
3	63 (36.2)	30 (35.7)	33 (36.7)
4	55 (31.6)	32 (38.1)	23 (25.6)
5	19 (10.9)	7 (8.3)	12 (13.3)
Known Learning Disability			
Yes	22 (12.6)	12 (14.3)	10 (11.1)
No	152 (87.4)	72 (85.7)	80 (88.9)
*Yearly Household Income			
< $15,000	22 (12.6)	15 (17.8)	7 (7.7)
$15,000 - $49,999	65 (37.4)	34 (40.5)	31 (34.4)
$50,000 - $99,999	50 (38.7)	21 (25)	39 (32.2)
$100,000 - $199,999	35 (20.1)	13 (15.5)	22 (24.4)
> $200,000	2 (1.1)	1 (1.2)	1 (1.1)
*Medication Status			
Yes	40 (23)	39 (46.4)	1 (1.1)
No	134 (77)	45 (53.6)	89 (98.9)

Note. *= ADHD and no-ADHD groups are significantly different, *p* <.05, using independent samples t-test or Chi-Square. [1]FSIQ-2 = Full scale IQ based on two subtests of the WISC-V. Medication Status = whether child is currently taking at least one medication for attention, learning, emotional, or behavioral difficulties. For ADHD and no-ADHD percentages, these are percentages of children with or without ADHD, not percentages of the total sample.

Inclusion/exclusion criteria. In order to be included in the larger research project, participants had to be between 8-10 years old, have an IQ of 80 or above based on the WASI-II (Wechsler, 2011), and attend school. Children diagnosed with autism, PDD, Intellectual Disability, or a severe visual or hearing impairment were excluded from the study. Children who took stimulant medication were asked to take a medication hiatus on the days they participated in the study. Of the 174 children, 84 (48%) met DSM-IV criteria for ADHD following an evidence-based assessment that included parent and teacher ratings of ADHD symptoms and impairment (Pelham, Fabiano, & Massetti, 2005) and a structured diagnostic interview (Fristad, Teare, Weller, Weller, & Salmon, 1998). The "or" rule was used so that at least 6 total symptoms of inattention, hyperactivity/impulsivity, or both had to be endorsed across raters. On the DBD, symptoms endorsed as "pretty much" or "very much" were counted as endorsed symptoms. A rating of 3 or higher on any domain of the Impairment Rating Scale was counted as impairment.

Procedures

Recruitment. All procedures were approved by the institutional review boards at both research sites. The larger study sought to recruit a sample in which 50% of the participants met criteria for ADHD and 50% did not. Recruitment flyers were distributed via schools, pediatric offices, parent support groups, and news advertisements. Interested parents were encouraged to call the research center in each state. During a preliminary phone screen, research assistants obtained information about each child that was used to invite children to attend an individual evaluation session with their parents (i.e., age,

previous diagnoses, medication status); those who were eligible for the project were invited to return to a group evaluation session.

Individual session. At the beginning of the individual session, parent consent, child assent, and permission to request teacher ratings were obtained. Parents and children were then escorted to separate rooms. Children completed a battery of tasks that included the WASI-II and the Fables tasks (see description below). Parents completed a battery of questionnaires that included the measures described below. The questionnaire also included questions about participant demographics such as race, annual household income, and learning disability status.

Group session. After completion of the individual sessions, eligible children were invited to participate in a 3-hour group session on a different day. Groups were comprised of 4 to 11 same-sex children who did not previously know each other. Group sessions were video- recorded. The group activities included four, 20-minute activities designed to facilitate group problem solving and interaction and two unstructured activities (i.e., free play) designed to observe peer interaction in the absence of a structured activity. During the latter two activities, children were able to choose their own playmates which provided the opportunity for social rejection and acceptance. Four staff members were present to provide instructions at the beginning of each task and monitory safety throughout the tasks; however, they remained on the periphery of the room for the duration of each activity to reduce adult involvement and enhance peer interaction. See Appendix A for a description of tasks. Upon completion of group activities, children were asked to complete sociometric ratings about themselves and

others in the play group. Additionally, two staff members completed parallel sociometric ratings on each child.

Measures

ADHD symptoms.

Disruptive Behavior Disorders Rating Scale (DBD; Pelham, Evans, Gnagy, & Greenslade, 1992). The DBD Rating Scale is a 45 item measure of parent- or teacher-rated DSM-IV symptoms of ADHD, ODD, and CD (see Appendix A). Items assessing inattention and hyperactivity/impulsivity were used for this study. Items are rated on a 4-point Likert scale with higher scores indicating greater symptom severity. Studies have shown that the DBD has high internal consistency (Parent α = .86-.92, across subscales; Teacher α = .81-.85) and adequate convergent validity (Teacher *r* = .70-.86) when compared to instruments measuring impairment (Fabiano et al., 2006). In the current sample, internal reliability ranged from .92 to .93 for parent ratings and .93 to .94 for teacher ratings. Scores for inattention and hyperactivity/impulsivity were averaged for each rater and were used as predictor variables in Aim 2.

Child measures from individual session.

Weschler Abbreviated Scale of Intelligence- Second Edition (WASI-II; Weschler, 2011). The WASI-II is a reliable screening measure of intellectual functioning. The FSIQ-2, a brief version of the WASI-II containing Vocabulary and Matrix Reasoning subtests, was used to efficiently obtain an estimate of cognitive functioning. Scores demonstrate strong internal reliability (r = .87 to .96 for children; Weschler, 2011) and correlations with full scale IQ. Subtest scores demonstrate convergent validity with

similar IQ subtests (r = .46-.74; Raiford, Zhou, & Drozdick, 2016). Scores were obtained to describe the sample and assess eligibility.

Inference frequencies from fables. During the individual session, two pre-recorded fables ("A Test of Strength" and "Father, Son, and Donkey"; previously used in Brown & Smiley, 1977), lasting about 2 minutes and 20 seconds each, were played for each child in a randomly assigned order. After listening to each fable, the examiner told the child to retell the story and audio recorded their response. Once children were finished with their narrative, the examiner gave two additional prompts for more information. Fable narratives were coded for inferences, each of which was categorized into one of four types (explanatory/elaborative, plausible/implausible). Details of the coding scheme are included in Appendix A. Thirty percent of the fables were coded by two raters (ICC explanatory plausible = .88; explanatory implausible = .48; elaborative plausible = .74; elaborative implausible = .59). The variables that were used in this study were the frequency of each type of inference across both fables. These frequency variables were used individually to represent inference abilities in our analyses.

Social competence outcomes.

Peer sociometric ratings. After completing the group session, children rated each peer in their group on a 4-point scale (1/*not at all* to 4/*very much*) in response to the question, *"How much did you like [child])?"* For each child, their peers' average ratings were used to calculate the variable measuring peer liking. Peer liking was used to create the latent variable described below (see Peer Status in a Novel Group) and it was also used as an individual outcome variable for analyses of each type of social competence.

Staff sociometric ratings. Staff who led groups provided ratings for each child in response to the question, *"How much did other children [in the group] like this child?"* Ratings used the same 4-point scale as the peer ratings. Two staff members rated each child, and the average of their ratings was used as the staff liking variable. Staff liking was one of the variables comprising the latent variable "Peer Status in a Novel Group" (see description below), and it was also used as an individual outcome variable for analyses of each type of social competence.

Observational variables. Trained research assistants who were unaware of the children's diagnostic statuses watched videos of play groups. For each of the six tasks, research assistants coded the frequency of children's behaviors and rated five broader domains of the children's behavior during the tasks (i.e., global ratings), using a 1 (Low degrees of the behavior) to 5 (High degrees of the behavior) scale. Two global rating domains were used in this study: global acceptance and global rejection (See Appendix A for more thorough coding descriptions). Each child's behavior was rated by two coders (ICC = .80 - .82). To create global acceptance and global rejection, the mean score was calculated across raters for each activity. Then, overall means for global rejection and acceptance were calculated using the mean score for each activity. Responses to these two variables were used in the latent variable described below (see Peer Status in Novel Group).

Peer Status in a Novel Group. In the larger project, general social impairment was defined using a latent variable: Peer Status in a Novel Group. The investigative team hypothesized that four social outcome variables- peer liking, staff liking, global

acceptance, and global rejection would comprise the latent variable. However, analyses revealed that the global acceptance did not load significantly onto a factor, and it did not account for any variance in the latent variable. Therefore, global acceptance was dropped from the model, and the final Peer Status in a Novel Group variable was comprised of peer liking, staff liking, and global rejection. In the current study, the factor scores were used to represent social competence, with larger factor scores indicating greater social competence and smaller factor scores indicating lower social competence. See Appendix A for more details.

Analytic Plan

  Assessment of covariates. Memory of facts and learning disability status were considered as potential covariates in the analyses. First, memory was examined to look for differences between children with and without ADHD. Because narrative methods require children to remember parts of a story, memory differences had to be accounted for to ensure that they would not be the reason for any inference differences. The variable used for memory (see description in Appendix A) was not related to Peer Status in a Novel Group, and there was no difference in performance on the memory task between children with and without ADHD. Therefore, it was not included as a covariate. Next, we examined learning disability status due to previous findings that it accounts for variance in social competence (Hall et al., 1999). Learning disability status was not related to Peer Status in a Novel Group, and there were no differences in learning disability status between children with and without ADHD. As such, it was also not included as a covariate.

Aim 1. To determine the extent to which ADHD symptoms, inference abilities, or their interaction predicted social impairment, 16 hierarchical linear regression analyses were conducted (8 for parent-rated variables and 8 for teacher-rated variables; see Figure 1 for a depiction of all models conducted). Across all analyses, the Peer Status in a Novel Group (PSNG) factor score was the dependent variable. All predictor variables were mean centered. Possible outliers were examined, but no cases were removed[1]. An ADHD variable was entered in Step 1. The ADHD variables were first divided into parent and teacher variables (Parent DBD or Teacher DBD). Then, each rater's DBD was separated by symptom type (inattention and hyperactivity/ impulsivity), and only one symptom type was entered in Step 1 to avoid multi-collinearity. This yielded four inattention regressions and four hyperactivity/impulsivity regressions each for parents and teachers. The inference variable (total explanatory plausible, total explanatory implausible, total elaborative plausible, total elaborative implausible) was entered in Step 2 for each regression. The interaction between the ADHD variable in the model and the inference variable in the model was entered in Step 3. The Holm (1979) procedure was used to control Familywise Type I error rate at $\alpha=.05$, with the 8 parent models and 8 teacher models considered as separate analytic families. Only variables in regressions containing significant interaction terms were examined in Aim 2. Table 2 provides the bi-variate correlations for all variables used in the regression analyses.

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[1] We used studentized residuals and leverage values to examine outliers in our data. Although some cases did have high leverage values, most had very low residuals and were not unusually discrepant from the overall relationships. Furthermore, deleting any of the top outliers did not result in any meaningful changes in our results.

All regressions were subsequently conducted using each component variable comprising Peer Status in a Novel Group (peer liking, staff liking, and global rejection) to replace the latent variable as the outcome. This was done to examine if ADHD symptoms were differentially related to different domains of social impairment and because Aim 2 requires a dichotomous social impairment variable.
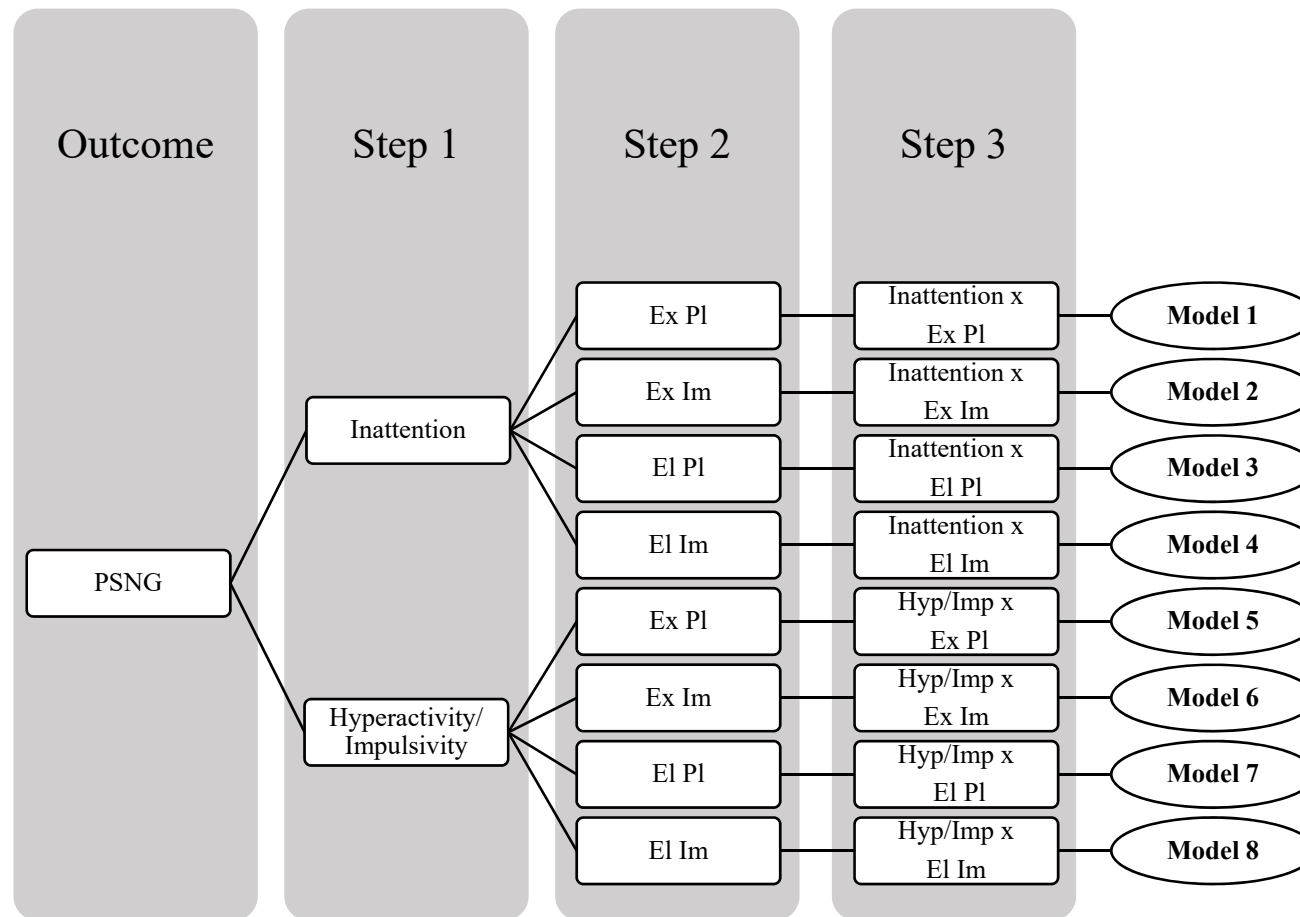
Figure 1. Graphic of models containing parent-rated symptoms of ADHD. These regressions were repeated for teacher-rated symptoms of ADHD for a total of 16 regression models. Note: Ex Pl = explanatory plausible; Ex Im = explanatory implausible; El Pl = elaborative plausible; El Im = elaborative implausible.

Table 2

Correlation Among All Study Variables (N = 174)

		1	2	3	4	5	6	7	8	9	10	11	12
	Mean	1.29	1.08	1.15	.90	3.20	.50	4.83	.22	.01	1.45	3.35	3.00
	(SD)	(.82)	(.81)	(.87)	(.83)	(2.36)	(.80)	(3.40)	(.53)	(.26)	(.46)	(.46)	(.26)
1	DBD-P, IA	1											
2	DBD-P, HI	0.73***	1										
3	DBD-T, IA	0.38***	0.29***	1									
4	DBD-T, HI	0.27***	0.41***	0.62***	1								
5	Total Exp Pl	-0.10	0.002	-0.12	-0.01	1							
6	Total Exp Im	-0.07	0.004	-0.11	-0.06	0.04	1						
7	Total Elab Pl	-0.06	-0.08	-0.13	-0.05	0.39***	0.14	1					
8	Total Elab Im	-0.10	0.03	-0.04	-0.04	0.11	0.04	0.09	1				
9	Factor Score (PSNG)	-0.22**	-0.28***	-0.26**	-0.33***	0.05	0.02	-0.00	0.08	1			
10	Global Rejection	0.19*	0.24**	0.21**	0.32***	-0.06	-0.04	0.01	-0.07	-0.95***	1		
11	Peer Liking	-0.13	-0.20**	-0.25**	-0.23**	0.02	-0.00	-0.03	0.12	0.72***	-0.54***	1	
12	Staff Liking	-0.26**	-0.28***	-0.24**	-0.22**	0.02	-0.02	0.03	-0.005	0.69***	-0.53***	0.41***	1
13	Learning Disability	0.01	0.04	0.17*	0.06	-0.22**	0.00	-0.05	0.11	-0.06	0.06	-0.06	-0.01

Note. *p <0.05, **p <0.01, ***p<0.001. DBD-P = DBD- Parent. DBD-T = DBD-Teacher. Exp = Explanatory. Elab = Elaborative. Pl = Plausible. Im = Implausible. PSNG = Peer Status in a Novel Group.

Aim 2. Variables involved in significant interactions from Aim 1 were used to conduct Receiver Operating Characteristic (ROC) curve analyses to determine the level of ADHD symptoms and inference-making abilities that best predicted social impairment. Because the Peer Status in a Novel Group variable was a factor score, it did not lend itself to a meaningful dichotomy. Thus, clinically-relevant impairment was indicated by scores falling one standard deviation above the mean (for global rejection) or below the mean (for peer liking and staff liking). The process used to determine the best cutoffs for the purpose of this study is presented in the Results section.

Results

Aim 1

Teacher models. Consistent with hypotheses, teacher-rated inattention and hyperactivity/impulsivity were significantly negatively related to social competence across all teacher models, with inattention accounting for 6.8% of the variance in social competence ($F\varDelta$ (1,172) = 12.58, $p < .001$) and hyperactivity/impulsivity accounting for 11.1 % of the variance in social competence ($F\varDelta$ (1, 172) = 21.54, $p < .001$). Contrary to hypotheses, none of the inferences were independently related to social competence, and no interactions between ADHD symptoms and inferences were found in any teacher models[2].

Parent models. Consistent with our hypotheses, parent-rated inattention and hyperactivity/impulsivity were negatively related to social competence across all models, with inattention accounting for 5% of the variance in social competence ($F\varDelta$ (1,172) = 8.84, $p < .01$, Beta = -.22) and hyperactivity/impulsivity accounting for 8% of the variance in social competence ($F\varDelta$ (1,172) = 15.02, $p < .01$, Beta = -.28). Contrary to our hypotheses, none of the inference variables were significant predictors of social competence in any of the models. The interaction between hyperactivity/impulsivity and explanatory implausible inferences was the only significant interaction found across models (b = .09, SE_b = .028, β = .23, $p < .01$), indicating that the relationship between

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[2] The above linear regression models were conducted a second time to investigate these relationships when social competence was defined by the individual component variables comprising PSNG. The pattern of results did not change.

hyperactivity and social competence depended on the level of explanatory implausible

inferences. Results for this model are provided in Table 3

Table 3

Summary of Linear Regression Analysis for Parent-rated Hyperactivity/Impulsivity and
Explanatory Plausible Inferences Predicting Social Competence (PSNG).

Variable	Step 1			Step 2			Step 3		
	B	SE B	β	B	SE B	β	B	SE B	β
DBD-P, HI	-.089	.023	-.283***	-.089	.023	-.283***	-.091	.023	-.289***
Exp Imp				.008	.023	.026	.019	.023	.060
DBD-P, HI x Exp Imp							.090	.028	.232**
R^2		.080			.081			.134	
F for ΔR^2		15.024***			.126			10.335**	

Note. $N = 174$. *$p <0.05$, **$p <0.01$, ***$p<0.001$. DBD-P; HI=Parent-rated hyperactivity/impulsivity; Exp Imp= Explanatory Implausible inferences; DBD-P, HI x Exp Imp = interaction between parent-rated hyperactivity/impulsivity and frequency of explanatory implausible inferences. PSNG = Peer Status in a Novel Group

Simple slopes were tested for low (-1 SD below the mean), moderate (mean), and

high (+1 SD above the mean) levels of explanatory implausible inferences (Aiken &

West, 1991). Results revealed significant negative relationships between parent-rated

hyperactivity and social competence for low (b= -.16, SE_b= .04, t (170)= -4.0, $p <.001$)

and moderate (b= -.09, SE_b= .03, t (170)= -2.88, $p <.01$) levels of explanatory plausible

inferences, but not high levels (see Figure 2).
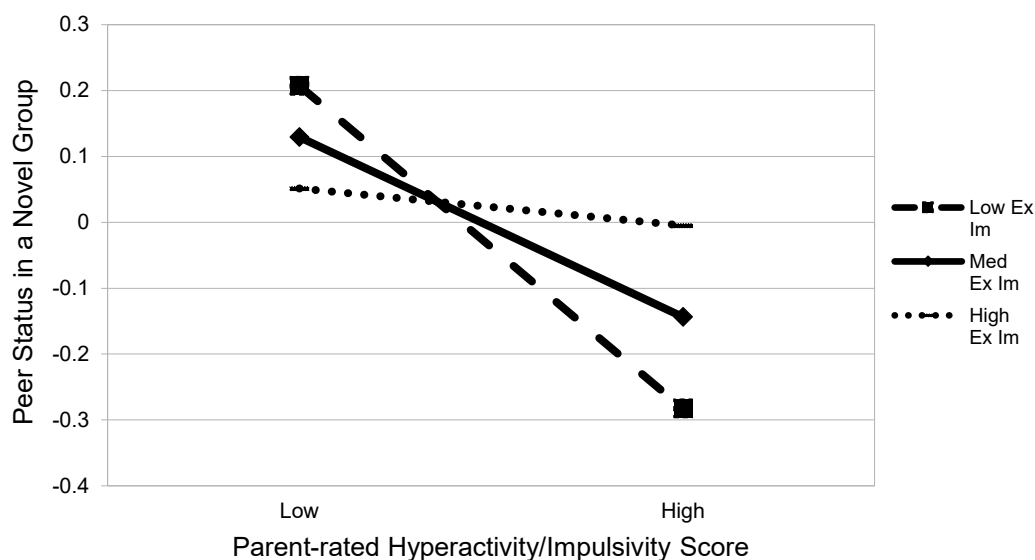
Figure 2. Simple slopes for significant interaction between parent-rated hyperactivity/impulsivity and explanatory implausible inferences.

The above linear regression models were conducted a second time to investigate these relationships when social competence was defined by the individual component variables comprising PSNG. The relationships found for PSNG were replicated for global rejection and staff liking. Parent-rated hyperactivity predicted peer liking, but inattention did not. The interaction was found in peer liking and global rejection models but not for staff liking models. Thus, global rejection and peer liking scores were used in the ROC curves in Aim 2.

Aim 2

Following significant interactions from Aim 1, the goal of Aim 2 was to conduct ROC curve analyses to determine the level of ADHD symptoms and the level of inference-making abilities that best predict whether a child is likely to be significantly

disliked or have clinically-elevated social rejection (Aim 2). Centered variables were used for Aim 2. Both variables were dichotomized for the ROC analyses.

Multiple experimental cutoff criterion were considered for classifying children as socially "impaired" and "unimpaired" (see Appendix A for more details). The chosen method used the means and standard deviations of the two classification variables in order to create an impaired group whose scores fell 1 SD above the mean (peer liking; 28 impaired, 146 unimpaired) or 1 SD below the mean (global rejection; 32 impaired, 142 unimpaired). For the purposes of these analyses, it was important to create meaningful cutoffs which, in this case, means that the cutoffs should be able to be tied to the anchors on the variables' scales. By using the aforementioned cutoffs for the two scaled variables as opposed to creating cutoffs for the factor score, we are able to glean more meaning from our findings. The cutoff for global rejection most closely corresponds to a '2' on the variable scale (i.e., children who experience at least some rejection, but either rarely or rejection of low severity). The cutoff for peer liking falls just below a 3 on the scale (i.e., children who are liked less than pretty much). Using these delineations, 23% of children with ADHD and 10% of children without ADHD were considered to be disliked by peers. Children with ADHD were twice as likely as children without ADHD to be rejected rather than not rejected ($p < .05$).

The area under the curve (AUC) is a measure of test accuracy. In terms of test accuracy in predicting cases and noncases, AUC values greater than .90 indicate high accuracy; values between .70 and .90 indicate moderate accuracy; values between .50 and .70 indicate low accuracy; and a value of .50 indicates that the test is no more accurate

than chance (Taylor, James, Bobadilla, & Reeves, 2008). For the ROC analyses, parent-rated hyperactivity/ impulsivity and explanatory implausible inferences were considered individually and in combination with each other to see if using both ADHD symptoms and number of inferences would better screen for social impairment than each variable alone.

First, an ROC analysis was conducted with parent-rated hyperactivity/impulsivity and explanatory plausible inferences as predictors of peer liking. Independently, parent-rated hyperactivity/impulsivity significantly predicted peer liking (AUC = .65, *SE*= .06, *p* = .02, 95% CI = .57 - .72) but had low accuracy despite this significance. The parent-rated hyperactivity/impulsivity cutoff score that maximized sensitivity and specificity was 1.04 (sensitivity=39.29, specificity=91.78). Independently, explanatory implausible inferences did not significantly predict peer liking (AUC= .524, *SE* = .051, *p*=.64, 95% CI = .447-.600), and the suggested cutoff of 0.5 and below was not meaningful and led to fairly low sensitivity and specificity (sensitivity=67.86, specificity=36.99).

To determine if the combination of hyperactivity and explanatory implausible would create better screening criteria than parent-rated hyperactivity/impulsivity alone, the hyperactivity/impulsivity ROC curve analysis was conducted with a filter for students who identified at or below the cutoff for explanatory implausible inferences (Devanand et al., 2008; Shultz, 1995). With these criterion, the probability that children would be correctly classified as being liked or disliked by peers increased from 64.8% to 72.9% (*p* < .001, *SE*=.07, 95%CI = .636-.808). The new cutoff for parent-rated hyperactivity was 0.25 (Sensitivity=65, Specificity=75). See Figure 3a and 3b for the graphical

representations of the ROC curves with hyperactivity/impulsivity alone and with the

addition of a cutoff for explanatory implausible inferences. Although the AUC increased,

the combination of tests provided only low to moderate accuracy. The AUCs above and

below the cutoff were not statistically different from each other.
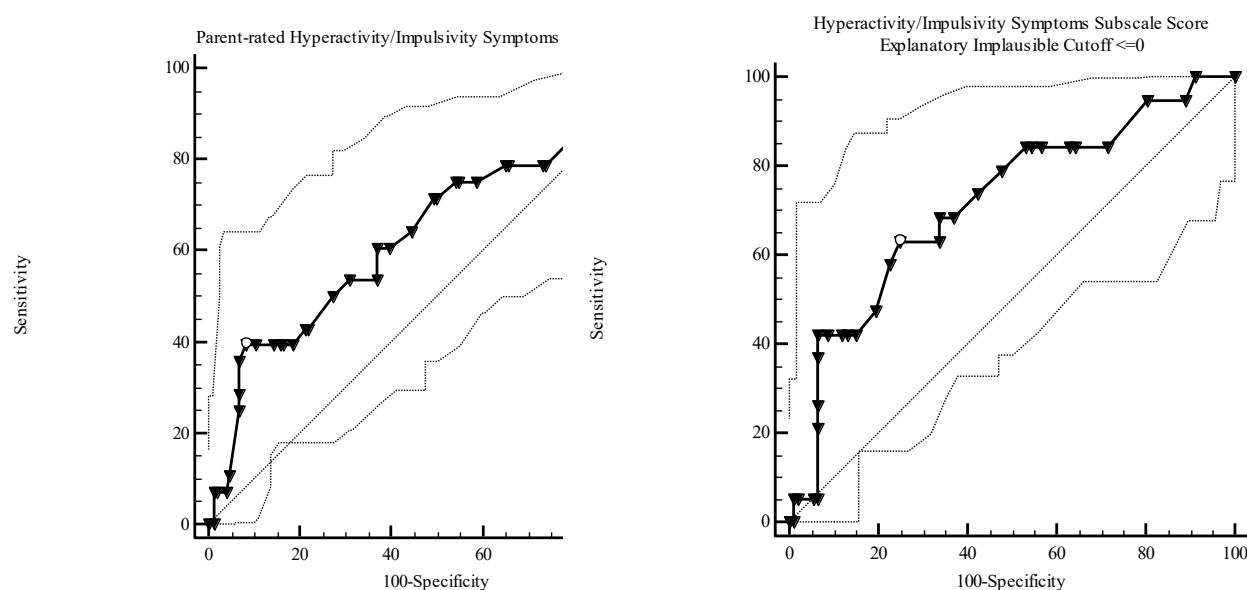
Figure 3. *Left*: Parent-rated hyperactivity/impulsivity as a predictor of peer liking. The dotted diagonal line represents classifications based on chance. The upper and lower dotted lines represent the 95% confidence interval for the ROC curve. *Right:* Parent-rated hyperactivity/impulsivity as a predictor of peer liking for children with explanatory implausible inference scores of 0 or less. The dotted diagonal line represents classifications based on chance. The upper and lower dotted lines represent the 95% confidence interval for the ROC curve.

Next, an ROC analysis was conducted with parent-rated hyperactivity and

explanatory plausible inferences as predictors of global rejection. The probability of

correctly predicting global rejection using parent-rated hyperactivity/impulsivity alone

was not significant (AUC= 0.58, *SE* = .07, *p* > .05, 95% CI= .51-.66). The suggested

cutoff of .92 resulted in Sensitivity of 37.50 and specificity of 90.14. Explanatory

implausible inferences also did not significantly predict global rejection (AUC=.53, $SE =$

.05, $p>.05$, 95% CI= .45-.61). The cutoff maximizing sensitivity and specificity was at or

below 0.50 (Sensitivity=71.87, Specificity=37.32). The hyperactivity/impulsivity ROC

analysis was conducted with a filter for students who identified at or below the

explanatory implausible cutoff of 0.50, which increased the probability of correctly

identifying rejected children from 58.3% to 68.9% ($SE=$ .08, $p =$ .02, 95% CI= .59-.77).

For children with explanatory implausible inferences at or below the cutoff score, the

recommended hyperactivity cutoff was greater than 0.36 (Sensitivity=65.22,

Specificity=79.78).

Discussion

The purpose of this study was to examine the relationships between ADHD symptoms, inference abilities, and social competence. We also sought to determine the optimal cutoffs for ADHD ratings and inference abilities that could be used to identify children who are at particular risk for experiencing social problems. Consistent with previous research, we found a negative relationship between ADHD symptoms and social competence, (for review see McQuade & Hoza, 2008). Interestingly, however, this relationship was not consistently found when peer-rated liking was the indicator of social competence. Contrary to our hypotheses, inferences were not related to social competence, and total explanatory implausible inferences was the only moderator of the relationship between parent-rated ADHD symptoms and social competence (specifically, PSNG, peer liking, and rejection). Furthermore, the present study reveals possible cutoff scores for hyperactivity/impulsivity symptoms and inferences that could predict social impairment with moderate accuracy.

Symptoms of ADHD and Social Competence

Consistent with our first hypothesis in Aim 1, the present study replicated previous research demonstrating that greater symptoms of ADHD (both hyperactivity/impulsivity and inattention) are related to lower overall social competence (e.g., Tseng et al., 2014; Wheeler & Carlson, 1994). This relationship was found for both categories of teacher-rated symptoms and the three specific types of social competence (i.e., global rejection, peer liking, and staff liking). The relationship also held for parent-rated symptoms in both domains and two types of social competence (global rejection

and staff liking), but not for peer liking. Parent-rated hyperactivity/impulsivity was associated with lower peer liking ratings, but parent-rated inattention was not. Additional data from the current study, as well as previous studies, offer some explanations for this difference.

First, data from the current study indicate that, when ADHD status was considered, there was no difference in the amount of rejection between children who met criteria for ADHD, predominantly inattentive presentation (ADHD-I) and those who did not meet criteria for any ADHD; however, there was a difference in rejection between children who met criteria for ADHD combined type (ADHD-C) and those who did not meet criteria for ADHD. Therefore, as found in previous studies (e.g., Tseng et al., 2014), hyperactivity/impulsivity is likely the driving force behind peer rejection. This is also somewhat supported by results from a study by Zoromski et al. (2015) which found that teacher-rated hyperactivity/impulsivity was more predictive of teacher-rated social impairment (i.e., student-teacher relationships and peer relationships) than was inattention. Most studies examine hyperactivity/impulsivity rather than inattention in relation to social outcomes, likely due to hyperactivity often being more visible than inattention, as well as the differential focus on boys with ADHD rather than girls. Many studies also do not differentiate between the two symptom domains. The emerging findings from this study and others suggest that the connection between rejection and inattention is weaker than the connection between rejection and hyperactivity/impulsivity.

Second, the lack of relationship between inattention and rejection found in this study may also be a function of the way in which inattentive symptoms manifest in social situations and the short amount of time the child participants spent together. Unlike children with hyperactivity or impulsivity, children with predominantly attentional difficulties are more likely to have covert rather than disruptive social difficulties. As a result, children with inattention might be less liked than typically developing peers, but they might not be actively disliked or rejected. Because the children in this study only interacted with each other for three hours, disruptive behaviors likely had a greater negative effect on peer relationships than did attentional problems.

Further, the short duration of this study likely also had an effect on the magnitude of the relationship between ADHD symptoms, particularly hyperactivity, and peer rejection. For example, Hoza, Mrug, et al. (2005) classified 52% of children with ADHD (14% of children without ADHD) as rejected, whereas the present study only classified 23% of children with ADHD (10% of children without ADHD) as rejected. Although we classified a group of children as "rejected" for the purpose of the ROC curve analyses, a better description for this group would be "at risk for rejection" because all children received scores less than three on the global rejection scale, indicating no more than occasional rejection with mild-to-moderate severity. One explanation for this difference in findings is that the children in the study by Hoza, Mrug et al. (2005) rated peers from their same classroom at school and therefore had more opportunities to have negative interactions and witness disruptive behavior. Had the children in the present study interacted for a longer period of time, it is possible that there would have been a stronger

relationship between ADHD symptoms and rejection. However, although the present findings were less robust, three hours was sufficient for children with greater symptoms of ADHD to be more rejected and less liked by their peers. Therefore, these results are noteworthy and consistent with previous studies in which children with ADHD are quickly rejected (Bagwell et al., 2001).

Unlike parent-rated inattention, teacher-rated inattention was related to peer liking. Teacher- and parent-rated ADHD symptoms also accounted for different amounts of variance depending on the social outcome measure. For example, compared to parents, teacher-rated symptoms accounted for more variance in peer liking and global rejection, but parent-rated symptoms better predicted staff-rated liking. One possible explanation for some of these differences is that children exhibit different behaviors in different environments; inattention is likely more apparent and impairing at school than it is at home, so teachers may have more opportunity and be better able to recognize symptoms of inattention than are parents (Mota & Schachar, 2000). Teachers might see inattention in a social context, whereas parents might see it in the context of daily chores or family interactions, which could explain why teacher ratings are more related to social outcomes. In addition, teachers have a normative comparison group whereas parents might not have a reference for typical behavior. These factors may have affected the pattern of findings in the current study

Inferences and Social Competence

Contrary to the second hypothesis in Aim 1, none of the inference types were related to social competence. Few studies have examined inferences as they relate to

social outcomes, and our results contradict the literature that does exist, as well as SIP theory. Namely, SIP theory posits that making fewer or less accurate inferences is related to poor social skills. Studies (Denham et al., 1990; Rieffe et al., 2005) have shown that children who make incorrect inferences (e.g., misinterpret peer intent or emotions) are more likely to be rejected and disliked. This would suggest that more implausible inferences would be related to lower social competence, but our results did not reflect this hypothesis.

One explanation for our findings is that the tools used to measure inferences in previous studies were put in a more relevant social contexts than were the fables used in this study. Results from previous studies were found using stories and pictures containing children who were similar in age to the study's participants, and the scenarios depicted were likely familiar to the participants. For example, a puppet show vignette from the preschool study by Denham et al. (1990) included a puppet who was sad about going to preschool. Rieffe et al. (2005) included a story about children playing with blocks. Children have likely experienced both scenarios. In contrast, the fables used in the present study contain scenarios that are less relevant to daily social interactions the children might have experienced (e.g., selling a donkey). In addition, none of the social interactions in the fables occurred between two children; they all involved adult-adult or adult-child interactions. It is possible that being less familiar with these scenarios and the inferences involved in adult social interactions made it more difficult for children in the present study to identify inferences such as cause-and-effect relationships and character motivations.

Another potential explanation for the findings is related to limitations in the fables coding scheme designed for the larger study. Namely, some of the children made somewhat ambiguous statements in their narratives which made it difficult to determine whether or not they should be labeled as inferences. One of the procedures used to determine whether a statement was an inference was to compare the statement to the information explicitly stated in the story. If the child's statement was explicitly stated, it could not be counted as an inference. However, this was not always a clear-cut decision. For example, the Donkey fable states at the end, "…by trying to please everybody, they had pleased nobody." One child stated, "None of the people were happy." Although this was not considered to be an inference by the coding scheme, the child made an inference about the people's emotional states, which is an elaborative inference. Their statement moves beyond stating what the father and son did and talks instead about how the people were feeling. It was also difficult to differentiate between factual errors (i.e., the child saying someone paid $20 instead of $50) and implausible inferences. For example, one of the children stated in their Donkey fable narrative, "The young dad said…," when multiple clues from the story indicated that the father was actually old. The current author considered this to be an implausible inference because the child clearly missed crucial story cues and, therefore, incorrectly inferred that the father was young, but it was considered to be an error by the coding scheme. Had these examples, and others, been coded as inferences, some of the relationships between inferences and social outcomes or ADHD symptoms might have been found. Future studies should consider creating a less a

modified coding scheme and having more explicit determination protocol in place for when these coding and definition discrepancies arise.

Inferences as Moderators

As previously described, no studies have examined the relationship between inferences and social outcomes in children with ADHD; this was the first study to examine the extent to which inferences moderate the relationship between ADHD and social competence. The present study extends the Sibley et al. (2010) and Milch-Reich et al. (1999) studies by examining interactions between ADHD symptoms and inferences. Across 16 models, only one interaction was significant: explanatory implausible inferences moderated the relationship between parent-rated hyperactivity and social competence as measured by Peer Status in a Novel Group, global rejection and peer liking. There was a negative relationship between parent-rated hyperactivity and social competence for children who made a low to moderate number of explanatory implausible inferences; parent-rated hyperactivity was not related to social competence when children made a high number of explanatory implausible inferences. This is contrary to what we expected given that inaccurate inferences have been associated with worse social outcomes (Rieffe et al., 2005). However, for children with high levels of hyperactivity, explanatory implausible inferences could be a protective factor.

Explanatory implausible inferences were made with the lowest frequency relative to the other inference types which calls into question the strength and meaningfulness of the moderating relationship that was found. Even so, some findings from previous research could provide evidence for the reality of this moderating effect. Diamantopoulou

et al. (2005) found that, for boys, higher levels of ADHD symptoms were associated with higher peer liking (when controlling for aggression, prosociality, and internalizing problems). To explain this seemingly backwards relationship, they suggested that boys with higher symptoms of ADHD have been shown to frequently initiate social interactions which can be associated with higher peer acceptance; explanatory implausible inferences could offer another hypothesis.

In certain contexts, explanatory plausible inferences could seem humorous to other children if they are used to tell funny, creative stories that do not necessarily require accurate causal connections. Children who are hyperactive and humorous (e.g., the "class clown") might be more acceptable to peers than children who are only hyperactive (but not creative or funny). More research needs to be conducted to see if this hypothesis holds, but at the very least, the present data suggests that the relationship between symptoms of hyperactivity/impulsivity and certain types of social competence may depend on explanatory implausible inferences. In addition, the relationship between hyperactivity and explanatory implausible inferences could be examined separately for boys and girls given that Diamantopoulou et al. (2005) only found the "class clown" effect for boys. Because Diamantopoulou et al. (2005) only used teacher-rated ADHD symptoms, the present study partially extends the findings by showing similar results with parent ratings. However, the lack of interactions involving teacher-rated symptoms in the present study contradicts the findings.

We found no significant interactions involving teacher-rated ADHD symptoms, indicating that if teachers are the only raters of ADHD, inferences would not help to

predict children with social impairment (rejection or peer liking) beyond what can already be predicted using teacher-rated symptoms alone. Differences between the present study and other studies could have accounted for some of the discrepancies in results. For example, children in the present study were younger (8-10) compared to the 12-year-olds from the Diamantopoulou et al. (2005) study. Pre-teens and adolescents often have multiple teachers who have a shorter amount of time to observe students each day whereas primary school teachers spend multiple hours each day with the same children. As such, teachers in the present study likely partially rated hyperactivity/impulsivity and inattention based on social contexts seen in the classrooms and, therefore, produced symptom ratings that were already more accurate than parent-rated symptoms. Therefore, there would not be a sizeable increase in teacher accuracy with the addition of inference variables. In situations when teachers spend less time with students (e.g., a once-per-week electives teacher or single-class high-school teacher), inferences may offer incremental accuracy. However, for teachers who already use social competence to inform their ADHD ratings and who have a more comprehensive view of student behaviors, inferences may not be helpful.

Cutoffs for Predicting Dichotomous Social Impairment

The second goal of this study was to determine the best ADHD symptom and inference cutoffs for predicting social impairment in our sample, and the results showed that the combination of explanatory implausible inferences and parent-rated hyperactivity/impulsivity produced the most accurate screening tool for peer liking and global rejection. Together, explanatory implausible inferences and parent-rated

hyperactivity/impulsivity generated a sensitive but non-specific screener, and its ability to correctly identify rejected and disliked children was better than screeners based solely on ADHD symptoms.

Future research using a larger school sample and more relevant inference measures should be conducted to determine whether inferences would be a helpful and feasible addition to screening measures. In addition, future studies should examine within-classroom peer sociometrics to see if amount of time spent with peer raters would change the results.

Limitations and Future Directions

The results of the present study should be considered in the context of its limitations. First, because this study was conducted using data that was previously collected from a larger study, this author had little control over the coding scheme for inferences or observer-rated rejection. Certain evidence, particularly correlation data, calls into question the validity our inference measure. IQ scores should be correlated with inferences because the ability to make inferences is a cognitive skill. The fact that our inference measures were weakly related to IQ scores ($r = .01 - .35$) either indicates that our IQ measure does not tap into the cognitive skills that underlie inference abilities, or the fables do not actually tap into the inference construct. In addition, our fables measures were weakly to moderately correlated with other measures of inferences in the larger study's database (e.g., Test of Problem Solving [TOPS; Bowers, Huisingh, & LoGiudice, 2005]; questions following a television episode of "Growing Pains"). We checked to see if the lack of relationship between inferences and social competence was due to the social

outcome variables by replacing our variables with scores from the Social Skills Improvement System – Rating Scales (SSIS; Gresham & Elliott, 2008), a widely used and validated measure of social competence. Even with this replacement, the relationship did not exist.

One likely problem with the fables variables, as well as most existing measures of inference abilities, is the lack of social context. Most studies examine inferences in an academic context, so it was not necessarily important for previous measures to have a social emphasis. Skills are most effectively measured in the context in which they are used, so it is possible that the lack of social relevance made our fables measure ungeneralizable to a social context. In addition, it is possible that the fables measure did not provide sufficient opportunities for all types of inferences, specifically explanatory inferences; the inference opportunities provided could have been too simplistic for this sample. This could partially explain the lack of relationships involving explanatory plausible inferences, and the overall low incidence of explanatory implausible inferences. Fables requiring more frequent and complex inferences could elicit more differences between children with good and poor inference abilities. In general, the fables tasks have limited psychometric properties, so more research should be done to determine whether these tasks are valid measures of inference-making abilities.

Second, due to sample and space limitations, we did not examine certain covariates, such as age and gender, which could have impacted the results. Inferences and social abilities have been shown to vary with both age and gender (e.g., Diamantopoulou et al., 2005; van den Broek, 1989). Younger children tend to have worse inference

abilities than older children, and genders have different social norms and react differently to the same social cues. Our sample has a narrow age range (8-10 years old), but future studies could use a wider age range, or look at the same children longitudinally, to see if the moderating effects of inferences change depending on the age of the child. In our study, we had about twice as many males as females, making it more difficult to compare the two groups. Future studies could collect a sample containing a more equal number of males and females to see if the relationships between ADHD symptoms, inferences, and different measures of social competence change depending on gender.

Lastly, our social competence outcome variables likely depended on the child's group placement. Behaviors that bother members of one group might be tolerated by members of a different group. In our study, three of the ten cases with the largest residuals were in the same group; children in this group may have given abnormally high ratings to these three children with ADHD-C, which could make the relationship between ADHD symptoms and social competence appear weaker than it actually is. Future analyses could examine children within their groups to see if the relationships between variables depend on the child's group members.

Conclusion

Our study showed that although ADHD is significantly related to social competence, ADHD symptoms alone only explained a small portion of the variance in social impairment. We examined inference abilities to see if they predicted social impairment independently or if they interacted with ADHD symptoms to improve upon our ability to predict social impairment with ADHD symptoms alone. Our findings

provide limited support for inference ability (as measured by the fables task) as a viable treatment target. This question remains unanswered until additional measures of inference are examined in a similar design. However inferences may offer additional power for screening tools designed to identify children experiencing different forms of social impairment. We also demonstrated the benefits of using multiple informants to measure ADHD symptoms and social outcomes and separating predictor and outcome variables into more distinct constructs (i.e., rejection, liking, and dislike). Future studies in this area should continue use these methods to examine mechanisms behind social impairment in children with symptoms of ADHD.

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Appendix A: Instruments and Methods

Descriptions of Group Tasks

Time	Duration	Activity
8:45 – 9:15	30 minutes	Arrival, children receive T-shirts and put them on, children make nametags, sit in designated area
9:15-9:30	15 minutes	Introductions, Icebreaker game (interviewing and introducing each other)
9:30-9:50	20 minutes	First structured activity (Create a Group Name and Banner)
9:50-10:10	20 minutes	Free play period #1
10:10-10:30	20 minutes	Second structured activity (Riverwalk)
10:30-10:50	20 minutes	Third structured activity (Puzzle)
10:50-11:10	20 minutes	Free play period #2
11:10-11:25	15 minutes	Snacks and bathroom break, begin sociometric assessments
11:25-11:55	30 minutes	Complete sociometric assessment, craft activity, certificates of completion
11:45--12:15	30 minutes	Departure, pay families, get signed receipts

Fables Transcriptions

A Test of Strength

1. _____Once there lived a chief
2. _____who had three sons.
3. _____They were all fine, strong young men.
4. _____and very bright, too.
5. _____But often their father wondered which of the lads was the strongest.
6. _____One day his advisors gathered for a meeting.
7. _____The chief looked around at the group of wise men,
8. _____and asked them to help him decide who was the strongest.
9. _____"Come over to this oak tree,"
10. _____he said to his advisors,
11. _____"and let my three sons be brought here immediately."
12. _____After a few moments
13. _____the three young men appeared,
14. _____ each leading a horse.
15. _____ "My sons," said the chief,
16. _____ "I want each of you to mount your horse
17. _____and show your power to all of my advisors.
18. _____You may do whatever you please,
19. _____but when you reach this oak tree,
20. _____you must perform a trick
21. _____To show us how strong and clever you are."
22. _____The three sons mounted their horses,
23. _____rode to the edge of a long path
24. _____leading to the oak tree
25. _____and prepared to show their strength.
26. _____The first son came galloping straight at the tree,
27. _____carrying no sword.
28. _____The people were afraid he might crash against the tree.
29. _____But suddenly,
30. _____his horse rose in the air like an arrow
31. _____and sailed right over the oak tree.
32. _____The rider and horse landed unharmed
33. _____on the other side.
34. _____The crowd laughed with pleasure and surprise.
35. _____"Surely," they said,
36. _____"no one can do better than that."
37. _____Then the second son, galloping furiously,

38. _____Made straight for the oak tree.
39. _____He swerved neither to the right or the left.
40. _____Holding his spear high
41. _____He plunged it into the trunk with such force
42. _____that it made a great hole.
43. _____Then to everyone's surprise,
44. _____the second son followed the spear
45. _____and leapt through the hole,
46. _____horse and all,
47. _____making a perfect landing
48. _____on the other side.
49. _____Those who were watching shouted their approval
50. _____with loud hearty cheers.
51. _____"Surely the third son will not be able to do better than this,"
52. _____they said to each other
53. _____and held their breath.
54. _____The youngest son came riding toward the tree.
55. _____As he reached it,
56. _____he seized its branches in both hands,
57. _____dug his heels into his horse
58. _____and pulled the whole tree from the ground,
59. _____roots and all.
60. _____Then he rode up to his father,
61. _____waving the tree and smiling.
62. _____The crowd roared with applause for the strongest son.

Father, Son, and Donkey

1. _____   A father and his son
2. _____   were taking their donkey to town
3. _____   to sell him
4. _____   at the marketplace.
5. _____   They had not gone a great distance,
6. _____   when they met a group of pretty maidens
7. _____   who were returning from the town.
8. _____   The young girls were talking and laughing
9. _____   when one of them cried out, "Look there.
10._____   Did you ever see such fools,
11._____   to be walking along side the donkey when they might be riding it?"
12._____   The father, when he heard this,
13._____   told his son to get up on the donkey,
14._____   and he continued to stroll along merrily.
15._____   The traveled a little further down the road,

16._____ and soon came upon a group of old men talking.
17._____ "There," said one of them,
18._____ "that proves what I was saying.
19._____ What respect is shown to old age in these days?
20._____ Do you see that idle young boy riding the donkey,
21._____ while his father has to walk?
22._____ You should get down
23._____ and let your father ride!"
24._____ Upon this the son got down from the donkey
25._____ and the father took his place.
26._____ The had not gone far
27._____ when they happened upon a group of women and children.
28._____ "Why, you lazy old fellow,
29._____ you should be ashamed."
30._____ cried several women at once.
31._____ "How can you ride upon the beast,
32._____ when that poor little boy can hardly keep up with you?"
33._____ So the good-natured father hoisted his son up behind him.
34._____ By now they had almost reached the town.
35._____ "Tell me friend," said a townsman,
36._____ "is that donkey your own?"
37._____ "Why yes," said the father.
38._____ "I would not have thought so," said the other,
39._____ "by the way you overwork him.
40._____ Why, you two are strong
41._____ and are better able to carry the poor beast than he is to carry you."
42._____ "Anything to please you, sir," said the father,
43._____ "we can only try."
44._____ So he and his son got down from the donkey.
45._____ They tied the animal's legs together,
46._____ and, taking a pole,
47._____ tried to carry him on their shoulders
48._____ over a bridge
49._____ that led to the marketplace.
50._____ This was such an odd sight
51._____ that crowds of people gathered around to see it,
52._____ and to laugh at it.
53._____ The donkey, not liking to be tied,
54._____ kicked so ferociously
55._____ that he broke the rope,
56._____ tumbled off the pole into the water,
57._____ and scrambled away into the thicket.
58._____ With this,
59._____ the father and his son hung down their heads

60._____ and made their way home again,
61._____ having learned that by trying to please everybody,
62._____ they had pleased nobody,
63._____ and lost their donkey, too.

Procedure for Coding Fables, Including Procedure for Coding Inferences

Fables Coding

General Steps:
- Get story
- Parse units, number the parsings, and code for ambiguous references
- Assign units and errors
- Code for global coherence
- Underline and identify inferences
- Complete transfer sheets
- Data entry in SPSS

Parsing Units:
- Use the original transcript sheets to help you parse the idea units
    - Parsings do not always match up to the story units
- Divide the story into the smallest meaningful idea units (called clauses, parses or idea units) which convey a complete idea
    - Use / to separate each unit
- May be a whole sentence or a sentence may contain a number of meaningful idea units
- Sometimes the child will qualify an idea without using separating words (such as "but", "and", or "then") so the original idea and the qualified statement are considered one unit ("because", "since it is", "so that", "when" and "about" does not necessarily mean parse into a new unit)
    - Ex: "the children are arguing about dad's birthday" is not "the children are arguing / about dad's b-day"
    - If a complete thought follows the qualifier, can parse as two
        - Ex: "The father told the son to go on the donkey / because the people told him to"
- Consult with original script if needed
- A list of nouns does not require parsing of a new unit for each item
    - Ex: "The knight carried his armor, sword, and shield" rather than "The knight carried his armor, / sword, / and shield"
- Keep dialogue as one unit

Errors:
- Story errors: errors that children make while telling the story, if it is clear that the child is just not remembering the course of the story correctly but you can tell where in the story the child is getting the event from, put the Unit number followed by an "E"
    - Ex: if the child says something like "The second son jumped over the hold" but in reality, the second son jumped through the hole, it is still clear what point in the story the child is referring to
    - Ex: 45E

- • Put the unit number of what it SHOULD be
- • Should directly contradict story
- Errors that are just so far out there that it is impossible to assign an unit, do not assign them an event unit from the event list
  - • So it will just be labeled "E" rather than 126E
- If wrong gender given, it is an error
- If the error is replacing a shown event, then it is an error
  - • Example of a replacement is saying "Richard sold orange soda" instead of lemonade
- Errors and inferences can coincide in one parsing (rare), and the information that creates the errors and the information that creates the inference are usually distinct from one another
  - • Ex: "The horse was really mad at the father and his son", 'the horse' is an error while the horse's (i.e., donkey's) emotion is an inference and are both in one parsing.
- If the character and the action are mismatched, code for the correct information and code the unit where the error appears as an error, code for the action over the person
  - • Ex: "The women told them to let the old man ride", code for the speech, but code as an error because the old men said this

Coding Inferences:
- Underline in recall
- Inference: event or conclusion reached based on information contained in a text or story, but not stated explicitly
  - • May include:
    - • connecting events in the story via causal relationships that are not explicitly stated
    - • if children interpret meaning from sarcastic statements or fragments of conversation
    - • character's motivation, emotion, thought, opinion, or feeling that was not explicitly stated
    - • if a character indirectly says an event happened, story said it would happen and it cuts to it already having happened
    - • lessons, proverbs learned from the story
- Does not include:
  - • if child rephrases what occurred or what was said
- Inferences are often made so automatically that skilled readers do not realize that they are creating them, thus, as a coder you must also discover what inferences you made in order to give children credit for those as well
- When coding stories, pretend as if you have no background knowledge of the information
  - • What information is missing?
  - • What character is the child referring to?

- Frequently compare to script units to determine if occurred or inferred
- If an inference extends more than one line of the recall, use an arrow at the right end of the first line and an arrow at the left end of the second line to show that it is one continues inference, as opposed to two separate ones.
- If an inference is repeated in two separate occasions (not consecutively), do not underline repetition (synonyms can be considered two separate inferences).
    - Ex: early in the recall: "The happy family…", later on "The cheerful family" = 2 inferences.
- Explanatory inferences: essential inferences that must be made in order for the story to be comprehensible.
    - Causal: relationship between two or more story events that is not explicitly stated or explained, often elaborate on the how and why of a story.
    - May explain motivation
    - Goal that is not explicitly stated
- Elaborative: adds additional but non-essential information to the story
    - Add details that color or "enrich" the passage, often emotions or details that are not essential to story line
    - embellishments
    - Also includes if a child adds own opinion
        - Ex: "This story is sadder than the other one"
- Predictive: Events that have not yet occurred in the story, based on previous events in the story
- Both explanatory and elaborative inferences are then categorized as accurate/plausible (reasonable in the context of story information) or inaccurate/implausible
- Test of Strength
- DO NOT COUNT YOUNGEST SON = LITTLEST SON
    - Explanatory Plausible
        - The third son was the strongest son
        - The sons had to do a test/contest to see who was the strongest
        - Third son waved the tree at his dad
        - First and second son lost
        - Someone went to go get the sons and brought them back
        - Crowd thinking the first son is the winner (one inference) and that the second son won't perform better (another inference)
        - Crowd thinks that second son performs better than first son (one inference) and that he is the winner (another inference)
        - People are applauding for the third son
        - Father tells sons to go to the oak tree
        - Sons need to ride to the oak tree
    - Explanatory Inaccurate
        - There are four men competing
        - The first or second son was the strongest
    - Elaborative Plausible
        - The father is a king/strong/old/boss

- Age of sons
- Advisors are "teachers" or "judges"
- Chief had been wondering who was the strongest son for a long time
- First son made a perfect landing on the other side of the tree
- Third son galloped straight at the tree
- Son rode as fast as he could
- Chief also wanted to know who was the smartest son
- Crowd was his advisors or included his advisors
- "Easy" for sons to do what they did
- Anytime they say crowd cheered, laughed, or applauded when it's not specified for that son
- Sons did their best effort
- Third son is smallest
- Brothers were jealous of third son
- Father, Son, and Donkey
  - Explanatory Plausible
    - Tied the donkey onto the pole
    - Townsman saw the guys
    - If anyone but the old men say ride the donkey, carry the donkey
    - Father and son went home sad
    - Boy got on the donkey after the pretty maidens told him to
    - The old men want the son to let the father ride because the father is old
    - The donkey is very tired
    - They got rope
    - The donkey tried to get out of the water
    - The father and son learned an important lesson
  - Explanatory Inaccurate
    - The father and son reach the town/marketplace
    - Any other person telling them to do something that's not in the story
  - Elaborative Plausible
    - Boy and father were walking down the street, anything to indicate traveling (like walking or running, unless it refers to 14)
    - Anything identifying proximity to who is walking (e.g., man is walking next to donkey)
    - They are going to a store
    - If any number of the people are named (e.g., two girls, 3 women and children)
    - Girls were laughing at the boy and father and donkey
    - Any other motivation given for a person telling the father/boy to get on or off the donkey that sounds reasonable but isn't explicitly given (e.g., father is tired so he should be able to ride)

- Identifying what type of body of water it is (e.g., lake, pond)
- Any dialogue that is beyond person actually says (E.g., "Oh no!" or "I'll ride the donkey!")
- Saying they tie the donkey's legs with rope or to the rope
- The donkey feeling any other emotion that "isn't liking to be tied" (though not including didn't like that the people were laughing at him, too metacognitive)
- The donkey CANNOT carry the father/son (embellishment to say he cannot, the story says that father/son are BETTER ABLE to carry)
- Calling the townsman a mayor, father a farmer, old men as grandpas
- Qualifying if dad is old or young
- Donkey is a pet
- If child says at the end, they had nothing left (could have only owned the donkey so possible)

Procedure for Coding Global Acceptance and Global Rejection

- Overall Considerations
    - Do not discuss child's behavior with other coder during viewing of the task
    - Do not assume motivations of children
    - One instance should not largely inflate a rating unless it is extremely severe
- Enter Global Values into SPSS and paper sheet
    - Open SPSS file: Dropbox → SPSS data → Grant Master File
    - Each subject is labeled with name, ID, group ID, and gender
    - Key to SPSS file Column names
    - Beginning: G or INT = Global
        - Number at end always symbolizes if it is first or second coder
    - Global Coding
        - EmoDys= Emotion Dysregulation
        - Neg= Negative social
        - Pos=Positive Social
        - Acc= Accepted
        - Rej=Rejected
    - Tasks (Intro, Bann, 1Free [1st free play], River, Puzz, 2Free [2nd Free Play])
    - Enter value for each coder
        - Try to keep the first and second coders somewhat consistent

Global Coding Descriptions

Socially Accepted
- included by the other peers in activities and treated respectfully
- accepted if tries to join group, is invited to play
- peers allow child to take turn
- tone and content of words directed to child respectful and positive
- allowed to play with multiple other children

1: few if any positive overtures from peers, not engaged by other children
2
3: child is part of the group for the majority of the time, overtures occur occasionally or with moderate severity
Ex: allowed to take turn, given toy when asked, listened to when speaking, may spend some time in solitary
4
5: child receives positive overtures, other peers respectful and attentive to child's conversation, frequent throughout the interval, high in severity, or long in duration, seen as a leader

Ex: engaged in conversation, may receive multiple invitations to play, is allowed to join group when asked, rarely voluntarily in solitary

Socially Rejected

- excluded from activities with peers and recipient of negative words/actions
- not allowed to join group, even if asks
- blamed for situation, yelled at, made fun of
- ignored after making overtures, unwillingly playing by self
  - child has to make some overtures to be rejected
- was cut in line, has object stolen from them

1: no evidence any peers rejected or ignored the child, also may occur if child is choosing to play by self but not as a result of being rejected by others
2
3: receives some negative overtures, occurs occasionally or with moderate severity
Ex: cut in line repeatedly, has object stolen, rejected from joining group, yelled at
4
5: child not allowed to play with group for an extended amount of time, may receive negative overtures that are frequent throughout the interval, high in severity, or long in duration
Ex: may be blamed for situation repeatedly, may frequently be in solitary due to exclusion from peers, lack of cooperative play or even parallel play

Creating the Peer Status in a Novel Group Latent Variable

The original hypothesized latent variable was defined by four measured indicators: global acceptance, global rejection, peer liking, and staff liking. A confirmatory factor analysis (CFA) was conducted in order to create the latent variable using all four indicator variables. Results showed that the model fit was adequate but not particularly good. Global acceptance did not have a significant factor loading and accounted for no variance in the latent variable. It was identified as a source of misfit and subsequently dropped from the model. The final model contained only global rejection, peer liking, and staff liking. We are unable to test whether this final model has good fit because we do not have enough degrees of freedom to do so. However, dropping the source of misfit (global acceptance) likely created a good fitting model.

Description of Memory Variable

Memory Variable (Percentage of Correct Facts Recalled). During the individual sessions in the larger study, children watched a television show (Growing Pains) and completed related tasks. For one of the tasks, children answered questions about the show that assessed children's memory for explicitly stated facts that relied solely on recall and required no inferences or other cognitive skills, except, perhaps, attention. The number of factual questions answered correctly out of the total number of factual questions was used to calculate the percentage of correct facts recalled. This is the purest measure of memory that we have for our study. The variables we used to measure inference abilities also have a memory component; children must create story narratives after listening to the fables rather than in the moment. Group differences in terms of general memory abilities would make it difficult, if not impossible, to determine if differences in inference generation was due to actual inference differences or due to overall memory problems. In order to rule out memory as a confounding variable for inference differences between children with and without ADHD, we ran an independent samples t-test using a variable representing recall of factual information taken from the larger study. Results indicated that children with ($M = 60.25$, $SD = 28.02$) and without ADHD ($M = 68.18$, $SD = 24.57$) do not differ in their ability to recall factual information, $t(167) = -1.96$, $p > .05$. Therefore, significant relationships between ADHD and inferences are likely not due to differences in general memory abilities.

Creating Dichotomous Impairment for Aim 2

First, the author created cutoffs based on the qualitative scale items and anchors. A cutoff of 2 or less was used to classify "impaired" for peer liking, meaning that the average response to the question "How much did you like (child's name)?" was "a little" or "not at all". A cutoff of greater than 2 was used to classify "impaired" for global rejection (See Appendix A for description of global rejection scale items). These cutoffs yielded highly uneven dichotomous groups, particularly for peer liking for which only three participants (1.7%) were classified as "impaired". The second method is previously described in the text.

Measures

Parent DBD Rating Scale

Child ID#:_____   Completed By (circle one): Mother   Father
          Other_____

Date Completed:_____

Check the column that best describes your/this child. Write DK for items where you do not know

the answer.

	Not at all	Just a Little	Pretty Much	Very Much
1. often interrupts or intrudes on others (e.g., butts into conversations or games)				
2. has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period)				
3. often argues with adults				
4. often lies to obtain goods or favors or to avoid obligations (i.e., "cons" others)				
5. often initiates physical fights with other members of his or her household				
6. has been physically cruel to people				
7. often talks excessively				
8. has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)				
9. is often easily distracted by extraneous stimuli or things unrelated to the task				
10. often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), e.g., runs into street without looking				
11. often truant from school, beginning before age 13 years				
12. often fidgets with hands or feet or squirms in seat				
13. is often spiteful or vindictive				
14. often swears or uses obscene language				
15. often blames others for his or her mistakes or misbehavior				

Parent DBD: continued

16. has deliberately destroyed others' property (other than by fire setting)				
17. often actively defies or refuses to comply with adults" requests or rules				
18. often does not seem to listen when spoken to directly				
19. often blurts out answers before questions have been completed				
20. often initiates physical fights with others who do not live in his or her household (e.g., peers at school or in the neighborhood)				
21. often shifts from one uncompleted activity to another				
22. often has difficulty playing or engaging in leisure activities quietly				
23. often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities				
24. is often angry and resentful				
25. often leaves seat in classroom or in other situations in which remaining seated is expected				
26. is often touchy or easily annoyed by others				
27. often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)				
28. often loses temper				
29. often has difficulty sustaining attention in tasks or play activities				
30. often has difficulty awaiting turn				
31. has forced someone into sexual activity				
32. often bullies, threatens, or intimidates others				
33. is often "on the go" or often acts as if driven by a motor"				
34. often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)				
35. often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)				
36. has been physically cruel to animals				

Parent DBD: continued

37. often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
38. often stays out at night despite parental prohibitions, beginning before age 13				
39. often deliberately annoys people				
40. has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery)				
41. has deliberately engaged in fire setting with the intention of causing serious damage				
42. often has difficulty organizing tasks and activities				
43. has broken into someone else's house, building, or car				
44. is often forgetful in daily activities				
45. has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun)				

<u>DBD Rating Scale (Teacher Version)</u>

ID #: _____   Assessment Point: _____   Date: _____

Teacher's Name: _____

Completed By: (circle one) (1) Science teacher (2) Math teacher (3) Social Studies teacher (4) Language Arts

teacher

Please check the column that *best describes* the child's school behavior over the past **month**. Check only **one** column for every question. ***Please do not leave any of the questions blank***. Due to the confidential nature of these rating scales, please return them promptly to the designated collection location.

|	Not at all	Just a little	Pretty much	Very much
1. Often interrupts or intrudes on others (e.g., butts into conversations or games)				
2. Often argues with adults				
3. Often talks excessively				
4. Is often easily distracted by extraneous stimuli				
5. Often fidgets with hands or feet or squirms in seat				
6. Is often spiteful of vindictive				
7. Often blames other for his or her mistakes or misbehavior				
8. Often actively defies or refuses to comply with adults' requests or rules				
9. Often does not seem to listen when spoken to directly				
10. Often blurts out answers before questions have been completed				
11. Often has difficulty playing or engaging in leisure activities quietly				
12. Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities				

Teacher DBD: continued

13. Is often angry and resentful				

	Not at all	Just a little	Pretty much	Very much
14. Often leaves seat in classroom or in other situations in which remaining seated is expected				
15. Is often touchy or easily annoyed by others				
16. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)				
17. Often loses temper				
18. Often has difficulty sustaining attention in tasks or play activities				
19. Often has difficulty awaiting turns				
20. Is often "on the go" or often acts as if "driven by a motor"				
21. Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)				
22. Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)				
23. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
24. Often deliberately annoys people				
25. Often has difficulty organizing tasks and activities				
26. Is often forgetful in daily activities				
27. Often daydreams when should be attending				
28. Is often sluggish or drowsy				

Appendix B: SIP Model
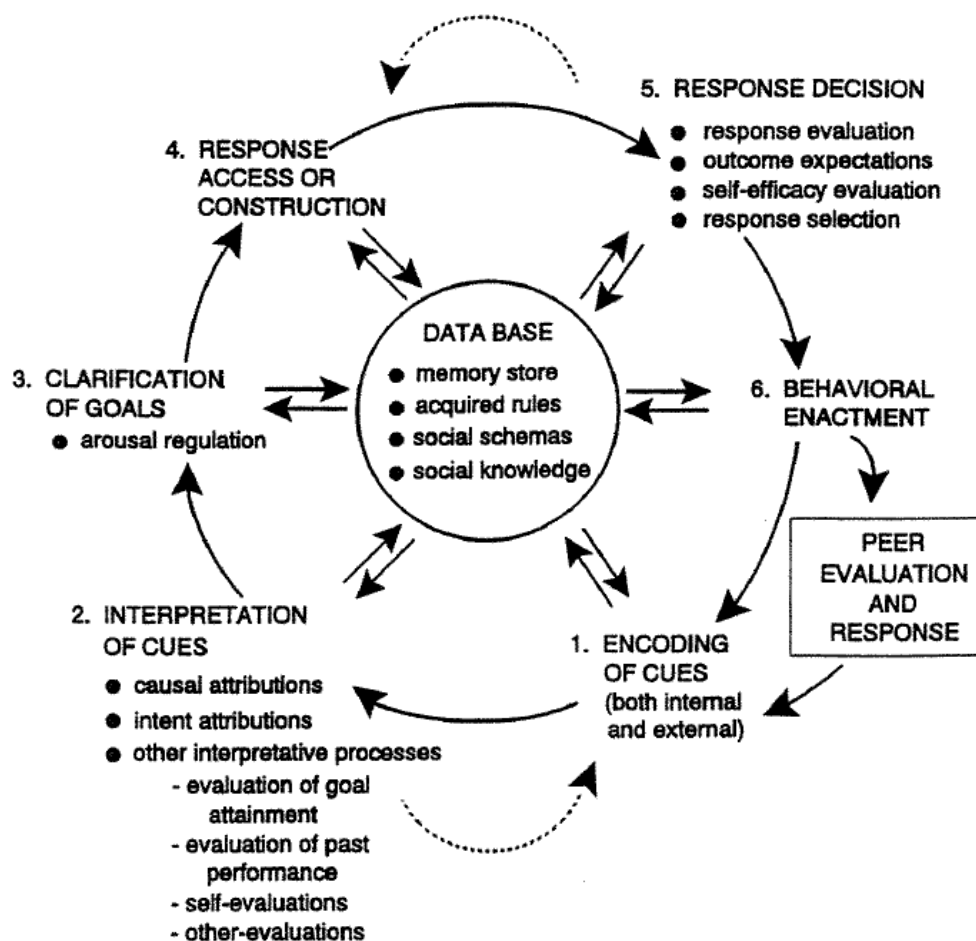
Figure 1B:. Reformulated social information processing model of children's social interactions. From "A review and reformulation of social information-processing mechanisms in children's social adjustment," by N.R. Crick and K.A. Dodge, 1994, *Psychological Bulletin*, *115*, p.76.

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