PRAGMATIC DEFICITS AND SOCIAL IMPAIRMENT IN CHILDREN WITH ADHD

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Abstract

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by

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Impaired social functioning in individuals with ADHD has been well-documented as early as the preschool years and often persists into adulthood. Existing treatments for ADHD are effective for improving the inattention, impulsivity and overactivity characteristic of the disorder, but they have limited effectiveness at improving social skills. This suggests that social deficits in ADHD may be secondary to a separate phenomenon rather than the core symptoms of the disorder. Language problems are also common in ADHD, with accumulating evidence of pragmatic language difficulties. Pragmatic deficits have been associated with social impairment in several developmental and neurological disorders; however, the degree to which pragmatic deficits affect social skills in individuals with ADHD is unclear. The present study examined the relation between pragmatic deficits and social impairment in children with ADHD. To this end, 63 children, ages 7-11 years, were recruited and assigned to an ADHD or typically developing group based on parent and teacher ratings of ADHD symptoms and a semi-structured interview with a parent. A comprehensive assessment of pragmatic language was conducted using parent ratings of pragmatic skills, standardized tests of pragmatic language, and a narrative task. Parents also completed a rating scale of children's social skills. Results indicated that compared to their peers, children with ADHD have poorer pragmatic language skills across measures. Pragmatic deficits were present over and above receptive language problems. Furthermore, pragmatic

language skills as measured by parent ratings mediated the effect of ADHD on social skills. These findings have implications for the treatment and possible prevention of social problems in children with ADHD.

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Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a complex neuropsychiatric disorder primarily characterized by developmentally inappropriate levels of inattention, hyperactivity, and impulsivity. ADHD affects 3-7% of school-aged children and is approximately three times more prevalent in boys than girls (American Psychiatric Association, 1994). Although ADHD has its onset in childhood and symptoms tend to decline with age, for a substantial portion of individuals it persists into adolescence and adulthood (Faraone, Biederman, & Mick, 2006). In addition, ADHD rarely occurs in isolation; the majority of individuals with ADHD have comorbid problems, including aggression, academic failure, and interpersonal difficulties (Greene et al., 2001). Social impairment is common in ADHD and has been documented as early as the preschool years (DuPaul, McGoey, Eckert, & VanBrakle, 2001), and is not limited to childhood; adults with the disorder also present with impairment in social functioning resulting in frequent job loss and increased divorce rates (Friedman et al., 2003; Bagwell, Molina, Pelham, Jr., & Hoza, 2001). Several factors have been proposed to explain social problems in ADHD, including the disorder itself, lack of social knowledge, as well as neuropsychological and social information processing deficits (Hodgens, Cole, & Boldizar, 2000; Hinshaw, 2002; Hoza, 2007). However, findings in support of these hypotheses have been inconsistent. Further, despite the multitude of existing treatments for ADHD, most have limited effectiveness at improving social skills (Hoza et al., 2005b; McQuade & Hoza, 2008), suggesting that social deficits may be due to a separate phenomenon that is not targeted through existing interventions.

Language problems also are common in ADHD, with some studies showing that language difficulties in ADHD are evident in the domain of pragmatic language (Camarata & Gibson, 1999; Kim & Kaiser, 2000). Pragmatics, in broad terms, is the social use of language

(Prutting & Kirchner, 1987) and is essential for successful communication. Although pragmatic deficits have been implicated in several clinical populations (e.g., autism, right hemisphere damage, and ADHD), there have been few studies that systematically evaluated pragmatic language abilities in typically-developing children and those with ADHD. It is well-known from the literature in other areas that pragmatic deficits are highly associated with social problems. However, to date, there has been only one study that investigated the degree to which pragmatic deficits are associated with social problems in children with elevated levels of inattention and hyperactivity (Leonard, Milich, & Lorch, 2011). There have been no studies that examined the relationship between pragmatic language and social skills in individuals diagnosed with ADHD.

This study was based on the hypothesis that social problems in ADHD are at least partially due to pragmatic deficits, and examined whether and to what extent pragmatic language deficits account for social difficulties in children with ADHD. This hypothesis was based on the facts that: 1) individuals with ADHD commonly experience social problems that are not specific to childhood, but for many persist into adolescence and adulthood; 2) ADHD is highly co-morbid with language problems and is the most common psychiatric disorder among children with speech and language problems; and 3) pragmatic deficits are associated with social impairment in the absence of general language deficits (e.g., Asperger's Syndrome). The primary aims of the study were to: 1) systematically evaluate the presence and nature of pragmatic language deficits in children with ADHD; 2) determine the specific role of pragmatic language in social impairment in ADHD above and beyond general language difficulties; and 3) examine the relationship between pragmatic deficits and social difficulties in children with and without ADHD. These goals were achieved by systematically evaluating pragmatic language abilities in children with and without ADHD. We hypothesized that a) children with ADHD will show

greater pragmatic deficits than typically developing children and these deficits will be evident over and above general language problems; b) the effect of pragmatic deficits on social skills will be greater for children with ADHD compared to typically developing children (moderator effect); and c) pragmatic deficits will account for a significant portion of the variance in social impairment in children with ADHD, such that the difference between social skills in children with ADHD and typically developing children will be reduced when pragmatic deficits are controlled for (partial mediator effect).

Chapter I. ADHD and Social Impairment

Attention-Deficit Hyperactivity Disorder (ADHD) is a complex neuropsychiatric disorder characterized by a persistent pattern of inattention, hyperactivity, and impulsivity that is more frequent and severe than what is developmentally appropriate. These difficulties are particularly apparent in settings that require sustained attention and restricted activity (Barkley, Cunningham, & Karlsson, 1983). ADHD affects 3-7% of school-aged children and is approximately three times more prevalent in boys than girls (American Psychiatric Association, 2000). The conceptualization of the disorder has changed over time. Currently, the DSM-IV-TR distinguishes between three ADHD subtypes. Predominantly Inattentive type is characterized by difficulties related primarily to inattention. Predominantly Hyperactive type is characterized primarily by symptoms of hyperactivity/impulsivity. Combined Type describes most severe cases and is characterized by difficulties in all three domains. Finally, the diagnosis of ADHD, Not Otherwise Specified is given in cases when an individual experiences multiple symptoms and associated impairment but does not fully meet criteria for any of the subtypes described above.

Although ADHD has its onset in childhood and symptoms tend to decline with age, for a substantial portion of individuals it persists into adolescence and adulthood (Faraone et al., 2006). In addition, ADHD rarely occurs in isolation; the majority of individuals with ADHD have comorbid problems, including aggression, academic failure, and interpersonal difficulties (Greene et al., 2001).

Social problems are increasingly seen as a central component of ADHD and have been reported in 52% to 82% of children with the disorder (Landau & Milich, 1988; Barkley, DuPaul, & McMurray, 1990; Huang-Pollock, Mikami, Pfiffner, & McBurnett, 2009). The current DSM-IV criteria include several symptoms related to social conduct (e.g., difficulty awaiting one's

turn, frequent interrupting), reflecting the recognition of the importance of social difficulties (Kofler et al., 2011). Although typically not reported by individuals with ADHD, social difficulties have been reported by parents, teachers and peers (Van der et al., 2005). Thus, observational studies report that children with ADHD are socially intrusive, hostile, disruptive, controlling, bossy, and physically and verbally aggressive (Frankel & Feinberg, 2002; Buhrmester, Whalen, Henker, MacDonald, & Hinshaw, 1992; Cunningham & Siegel, 1987; Erhardt & Hinshaw, 1994e; Grenell, Glass, & Katz, 1987). They are more likely to initiate an interaction with peers, but have difficulty adjusting their behavior to others (Nijmeijer et al., 2008). Children with ADHD engage in more rule violations (Hinshaw & Melnick, 1995) and have difficulty handling conflict (Grenell et al., 1987). They also elicit more negative interactions both from their peers (Cunningham et al., 1987) and parents (Winsler, 1998).

Peer relationship difficulties in general have been documented as early as the preschool years (DuPaul et al., 2001) and are associated with a variety of negative outcomes in adolescence and adulthood, including academic difficulties, delinquency, dropping out of school, substance abuse, and overall poor psychological adjustment (Ollendick, Weist, Borden, & Greene, 1992; Parker & Asher, 1987). Social problems have also been linked to poor long-term outcomes for children with ADHD (Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997; Greene et al., 1999; Klein & Mannuzza, 1991). More specifically, early social skills deficits in children with ADHD have been shown to predict academic, occupational, marital, legal and psychological problems in adolescence and adulthood (Hoza et al., 2005a; Murphy & Barkley, 1996; Barkley, Murphy, & Kwasnik, 1996). As pointed out by Huang-Pollock and colleagues, “peer problems represent one of the most chronic and concerning real-world impairments facing children with ADHD” (Huang-Pollock et al., 2009).

Behaviors that are most frequently linked to social problems in children with ADHD are aggression and hyperactivity/impulsivity. As discussed by Barkley, behaviors such as yelling, running around, talking at inappropriate times, and interrupting other children's play are intrusive, often inappropriate in the given context, and resistant to change (Barkley, 1997). Although less impairing than the aggressive behaviors, hyperactive behaviors have been shown to lead to peer rejection independent of aggression (Wheeler & Carlson, 1994). Children with ADHD also experience social difficulties due to inattention: they appear as not listening and "dreamy", are oftentimes distracted and off-task, and struggle with switching roles (Landau et al., 1988). Inattentive children are more likely to be anxious, shy, and withdrawn compared to both typically developing and hyperactive children (Hodgens et al., 2000; Carlson, Lahey, Frame, Walker, & Hynd, 1987). These internalizing problems decrease interactions with peers and add to the negative impact on social functioning (Mikami, Ransone, & Calhoun, 2011).

Several studies compared social skills of children with Predominantly Inattentive and Combined Types of ADHD and consistently showed that the former are more likely to be perceived as passive, whereas the latter are perceived as aggressive. Hodgens, Cole, and Boldizar (2000) used a sociometric method to examine social preference scores (calculated as "liked most" minus "liked least" ratings) of boys with ADHD Combined Type, Inattentive Type, and typically developing controls. They found that children with both ADHD subtypes received lower social preference scores than those without ADHD. The study also showed that children with the Combined Type were more likely to be rated as "starts fights or arguments", while those with the Inattentive Type were rated as "shy." A similar pattern of peer ratings was shown in girls (Hinshaw, 2002). The limitation of these studies was that they did not take into account comorbid conditions such as oppositional behavior or anxiety, which are likely to affect one's

social functioning and perception by others (Mikami et al., 2011). Further, the majority of children were taking stimulant medications at the time they were rated. Solanto and colleagues (2009) compared social functioning of unmedicated children with ADHD Predominantly Inattentive and Combined Types as rated by parents and teachers on the Social Skills Rating System. The study reported that children with both types of ADHD showed social impairment after accounting for comorbid internalizing and externalizing disorders both on parent and teacher ratings. In contrast to the studies described above, there was no difference in severity of social problems between the two ADHD groups; however, the nature of social problems varied by the subtype. Consistent with the proposed hypotheses, children with ADHD Combined Type showed low self-control, while inattentive children showed deficits in assertiveness (Solanto, Pope-Boyd, Tryon, & Stepak, 2009). Overall, it appears that there are consistent differences in the nature of social problems between ADHD subtypes, which have contributed to the discussion of whether the inattentive ADHD subtype should be considered a separate disorder (Lahey, Schaughency, Strauss, & Frame, 1984).

Difficulties in social functioning are also apparent in adult ratings of children with ADHD. Thus, in a study by Clark and colleagues (1999), 65-80% of parents of children with ADHD reported difficulties in social interaction and communication; 85% of children with ADHD were rated as "lacking awareness of feelings of others (Clark, Feehan, Tinline, & Vostanis, 1999). Santosh and Mijovic also found that children with ADHD show more Pervasive Developmental Disorder (PDD) symptoms in comparison with normal controls (Santosh & Mijovic, 2004). These investigators proposed that there are two kinds of social impairments in ADHD depending on whether there are comorbid Oppositional Defiant Disorder (ODD)/Conduct Disorder (CD) or PDD features, resulting in "relationship difficulty" and "social communication

difficulty," respectively. Greene et al. (1996) compared children with and without ADHD on a "social disability" score that was defined as greater than 1.65 standardized discrepancy score between observed scores on a measure of social functioning and expected scores estimated from the Full Scale IQ. Based on this classification, 22% of children with ADHD qualified as "socially disabled," while none of the typically developing peers did. In addition to social impairment, those children who met criteria for social disability had greater rates of psychiatric comorbidity. The authors concluded that children with ADHD and comorbid social impairment have poorer prognosis and are at a greater risk for adverse outcomes (Greene et al., 1996).

Social problems in children with ADHD have also been reported by teachers (Nolan, Gadow, & Sprafkin, 2001; Gaub & Carlson, 1997). In a study by Gaub and Carlson, teachers were asked to estimate the percentage of children in class who liked, disliked, or ignored a particular child. Results showed that children with ADHD were less popular than their typically developing peers and children with the Combined Type ADHD were more impaired than those with the Predominantly Inattentive Type (Gaub et al., 1997). Bagwell and colleagues used parent and teacher ratings, and self-reports of adolescents with ADHD to assess their peer relationships. Greater rates of peer rejection were reported by parents and teachers, but not the adolescents themselves. Adolescents with ADHD did report, however, that their friends engaged in fewer conventional activities. The study also examined whether persistence of ADHD diagnosis was associated with greater social impairment and showed that adolescents with persistent ADHD had the highest rates of peer rejection and fewer friends, as reported by parents. Both ADHD groups had higher rates of peer rejection compared to those adolescents who had no history of ADHD in childhood (Bagwell et al., 2001).

Inadequate social behaviors in children with ADHD are noted not only by parents and teachers, but also by peers. Given that peer status and popularity have been directly related to prosocial (i.e., positive) interactions and low levels of inappropriate and disruptive behavior (Dodge, Coie, & Brakke, 1982; Parker et al., 1987), it is not surprising that children with ADHD are rejected more often compared to their non-ADHD peers. Thus, results from peer nomination sociometric studies clearly indicate that children with ADHD are rated lower on social preference, are less well liked, have fewer reciprocal friends, and are more likely to be chosen as non-friends by popular peers (Hoza et al., 2005a). As reported by Hoza and colleagues, one in two (52%) children with ADHD from the Multimodal Treatment Study of Children with ADHD had a rejected status (Hoza et al., 2005a). Peer nomination studies report that children with ADHD are disliked after very brief peer interactions (Bickett & Milich, 1990; Erhardt & Hinshaw, 1994d; Erhardt & Hinshaw, 1994c; Erhardt & Hinshaw, 1994b). For example, Pelham and Bender (1982) showed that in the context of peer groups comprised of one child with ADHD and four non-ADHD children, the child with ADHD was consistently the most disliked member as early as the first session. The study also showed that peer rejection was associated with high rates of intrusive, off-task, noncompliant and aggressive behaviors. The limitation of the study was that the investigators did not take into account nonbehavioral factors (e.g., physical attractiveness, academic achievement) that may influence peer status. Erhardt and Hinshaw (1994) compared social behavior of 6-12 year-old boys with and without ADHD, who attended a summer research program. Both prosocial behaviors, such as following rules and compliance, and negative social behaviors, such as noncompliance, aggression and isolation, were measured by live observations of classroom and playground activities. Sociometric measures were obtained by presenting photographs of children to each child and asking “How much would you like to

have this boy as a friend?" Each child was also asked to nominate up to three peers with whom he would most and least like to be friends. The peer status was based on the mean friendship rating score and the proportion scores for positive and negative nominations. Results of the study indicated that children with ADHD showed higher rates of both non-compliant and aggressive behaviors, while rates of prosocial behaviors and social isolation were the same. The study also showed that ADHD boys were rejected as early as the first day of interaction. Importantly, aggression and noncompliance strongly predicted negative nominations over and above non-behavioral factors such as physical attractiveness, intelligence, academic achievement, athletic ability and group status (i.e., ADHD) (Erhardt & Hinshaw, 1994a).

As indicated above, Hodgens and colleagues (2000) also used the peer nominations method to compare children with ADHD, Predominantly Inattentive Type, those with the Combined Type and their typically developing peers. Peer nominations were obtained both from peers in play groups and in the classroom and social preference score was derived as the ratio of positive and negative nominations. Children were also asked which of their classmates were "very shy", "most likely to start fights or arguments for no good reason", "most likely to be teased by others", and "left out". For the play groups, children were asked similar questions after the third play session. Social withdrawal and peer rejection were also rated by trained observers. Results showed that both ADHD groups received lower social preference scores in the classroom compared to their non-ADHD peers. Inattentive children were more likely to be described as shy and displayed more withdrawn behavior, while children with the combined type were described as bossy and aggressive. Interestingly, children with ADHD received lower social preference ratings from their peers in the classroom, but not in play groups (Hodgens et al., 2000).

In a more recent study, Hoza and colleagues (2005) used peer nominations to assess outcomes of children with ADHD following treatment as part of their participation in the Multimodal Treatment Study of Children with ADHD (MTA). Social preference, social impact, and liking scores were computed to assess peer status and popularity. Results of the study indicated that regardless of the type of treatment received (medication management, behavior therapy, or combined treatment) participants continued to have impairment in social relationships, with over half of participants (52%) rejected by their peers and fewer than 1% receiving popular status (Hoza et al., 2005a).

Research also suggests that children with ADHD are less likely to have friendships compared to typically developing peers (Blachman & Hinshaw, 2002; Hoza et al., 2005b). In the study by Hoza and colleagues, 56% of children with ADHD had no reciprocal friends, 33% had one friend, and 9% had two friends compared to 32, 39, and 22% of typically developing children (Hoza et al., 2005b). Another study showed that 76% of third-grade children with ADHD and comorbid conduct problems had no reciprocated friends in class, relative to 42% of children with elevated internalizing and externalizing symptoms (but not ADHD), and 30% of control children (Gresham, MacMillan, Bocian, Ward, & Forness, 1998). Moreover, group differences persisted the following school year. When children with ADHD have friendships, they appear to be less stable and of lower quality (Blachman et al., 2002). Both studies showed that children with ADHD report more negative features in their friendships (i.e., conflict, relational aggression). Blachman and Hinshaw (2002) did not report any differences in positive features of friendships between girls with and without ADHD. In contrast, Heiman reported the lack of positive features of friendship in his predominantly male sample of children with ADHD. The study also reported that only 15% of ADHD children compared to 45% of their typically

developing peers characterized their friendships as “emotionally supportive” (Heiman, 2005). Children with ADHD are more likely to select other children with ADHD (Blachman et al., 2002) as friends and those who select them as friends are likely to have peer problems (Blachman et al., 2002; Hoza et al., 2005b). Parents of children with ADHD are also more likely to disapprove of the child’s friends (Bagwell et al., 2001). Taanila and colleagues (2009) found that adolescents with ADHD reported that they lacked close friends and rated their overall psychological functioning poorer than those without ADHD symptoms. A significantly larger proportion of adolescents with ADHD symptoms reported that they were dissatisfied with their overall life situation (Taanila, Hurtig, Miettunen, Ebeling, & Moilonen, 2009). It has been pointed out that given that children with ADHD tend to underestimate their difficulties, their true friendship impairment may be even greater than what is reported in self-report studies (Mikami, 2010).

Both ADHD and associated social difficulties persist into adolescence and adulthood (Bagwell et al., 2001; Young, Heptinstall, Sonuga-Barke, Chadwick, & Taylor, 2005). It has been proposed that social problems are an important factor in both short and long-term prognosis of children with ADHD (Greene et al., 1996; Greene et al., 1997). As described earlier, Greene and colleagues showed that “social disability”, defined by the discrepancy between observed and expected social functioning, was associated with higher rates of psychiatric disorders, including mood, anxiety, disruptive and substance abuse disorders. Further, social disability predicted later CD and substance abuse after controlling for baseline attention problems, aggressive behavior, mood and conduct disorders (Greene et al., 1997). It appears that the effects of ADHD and social problems are additive; when both are present, the risk for adjustment problems is greater (Hoza et al., 2005b; Mikami et al., 2011). Given the chronic nature of ADHD and the fact that a

substantial portion of the functional impairment associated with ADHD across the lifespan appears to be directly attributable to poor social skills, it has been suggested that social problems are at least partially related to persistence of ADHD (Bagwell et al., 2001).

Several studies have shown that difficulties in peer relationships in childhood have been associated with both concurrent and future "maladjustment" (Bagwell, Newcomb, & Bukowski, 1998). Peer rejection limits opportunity to practice social skills and exacerbates social problems (Hoza, 2007). Problems in social functioning have been regarded as the universal factor for the development of psychological disorder (Biederman, 2005; Johnston & Mash, 2001; Forssman et al., 2009) and have been related to both the onset (Sandberg, Rutter, Pickles, McGuinness, & Angold, 2001) and persistence of psychopathology (Mathijssen, Koot, & Verhulst, 1999).

Similarly, follow-up studies of children with ADHD have shown them to be at elevated risk for adverse outcomes such as antisocial behavior (Satterfield, Swanson, Schell, & Lee, 1994); academic and occupational impairments and dropping out of school (Barkley, 1998); elevated rates of driving accidents (Barkley, Guevremont, Anastopoulos, DuPaul, & Shelton, 1993); and social problems (Weiss & Hechtman, 1993). Since both social problems and ADHD have been associated with poor outcomes, children who have both ADHD and poor social skills may be at particular risk for poor outcomes (Hoza et al., 2005b; Mikami & Hinshaw, 2006).

Hypothesis for Social Impairment in ADHD: Symptoms of ADHD as the Cause of Social Deficits: One hypothesis as to the cause of social impairment in ADHD posits that social dysfunction is inherent to ADHD itself and directly linked to symptoms of ADHD (de Boo & Prins, 2007; McQuade et al., 2008; Hoza, 2007). For example, intrusive behavior has been related to symptoms of impulsivity ("often interrupts or intrudes", "has difficulty waiting turn")

and hyperactivity ("often talks excessively"). Social problems have been shown to correlate with both ratings of hyperactivity (Humphrey, Storch, & Geffken, 2007) and inattention (Andrade, Brodeur, Waschbusch, Stewart, & McGee, 2009). The link between ADHD symptoms and social problems is also supported by differences between the subtypes. As described earlier, although social problems have been described in all subtypes, the Combined Type has been associated with aggression, while the Inattentive Type has been associated with social isolation, based on both peer and adult ratings (Maedgen & Carlson, 2000; Solanto et al., 2009; Hodgens et al., 2000; Hinshaw, 2002). Among sociometric studies, only one (King & Young, 1982) showed that there was no difference in social preference between boys who met criteria for ADHD-Combined and ADHD-Inattentive Type. Studies by Carlson et al. (1987), Lahey et al., (1984) and Gaub and Carlson (1997) showed that children with the Combined Type ADHD were more actively rejected and had more severe social problems. In all studies, children with the Inattentive Type had poorer social skills than control children. Wheeler and Carlson (1994) suggested that children with ADHD Combined Type may have difficulties in social performance, while those with the Inattentive Type have deficits in both social knowledge and social performance. They also proposed that these deficits are mediated by symptoms where impulsivity and hyperactivity may prevent a child with ADHD from effectively using their social knowledge, while in the case of the Inattentive Type, anxiety and disorganization may prevent children from having social interactions, observing social cues, and hence acquiring social knowledge (Wheeler & Carlson, 1994).

A major argument against the notion that social deficits in ADHD are caused by the disorder itself is that treatments for ADHD, while successful at improving symptoms, do not normalize social functioning. In a series a studies, Whalen and colleagues showed that

pharmacological treatment, despite reducing the symptoms and improving non-compliant and disruptive behavior, has limited impact on social skills or peer status (Hinshaw, Henker, Whalen, Erhardt, & Dunnington, Jr., 1989; Whalen et al., 1989; Whalen & Henker, 1991). Even intensive intervention, such as that delivered in the Multimodal Treatment Study of Children with ADHD, does not eliminate social impairment (Hoza et al., 2005a). Although symptom improvement was reported for children in the combined treatment group, no treatment modality normalized social relationships (Hoza et al., 2005a). Further, while ADHD is clearly accompanied by social problems, not all individuals with ADHD demonstrate inadequate social behavior. Thus, social problems are not universal and when present, vary in intensity. These findings suggest that while ADHD symptoms may contribute to the development of social problems, they do not fully account for social impairment associated with the disorder.

Lack of Social Knowledge: Others have hypothesized that social problems in ADHD stem from lack of social knowledge (McQuade et al., 2008; Pfiffner & McBurnett, 1997). Grenell, Glass, and Katz (1987) assessed the knowledge of socially appropriate behavior in boys with ADHD using the Social Knowledge Interview. Performance of social skills with peers was rated by independent judges during free play, a cooperative puzzle task, and a persuasion task. In addition, peers also rated subjects' desirability as partners for work, play, and friendship. The results of the study showed that boys with ADHD had deficits in knowledge of how to maintain relationships and handle interpersonal conflict; they also demonstrated more negative behavior in the cooperative puzzle task than did controls. Hyperactive children also were rated by judges as less likely to achieve academic success than controls and were rated by peers as less desirable potential work partners in school. The authors found significant correlations between social

knowledge and performance with peers and concluded that children with ADHD exhibit deficits both in their social knowledge and in their performance of socially skilled behavior (Grenell et al., 1987).

Maedgen and Carlson (2000) predicted that deficits in social knowledge would be specific for inattentive children, while children with the Combined Type would have deficits in social performance. They used parent and teacher ratings of how children would behave in response to a series of social vignettes. To assess social knowledge and social performance, children were presented with vignettes and asked what they should do and what they typically do in that situation. Social status was based on parent and teacher estimates of how others liked, disliked, or ignored the child. The results indicated that parents and teachers characterized the responses of children with Combined Type as more aggressive than those with Inattentive Type or non-ADHD children. Children with the Combined Type also displayed emotional dysregulation and high rates of both positive and negative behavior compared to the other two groups. In contrast, children with the Inattentive Type were rated as socially passive and showed more deficits in social knowledge. Parents and teachers rated children with Combined Type as less liked and more disliked than typically developing children. There was a trend for inattentive children to perform less well than the control group on a child-rated measure of social knowledge, providing partial support for the hypothesis of greater social knowledge deficits in the inattentive group. At the same time, the study showed that emotional dysregulation and not lack of social knowledge predicted peer-rated social status (Maedgen et al., 2000).

One can reasonably argue that if social difficulties are caused by the lack of social knowledge, social skills training should improve social functioning. However, although social skills training has been found effective for aggressive and antisocial children, findings on the

efficacy of such programs in ADHD have been inconsistent. Some programs have shown positive results as measured by improvement in parent- and teacher-rated behaviors (Pfiffner et al., 1997; Pfiffner, Calzada, & McBurnett, 2000); however, other studies have not found them to be helpful (Landau, Milich, and Diener, 1998; Quinn et al., 1999). As suggested by the outcomes from the MTA study, even such programs in combination with medication or other behavioral techniques do not improve the social status of children with ADHD (Hoza et al., 2005a). The effects of social skills training do not seem to generalize to home and classroom settings (Antshel & Remer, 2003). To date, no long-term benefits of social skills training have been established in ADHD (Beelman, Pfingsten, & Lösel, 1994). In a recent review of ADHD treatments on social skills, post-medication reduction of symptoms, although modest, was the strongest predictor of social skills improvement (de Boo et al., 2007). Two other studies also showed that social skills training did not improve social skills above and beyond stimulant medication (Abikoff et al., 2004). These findings suggest that improving social skills knowledge is difficult to implement in complex environments and is not particularly effective for improving social functioning in ADHD, as such, it is not likely to be the major cause of social impairment in ADHD. Wheeler and Carlson (1994) argued that perhaps children with ADHD do not benefit from social skills training the same way as other children do because their deficits come not from lack of social knowledge, but from their ability to perform appropriate social skills when needed. In a similar vein, two recent reviews attributed social deficits in ADHD to a performance deficit rather than a knowledge deficit (de Boo et al., 2007; Huang-Pollock et al., 2009).

Neuropsychological Deficits and Social Impairment: Social problems in ADHD have also been linked to neuropsychological deficits, particularly in behavioral inhibition and executive functioning (Barkley, 1997). This is not surprising given that executive deficits have been

described in ADHD and associated with real-world impairment (Nigg & Casey, 2005). According to this theory, children with ADHD have problems in social interactions because they have difficulty inhibiting responses and regulating emotions. Barkley argued that children need to inhibit their responses long enough to consider that someone else's perspective is different from their own and to understand the emotional experience of another person (Barkley, 2006 in (Marton, Wiener, Rogers, Moore, & Tannock, 2009). Thus, children with ADHD may have social knowledge, but are unable to apply it properly. Although executive deficits have been well documented in ADHD (Seidman, 2006), findings from studies examining the relationship between neuropsychological and social deficits have been inconsistent. In one of their earlier studies, Nigg and colleagues (1999) showed that children's performance on executive tasks of mental inhibitory control and verbal fluency was associated with teacher-rated social competence two years later. The association remained independent of the initial social competence. Further, general IQ, visual spatial and reading ability did not produce similar effects, suggesting that the association with social functioning was specific for executive abilities (Nigg, Quamma, Greenberg, & Kusche, 1999). Similarly, executive problems predicted adult-rated socialization problems on the Vineland Adaptive Behavior Scales (Clark, Prior, & Kinsella, 2002).

In a study by Diamantopoulou and colleagues, executive functioning deficits were associated with poor peer nominations above and beyond ADHD symptoms a year later (Diamantopoulou, Rydell, Thorell, & Bohlin, 2007); however, executive functioning did not predict social status independently of ADHD. The study also reported interactive effects of ADHD and executive functions. Similarly, Biederman and colleagues (2004) found that children with ADHD with and without executive functioning deficits did not differ in social problems as rated by parents (Biederman et al., 2004).

There is some evidence suggesting an association between social functioning and working memory. For example, a significant correlation between working memory deficits and social problems in preschool children was reported (Alloway, 2005). Another experimental study showed that increased working memory demands were associated with disruption in one's ability to interpret nonverbal social and emotional cues in others (Phillips et al., 2007).

Huang-Pollock and colleagues (2009) examined the relation between executive functions and social adjustment in ADHD by using both parent and teacher ratings, as well as direct observations during a "chat room" task. They also examined whether there were any subtype differences. Their findings showed that executive function did not mediate the relationship between ADHD and social impairment based on parents and teacher ratings. In addition, executive deficits did not predict peer-rated social preference (Huang-Pollock et al., 2009).

Conflicting findings regarding the relation between executive dysfunction and social problems may in part be explained by heterogeneity of executive functions and differences in assessment techniques. Further, in recent years, the specificity of executive deficits in ADHD has been challenged leaving room for other cognitive deficits to contribute to social impairment in ADHD (Nigg, 2005). Lambek and colleagues (2010) showed that when a comprehensive battery of executive functions was used, only half of children with ADHD show executive dysfunction (Lambek et al., 2010). Deficits in other neuropsychological domains, such as processing speed (Shanahan et al., 2006) and naming speed (Rucklidge & Tannock, 2002) have also been described. Conversely, executive deficits are not unique to ADHD (Sergeant, 2000). Given the inconsistency in findings, it appears that executive dysfunction is likely not the sole cause of social impairment in ADHD.

Social Information Processing Deficits and Social Impairment: Finally, social problems in children with ADHD have been discussed in the context of the social information processing model (Crick and Dodge, 1994). Based on this model, social information processing consists of several components, including interpreting social cues, setting a goal, evaluating responses and selecting the optimal response. Deficits in any one of these processes can result in socially inappropriate behavior; for example, failure to attend to and represent social events, which is conceptually the most powerful stage, will lead to processing deficits and subsequently to maladaptive social responses.

A study by Matthys and colleagues (1999) provided some evidence supporting a social processing deficit in ADHD. The investigators asked children to respond to videotapes of problematic social interactions. The results of the study showed that children with ADHD, both with and without comorbid Oppositional Defiant Disorder and Conduct Disorder, display social problem solving deficits. More specifically, children with ADHD encoded fewer social cues and generated fewer possible solutions. Children with ADHD and comorbid ODD/CD also demonstrated deficits in response selection and were more likely to select an aggressive response (Matthys, Cuperus, & Van, 1999). Another group of researchers compared nonverbal (affect) processing abilities of children with ADHD, CD with and without ADHD, and typically developing children by having them interpret emotional cues from pictures of facial expressions and voice recordings. The study showed that both children with ADHD and CD were less accurate in interpreting emotions than were their typically developing peers. Further, children with ADHD and CD differed in the type of errors that they made: while children with CD tended to misinterpret emotions as anger, children with ADHD appeared to make random errors suggesting that their misattributions may be due to poor attending to social cues rather than

misinterpretations of those cues. An interesting finding from the study was that children with ADHD and comorbid CD performed as accurately as controls and showed a pattern of errors that was distinct from both children with ADHD and CD (Cadesky, Mota, & Schachar, 2000).

Children with ADHD also have been found to have difficulty integrating relevant social information (Milch-Reich, Campbell, Pelham, Jr., Connelly, & Geva, 1999). These findings suggest that children with ADHD may have a unique pattern of impairment in social information processing.

Social problems are highly common in ADHD and are increasingly seen as an important associated feature of the disorder. Impairment in social functioning has been reported by parents, teachers and peers, and documented as early as the preschool years. Children with ADHD are rated lower on social preference, have fewer reciprocated friendships, and are more often disliked by their peers, as soon as the first day or even within 20 minutes of the social interaction. Peer rejection in turn has been associated with negative long-term outcomes including substance abuse, school dropout, delinquency, academic problems, and higher rates of psychopathology. Further, rejection limits a child's opportunity to practice social skills and as such exacerbates social problems. Importantly, social problems are not limited to childhood and account for difficulties (e.g., frequent job loss and increased divorce rates) in adults with ADHD.

Social problems in ADHD have primarily been attributed to impulsivity (e.g., interrupting, difficulty waiting turn) and inattention (e.g., not listening), as well as to specific comorbid problems (e.g., oppositional behavior or anxiety). In addition, social impairment has been related to lack of social knowledge, neuropsychological, and social information processing deficits. Findings in support for these explanations, however, have been inconsistent. Thus, existing treatments for ADHD, although helpful in treating core symptoms, have limited

effectiveness at improving social skills, suggesting that social deficits are not fully explained by the disorder. While some studies show effectiveness of social skills training programs in children with ADHD, generalization beyond the treatment setting is limited, suggesting that lack of social knowledge does not fully account for the social impairment.

Chapter II. ADHD and Language Impairment

Multiple studies indicate high comorbidity between ADHD and language problems (Baird, Stevenson, & Williams, 2000; Bruce, Thernlund, & Nettelbladt, 2006; Kadesjo & Gillberg, 2001; Kadesjo et al., 2001; Tirosh & Cohen, 1998). ADHD has been found to be the most common psychiatric disorder in children with language disorders (Beitchman, Nair, Clegg, Ferguson, & Patel, 1986; Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996; Beitchman et al., 2001; Biederman, Newcorn, & Sprich, 1991; Cohen et al., 1998; Cohen, Davine, Horodezky, Lipsett, & Isaacson, 1993). For example, Cohen and colleagues (1998) reported that 46% of child psychiatric outpatients with language impairment had the diagnosis of ADHD. In another study, as many as two thirds of children referred to speech and language clinics had a diagnosis of ADHD (Love & Thompson, 1988). Children with language disorders are more likely to be diagnosed with ADHD than those without language disorders (McGrath et al., 2008) and are rated by parents and teachers as having more severe attention problems (Tirosh et al., 1998).

Conversely, children with ADHD have high rates of communication/language disorders (Cohen et al., 1998; Love et al., 1988; Beitchman, Tuckett, & Batth, 1987), with nearly half experiencing language problems (Tirosh et al., 1998). The reported rates of comorbidity between language impairment and ADHD range from 8 to 90%, with most studies suggesting an overlap of between 40 and 60%. Only one study has not found significant comorbidity between language impairment and ADHD, but showed that a higher incidence of behavior problems in children with language impairment was due to lower IQ rather than a linguistic deficit per se (Benasich, Curtiss, & Tallal, 1993). Due to their high rate of co-occurrence, it has been proposed that language impairment could be the cause of social problems in children with ADHD (Cohen et al., 1998).

Children with ADHD have been shown to have a later onset of talking (Hartsough & Lambert, 1985; Szatmari, Offord, & Boyle, 1989). Reports of specific language deficits in ADHD have been inconsistent. Some studies suggest that language impairment is more common than speech disorder in children with ADHD (Damico, Damico, & Armstrong, 1999). However, Barkley, Cunningham, and Karlsson (1983) reported that children with ADHD have speech impairment as well. These investigators compared verbal interactions of hyperactive and typically developing boys with their mothers. In the first study, they showed that both hyperactive boys and their mothers used more utterances than typical mother-child pairs during free play, but not task-related activities; however, the ratio of mother's to child's level of language complexity was smaller for hyperactive boys. In the second study, the researchers examined the effects of methylphenidate on language and showed that treatment was associated with the decline in frequency, but not complexity, of language both in the hyperactive boys and their mothers (Barkley et al., 1983).

Mathers (2005) applied discourse analysis to spoken and written language samples of children with ADHD and their typically developing peers. The study reported that children with ADHD had grammatical impairments in written, but not spoken language (Mathers, 2005). However, in a follow up study differences both in spoken and written language were found (Mathers, 2006). Children with ADHD have also been shown to be less mature in their spontaneous private speech (Berk & Potts, 1991) and have poorer narrative skills (Renz et al., 2003).

Some studies reported that children with ADHD are more likely to have problems in expressive but not receptive language (Barkley et al., 1990; Munir, Biederman, & Knee, 1987). However, Baker and Cantwell (1982) reported that children with ADD had both speech

articulation (78%) and language impairments. Out of those with language impairment, 58% had impairment in expressive language, 34% in receptive language, and 69% had impairment in language processing (auditory memory, discrimination, or association).

A substantial proportion of children with ADHD meet criteria for a reading disability (August & Garfinkel, 1990; Dykman & Ackerman, 1991; Faraone et al., 1993; Lambert & Sandoval, 1980; Semrud-Clikeman et al., 1992; Kadesjo et al., 2001), particularly those with the Inattentive Type (Willcutt & Pennington, 2000), which in turn is associated with language impairments (Lapadat, 1991). McGrath and colleagues (2011) tested a multiple cognitive deficit model of ADHD, reading disability (RD), and their comorbidity. The unique predictors of RD were phonological processing and naming speed, while response inhibition emerged as the single unique predictor of ADHD. Processing speed was the shared predictor of ADHD and RD, accounting for comorbidity (McGrath et al., 2011).

Beitchman, Tuckett, and Batth (1987) showed that children with ADHD and comorbid language impairment performed worse on a measure of receptive language compared to children with ADHD with normal language. Similarly, Purvis and Tannock (1995) compared children with ADHD, reading disability (RD), ADHD + RD, and typically developing children to find that children with ADHD demonstrated deficits in organizing their storytelling while children with RD showed receptive and expressive language deficits. The authors concluded that such specific deficit displayed by children with ADHD was consistent with executive deficits (Purvis & Tannock, 1997). However, another study that compared children with ADHD, Specific Language Impairment (SLI) ADHD and developmental language disorder (ADHD + DLD) and comparison children on episodic coherence of oral narratives showed that only children with SLI

and ADHD+DLD showed poorly organized narratives, while performance of children with ADHD only was similar to that of typically developing children (Luo & Timler, 2008).

It appears that the effects of ADHD and language impairment are additive. Several studies have shown that children with ADHD and language impairment perform worse on measures of academic achievement and cognitive functioning in general in comparison to typically developing controls, children with ADHD only, and children with other psychiatric disorders and language impairment (Cohen et al., 2000). In a similar vein, Giddan and colleagues (1991) showed that children with speech, language, or pragmatic difficulties and comorbid attention problems and hyperactivity are at a double risk for adverse outcomes.

Some have argued that behavioral difficulties associated with ADHD may interfere with performance on language assessments and mimic language disorders (Oram, Fine, Okamoto, & Tannock, 1999). Conversely, language difficulties are often misattributed to inattention (Redmond, Thompson, & Goldstein, 2011). Recently several studies compared performance of children with ADHD vs. SLI with somewhat mixed findings. In a series of studies Redmond and colleagues examined the differences in conversational and psycholinguistic profiles of children with SLI and ADHD. Their research showed that both children with SLI and ADHD performed poorer on sentence recall compared to typically developing children; however, only children with SLI had difficulty with past-tense marking of regular and irregular verbs (Redmond, 2005). Children with ADHD also performed similarly to typically developing children on measures of lexical diversity and morpho-syntactic development (grammar use) (Redmond, 2004). In a more recent study, Redmond, Thompson, and Goldstein (2011) investigated whether tense marking, non-word repetition, sentence recall and narrative could contribute to the differential diagnosis of developmental language disorder and ADHD. The results showed that children with SLI

performed more poorly on all measures, while performance of children with ADHD was similar to that of typically developing controls (Redmond et al., 2011). In addition, results showed that all measures could differentiate children with SLI from typically developing peers, as well as children with SLI and ADHD, although the sensitivity was stronger when distinguishing children with SLI from typically developing comparison children. However, comparison of conversational profiles of children with ADHD, SLI, and typical children showed that children with ADHD performed more poorly compared to typically developing children and similarly to children with SLI. Overall, these findings suggested that children with ADHD show more impairment in oral than written language, which the authors interpreted as a performance, rather than a knowledge, deficit.

The overlap between attention and language problems has been discussed for over two decades. In 1989, Tallal, Dukette, and Curtiss showed significant correlations between language, attention problems, and motor delays in a sample of preschool children with language impairment. It was concluded that perceptual and motor delays explained both attention and language problems. Similar findings of overlap between attention and language problems (59%) were reported by Beitchman et al. (1989). Cardy, Tannock, Johnson, and Johnson (2010) also showed that both children with ADHD and SLI were slowed on auditory repetition and processing tasks compared to other children. Overlap between attention and language difficulties suggests that both could be caused by a broader delay in neurodevelopment (Cardy, Tannock, Johnson, & Johnson, 2010).

It has been proposed that developmental disorders with language impairment, such as autism, SLI, and ADHD might represent a continuum of “defective time parsing mechanisms” or various cognitive processes involved in breaking down and analysis of both linguistic and non-

linguistic information (Boucher, 2000). According to this hypothesis, differences in clinical symptoms and manifestations seen among these clinical populations represent differences in severity of underlying temporal processing mechanisms rather than different diagnostic categories.

Language problems are common in ADHD, reportedly occurring in nearly half of children with the disorder. Conversely, ADHD is the most common psychiatric diagnosis in children with language disorders. A wide range of specific difficulties has been described in ADHD, including impairment in oral and written, receptive and expressive language. Reading disability is a common comorbidity in ADHD. It appears that children with ADHD and language disorders are at a "double risk" for adverse outcomes and are much more likely to have academic and cognitive difficulties. Given the overlap between attention and problems, it has been suggested that both reflect a broader neurodevelopmental delay (Cardy, Tannock, Johnson, & Johnson, 2010).

Chapter III. Language deficits and social impairment

There are a host of studies suggesting that language impairment is associated with negative outcomes. Language difficulties in children are common, with about 6% of children experiencing language problems (Law, Garrett, & Nye, 2003). Findings regarding long-term outcomes for these children are inconsistent. Some studies of preschoolers with expressive language delays reported that their vocabulary normalizes by the age of five years (Rescorla & Schwartz, 1990) and they are at no greater risk for reading difficulties by the age of eight (Stevenson & Richman, 1976; Silva, McGee, & Williams, 1982). There is also evidence that many children with early language problems present with age-appropriate language skills by the time they enter school (Dale, Price, Bishop, & Plomin, 2003; Paul, Murray, Clancy, & Andrews, 1997). However, other studies indicate less favorable outcomes. For example, Bishop and Edmundson (1987) showed that 87% of children with early language difficulties were experiencing problems at school entry. In another study, Bishop and Adams (1990) reported that children whose language difficulties resolved by age five developed normally, whereas those who still had difficulties at age five had persisting language difficulties and reading problems at age eight (Bishop & Adams, 1990). Two other studies showed that as children grow older and as school demands increase, their language difficulties also become more pronounced (Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998; Davison & Howlin, 1997).

Language and verbal behavior are important in children's social development, as children rely on language to share information, express feelings and direct their behavior (Barkley et al., 1983; Mathers, 2006); thus, it is not surprising (and indeed is well-documented (Aram, Ekelman, & Nation, 1984) that many children with language difficulties experience social problems.

In a series of studies, Beitchman and colleagues showed that children with speech/language impairments are at increased risk for psychiatric disorders, particularly ADHD (Beitchman et al., 1986; Beitchman et al., 1986). Children with language difficulties seem to be at a greater risk for psychiatric disorders than those with speech and articulation problems (Baker & Cantwell, 1982). One longitudinal study reported that children with receptive language (comprehension) problems had a particularly poor prognosis at a seven-year follow-up (Beitchman et al., 1996). In a 15-year follow-up study of children with well-documented language abilities, persistence of language impairment was associated with both attention and social difficulties, while participants whose language deficits resolved by age 5.5 years, had a good outcome (Snowling, Bishop, Stothard, Chipchase, & Kaplan, 2006). Different language difficulties were independently associated with different areas of impairment. Thus, children with attention problems had expressive language difficulties, those with social impairment displayed both receptive and expressive language difficulties, and those with both attention problems and social impairment had low IQ and global language impairment (Snowling et al., 2006).

Glogowska and colleagues (2006) compared the outcomes of children who were referred to and prioritized for speech therapy, those who were referred to but not prioritized for speech therapy, and children without speech and language difficulties who had never been referred for speech therapy. Children were compared on measures of language and literacy, as well as parent and teacher ratings of educational and social outcomes. The study reported that although the scores of many children were within the normal range, 38% of children prioritized for speech therapy showed language impairment compared to 16% from the non-prioritized group and 8%

of controls. In addition, both parents and teachers reported greater social difficulties in children with language problems (Glogowska et al., 2006).

In a series of studies, Brinton and Fujiki showed that children with language impairment have difficulties in various social settings; they are excluded from group work in the classroom and at recess and have difficulty making friends (Brinton, Fujiki, Montague, & Hanton, 2000; Fujiki, Brinton, Isaacson, & Summers, 2001; Fujiki, Brinton, Hart, & Fitzgerald, 1999). Children with language impairment tend to be reticent both as toddlers and as they grow older, and have difficulty initiating interactions with peers. When involved in an interaction, they tend to be unresponsive and are not fully integrated in work or play and do not participate in negotiation (Brinton, Fujiki, & McKee, 1998; Grove, Conti-Ramsden, & Donlan, 1993). A recent follow-up study of five girls with early language impairment showed that eight years later four out of five had a variety of academic, behavioral and social problems and experienced social isolation based on parent-, teacher-, or self-report. Only one out of four participants who completed the follow-up assessment performed within the normal range on a measure of language. The fifth participant did not complete the assessment due to school expulsion for violent behavior (Brinton, Fujiki, & Baldridge, 2010). These findings also suggest that children with severe language impairments continue to experience significant difficulties in various domains of their lives, including socialization.

A series of studies by Rice and colleagues (1991) showed that children with speech and language problems interact differently with their peers. They compared children with language impairment, speech impairment, those for whom English is a second language (ESL), and typically developing children and showed that even preschoolers are aware of communication abilities of their peers and prefer to interact with children who have typically developing skills.

Children with both speech and language impairment preferred to interact with adults. Children with ESL were least preferred and least likely to initiate conversations (Rice, Sell, & Hadley, 1991).

Cohen and colleagues (1998) compared children with psychiatric problems who did and did not have comorbid language difficulties and showed that those with language impairment experienced greater difficulties in social processing (understanding emotional expression and social problem solving) compared to children with normal development (Cohen et al., 1998).

Although language impairment appears to be primarily associated with ADHD and internalizing disorders (Beitchman et al., 1986), it has also been reported in populations with conduct problems (Cohen et al., 1998). High rates of language impairment have also been reported among adolescents in treatment for conduct problems (Giddan, Milling, & Campbell, 1996) and those incarcerated (Davis, Sanger, & Morris-Friehe, 1991).

Brownlie et al. (2004) examined antisocial outcomes of a community sample of children with early speech and language impairment. The study reported that boys diagnosed with language problems at age five had high levels of parent-rated delinquent behaviors by age 19, as well as higher rates of arrests and convictions. The effect remained after controlling for verbal IQ, demographic and family variables. Language impairment was not related to aggression or delinquency in girls. The authors concluded that language skills are essential to "navigating social life" and affect children's experiences in various contexts. The authors further argued that behavioral difficulties, including delinquent behavior, may be children's way of dealing with the situation when their language resources are not sufficient. By engaging in delinquent behavior children may obtain social status that they cannot achieve through language (Brownlie et al., 2004).

Most outcomes studies of language impairment have been conducted with children with SLI characterized by impairment in language in the absence of hearing, neurological, and nonverbal cognitive problems (Bishop et al., 1990). SLI has been associated with behavioral, emotional, and social difficulties, referred to as BESD (Beitchman, Hood, Rochon, & Peterson, 1989; Cantwell, 1996; Cantwell, Baker, & Mattison, 1981; St Clair, Pickles, Durkin, & Conti-Ramsden, 2011). Multiple studies showed that children and adolescents with SLI experience social difficulties (Lindsay, Dockrell, & Strand, 2007; Beitchman et al., 1989; Benasich et al., 1993). They tend to be withdrawn, have difficulty relating to peers (Gertner, Rice, & Hadley, 1994), poor quality of friendships (Durkin & Conti-Ramsden, 2007), and are at risk for victimization (Conti-Ramsden & Botting, 2004). Durkin and Conti-Ramsden found that receptive language skills at age seven predict quality of friendship at age 16. Gertner, Rice and Hadley (1994) showed that children with SLI were less likely to be nominated as friends by peers compared to children with typical communication skills. Craig and Washington (1993) showed that children with SLI have difficulty performing basic social tasks, such as joining social interactions.

Fujiki et al. (1996) examined teacher-rated social skills and quality of friendships of children with and without SLI. Not surprisingly, children with SLI were rated as having poorer social skills. In addition, they made fewer social contacts in common activities, such as board games, sports, or lunch. The study also reported that children with SLI were not satisfied with their social interactions (Fujiki, Brinton, & Todd, 1996).

Persisting language difficulties are associated with persisting social problems. One longitudinal study of individuals with early language problems reported that participants experienced social impairment in various domains in their early thirties (Rutter & Mawhood,

1991 in Brownlie et al., 2004). Similarly, social problems in individuals with SLI persist into adulthood. Clegg et al. (2005) followed a sample of children with SLI into adulthood and showed that in their mid-thirties, more than half of the sample had a limited range of social relationships and less than a third had been married or in a relationship. The findings described above suggest that not only are language difficulties associated with impaired social functioning, but for many individuals the difficulties persist well into adulthood (Clegg et al., 2005).

There is abundant evidence indicating negative outcomes associated with language impairment. Although some studies suggest normalization of language skills by school age, others indicate that early language problems are likely to persist. Findings from longitudinal studies of children with early language problems show that these children develop attention and social difficulties, and higher rates of psychiatric diagnoses. Behavioral, social, and emotional problems have been described in children with SLI. Children with psychiatric problems and comorbid language difficulties have more social problems than those with normal language development. Language problems have also been associated with adverse outcomes due to their comorbidity with ADHD, internalizing, and externalizing disorders. Behavioral difficulties and delinquent behavior are common in youth with language problems. Importantly, persisting language difficulties are associated with persisting social problems.

Chapter IV. Pragmatic deficits and social impairment

Pragmatics is defined as the appropriate use and interpretation of language in relation to the context in which it occurs (Tannock & Schacher, 1996 in Geurts et al., 2004). It has also been described as the social use of language (Prutting et al., 1987). Pragmatics is the domain of language that is concerned with how the other aspects of language (phonology, semantic, morphology, and syntax) are used in conversational contexts (Camarata & Gibson, 1999), and how verbal (language) and non-verbal (gestures) means are used to communicate (Rapin, 1996). Pragmatics is generally considered to be a heterogeneous construct and includes a broad array of skills. For example, Russell (2007) distinguished 16 domains of pragmatic competence, ranging from topic control to nonliteral language to theory of mind. Another classification divides pragmatics into three separate domains: discourse management (skills to initiate, maintain, and end a conversation), communicative intent (commenting, informing, or requesting) that can be expressed directly or indirectly, and presupposition (making assumptions about the conversational partner and the specific social context, theory of mind) (Landa, 2005). Specific pragmatic abilities emerge at different points in development and all contribute to effective communication (Russell, 2007). Moreover, individual pragmatic domains must be integrated with the other domains in order to achieve pragmatic competence.

Pragmatic deficits refer to any disruptions in communication that are not due to structural aspects of language (i.e., phonology, semantics, morphology, and syntax) (Camarata & Gibson, 1999). One example is failing to maintain eye contact; while it would not affect structural aspects of language, it would likely disrupt the communication. Prutting and Kirchner (1987) discuss pragmatic deficits in the context of three areas, all of which are important for “conversational competence”. Verbal aspects of pragmatics are actual linguistic behaviors that include word

selection, stylistic variation, topic maintenance, etc. Paralinguistic aspects or "mechanisms of speaking" include intelligibility, fluency, and prosody, among some examples. Although related to phonology, these would be considered pragmatic and not phonological deficits when they affect the conversational exchange. Finally, non-verbal aspects of pragmatics include physical proximity, gestures, eye contact, etc. (Prutting et al., 1987). An example of a nonverbal pragmatic deficit would be standing too close to the conversation partner.

Expressive and receptive difficulties and pragmatic deficits can occur together or independently from each other. General language ability is typically correlated with pragmatic skills. For example, Astington and Jenkins (1999) showed that early language skills predicted later theory of mind abilities; however, early theory of mind abilities did not predict later language skills, indicating that language is crucial for the development of theory of mind (Astington & Jenkins, 1999). Further, although SLI is primarily characterized by structural language impairment, many children with SLI experience pragmatic language problems. For example, they have been described as violating turn-taking conventions and unable to carry a conversation effectively (Ketelaars, Cuperus, Jansonius, & Verhoeven, 2009; Osman, Shohdi, & Aziz, 2011).

Pragmatic deficits can also occur independently of general language delays or impairment. Several researchers have described a subgroup of children within the population of developmental language disorders whose primary difficulties are related to the use of language in social contexts and cannot be accounted for by general language problems (Bishop, Chan, Adams, Hartley, & Weir, 2000; Willcox & Mogford-Bevan, 1995). Bishop (2000) called such pattern "pragmatic language impairment" (PLI); it has also been referred to as "semantic-pragmatic language disorder". Disproportionate impairment in pragmatics can be observed in

cases of Asperger syndrome (Bishop & Baird, 2001). Children with PLI can be verbose, have poor turn-taking skills, and can have difficulty staying on topic and developing conversational skills. Impaired pragmatic language has also been shown to contribute to impairments in school functioning/performance, peer relationships, and overall psychiatric adjustment (Russell, 2007). Pragmatic difficulties have been associated with many developmental and psychiatric disorders, including autism spectrum, externalizing and internalizing disorders (Russell & Grizzle, 2008).

Communication skills are essential for normal social interactions. Both communication and social difficulties are a core deficit in autism, which is associated with impairment in various areas of functioning (American Psychiatric Association, 2000; Rapin, 1996). Pragmatic and social deficits are also found in children with developmental language delays and specific language impairment (SLI) in the absence of autism (Botting & Conti-Ramsden, 1999).Children with general language problems and pragmatic difficulties are particularly vulnerable to social difficulties (Bishop et al., 2000).

Whitehouse and colleagues examined the outcomes of children diagnosed with SLI, PLI, and autism. Results of one of their studies showed that language impairment profiles persisted into adulthood such that children with PLI had primarily pragmatic deficits at follow up, while children with SLI had primarily impairment in structural language and literacy and less pronounced pragmatic deficits. Not surprisingly, children with autism had a combination of pragmatic and structural language difficulties (Whitehouse, Watt, Line, & Bishop, 2009). Results of a second study showed that although adults with ASD had most social impairment, those with PLI had more difficulty establishing and maintaining both friendships and romantic relationships than those with SLI. The authors concluded that pragmatic deficits are more likely to be an obstacle in social relationships than structural language problems.

Conti-Ramsden and Botting (2004) showed that children with SLI had poor social competence at four-year follow-up, with 36% of children with SLI being at risk for victimization compared to 12% of typically developing children. The study also found that of different linguistic abilities, pragmatic language difficulties as measured on the Children's Communication Checklist, Second Edition were related to poor social outcomes and victimization (Conti-Ramsden et al., 2004). General language abilities were not related to social outcomes.

Another recent follow up study of adolescents with SLI showed an increase in social problems even though rates of behavioral problems decreased (St Clair et al., 2011). Moreover, different language abilities were independently associated with different outcomes. More specifically, reading skills and expressive language abilities were associated with behavioral problems only, while pragmatic abilities were related to behavioral, emotional, and social difficulties. The authors suggested that problematic behaviors may be a consequence of comprehension and communication difficulties. They further posited that pragmatic skills can be particularly important in adolescence. As part of socialization, talk with peers increases from childhood to adolescence and pragmatic skills, such as the ability to appreciate humor and make inferences, become even more relevant when the ability to "tune in" with peers is so important (St Clair et al., 2011).

To summarize, pragmatics refers to the social use of language. It includes a wide range of verbal and non-verbal skills that can be divided into separate domains (e.g., discourse management, presupposition, and narrative discourse). Although general language ability is typically correlated with pragmatic skills, pragmatic deficits can occur in the absence of general language problems. Pragmatic skills are an important part of social cognition and social

processing which in turn are important in social relations. Impairment in pragmatic language has been shown to contribute to problems in school functioning/performance, peer relationships and overall psychiatric adjustment, and is associated with many psychiatric disorders. Pragmatic language impairment can persist into adulthood continuing to affect multiple areas of functioning. including social outcomes. Although pragmatic impairment has been primarily studied in individuals with autism and SLI, there is evidence of pragmatic deficits in other behavioral disorders, including ADHD (see Chapter 5).

Chapter V. ADHD and Pragmatic Deficits

Several studies have reported pragmatic deficits in ADHD (Giddan, 1991; Westby & Cutler, 1994 in Heyer, 1995). Given that efficient communication requires the ability to initiate, respond, and maintain sufficient attention, it is not surprising that several symptoms of ADHD are potentially related to pragmatic deficits (e.g., does not listen, interrupts others, has difficulty awaiting turn) (Westby & Watson, 2004). Camarata and Gibson (1999) reviewed ADHD symptoms and pragmatic skills and discussed how from the pragmatic perspective both inattention and hyperactivity/impulsivity can interfere with communication (Camarata & Gibson, 1999). Examples of inattentive behaviors that can disrupt communication are "has difficulty sustaining attention", "easily distracted", "does not seem to listen when spoken to directly." When it comes to hyperactive behaviors, talking excessively, blurting out answers, and interrupting others can be conceptualized as pragmatic deficits. As discussed by Camarata and Gibson, in addition to disrupting the conversational exchange, these difficulties can interfere with language learning. More specifically, inattentive behaviors are more likely to interact with verbal aspects of pragmatics; for example, inattention is likely to affect one's ability to stay on topic. Hyperactive and impulsive behaviors are more likely to affect both verbal and non-verbal aspects of communication. For example, talking excessively can also affect topic maintenance, and fidgeting and being "on the go" are likely to result in inappropriate physical proximity. After reviewing symptoms of ADHD and pragmatic skills, Camarata and Gibson concluded that pragmatic aspects of language "may be particularly vulnerable to disruption" in children with ADHD (Camarata & Gibson, 1999). Baird, Stevenson, and Williams (2000) have argued that the development of attentional and language systems are not independent from each other and

proposed that communication deficits may be a factor in the underlying cause of ADHD (Baird et al., 2000).

Observations of children with ADHD reveal numerous behaviors suggesting pragmatic deficits. Thus, children with ADHD are described to begin conversations at awkward moments, switch topics, and not adapt the message to the listener (Landau, Milich, & Diener, 1998). Baker and Cantwell (1982) reported that children with ADHD were "dysfluent" and wandered off topic in conversations. Ludlow, Rapoport, Bassich, and Mikkelson (1978) used language sampling and linguistic analysis, as well as standardized language testing, to evaluate language abilities of children with and without ADHD. They showed that the performance of children with ADHD on language tests, although within the normal range, was overall lower than that of typically developing children. There was no difference in language complexity (the number of utterances); however, children with ADHD produced shorter stories and showed more off-task speech and behavior. Interestingly, many measures of language performance were related to age for ADHD participants, but not for typically developing children. The authors suggested that "the younger hyperactive subjects were delayed in their use of complex linguistic structures in their spontaneous speech" (Ludlow et al., 1978). Barkley and colleagues (1983) also showed that children with ADHD use shorter utterances, talk excessively and are unable to modify language to specific demands of the task at hand.

Several studies have described pragmatic language impairment in children with ADHD. Kim and Kaiser (2000) compared children with and without ADHD on their semantic, syntactic, and pragmatic language skills. Pragmatic language was assessed using the Test of Pragmatic Language (TOPL; Phelps-Terasaki & Phelps-Gunn, 1992). In addition, children were observed during a free-play conversation with an adult and their language samples were analyzed using the

Pragmatic Protocol (Prutting et al., 1987). The data indicated that children with ADHD showed impairment at the level of pragmatics rather than vocabulary or grammatical acquisition compared to typically developing peers (Kim & Kaiser, 2000). With respect to pragmatic abilities, differences emerged in pragmatic performance in conversational interactions (i.e., children with ADHD produced more inappropriate pragmatic behaviors: they were not coherent, did not respond to questions, interrupted, and provided less feedback to the speaker), but not in pragmatic knowledge as assessed using a standardized test (Kim & Kaiser, 2000). Children with ADHD also performed lower on the sentence imitation and word articulation subtests. The researchers argued that children with ADHD may have more pragmatic performance deficits as opposed to pragmatic knowledge. Consistent with Barkley's theory (1997), they may know how to communicate properly, but have difficulty when they are required to produce their own responses in social situations (Kim & Kaiser, 2000).

Pragmatic deficits in ADHD have been reported by caregivers. Bruce et al. (2006) obtained parental reports across several problems areas, including speech, language, and communication in a sample of children with ADHD and found that the majority of children had pragmatic deficits. Further, parents of children with ADHD rated comprehension and communication problems three times as high as expressive language problems. Not surprisingly, items reflecting comprehension difficulties overlapped with the domain of Learning whereas those reflecting pragmatic difficulties appeared in the domain of Social Skills. More than two thirds of children who experienced problems with language also had problems with learning and half experienced problems with social skills. Only one fourth of children with social problems had no language or learning difficulties (Bruce et al., 2006).

Humphries, Koltun, Malone and Roberts (1994) compared children with attention problems, learning disabilities and their typically developing peers on teacher ratings of language skills. The study showed that teachers rated children with attention problems as having significantly more pragmatic language problems, such as difficulty in maintaining a conversation. Children with attention problems also had more receptive and expressive language problems compared to controls, but not compared to those with learning disabilities (Humphries, Koltun, Malone, & Roberts, 1994).

Several studies used the Children's Communication Checklist (CCC; (Bishop, 1998) to compare language profiles of children with ADHD, Autistic Spectrum Disorders (ASD) and typically developing controls. In the first study, Bishop and Baird (2001) showed that not only did children with ADHD have pragmatic language problems (e.g., showed more stereotyped conversations, had problems maintaining rapport), but strikingly, children with ADHD hardly differed from those with (ASD). These findings were replicated in two studies by Geurts and colleagues (2004), although they found that pragmatic difficulties in children with ADHD were less profound that those observed in children with ASD. Children with ADHD showed as many problems as children with High Functioning Autism on the Inappropriate Initiation and Social Relationship scales. More recently (2008), using the Children's Communication Checklist-2 (CCC-2, Bishop, 2003), Geurts and Embrechts replicated earlier findings and showed that children with ADHD performed similarly to those with ASD and had significant communication difficulties compared to typically developing children. However, children with ASD had more difficulties on the use of context, nonverbal communication and social relationship scales. Children with ASD also appeared to have more difficulties when problems in general language were taken into account (Geurts & Embrechts, 2008).

Oram, Fine, Okamoto, and Tannock (1999) compared children with ADHD, ADHD with comorbid language impairment and typically developing children on three commonly administered language measures. Results showed that children with ADHD and language impairment performed worse than children with ADHD only and controls. Both ADHD groups performed in the borderline range on the Formulated Sentences subtest, where they were required to produce sentences using the target word. Although both ADHD groups experienced difficulty on the task, children with ADHD and comorbid language impairment made more semantic errors consistent with their general weakness in language, while children with ADHD only tended to make syntactic errors (e.g., beginning the sentence with 'and'). The authors proposed that in addition to impulsivity, such errors could be due to the failure to evaluate the context of the task and provide appropriate information resulting in a pragmatically inappropriate response. Overall, findings suggested that children with ADHD have deficits in language use rather than the basic language system (phonology, semantics, syntax) (Oram, Fine, Okamoto, & Tannock, 1999).

Tannock, Purvis, and Schachar (1993) used a story retelling task to assess narrative abilities in boys with and without ADHD. Each child listened to two stories and retold them for another child. Results indicated that the two groups did not differ in their ability to comprehend and extract the main ideas from the stories, but did differ in the production of narratives. Boys with ADHD provided less information overall; in addition, their stories were more poorly organized, less cohesive and contained more inaccuracies, and as a result, were hard to follow. Findings were replicated in another study by Purvis et al. (1997). This time, the authors compared four groups of boys: those with ADHD only, ADHD and comorbid reading disability (RD), RD only, and typically developing children. Children were administered a story narrative

task and two measures of semantic aspects of language, such as expressive vocabulary, the ability to identify appropriate synonyms, etc. Results showed that children with ADHD had deficits on the story telling task, while children with RD showed semantic deficits on language processing tasks. Children with ADHD and comorbid RD demonstrated deficits consistent with both groups. The authors argued that since organization and monitoring are aspects of executive functions, deficits in narrative discourse and pragmatics in children with ADHD may reflect underlying deficits in executive processes. Tannock also argued (1996) that because of the relationship to executive functions, of all aspects of language, narrative discourse and pragmatics are more likely to be impaired in children with ADHD.

Downs and Smith (2004) compared the social-emotional abilities of children with autism, ADHD comorbid with ODD and children with no history of psychiatric diagnoses with respect to their social-emotional abilities. Emotional understanding was assessed using a theory of mind task. Cooperative behavior was assessed using the prisoner's dilemma game, where participants chose to cooperate or compete with an imaginary partner on a token task. Children's social behavior was assessed using the social orientation choice card task and using parent ratings on the Behavioral Development Questionnaire. A surprising finding was that children with ADHD and ODD showed a lower level of emotional understanding than the control and the autism group. The ADHD+ODD group also made fewer cooperative responses on the prisoner's dilemma's task and was rated by parents as having more atypical behaviors than comparison children. Children with ADHD+ODD were also rated as displaying more aloof behaviors than typically developing children and those with autism (Downs & Smith, 2004). Although the study had several limitations including a small sample size and unblinded status of the experimenters,

findings are consistent with other reports of theory of mind deficits in ADHD (Buitelaar, van der, Swaab-Barneveld, & van der Gaag, 1999).

Carpenter et al. (2009) assessed social problems in a large sample of children and adolescents with ADHD and showed that increased hyperactivity was associated with Social Immaturity, associated with a PDD risk. Results revealed a strong association between PDD risk and social difficulties in children with ADHD suggesting that the construct of social immaturity may be shared by the two disorders (Carpenter, Loo, Yang, Dang, & Smalley, 2009).

Children with ADHD have been shown to have empathy and social perspective deficits. Empathy as a response coming from understanding the other person's emotional state is important in prosocial behavior (Marton et al., 2009). Social perspective taking is the ability to understand a social situation from another person's perspective and has been described as the "fundamental determinant of social and moral development in children" (Selman, Jaquette, & Lavin, 1977). Two studies have shown that children with ADHD show less empathy compared to typically developing children (Braaten & Rosen, 2000; Dyck, Ferguson, & Shochet, 2001). They have difficulty recognizing facial expressions and understanding emotional consequences of being in a particular situation (Dyck et al., 2001).

Marton et al. (2009) also examined aspects of social cognition, in particular empathy and social perspective taking in children with and without ADHD. Empathy was assessed on self-report on the Index of Empathy for Children and Adolescents (Bryant, 1982) and parental report on My Child Questionnaire (Kochanska, 1992). Social perspective taking was assessed on the Interpersonal Negotiation Strategies interview (Schultz et al., 1989). The children were presented with hypothetical dilemmas and asked questions that assessed their social perspective taking on five steps: defining the problems, identifying feelings, alternative strategies, selecting the best

strategy, and evaluating outcomes. The study showed that children with ADHD were rated as less empathic by parents, but no differences emerged on the self-report. Children with ADHD also produced fewer solutions to interpersonal dilemmas. Children with ADHD showed lower levels of social perspective taking even after accounting for IQ, language abilities, oppositional and conduct problems (Marton et al., 2009).

Recent years have seen accumulating evidence of pragmatic language difficulties in children with ADHD. Several ADHD symptoms are directly related to pragmatic deficits, and both inattention and hyperactivity have been shown to interfere with communication. Pragmatic language problems in ADHD have been reported by parents and teachers, and include deficits in discourse managements (e.g., maintaining a conversation), narrative discourse, empathy, and social perspective taking. It has been showed that pragmatic language skills of children with ADHD are only marginally different from those of children with ASD.

ADHD, Pragmatic Deficits and Social Problems

As described earlier, many children with ADHD have difficulty relating to others. Although social difficulties in ADHD have been associated with aggressive behavior, some have been described as lacking reciprocity. Several factors have been proposed to explain social impairment in ADHD; however, findings supporting those hypotheses are inconsistent. For example, although ADHD symptoms have been associated with social impairment, not all individuals with ADHD experience social difficulties. Moreover, treatments for ADHD and social skills have had limited success in improving the social functioning in ADHD suggesting that other contributing factors should be considered.

Language problems commonly co-occur with ADHD, with accumulating evidence of pragmatic deficits. Pragmatics refers to the use of language in social interactions and as such, is directly related to social functioning. Pragmatic deficits have been linked to social impairment in several clinical populations (i.e., autism); however, to date only one study has examined the association between pragmatic deficits, social problems, and ADHD. We proposed that pragmatic deficits would mediate social impairment in children with ADHD. This finding could have important implications by providing a new framework for developing novel approaches to treating social problems in ADHD. Alternative interventions are needed in light of modest efficacy of social skills programs and, if effective, could improve the quality of life for many children suffering from the disorder, as well as their families.

A recent study by Leonard, Milich, and Lorch (2011) assessed pragmatic language in a community sample of children with varying levels of hyperactivity and inattention, and examined whether pragmatic deficits mediate the relation between hyperactivity, inattention, and social skills problems. Pragmatic language was assessed via parent ratings on the Children's Communication Checklist-2 (CCC-2; Bishop, 2003). Social skills were measured using parent reports on the Social Skills Ratings System (SSRS; Gresham & Elliott, 1990). Hyperactivity and impulsivity were assessed using parent ratings using the Conners Parent Rating Scales (CPRS; Conners, 2001). General intellectual and receptive and expressive language abilities were also assessed. On average, the sample was rated above the mean in terms of pragmatic language use. Pragmatic language fully mediated the relation between hyperactivity and social skills problems and partially mediated the relation between inattention and social skills problems. While the study provided an important start in examining the relation between pragmatic and social difficulties in ADHD, it was limited by the use of only parent ratings to assess both pragmatic

language and social skills. In addition, results were based on a community sample of children with a range of hyperactive and inattentive behaviors. One can argue that children who meet criteria for ADHD diagnosis would be more impaired and have different profiles of behavioral difficulties, and social skills, as well as pragmatic language abilities.

This study extended the question to a sample of children who meet diagnostic criteria for ADHD. The aim of the current study was to systematically evaluate the nature and extent of pragmatic deficits in ADHD and to examine whether and to what degree pragmatic deficits affect social skills in children with ADHD. In comparison to the study by Leonard, Milich, and Lorch (2011), we conducted a comprehensive assessment of pragmatic language that included parent ratings, standardized tests of pragmatic language, and a narrative task. Further, as indicated above, our ADHD participants met diagnostic criteria for ADHD based on a semi-structured interview with a parent, parent and teacher ratings of ADHD symptoms, as well as direct clinical observations. Our specific hypotheses were that a) children with ADHD will show greater pragmatic deficits than typically developing children, which will be evident over and above general language problems; b) the effect of pragmatic deficits on social skills will be greater for children with ADHD compared to typically developing children (moderator effect); and c) pragmatic deficits will account for a significant portion of the variance in social impairment in children with ADHD, such that the difference between social skills in children with ADHD and typically developing children will be reduced when controlled for pragmatic deficits (partial mediator effect). As indicated above, the finding that pragmatic deficits mediate social problems in children with ADHD would have important implications for understanding and treatment of social impairment in ADHD.

Method

Participants

Participants for this study were recruited from the Queens College Preschool Project (QCPP), an ongoing longitudinal study of ADHD conducted at Queens College. Children were eligible if they met the following inclusion criteria: no history of a Pervasive Developmental Disorder (PDD), neurological disorder, or severe receptive and/or expressive language delays; no history of chronic illness that requires taking a systemic medication other than psychostimulant treatment for ADHD; Full Scale IQ (FSIQ) of or greater than 80. In order to participate in the study, children were required to be proficient in English and attend school. Children with ADHD had to meet DSM-IV-TR diagnostic criteria for the disorder. Parents of children eligible for the study were contacted via letters inviting them to take part in a study of pragmatic language and ADHD, and asked to contact the study coordinator if they were interested in participating; families that expressed interest were invited to come to the laboratory for an evaluation. The study procedures were explained to the participants and written parental consent was obtained. Recruitment letters and all research procedures were approved by the Queens College Institutional Review Board.

Exclusion criteria were a diagnosis of a PDD, neurological disorder, history of severe receptive and/or expressive language delays, or chronic medical or psychiatric illness that requires taking a systemic medication other than psychostimulant treatment for ADHD. Those receiving treatment for ADHD with psychostimulants were included in the study; however, parents were asked to withhold medication on the day of the evaluation. Other medications for ADHD such as guanfacine or atomoxetine were exclusionary as they cannot be easily/safely withdrawn on an acute basis. Children with an estimated FSIQ below 80 were also excluded

from the study. FSIQ was assessed using the WISC-IV at age six as part of children's annual QCPP evaluation. Given that schools provide an important social context for children and that teacher ratings were used for assessment of ADHD, children who did not attend school were excluded. Finally, due to the fact that linguistic functioning was the focus of this study, children from non-English-speaking homes were excluded from the study.

The final sample consisted of 63 children ranging in age from seven to 11 years old (M (SD) = 8.88 (1.49). Children in the ADHD group (N = 28) met DSM-IV-TR criteria for ADHD at the time of their last annual evaluation from the longitudinal study (mean (SD) time interval = 21 (17) weeks), based on parent and teacher ratings and a semi-structured interview with the parent(s); 8 children met criteria for Predominantly Inattentive type, 1 for Predominantly Hyperactive-Impulsive type, and 19 for Combined type. Children who did not meet criteria for ADHD (N = 35) were assigned to the typically developing group. Among the sample, 38 children were Caucasian, seven were African-American, eight were Asian, and 10 were of mixed descent; 18 children were Hispanic. Mean socioeconomic status was 63.56 as measured by the Nakao and Treas (1994) scale, representing, on average, a middle class sample. Demographic characteristics are presented in Table 1.

Table 1. Sample Characteristics

Variable	ADHD (N = 28)	TD (N = 35)	t/γ	p
Age (years) M (SD)	8.62 (1.86)	9.08 (1.08)	1.15	.258
Sex (% male)	82.1	68.6	1.51	.219
SES M (SD)	55.54 (14.06)	69.97 (16.23)	3.78	< .001
Race	57.1% W 5.7% AA 20% A 17.1% Mixed	64.3% W 17.9% AA 3.6% A 14.3% Mixed	5.58	.134
ADHD KSADS Mean Total Score (0 – 36)	27.46	5.69	-15.38	< .001

Measures

Children and their parents visited the laboratory for an evaluation that lasted between two and 2.5 hours, during which children were administered several measures to assess their pragmatic and general language functioning. Parents completed rating scales of children's pragmatic and social skills. Following the completion of the evaluation, the examiner completed the behavioral observations form and a rating scale of autism-related behaviors. All measures are described below:

Diagnostic measures:

Attention-Deficit/Hyperactivity Disorder Rating Scale, Fourth Edition (ADHD-RS-IV; DuPaul, Power, Anastopolous, & Reid, 1998): ADHD-RS-IV is a DSM-IV checklist of ADHD symptoms that has been widely used as a standard instrument for the assessment of ADHD-related behaviors. For the purpose of this study, parent- and teacher-completed ADHD-RS-IV scales were used as a supplementary source of information which was integrated with the parent reports

on the KSADS-PL to formulate diagnoses. The ADHD-RS rating scales were not collected separately for this study; instead, with parental consent, scales obtained as part of children's QCPP evaluation were used. All ADHD-RS-IV scales were completed within three months prior to the evaluation for this study.

Child Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988): Although PDD was an exclusion criterion for the original QCPP sample, it was possible that in some children PDD symptoms may not have been detected during their initial evaluation. Thus, we used the CARS to rule-out such disorders in children entering the study. The scale was completed by the evaluator after observing the child. The CARS has been shown to discriminate between children with Autistic disorder, PDD-NOS, mental retardation and developmental delays (Perry, Condillac, Freeman, Dunn-Geier, & Belair, 2005). In the same study, it was also shown to have high concordance with DSM-IV diagnosis, both with respect to sensitivity and specificity (Perry et al., 2005). For the purposes of the study, the cutoff of 10 out of 15 was used; none of the participants received a score higher than five.

Kiddie-Schedule for Affective Disorders and Schizophrenia, Present and Lifetime Version (K-SADS-PL; Kaufman et al., 1997): The KSADS-PL is a reliable, commonly-used, semi-structured child psychiatric interview that assesses a wide array of psychiatric conditions according to DSM-IV-TR criteria. Although administered to the parent, the K-SADS specifically addresses issues related to the child's behavior in school, in addition to home. Further, information about the child's social functioning is gathered as part of the interview. The K-SADS-PL interview had been administered on an annual basis to parents as part of children's participation in the QCPP. In addition to the information provided during the interview, parent and teacher ratings of children's behavior and behavioral observations of the child during testing were used to arrive at

a diagnosis. The diagnostic data from the most recent interview were used in this study. For one child, who did not complete his annual evaluation prior to the study, the diagnosis was derived based on the parent ratings of ADHD-RS completed at the time of the study.

Pragmatic language measures:

The assessment of pragmatic language poses several challenges. First, pragmatics is a heterogeneous construct that includes a wide array of verbal and non-verbal skills, which makes it difficult to assess with a single measure (Landa, 2005; Russell, 2007). Second, specific pragmatic language abilities have different developmental trajectories (e.g., the ability to express communicative intent develops before theory of mind), making the assessment of pragmatic language in children particularly challenging (Landa, 2005). Third, because by definition pragmatics is tied to social context, it has been argued that formal assessment of pragmatic skills via standardized testing does not reflect a person's true abilities to use the language in a natural setting. To account for these issues, a combination of formal tests, questionnaires and discourse analysis was used in the present study.

Children's Communicative Checklist, Second Edition (CCC-2; Bishop, 2003): The CCC-2 is a 70-item questionnaire designed to assess children's skills in various areas of language, including pragmatics. It is administered to a caregiver, who rates the frequency of behavior described in each item. The CCC-2 provides standard scores for 10 scales, four of which (Coherence, Initiation, Scripted Language, and Context) focus on verbal and non-verbal pragmatic skills. In the original CCC, the five pragmatic scales yielded the pragmatic language composite, which was shown to discriminate between children with specific language impairment and pragmatic language impairment, and thus was considered a reliable indicator of pragmatic language

difficulties (Bishop, 1998; Botting, 2003). In addition, the CCC was used to document pragmatic language deficits in ADHD (Bishop et al., 2001; Geurts et al., 2004). The CCC-2 has been shown to differentiate children with specific language impairment, pragmatic language impairment and ASD (Geurts et al., 2008). The CCC-2 does not provide the pragmatic language composite, but retains the same subscales related to pragmatic language skills. For the purposes of this study, we calculated the pragmatic language composite by using the sum of pragmatic language subscales. A similar procedure was used by Leonard et al. (2011) and Bignell and Cain (2007). The CCC-2 ratings were obtained from parents at the time of their participation in the study.

Comprehensive Assessment of Spoken Language (CASL; Carrow-Woodfolk, 1999): CASL is a standardized language assessment battery that assesses linguistic abilities in four domains: Lexical/Semantic, Syntactic, Supralinguistic, and Pragmatic. Nonliteral Language, Inferences, and Pragmatic Judgment subtests were used to assess children's pragmatic language abilities. For the Nonliteral Language subtest, children were asked to interpret the meaning of sentences that contain words used in their nonliteral, figurative meaning, such as indirect requests or idioms (e.g., At 8pm Dad said to his daughter, "I think your doll is yawning". What did Dad really mean?). For the Inferences subtest, children were read brief stories in which part of the information was omitted. Children then had to answer questions using both their general knowledge and the ability to infer information from the context (e.g., Mary wanted a glass of milk, but after looking at the refrigerator, she drank orange juice instead. Why?). For the Pragmatic Judgment subtest, children were read brief passages that represent some aspect of an everyday life situation requiring communication and were asked to provide an appropriate response (e.g., Cassie spills her milk at the table. What does she say to her mother?). For each

subtest, one point was awarded for each correct answer and the total score was used to obtain a standard score. In addition, the sum of Nonliteral Language and Inferences standard scores yielded a Supralinguistic domain standard score. Internal consistency of responses for the administered subtests within the normative sample was reported to range from 0.78 to 0.94., indicating high homogeneity among test items. Test-retest reliability ranged from 0.83 to 0.85, suggesting stability of subtests scores. All CASL index scores showed poorer performance in children with language impairment and performance on the Pragmatic Judgment subtest was lower in children with language delays. The Pragmatic Judgment score was also one of the two lowest subtest scores among children and adolescents with mental retardation, which may reflect lower adaptive functioning in addition to language ability. In addition, the Inferences subtest was shown to document difficulties in adaptive use of language and communication among individuals with Autistic Spectrum Disorder reported on the Vineland Adaptive Behavior Scales, supporting the test's concurrent validity (Reichow, Salamack, Paul, Volkmar, & Klin, 2008).

Test of Pragmatic Language, Second Edition (TOPL-2, Phelps-Terasaki & Phelps-Gunn, 2007): TOPL-2 is designed to elicit functional communicative interactions by using situations that occur in common settings, such as home, school, and neighborhood. Participants were shown pictures and read brief stories describing a social interaction and asked questions that involved making inferences about the story and the characters. Responses were scored based on several criteria that were unique for each item but involved similar themes, such as making reference to the context, appreciation of the facial expressions, gestures, emotional state of the characters, etc. The total raw score was used to obtain a Pragmatic Language Usage (PLU) index expressed as a standard score. The average internal consistency reliability coefficient for the PLU was shown to be 0.91, while test scorer reliability was 0.98 (Phelps-Terasaki & Phelps-Gunn, 2007). The

TOPL-2 was shown to be correlated with pragmatic language subtests from the CASL, Pragmatic Language Index from the Pragmatic Language Skills Inventory, and Spoken Language Index from the Test of Adolescent and Adult Language-Fourth Edition, with correlation coefficients in the 0.70 to 0.99 range.

Narrative Assessment Profile: Discourse Analysis (NAP; Bliss, McCabe, & Melinda, 1998): The Narrative Assessment Profile (NAP) is a discourse analysis approach that provides qualitative assessment of several domains of discourse, including 1) topic maintenance, 2) event sequencing, 3) informativeness, 4) referencing, 5) conjunctive cohesion, and 6) fluency. The procedure was as follows. Topic maintenance describes the ability to stay on topic while producing a narrative. Event sequencing describes whether the story events are produced in a chronological order. Informativeness includes three components, namely "police officer", "teacher", and "chef". "Police officer" captures whether the narrator was able to name important facts from the story. "Teacher" describes the degree to which the narrator uses elaborations and provides details that would contribute to the understanding of the story. Finally, "chef" includes *actions* defined as two successive verbs in the past tense, *descriptions*, and *evaluations*, which include any expressions of emotions or judgment (e.g., "he liked it", "he didn't care", "he was hurt"). Referencing refers to the ability to properly refer to the characters in the narrative. Conjunctive cohesion describes the use of conjunctions in the narrative. Finally, fluency describes whether the narrative is fluent or characterized by interruptions, repetitions, etc.

The procedure was as follows. Children were presented with a wordless picture book "The Snowman" (Briggs, 1978) and asked to produce a narrative describing the story depicted in the book. Children were encouraged to be creative and tell "as exciting a story as you can". "The Snowman" book was chosen based on its child-friendly content with high pragmatic load (e.g.,

interactions between the child and the snowman, the child feeling sorry for the snowman). To account for the fact that some children had been exposed to the book, all participants were instructed to look through all the pictures before telling the story. The children were also allowed to look at the pictures while telling the story. If a child stopped during the task, they were encouraged to continue with neutral prompts such as "uh huh", "and", "tell me more" or "what happened next?" With parental consent, children's narratives were recorded and subsequently transcribed verbatim by the principal investigator of the study and two undergraduate students. All samples were checked for accuracy and coded by the investigator. The narratives did not contain any identifying information and the author was blind to the group status of participants. Although the author had known some children through their participation in QCPP and was able to recognize some children by their voice, clinical diagnosis was never checked prior to coding. To ensure consistency in scoring, nine randomly selected narratives (15% of all) were also coded by the author of NAP and inter-rater reliability was assessed. The correlation coefficients for the six individual narrative dimensions ranged from .5 to 1, the reliability for the total score was .98 ($p < .001$). Cases where discrepancy was found were discussed between the two raters and consensus was reached.

The narratives were coded on six dimensions listed above using the quantitative version of Narrative Assessment Protocol adapted for this study. Topic maintenance, event sequencing, informativeness ("teacher" and "chef"), and conjunctive cohesion were rated on a 3-point scale. Referencing was rated on a 4-point scale. To assess fluency, each instance of dysfluency, such as word repetition or false start, was counted and added to calculate the total fluency score. To assess the "police officer" aspect of informativeness, a list of key story elements was generated

and the total of elements mentioned was calculated for each narrative. Specific criteria for each discourse dimension and sample narratives are presented in the Appendix.

General Language:

Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4; Semel, Wiig, & Secord, 2003): The Concepts and Following Directions, and Formulated Sentences subtests were administered to assess receptive and expressive language abilities, respectively. CELF-4 is a widely used measure to assess a variety of language skills that has been shown to identify varying degrees of impairment among children. Clinical validation studies have shown that CELF-4 is sensitive to language difficulties in a variety of clinical populations including learning disability, intellectual disability, hearing impairment, and autism. It has also been shown to have very good sensitivity and specificity for identifying verbal learning disability (Acrhibald & Joanisse, 2009). For the Concepts and Directions subtest children were asked to point to visually presented stimuli in the same order as instructed by the examiner. For the Formulated Sentences subtest, children were presented with pictures and asked to produce a sentence with a target word based on the picture. Standard (scaled) scores were obtained for both subtests. After careful consideration, we opted to not use expressive language in final analyses due to the significant overlap between expressive and pragmatic language.

Social skills measures:

Social Skills Improvement System (SSIS; Gresham & Elliott, 2008): The SSIS is a rating scale that measures social behavior of children (e.g., cooperation, empathy, self-control), as well as problematic behavior (e.g., externalizing problems, hyperactivity) and academic competence.

Each behavior is rated on a 4-point scale. Parents completed parent versions at the time of the evaluation. Item development for the SISS was based on a broad survey of literature on social skills deficits in special populations, reviews of the Social Skills Rating system, the original scale, and research on the relationships between specific social behaviors and social outcomes. Comparisons of SSIS with SSRS and BASC-2 showed moderate to high correlations between similar scales and subscales both for parent and teacher versions (Gresham & Elliott, 2008). SSIS was shown to discriminate between typically developing children and children with autism, ADHD, developmental delays, and speech and language impairment (Gresham & Elliott, 2008). Test-retest reliability for the Social Skills subscales on the parent form completed by the same parent was in the .70s and inter-rater reliability between both parents or a parent and a close relative was .62 (Gresham & Elliott, 2008).

Deriving Pragmatic Language Constructs:

Three measures of pragmatic language were constructed for the analyses. The pragmatic language composite from the CCC-2 was used as a measure of Discourse Management. A principal component analysis of the Non-Literal Language, Inference, and Pragmatic Judgment subtests from the CASL and the Pragmatic Language Use index from the TOPL-2 was used to create a test-based composite measure of pragmatic language. The principal component analysis generated a unitary factor solution accounting for 70% of the variance with good internal consistency of the construct as indicated by the alpha coefficient of 0.84. The derived factor score was used as a measure of Presupposition. In order to generate the measure of Narrative Discourse, the six story dimensions were examined for face and convergent validity. Based on the descriptions of what the individual dimensions were supposed to measure and scale

characteristics, were selected to comprise the Narrative Discourse composite. This composite score was significantly correlated with parent ratings of pragmatic language (Discourse Management) and test-based factor score (Presupposition), indicating good convergent validity. The three scores that were not included into the Narrative Discourse composite (informativeness, fluency, and conjunctive cohesion) were not correlated with the other two measures of pragmatic language, supporting good convergent and divergent validity of the composite. The three measures of pragmatic language, namely Discourse Management, Presupposition, and Narrative Discourse composite scores were used in subsequent analyses.

Data Analysis: The first level of analyses examined group differences on measures of pragmatic language, followed by secondary moderation and mediation analyses. All three measures of pragmatic language were used in the analyses. The following hypotheses were tested:

Hypothesis A: Children with ADHD will show greater deficits in pragmatic language compared to typically developing children over and above receptive language difficulties. This hypothesis was tested using multivariate analysis of covariance (MANCOVA) to compare the ADHD and TD groups on measures of the three measures of pragmatic language including Discourse Management, Communicative Intent, and Narrative Discourse. Receptive language abilities as measured by the CELF-4 were entered as a covariate.

Hypothesis B: The association between pragmatic deficits and social impairment will be stronger for the ADHD group compared to the TD group (moderation model). This hypothesis was tested using hierarchical regression analyses. Centered variables representing pragmatic language and group (ADHD, TD) were entered simultaneously into the model in step 1 followed by the interaction term in step 2 to determine whether the relation between pragmatic deficits and

social impairment is stronger for the ADHD group. The model was tested separately using the three pragmatic language constructs (Discourse Management, Presupposition, and Narrative Discourse). The Excel version of the ModGraph program was used to create the figures (Jose, 2008).

Hypothesis C: Social skills deficits in children with ADHD will be largely accounted for by pragmatic language deficits (partial mediation model). In order to demonstrate that pragmatic language mediates the effect of ADHD on social skills, the following conditions must hold (Baron & Kenny, 1986): a) the independent variable (ADHD) must be associated with the dependent variable (social skills); b) the independent variable (ADHD) must be associated with the mediating variable (pragmatic language), c) the dependent variable (social skills) must be associated with the mediating variable (pragmatic language), and d) the association between the independent variable (ADHD) and dependent variable (social skills) must be reduced when controlling for the mediator (pragmatic language).

First, bivariate correlation coefficients were calculated to examine associations between all measures of pragmatic language, ADHD, and social skills to satisfy the requirement of the mediation. Next, following procedures established by MacKinnon, Krull, and Lockwood (2000), a series of bivariate correlation coefficients were calculated to examine associations between all measures of pragmatic language, ADHD, and social skills were computed to calculate the effects of the independent variable on the dependent variable with the proposed mediators in the model. More specifically, social skills were regressed on pragmatic skills; next, social skills were regressed on ADHD (group), and finally social skills were regressed on both pragmatic skills and ADHD. A reduction of the effect after including both factors in the model would suggest the mediating effect of pragmatic skills. Separate analyses were conducted with three pragmatic

language constructs (Discourse Management, Presupposition, and Narrative Discourse). Receptive language abilities as measured by the CELF-4 Concepts and Following Directions subtest were entered as a covariate.

Given the role of SES in children's language development, the analyses were repeated using SES as a covariate. Finally, in order to assess for the impact of gender, the analyses were performed using the data from boys only.

Results

Hypothesis A: Multivariate analysis of covariance (MANCOVA) was used to test the hypothesis that children with ADHD have greater pragmatic language deficits compared to typically developing children over and above receptive language difficulties. Group differences were assessed on the three measures of pragmatic language: Discourse Management, Presupposition, and Narrative Discourse.

Results of the MANCOVA indicated that there was a significant difference between the groups on measures of pragmatic language ($F = 28.495$, $p < .001$, Wilk's $\lambda = .387$, Partial $Eta^2 = .613$). Given that the overall model was significant, it allowed us to examine individual dependent measures separately. Follow-up univariate ANCOVAs indicated that children with ADHD had significantly poorer pragmatic language skills as assessed by all three measures after controlling for receptive language abilities (all $p < .01$). The difference between the groups was most prominent for Discourse Management ($F = 40.286$, $p < .001$, Partial $Eta^2 = .590$); the groups also differed significantly on measures of Presupposition ($F = 8.490$, $p = .001$, Partial $Eta^2 = .233$) and Narrative Discourse ($F = 6.748$, $p = .002$, Partial $Eta^2 = .194$) (see Table 2). Group differences on measures of pragmatic language were also significant after controlling for SES both within the overall sample and among boys only.

Table 2. Group Differences on Measures of Discourse Management, Presupposition, and Narrative Discourse after Controlling for Receptive Language Abilities.

Pragmatic language Measure	ADHD (25) Mean (SD)	TD (34) Mean (SD)	F	p	Partial Eta^2
Discourse Management raw score	32.00 (6.00)	45.88 (6.11)	40.286	.001	.590
Presupposition z-score	-.46 (.81)	.38 (1.0)	8.490	.001	.233
Narrative Discourse raw score	4.08 (1.26)	5.18 (1.09)	6.748	.002	.194

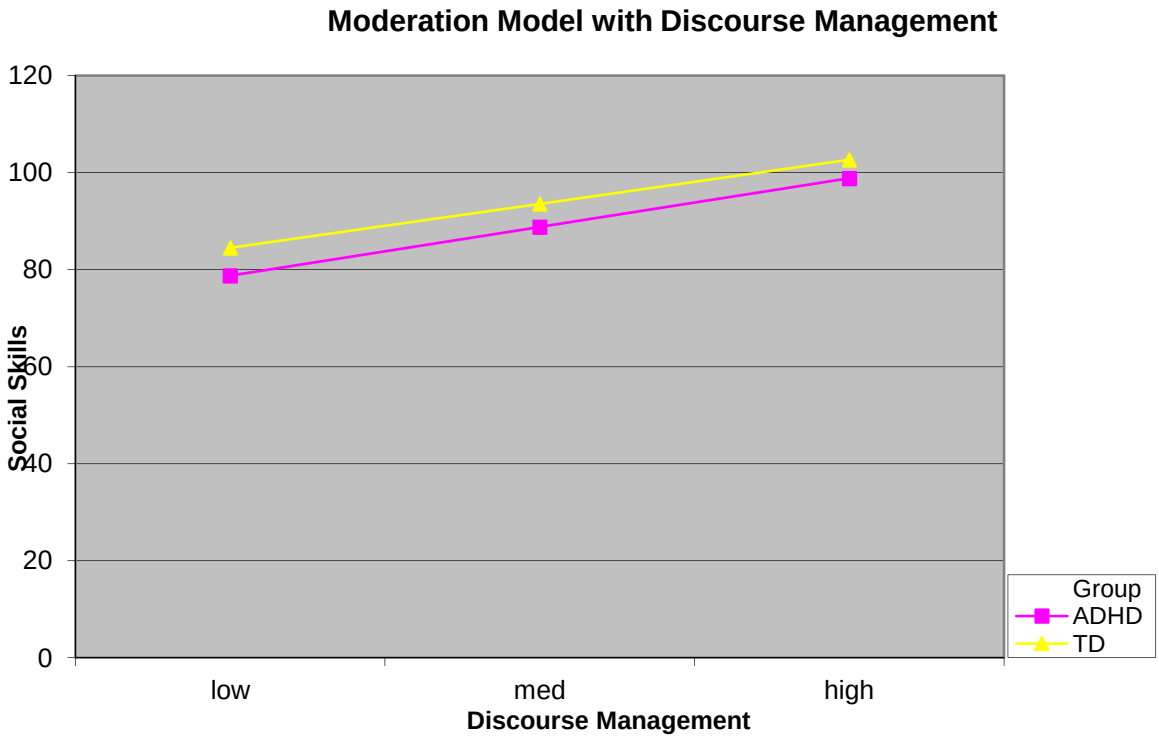
Hypothesis B: Linear regression analyses were conducted to test the hypothesis that the association between pragmatic deficits and social impairment is stronger for the ADHD group compared to the TD group (moderation model). First, variables representing pragmatic language and group (ADHD, TD) were centered and interaction variables were computed. To test the moderation model, centered pragmatic language and group status (moderating variable) were entered into the regression model in the first step followed by the interaction term in the second step. Parent-rated social skills as measured by the SSIS was used as the dependent variable. The model was tested separately using the three pragmatic language constructs (Discourse Management, Presupposition, and Narrative Discourse).

As shown in Table 3 and depicted in Figure 1, there was a strong main effect for Discourse Management, accounting for 50% of the variance in social skills ($\beta = .497$, $p < .001$). Group accounted for approximately three additional percent of the variance approaching significance ($\beta = -.266$, $p = .052$). No significant interaction effect was found suggesting that ADHD did not moderate the effect of Discourse Management on social skills ($\beta = .035$, $p = .702$).

Table 3. Moderation Model with Discourse Management. Main and interaction effects.

Variable	β	P	Adjusted R square	r^2 change
Discourse Management	.497	< .001	.496	.513
Group	-.266	.052		
DM x Group Interaction	.035	.702	.489	.001

Figure 1. Moderation of the Effect of Discourse Management on Social Skills by ADHD.

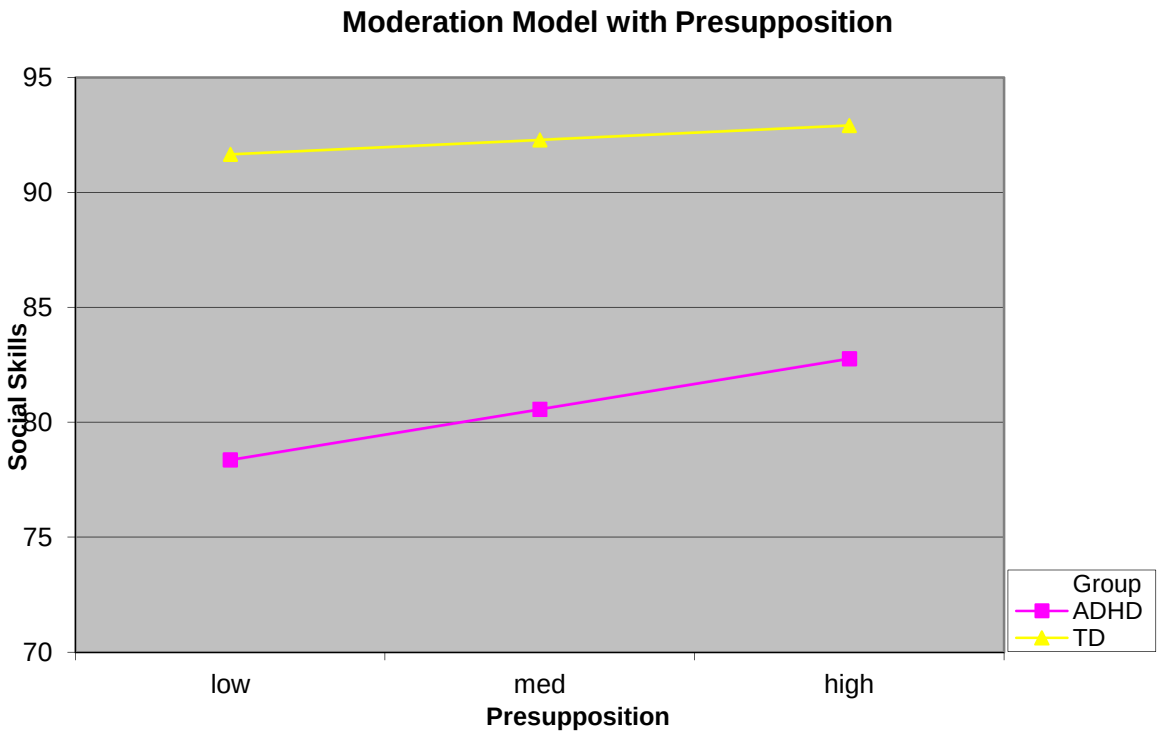


The model with Presupposition indicated a significant main effect of group accounting for approximately 65% of the variance (β = -.654, p < .001). Neither pragmatic language, nor the interaction term predicted social skills (β = .012, p = .911; β = .086, p = .414, respectively). These results are presented in Table 4 and Figure 2.

Table 4. Moderation Model with Presupposition. Main and interaction effects.

Variable	β	p	Adjusted R square	r^2 change
Presupposition	.012	.911	.416	.435
Group	-.654	< .001		
PS x Group Interaction	.086	.414	.413	.007

Figure 2. Moderation of the Effect of Presupposition on Social Skills by ADHD.

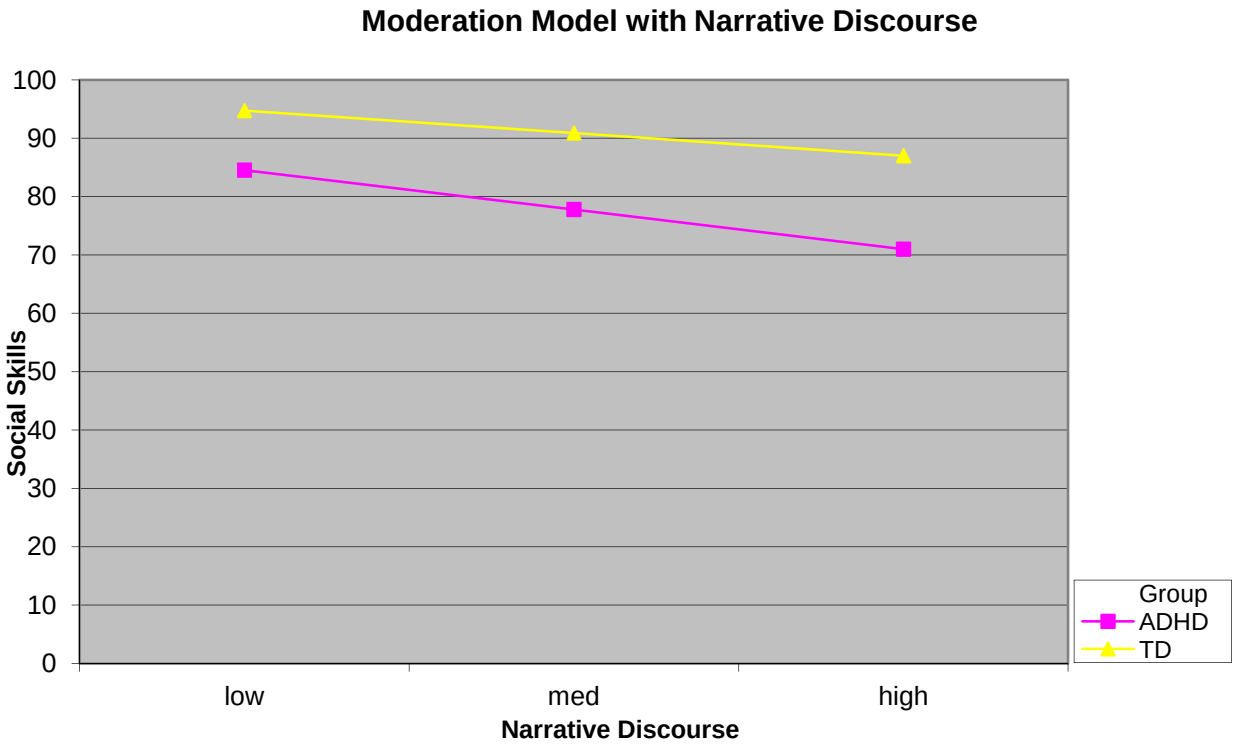


As shown in Table 5 and depicted in Figure 3, analyses with Narrative Discourse showed significant main effects of pragmatic language and group, accounting for approximately 22% and 74% of the variance, respectively (β = -.224, p = .048; β = -.744, p < .001). No interaction effect was found (β = -.151, p = .132).

Table 5. Moderation Model with Narrative Discourse. Main and interaction effects.

Variable	β	p	Adjusted R square	r^2 change
Narrative Discourse	-.224	.048	.437	.457
Group	-.744	< .001		
ND x Group Interaction	-.151	.132	.451	.023

Figure 3. Moderation of the Effect of Narrative Discourse on Social Skills by ADHD.



Hypothesis C: The hypothesis that social skills deficits in children with ADHD is largely accounted for by pragmatic language deficits (partial mediation model) was tested. Table 6 presents Pearson correlations between pragmatic language, ADHD, and social skills. As expected, there were significant correlations among all study variables with the exception of that between Narrative Discourse and social skills. The strongest correlation was found between

ADHD and parent-rated Discourse Management language deficits ($r = .740$, $p < .001$). However, as shown in Table 7, after controlling for receptive language abilities, only Discourse Management was significantly correlated with both ADHD and the measure of social skills. As it is critical to control for receptive language abilities in order to truly assess the impact of pragmatic language, mediation analysis could only be conducted using the Discourse Management measure of pragmatics.

Table 6. Zero-order Correlations among ADHD, Pragmatic Language, and Social Skills.

	ADHD	Discourse Management	Presupposition	Narrative Discourse
Discourse Management	-.740**			
Presupposition	.-432**	.357**		
Narrative Discourse	-.429**	.291*	.465**	
Social Skills	-.633**	.693**	.295*	.088

**p < .01; *p < .05

Table 7. Partial Correlations among ADHD, Pragmatic Language, and Social Skills after Controlling for Receptive Language.

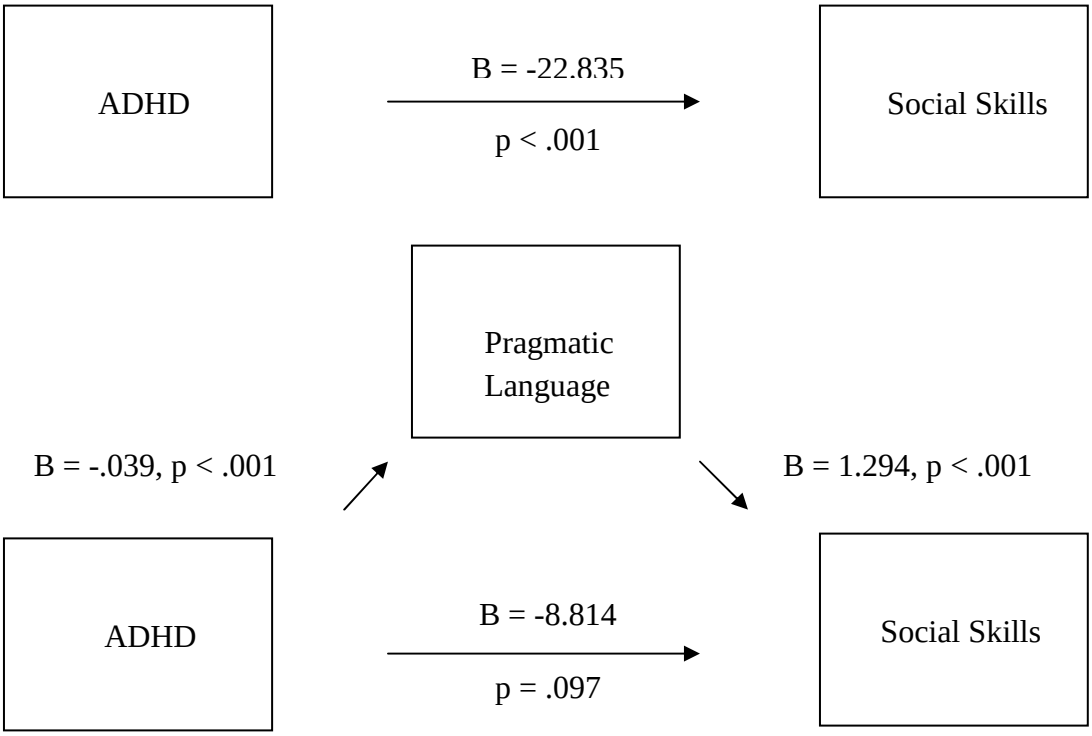
	ADHD	Discourse Management	Presupposition	Narrative Discourse
Discourse Management	-.761**			
Presupposition	-.315*	.282*		
Narrative Discourse	-371**	.263*	.411**	
Social Skills	-.625**	.669**	.190	.029

**p < .01; *p < .05

Figure 4 depicts the mediating effect of Discourse Management on the relationship between ADHD and Social Skills. After controlling for receptive language difficulties, ADHD was a

significant predictor of social skills and contributed to 40% of the variance in social skills (B = -22.835, β = -.626, p < .001). However, when Discourse Management was added into the model, there was a significant reduction in B (Sobel SE = -5.22, p < .001) and the association between ADHD and social skills was no longer significant (B = -8.814, β = -.241, p = .097), indicating that Discourse Management served as a full mediator of the relation between ADHD and Social Skills. When SES was used as a covariate, Discourse Management served as a partial mediator; a similar finding was observed looking at boys only.

Figure 4. Mediation Model Using Ratings of Discourse Management.



Discussion

The goal of the present study was to investigate the relation between pragmatic language, ADHD, and social skills. In particular, the study examined the role of pragmatic language in social skills and thus attempted to possibly identify another factor that may contribute to social impairment in ADHD. Research has shown that as many as 80% of individuals with ADHD experience difficulties in social functioning. Social problems in ADHD have been documented as early as in preschool years, but also affect adolescents and adults with ADHD and cannot be solely attributed to ADHD per se. Although other factors have been proposed to explain social impairment in ADHD (e.g., neuropsychological or social processing deficits), findings in support of these theories have been inconsistent.

Language problems are also comorbid in ADHD with recent evidence of pragmatic deficits. Impairment in pragmatic language has been implicated in several clinical populations (e.g., autism, right hemisphere damage, and ADHD) and has been associated with social deficits; however, there has been only one study that investigated the degree to which pragmatic deficits affect social skills in children with elevated rates of inattention and hyperactivity.

This study examined the role of pragmatic language deficits in social impairment among children diagnosed with ADHD. The following hypotheses were tested: a) compared to typically developing children, those with ADHD have greater pragmatic language deficits over and above receptive language difficulties; b) the association between pragmatic language deficits and social problems is greater for children with ADHD compared to typically developing children (moderation effect); and c) pragmatic language deficits mediate social impairment in children with ADHD such that the effect of ADHD on social impairment is reduced after taking pragmatic language skills into account (mediation effect).

The results supported the first hypothesis and indicated that children with ADHD performed more poorly on all measures of pragmatic language after controlling for receptive language abilities. The same finding was observed after controlling for SES. It is of note that although children with ADHD performed in the Average range on standardized measures of pragmatic language, their performance was lower compared to typically developing children. This finding is consistent with empirical findings and clinical observations that children with ADHD tend to perform less well on measures of intelligence, neuropsychological and achievement functioning compared to their typically developing peers even if their performance still falls within expected range (Barkley, 1997; Barkley, 1998; Kuntsi et al., 2004).

The findings are also consistent with the literature that suggests that pragmatic deficits can occur independently of general language difficulties (Bishop et al., 2000). As discussed above, pragmatics is the aspect of language that is responsible for the appropriate use of language in the social context. It includes a wide range of verbal and non-verbal skills, including eye contact, conversational give and take, and theory of mind among others. Previous research with certain clinical populations such as Asperger's syndrome has shown that some individuals experience pragmatic language deficits and social problems in the absence of general language delays or impairment; findings from this study are consistent with this literature and provide evidence of a similar dissociation between general language and pragmatic language in ADHD. Although we covaried for receptive and not expressive language due to significant overlap with pragmatic language, the findings did not changed when expressive language was used as a covariate.

The second hypothesis was not supported. Although results showed main effects of both group and certain aspects of pragmatic language (i.e., Discourse Management and Narrative

Discourse) on social skills, a significant interaction effect was not found. This suggests that the effects of ADHD and pragmatic language deficits are additive. More specifically, our findings indicated that both ADHD and pragmatic deficits are associated with increased risk for social impairment; however, the effect of pragmatic language deficits on social skills is not greater for children with ADHD than their typically developing peers. In other words, ADHD does not moderate the effect of pragmatic deficits on social skills. Thus, it is possible that poorer social skills in children with ADHD are associated with an increased likelihood of pragmatic deficits, but having pragmatic deficits does not have a differentially greater negative impact on children with ADHD.

Finally, the third hypothesis was partially confirmed. Our findings indicated that pragmatic language skills as measured by parent ratings of discourse management fully mediated the relation between ADHD and social skills. More specifically, after including discourse management in the model, ADHD was no longer a significant predictor of social impairment. After controlling for SES, a partial mediator effect was observed; in other words, the relation between ADHD and social impairment was reduced after Discourse Management was added into the model. A similar finding was observed among boys only. There was no difference on measures of pragmatic language and social skills among boys and girls. Pragmatic language as measured by tests of presupposition did not serve as a mediator. Lastly, narrative discourse skills were not correlated with social skills and thus could not be assessed in the mediation model.

Overall, our findings revealed different relationships between pragmatic and social skills depending on the measure of pragmatic language that was used. Several possible explanations can be offered for such discrepancy. First, it is of note that the three pragmatic language areas assessed in the study refer to distinct abilities. Thus, discourse management describes skills

related to managing a conversation, including the ability to properly initiate, maintain, and end a conversation. Presupposition is an area of pragmatic language that includes the ability to make inferences about the conversational partners and particular context, also known as the theory of mind. Finally, narrative discourse refers to the ability to produce a coherent narrative that would be appropriate for a particular context and would be understood by the listener/reader. Further, each of the three areas of pragmatic language was measured via different assessment methods. Specifically, discourse management skills were rated by parents. Presupposition abilities were assessed via standardized tests, and narrative discourse abilities were measured using a narrative task. It should be noted that both ratings of pragmatic language and social skills were completed by the same informant (i.e., parent), which may have created a rater bias. However, the fact that parent-rated pragmatic language skills served as a full mediator between ADHD and social problems diminishes the likelihood that rater bias alone accounts for the whole effect. It is more likely that skills within the domain of discourse management are easier to measure and/or are more directly related to the social skills observed by parents. For example, interrupting others in conversation may be easier to observe and may have a more direct adverse effect on popularity among peers compared to difficulty understanding irony and sarcasm. This is supported by the fact that the strongest correlation between pragmatic language and social skills was found for discourse management ($r = .693$, $p < .001$).

Further, one can argue that certain pragmatic language abilities may have particular relevance for social skills at different stages of development both due to differences in cognitive abilities and in the quality of friendships across the lifespan. For example, theory of mind abilities are not fully developed in early childhood (Adams, 2002). Thus, difficulty understanding humor and sarcasm measured by presupposition might result in more impairment

in adolescence and adulthood. In addition, given that adults spend more time in conversation with their friends, understanding the other person's perspective becomes more important. On the other hand, typical child friendships are based on play-related activities; hence one can argue that appropriate turn taking may be of greater importance.

Another possible explanation for the discrepancy in findings across different areas of pragmatic language is that pragmatics is a complex and heterogeneous construct that is difficult to measure (Adams, 2002). As described earlier, pragmatic language includes a wide range of verbal and non-verbal abilities, all of which are important in social interactions. One can argue that perhaps a perfect measure of pragmatic language should assess all of the skills and areas mentioned above in order to truly gauge one's pragmatic language functioning. Further, since pragmatic language by definition refers to the social use of language, it is particularly difficult to measure in the context of the laboratory, and the ecological validity of pragmatic language tests may be limited. For the same reason, ratings scales may be a better approach to measuring pragmatic language skills in a natural setting. The issue of test ecological validity has been widely discussed in the field of neuropsychological testing where similar discrepancy has been described between performance-based and rating scale measures of executive functions, which represent another complex construct (Sbordone, 1996; Sbordone & Guilmette, 1999). Thus, only modest correlations have been found between ratings on the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) and performance on the subtests from the Delis-Kaplan Executive Function Scale (D-KEFS; Delis, Kaplan, & Kramer, 2001; Sbordone, 1996).

This study differed from previous attempts to evaluate pragmatic language in ADHD in several important ways. First, it used a comprehensive battery to assess pragmatic language skills, which included parent ratings of pragmatic language, several standardized test measures,

and a narrative task; as such, this was the first study that carried out a comprehensive assessment of pragmatic language in children with ADHD. Second, whereas previous studies examined children with elevated levels of parent-rated inattention and hyperactivity (Leonard, Milich, and Lorch, 2011), participants in this sample had been diagnosed with ADHD based on a comprehensive clinical interview in addition to parent and teacher ratings and clinician observations of the child behavior during the evaluation. This can explain the difference in findings between this study and that by Leonard, Milich, and Lorch (2011) who found above average pragmatic language skills among their sample. We found that children with ADHD had average pragmatic language skills as measured on standardized tests, but not on parent ratings, which was reported by Leonard, Milich, and Lorch (2011). Participants in their study were children from the community who were rated to have elevated levels of inattention and hyperactivity on parent ratings while our ADHD participants met diagnostic criteria for ADHD. Given the association between ADHD and pragmatic language problems, it is not surprising that children diagnosed with ADHD exhibited higher levels of symptoms and greater pragmatic deficits. Finally, the sample was ethnically diverse reflecting the multi-ethnic community of Queens, which increases external validity of the study.

Despite these strengths, the study has its limitations. The major limitation was the fact that the same informant rated the independent (discourse management) and dependent variables (social skills). It will be critical for future studies to collect ratings from a separate informant. Teacher ratings would be particularly useful given that schools play a primary role in children's socialization experience. Obtaining additional independent ratings from another parent or family member would also be helpful. We were initially prevented from collecting teacher ratings by the IRB and as such we were able to obtain them for only a third of participants. Alternatively, observation of children engaging in a social interaction with their peers would provide an important source of information

when attempting to evaluate both pragmatic and social skills. Although most participants in the sample were not familiar with the picture book used to generate a narrative, using "personal narratives" (i.e. stories describing personal experiences) rather than a "fiction narrative" may be a more naturalistic measure of narrative discourse. It has been shown that children's personal narratives tend to be more coherent and less of "picture description" (McCabe, Bliss, Barra, & Bennett, 2008); as such, they may be a more sensitive measure of pragmatic language.

Second, the sample was relatively small. Given that the primary objective of the study was to examine the specific effect of pragmatic language on social skills over and above any general language difficulties, children with ADHD and comorbid language problems were excluded. However, in light of the high comorbidity between ADHD, language disorders, and social problems, it would be important to evaluate pragmatic language skills of children with ADHD and comorbid language difficulties.

Overall, our findings indicate that children with ADHD have poorer pragmatic language skills compared to their typically developing peers across multiple aspects of pragmatic language, even after controlling for receptive language abilities. This finding is important and consistent with the notion that social skills in ADHD are not solely explained by the disorder itself. Although one can argue that certain discourse management skills overlap with ADHD symptoms (i.e., turn-taking and difficulty waiting turn), other pragmatic language skills measured by presupposition and narrative discourse are not directly related to ADHD behaviors and suggest a separate area of difficulty independent of ADHD symptoms.

Further, our results indicated that pragmatic language deficits as measured by parent ratings of discourse management mediate the social impairment seen in ADHD. In other words, ADHD was no longer a significant predictor of social impairment after accounting for ratings of discourse management. This finding has important clinical implications and suggests that at least

for some children with ADHD, effective social skills interventions need to address pragmatic deficits in addition to social skills. Incorporating pragmatic language component into social skills training could potentially be a new framework for developing treatment approaches, which is important in light of limited effectiveness of existing interventions. As discussed earlier, pragmatic language is a complex construct that includes various verbal and non-verbal abilities. Given the heterogeneity of pragmatic language skills and a wide range of social deficits seen in children with ADHD, an intervention would likely be most effective when targeting specific difficulties that a child experiences. For example, the optimal intervention for a child who struggles to maintain eye contact might be different from a child who lacks the sense of boundaries and has difficulty maintaining proper distance from others.

To date, there are no specific interventions of pragmatic language that have been applied in ADHD. The findings from our study suggest that pragmatic language is an area of weakness in many children with the disorder. Given the prevalence of ADHD and associated social impairment, such alternative interventions have the potential for improving the quality of life of many individuals with ADHD and their families.

Our results also indicated that children's performance on the narrative task was consistent with other measures of pragmatic language. This suggests that using narrative tasks may be an alternative valid method for assessing children's pragmatic language abilities that may be more palatable to children compared to standardized testing. This is particularly important for testing children with behavioral difficulties including ADHD, when obtaining optimal performance can be challenging.

Finally, our finding of pragmatic language deficits in ADHD is consistent with one of the most prominent theories of ADHD, which suggests that the core symptoms of the disorder arise

from a deficit in executive dysfunction (Barkley, 1992; Barkley, 1997; Schachar et al., 2000). Executive functions include cognitive flexibility and allow us to properly maintain and switch problem-solving sets in order to navigate the constantly changing environment (Barkley, 1997). Pragmatic language, broadly defined as the use of language in social contexts, also requires flexibility, as we use various cues to infer information from the context, monitor conversations, and organize our verbal output to achieve successful communication. As such, pragmatic language has been described as a neurolinguistic ability that relies not only language but also on other cognitive domains, including executive functions (Abdelal, 2009). Similarly to executive problems, pragmatic deficits have been associated with real-world impairment (Nigg & Casey, 2005). Executive deficits have been well documented in ADHD (Seidman, 2006). Pragmatic deficits in ADHD, in particular narrative discourse deficits, have also been attributed to executive dysfunction (Purvis & Tannock, 1997). Further, it has been argued that because of the relationship to executive functions, narrative discourse and pragmatics are more likely to be impaired in children with ADHD of all aspects of language (Tannock, 1996). Pragmatic deficits can also be related to executive dysfunction from the neuroanatomical perspective as both have been associated with frontal regions, including the anterior cingulate gyrus (Ferstl et al., 2008; Tesink et al., 2009; Stuss, Gallup, and Alexander, 2001; Rowe, 2001). Given that frontal networks have been implicated in ADHD, it is not surprising that individuals with ADHD present with pragmatic problems. As discussed above, findings supporting the relation between executive deficits and social impairment in ADHD have been inconsistent. However, executive functions comprise a wide range of skills and abilities. Our findings suggest that individuals with ADHD and comorbid pragmatic language problems are at an increased risk for social difficulties. In future studies, it would be important to examine the relation between the severity of pragmatic

and executive deficits, and whether strong executive abilities can be protective of social impairment.

Appendix. NAP Scoring Criteria.

Narrative Aspect	Criteria
Topic Maintenance	2 = All utterances on topic 1 = Most utterances on topic, some off topic associations 0 = Most utterances off topic
Event Sequencing	2 = All events in chronological order 1 = Most events chronologically ordered 0 = No chronological ordering
Informativeness: Police Officer	Total number of details (see below)
Informativeness: Teacher	2 = Appropriate elaboration 1 = Moderate elaboration 0 = Minimal elaboration, 1-2 statements at best
Informativeness: Chef (elaborations, evaluations, actions)	2 = All three ingredients present 1 = One ingredient missing 0 = Two missing
Referencing	3 = All references appropriate for culture and SES 2 = Most pronouns used appropriately 1 = Mildly impaired referencing (5-15 errors) 0 = Severely impaired referencing (> 15 errors)
Conjunctive Cohesion	2 = Variety used

	1 = Only "ands" and "thens" 0 = No conjunctions
Fluency	Total number of dysluencies (i.e., repetitions, false starts)

Informativeness: Key story elements

1. Boy is sleeping/wakes up
2. It starts snowing
3. Boy makes snowman
4. Boy goes to sleep
5. Boy wakes up
6. Boy goes to see snowman
7. Snowman comes alive
8. Boy invites Snowman inside
9. They go to (only one mention of following)
    a. Into kitchen
    b. Parents' room
    c. Boy's playroom
    d. Garage
10. Two go flying
11. They come back
12. They say good-bye
13. Boy goes to sleep
14. Boy wakes up, runs downstairs
15. Snowman is melted, gone

Narrative Sample 1.

The boy woke up and he saw it was snowing, so he got dressed quickly and asked his mom if he could go outside. He put his boots and his hat on and ran outside. The boy made a large (DESCR) snowman and he asked/and he asked his mom if he could borrow a hat and scarf. Then he took an orange and some coal and the orange was the nose, the coal was the buttons and the eyes. Then with his fingers he made a smile. Then it was time to go back in the house. So (CONJ) he kept looking out the window to make sure his snowman was ok, even when he brushed his teeth and went to go to bed. His mom tucked him in bed (DET) and he pretended to go to sleep and he woke up again. He looked at the window and saw his snowman. Then he went back into bed and he couldn't fall asleep, so he put his robe on and slippers (DET) and went down the stairs to look at his snowman in the window. He went outside and saw that his snowman was alive. The snowman walked over to him and shook his hand. Then the/the little boy let him into his house. He showed him the living room, his cat (DET) and then he let him watch tv. He showed him how to turn/turn off a lamp (DET) and turn it on. Then he (REF) went upstairs and the boy told him to be quiet. He/the/the little boy opened the door and they saw the kitchen. He showed him (REF) how to turn off and on the switch and how to turn on/on the stove, the sink, then the snowman found something interesting and squeezed it. Next (CONJ) he started unrolling the paper towels, so the little boy told him to stop and showed him the ice cube container. Then he opened up a cabinet and the snowman was/was very interested in it (EVAL). So they went upstairs and the little boy showed him (REF) his parents. The snowman tried on his (REF) glasses, tie and his mother's hat and his father's pants suit. Then they left. The s/he/the little boy showed him, the snowman his room. They/they/they played and played. Then (CONJ) they went downstairs, the little boy showed the snowman his/his Mo/his parent's car, then he

(REF) pretended to/to drive it. Then they opened a cooler and let the snowman sit inside it. They got out and got some food, the little boy cooked it and they ate. Then they washed the dishes and went back outside. The s/the snowman showed him something and the snowman could fly. They/they flied so high the little boy could see the town (CAUS). They went all over the world. The s/the snowman stopped at a deck. They looked at the sunrise (DET), then they had to go back home. When (CONJ) they came back home, the snowman led the little bo/the little boy to his house. They said good-bye and the snowman went back into his place standing there. The little boy looked out the window. He went back into bed and fell asleep. He woke up and put his robe and slippers on and ran down the stairs. His mom and dad were eating breakfast. He ran to look outside and his snowman had melted.

Scoring: Topic maintenance = 2

Sequencing = 2

Informativeness = 19 (Police Officer = 15; Teacher = 2; Chef = 2)

Referencing = 2

Conjunctive Cohesion = 2

Fluency = 18

Narrative Sample 2.

So it's about this boy who built a snowman. It took/it takes all day. He (REF) wakes up at midnight and he magically springs to life (EVAL). He did all sorts of fun things. He puts on/he puts silly things and they/they went into this box thing. They (REF) had a feast. They are flying. They flied all over the city. And the boy went/ and the boy was asleep. When he woke up he/he didn't just ran out, he sprint to the snow. And what he found, the snowman melted. The end.

Examiner: Can you tell me some more details from the story?

Also, also/they also had lots of fun. It was a great night that time. That's all.

Examiner: How about you start from the beginning and you tell me…?

He (REF) woke up. He saw the snow. So he got up and he got all his clothes. He told his mom that he wanted to go outside. So he put on his boots, his hat, and when he is just around, he is fast a lot. And he made/he constructed a snowman. It took him all day. And then one night (SEQ) when he was sleeping, he woke up, he couldn't just leave it, so he just walked outside and the snowman sprung to life! And ohhhh, oh my (EVAL)! And then he (REF) came and shook his (REF) hand. And they (REF) had so much fun. He (REF) went in the house. He/he pet a cat kitty buddy, it ran away. He watched TV. He looked at the lamp. He tried to cut but the boy said, "Be careful, ok?" So he's/he looked at picture/ looking at the picture, what do you think? / wait/ and then he (REF) invited him (REF) into the kitchen and he turned on the lights and turned off the lights and they (REF) turned on the lights and turned off the lights. And they played with water in the sink. And they even did one on the stove. He (REF) took this cream and he spread it out. He even took out paper. He took out ice cubes. He opened/he opened this drawer which looked like it had lots of light in it. And then he (REF) went upstairs to his (REF) mom's bedroom and

he was so quiet. They (REF) were so quiet. They were sleeping. And the snowman figured out what were those things that look like fake teeth. And then he saw a picture of the boy. And then he showed him what/what is/then he started to wore it, wearing very funny things (DESCR). After that he (REF) took it all off and he went to his (REF) room. Then he hung on a skateboard. And he (REF) took him (REF) and helped him with it, he fell and he helped him. He (REF) also did this light and there were so much balloons, wheeeee (EVAL)! Then they (REF) went downstairs. They went to the car and they turned on the lights. And he (REF) went outside and got to this thing. And then he went inside, it felt so warm or something. Then he got out. And then he sat into a chair and they had a little feast. And then when they (REF) were done, they cleaned everything. And then they went outside. Then he (REF) ran and he ran and then he flew up in to the sky! He flew in this dark snowy (DESCR) night. He flew over the c/over the sky. And he flew over to a/to a castle looking thing (DESCR, DET). And he saw the view. And then he pointed it and he thought they/ he shou/they should go that way and he let them go home. He saw the sun so they we/so they/so they hurry as fast as they can. They (REF) got to the xxx before the sun rises because he (REF) knew what/they knew would happen. So they all hugged each other and he said goodbye to the snowman. And then he (REF) turned it over to his snowman. He watched him all night/he watched him all night. Then he went to bed and he had so much problems. And when he woke up he just ran out of his bedroom. He put up his stuff. He ran. His mother and father noticed how he just ran. They were at the table. Right after/right even before he ate breakfast, but then the snowman had melted.

Scoring: Topic maintenance = 2

Sequencing = 1

Informativeness = 15 (Police Officer = 13; Teacher = 0; Chef = 2)

Referencing = 0

Conjunctive Cohesion = 2

Fluency = 24

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