ASD symptoms in children with ADHD
Nijmeijer, Judith Simone

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Attention-deficit/Hyperactivity Disorder and Social Dysfunctioning

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Abstract

Attention-deficit/hyperactivity disorder (ADHD) is associated with functional impairments in different areas of daily life. One such area is social functioning. The purpose of this paper is to critically review research on social dysfunctioning in children with ADHD. Children with ADHD often have conflicts with adults and peers, and suffer from unpopularity, rejection by peers, and a lack of friendships, in part as a consequence of their ADHD symptoms. Comorbid oppositional defiant or conduct disorder aggravates these impairments. In some cases the inadequate social behavior of children with ADHD may be phenomenologically and etiologically related to autism spectrum disorders (ASD). However, the causes and consequences of ASD symptoms in ADHD are understudied. Also, the relative contributions of ADHD, on the one hand, and comorbid disorders, on the other, to the course of social impairments are unknown. Social dysfunctioning in children with ADHD appears to increase their risk of later psychopathology other than ADHD. Thus far effective treatment for social dysfunctioning is lacking. Future research should address the exact nature and long-term consequences of social dysfunctioning in children with ADHD, and focus on development of effective treatment strategies.
Introduction

Attention-deficit/hyperactivity disorder (ADHD) is characterized by inattention, impulsivity, and hyperactivity and has recently been estimated to affect 3.5% of school-aged children worldwide (Polanczyk, 2007), being one of the most common psychiatric disorders of youth (American Psychiatric Organisation [APA] 2000). Based on the pattern of symptoms present, the Diagnostic and Statistical Manual (DSM IV; APA, 1994) distinguishes three subtypes, the inattentive, the hyperactive/impulsive, and the combined subtype. The latter is by far the most common. Although ADHD symptoms tend to decline with age, at least 50% of children with ADHD will still experience impairing symptoms in adulthood (Faraone, Biederman, & Mick, 2006); in other words, it is a chronic and sometimes life-long disorder.

ADHD is associated with impairments of functioning in cognitive, academic, familial, and eventually occupational domains of daily life (Barkley, 2003). Another important area that is impaired in ADHD is social functioning. This may become manifested as rejection by peers and conflicts with other children and adults. Social dysfunctioning may be of crucial importance for the prognosis of children with ADHD on both short and long-term (Greene et al., 1996; Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997). The behaviors that cause social impairments may in at least some children be a direct consequence of the defining symptoms of ADHD. Some of the criteria for ADHD in DSM-IV even refer directly to inadequate social behavior, such as "interrupting or intruding on others." In general, the combination of hyperactivity, impulsivity, and inattention is likely to affect adequate fine-tuning of social behavior. Nevertheless, not all children with ADHD show inadequate social behavior. Furthermore, the DSM-IV ADHD-criteria are not sufficient to describe all inadequate social behaviors that can be observed in children with ADHD. Other important indicators of social impairment are oppositional behaviors and conduct problems as seen in oppositional defiant disorder (ODD) and conduct disorder (CD). This corresponds with the high rates of comorbid ODD and CD in children with ADHD. Estimates for the co-occurrence of either disorder range from 30 to 50% in both clinical and epidemiologic samples (Spencer, 2006).

It is an intriguing question why some children with ADHD, despite having difficulties in performing tasks at school, have a healthy social life, and why others appear to be unable to connect with peers and other people in a normal way. The latter group of children may have a diminished capacity for social reciprocity and difficulties in understanding social cues. These features appear similar to what constitutes the core of autism spectrum disorders (ASD), in DSM-IV described under the heading of problems in social interaction.

This interesting link between ASD and ADHD is one of the topics we will elaborate on in this review. We will start, however, by describing the inadequate social behaviors
that are commonly observed in children with ADHD. These behaviors show overlap with the characteristics of the other childhood disorders that primarily affect social functioning, i.e., ODD, CD, and ASD, thus leading to diagnostic difficulties that will be discussed in the second section. Next, we will report on findings that may support the idea that at least in some cases the inadequate social behaviors of children with ADHD may be phenomenologically and etiologically related to ASD. Also, the prognostic relevance of social dysfunctioning associated with ADHD will be described. Furthermore, currently used assessment methods and treatments for problematic social behavior will be summarized. Finally, we will provide suggestions for future research.

Publications reviewed here were found by internet-based literature searches in PubMed and EBSCOhost. In addition to this, we explored the literature references of relevant papers. Our searches were not limited to certain key-words, as the terminology used in the topics we reviewed varied widely between studies. When publications on a topic were scarce, older relevant publications were studied as well. Table 1 provides a summary of the key publications of this review.

Throughout this review, the term social dysfunctioning is used to refer to a broad range of social problems (that are not specific for ADHD), including problems in adequately tuning behavior to different social situations, difficulties in understanding social information, reduced contact and social interest, or a lack of meaningful relations.

**How Do Children With ADHD Behave Socially?**

In understanding the link between ADHD and social dysfunctioning, it is important to first understand how children with ADHD behave socially. Important studies on this subject are summarized in Table 1. In observational studies, children with ADHD appeared to be more socially intrusive (Frankel & Feinberg, 2002) and to initiate interaction with other children more frequently than control children (Buhrmester, Whalen, Henker, MacDonald, & Hinshaw, 1992; Erhardt & Hinshaw, 1994; Grenell, Glass, & Katz, 1987; Pelham & Bender, 1982; Whalen & Henker, 1985). Indeed, children with ADHD generally do not lack interest in contact with other people, but often have difficulties in attuning their behavior to other people. Two behavioral elements are frequently found to be associated with the social impairments of children with ADHD. These are the negative, aggressive nature of their interactions and, furthermore, their hyperactive/impulsive behavior. Examples of the first element are rule violations, hostile and controlling behavior, and the use of physical and verbal aggression (Cunningham & Siegel, 1987; Buhrmester et al., 1992; Erhardt et al., 1994; Grenell et al., 1987; Pelham et al., 1982). These behaviors may form a direct threat to other people,
and have been shown to be strong predictors of negative peer nominations in children with and without ADHD (Erhardt et al., 1994; Hinshaw & Melnick, 1995; Mikami & Hinshaw, 2003; Mrug, Hoza, Pelham, Gnagy, & Greiner, 2007; Pelham et al., 1982). The second element refers to restless and intrusive behaviors that are often inappropriate in the given context and resistant to correction. Examples are yelling, running around, talking at inappropriate times, and interrupting other children's play (Barkley, 1997). These behaviors, although having less impact than the negative-aggressive behaviors, have been suggested to be related to peer rejection independent of concurrent aggressive behavior (Wheeler & Carlson, 1994).

Inattention is another characteristic of children with ADHD, which in social situations manifests itself by not listening, being distracted and off-task, and having trouble switching roles (Landau & Milich, 1988; Whalen, Henker, Collins, McAuliffe, & Vaux, 1979). Similar to hyperactive behaviors, inattentive behaviors may independently contribute to rejection by peers (Pope, Bierman, & Mumma, 1991). This can also be seen in children with the DSM-IV predominantly inattentive ADHD subtype, who experience more peer related impairments than do controls (Carlson, Lahey, Frame, & Walker, 1989; Carlson, Lahey, Frame, Walker, & Hynd, 1987; Hodgens, Cole & Boldizar, 2000). These children do not show the aggressive and hyperactive behaviors described before, but tend to be more dreamy, passive, and slow in their style of behavior (Carlson & Mann, 2000; Maedgen & Carlson, 2000). They also demonstrate more anxiety, shyness, and withdrawal in comparison to children with ADHD with hyperactivity, and healthy controls (Hodgens et al., 2000; Lahey, Schaughency, Strauss, & Frame, 1984; Maedgen et al., 2000; Milich, Balentine, & Lynam, 2001; Willcutt, Pennington, Chhabildas, Friedman, & Alexander, 1999). Anxiety, shyness, and withdrawal may all have a negative impact on social function by diminishing the frequency of interaction with others. It has been proposed that the inattentive ADHD subtype differs in so many ways from the hyperactive/impulsive or combined subtype that it should be considered a separate disorder (Barkley, 2003, Milich et al., 2001). When studying the social problems of children with ADHD, it would be preferable to make a distinction between the three subtypes. Thus far this has been taken into account by only few studies on this subject.

Possible consequences of inadequate social behaviors include rejection and unpopularity with peers, and having few or no friends. Peers are important sources of information about the consequences of having ADHD for children's popularity. Peer opinion may be a better predictor of later psychiatric status than adult ratings (Cowen, Pederson, Babigian, Izzo, & Trost, 1973), perhaps because the opinion of peers is based on interactions not monitored by either parents or teachers, and evaluated by criteria that may be more relevant to daily life than those applied by adults. Therefore, sociometric studies are considered the “gold standard” for assessing peer relations. From the few sociometric studies involving children with ADHD, children with ADHD
### Table 1  Publications on ADHD and social dysfunctioning

<table>
<thead>
<tr>
<th>Authors (pub date)</th>
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</tr>
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<td>ToM and EF-tasks</td>
<td>ADHD: 9 out of 20 psychiatric controls; autism: 20; PDDNOS: 20; normal: 20; 8-18 yrs</td>
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<td>ADHD: 49; 5-15 yrs</td>
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<td>Luteijn et al. (2000)</td>
<td>Questionnaires; CSBQ; Autism Behavior Checklist, CBCL-items</td>
<td>ADHD: 152; PDDNOS 190; both: 98; clinical controls: 65; 4-18 yrs</td>
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*M=males only.

Note. ADHD=Attention-Deficit/Hyperactivity Disorder; ASD=Autism Spectrum Disorders; CBCL=Child Behavior Checklist; CD=Conduct Disorder; CSBQ=Children’s Social Behavior Questionnaire; EF=Executive Functioning; HKD=Hyperkinetic Disorder; OCD=Obsessive Compulsive Disorder; PDDNOS=Pervasive Developmental Disorders (Not Otherwise Specified); SAICA= Social Adjustment Inventory for Children and Adolescents; ToM= Theory of Mind
Outcome. Children with ADHD (vs controls):

- were more socially engaged, showed more hostile, disruptive, impulsive behavior. Aggressive behavior predicted dislike by younger children.
- were rejected on first day of interaction. Aggression strongly predicted negative friendship nominations.
- showed deficiencies in handling conflict and maintaining friendship, more unfriendly and impulsive behavior.
- showed more rule violations, defiance, disruptive behavior. Aggression resulted in worse sociometric status.
- were rated lower on social preference, higher on social impact, were less well liked, more often rejected, had fewer reciprocal friends, were chosen as non-friends by popular children.
- showed a bossy, aggressive interaction style, and were rejected by peers after 20 minutes of interaction.

Children with ADHD-ASD:

- scored similar to children with autism and PDDNOS, performed worse than clinical controls and normal children.
- (no controls) 65-80% of parents reported difficulties in social interaction and communication. Repetitive and stereotyped behavior occurred in at least one-third of children.
- scored higher on measures of ASD than clinical controls.
- showed more ASD-symptoms than clinical controls, including impairments in social interaction, qualitative impairments in communication, repetitive and stereotyped behavior. There may be 2 different types of social impairment in HKD, one of which is associated with autistic symptoms.

Prognosis:

- with social disability showed higher rates of mood, anxiety, disruptive and substance abuse disorders. Social disability predicted later CD and substance abuse after baseline mood and conduct disorders and ratings of aggressive behavior and attention problems were controlled.

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appear to be substantially more rejected by their peers than are control children (Erhardt et al., 1994; Hodgens et al., 2000; Hoza et al., 2005b; Pelham et al., 1982). In a relatively large study in which 165 children with ADHD were compared with their classmates in a natural setting, classmates often mentioned not wanting to be friends with children with ADHD, and not liking them. Of concern, 1 in 2 children with ADHD had a rejected status (defined as “highly visible and poorly liked”; Hoza et al., 2005b). Popular peers, whose opinion is likely to be important in establishing a social hierarchy, more often chose children with ADHD than children without ADHD as non-friends (Hoza et al., 2005b). Even after brief periods of interaction, such as one day of contact (Erhardt et al., 1994) or even two 20-minute play sessions (Pelham et al., 1982), children with ADHD appear to be rejected by their peers.

An important aspect when assessing the quality of peer relationships is the presence of reciprocal or dyadic friendships. Friendships are relatively independent of acceptance or rejection by peers (Parker & Asher, 1987) and are also important for the well-being of children and later psychosocial adjustment. Children with ADHD appear to have less dyadic friends than controls (Gresham, MacMillan, Bocian, Ward, & Forness, 1998; Hoza et al., 2005b; King & Young, 1981), but the number of available studies on this subject is limited. A notable finding is that parents and teachers perceive children with ADHD as having less close friendships than the children report themselves (Bagwell, Molina, Pelham, Jr., & Hoza, 2001; Hoza et al., 2005b, Heiman, 2005). This may be a consequence of differing definitions of friendship (Heiman, 2005), but may also be caused by illusionary positive self-concepts to which children with ADHD may be inclined (Hoza, Pelham, Jr., Dobbs, Owens, & Pillow, 2002; Hoza et al., 2004). The latter is supported by the finding that children with ADHD viewed their classmates as more likeable than their classmates rated them (Hoza et al., 2005b), implying that their preferences were not reciprocal.

The male predominance in clinical samples of children with ADHD is probably an important reason for the scarcity of studies on the social functioning of girls with ADHD. Estimates of the ratio of boys to girls range from 4:1 to 9:1 in clinical samples, and 2:1 to 3:1 in non-clinical samples (APA, 2000; Gaub & Carlson, 1997). From the few studies that specifically address girls with ADHD it appears that they have at least as many social skill deficits as boys (Biederman et al., 2005; Carlson, Tamm & Gaub, 1997; Greene et al., 2001). Just as boys with ADHD, girls with ADHD appear to behave more aggressively than healthy comparison girls (Ohan & Johnston, 2007, Thurber, Heller, & Hinshaw, 2002, Zalecki & Hinshaw, 2004), have fewer friends than control girls, have difficulty maintaining friendships (Blachmann & Hinshaw, 2002), and are more often rejected by peers (Hinshaw, 2002). Given that hyperactive behavior is more normative in boys than in girls, it has been suggested that ADHD symptoms may have an even bigger impact on girls’ social status (Carlson et al., 1997; Ohan & Johnston, 2007). Since studies on social functioning in girls with ADHD are scarce, in this review we will...
continue to report on studies that mainly address boys. It will be mentioned explicitly when girls have been considered separately.

In summary, both boys and girls with ADHD may show disruptive, aggressive, and hyperactive behaviors, which are important predictors for peer rejection. Children with these problems are often unpopular and lack reciprocal friendships, but are not always aware of their own unpopularity. Although children with the inattentive ADHD subtype also appear to suffer from rejection by peers, their social behavior is of a more subdued nature than that of children with the combined ADHD subtype. The former children’s passivity and slowness, and the anxiety, shyness, and withdrawal they are prone to may compromise their social skills.

Is Social Dysfunctioning Inherent to ADHD or a Consequence of Comorbidity?

The findings reviewed so far demonstrate that ADHD is associated with dysfunctional social behavior. A question that is more difficult to answer is whether or not social dysfunctioning is inherent to ADHD in itself and therefore might be uniformly present in children with ADHD, if in varying degrees of severity. Some of the behaviors that significantly contribute to the social dysfunctioning of children with ADHD are directly related to DSM-IV-TR criteria for ADHD. For instance, the intrusive behavior mentioned earlier is clearly represented in the impulsivity symptoms (“often interrupts or intrudes on others”, “has difficulty awaiting turn”) and the same applies to some of the hyperactivity symptoms (“often has difficulty playing or engaging in leisure activities quietly”, “often talks excessively”). Moreover, while symptoms of inattention, such as “often does not seem to listen when spoken to directly” and “often does not follow through on instructions…” do not constitute intentional rule-breaking behaviors, they can easily be interpreted and presented as such by parents or teachers. In a more general sense, children with ADHD often have difficulties restricting their behavior when appropriate or requested, and in resisting the temptation of immediate reward (Sonuga-Barke, Dalen, & Remington, 2003). Furthermore, they typically have problems focusing on relevant information in their environment, including the verbal and nonverbal behavior of other people. All three ADHD core dimensions impair the adjustment of behavior to a continuously changing (social) environment. Therefore, problems in social interaction may at least in some children be a direct consequence of the core dimensions of ADHD. Indeed, children with ADHD have been shown to have appropriate knowledge of adequate social behavior, but difficulties to apply this in real world settings (Barkley, 1997).

While ADHD is apparently often accompanied by social problems, many more factors contribute to social dysfunctioning in children. Psychiatric disorders in general...
and adverse environmental circumstances may also affect a child’s social behavior. It is important to keep this in mind when assessing a child with ADHD who has problems in social functioning. However, the most important predictors of rejection by peers are disruptive, aggressive behaviors, as stated in the first section of this article. Therefore, we will next focus on the contribution of comorbid ODD/CD to the social dysfunctioning of children with ADHD. A more controversial subject is the role of comorbid ASD symptoms in the social dysfunctioning of children with ADHD, which will be discussed in the subsequent section.

The negative, aggressive behaviors just mentioned are no part of our current definition of ADHD. Nevertheless, these behaviors are present in at least 40-70% of school-aged children with ADHD (Barkley, 2003). These percentages reflect the high comorbidity rates for ODD and CD in ADHD. CD may represent the severe end of what probably is a continuum of aggressive/deviant behaviors present in the majority of children with ADHD. The co-occurrence rate for ODD has been estimated to be around 30 to 60% in children with ADHD of 7 years and older (Biederman, 2005; Biederman, Newcorn, & Sprich, 1991; Goldmann, Genel, Bezman, & Slanetz, 1998; Jensen et al., 2001), and for CD at least 20% of school-aged children, with rates that tend to increase in adolescence (Biederman & Faraone, 2005). When ODD or CD can be diagnosed, ADHD is associated with more severe social impairments (Bagwell et al., 2001). For instance, children with ADHD and comorbid ODD and/or CD have more conflicts with their parents and teachers (Barkley, Anastopoulos, Guevremont, & Fletcher, 1992; Barkley, Fischer, Edelbrock, & Smallish, 1990; Edwards, Barkley, Laneri, Fletcher, & Metevia, 2001; Whalen, Henker, & Dotemoto, 1980), and also more peer problems than children with ADHD only (Gresham et al., 1998).

To summarize, ADHD in itself may bring along social dysfunctioning, but in a majority of children with ADHD, especially in referred samples, comorbid disorders can be diagnosed as well, with consequences for social functioning. However, the pathways leading to social impairments may differ in pure and comorbid groups. To complicate things even more, we do not know whether ADHD with and without one or more comorbid disorders is one and the same disorder. Indeed, some findings suggest that the combination of ADHD and ODD/CD may be an etiologically distinct ADHD subtype (Faraone, Biederman, Jetton, & Tsuang, 1997; Faraone, Biederman, & Monuteaux, 2000; Jain et al., 2006; Smalley et al., 2000). Longitudinal studies are needed to investigate the implications of comorbidity for social behavior over time. So far, studies on social behavior in children with ADHD have almost exclusively been cross-sectional, making it difficult to disentangle the way comorbidity may interact with ADHD, eventually leading to (an increase in) social impairments.
Overlap Between ADHD and ASD

The inadequate social behaviors of many children with ADHD are characterized by an apparent lack of comprehension of the impact of their actions on others, and the presence of a limited repertoire of social responses. These features are similar to those that apply to the social behavior of children with ASD and suggest a certain degree of symptomatic overlap between ADHD and ASD. It is an interesting question whether the social problems in children with ADHD are not only similar in presentation to those of children with ASD, but also share a common pathology. However, the nature, causes, and consequences of the symptom overlap between ADHD and ASD are relatively understudied.

Diagnostic issues

The paucity of studies on the co-occurrence of ASD and ADHD is at least in part due to two diagnostic issues. In the first place, both the International Classification of Diseases (ICD-10, World Health Organisation (WHO), 1992) and DSM-IV (APA, 1994) implicitly state that ASD takes precedence over ADHD, which does not easily allow for a combined diagnosis of ADHD and ASD. This strict segregation of ADHD and ASD may not do justice to clinical practice and research findings. Both ADHD and ASD are highly heritable disorders that can be seen as lying along a continuum of severity (Constantino & Todd, 2003; Constantino & Todd, 2005; Levy, Hay, McStephen, Wood, & Waldman, 1997; Pickles et al., 2000). Some children with ASD display symptoms of ADHD (Ghaziuddin, M., 2002; Ghaziuddin, M., Wedmer-Mikhail & Ghaziuddin, N., 1998; Goldstein & Schwabach, 2004; Keen & Ward, 2004; Lee & Ousley, 2006; Yoshida & Uchiyama, 2004). It is therefore not unlikely that some children with ADHD also have subtle ASD symptoms. A strict division of ADHD and ASD may leave children with ADHD with serious deficits in social behavior with an incomplete diagnosis, and vice versa.

Second, one of the diagnoses in the ASD category, namely Pervasive Developmental Disorders Not Otherwise Specified (PDDNOS), is used for milder conditions that do not fit into one of the other defined disorders. No positive criteria have been formulated for this disorder in the current DSM version (APA, 1994). As a consequence, there are no cut-off criteria to distinguish between normal children and children with PDDNOS, nor between PDDNOS and other developmental disorders. The distinction between PDDNOS and ADHD may be particularly difficult, as ADHD is evidently associated with problems in social interaction, which could be interpreted as ASD symptoms. As a result of these unresolved diagnostic issues, different studies on the co-occurrence of ASD symptoms and ADHD symptoms may be difficult to compare because of varying study group characteristics due to differences in applied diagnostic rules. Still, a number of research findings do support the presence of ASD symptoms in children with ADHD, which will be discussed in the following section.
ASD symptoms in children with ADHD

Children with ADHD were shown to have more social problems and higher scores on measures of ASD behaviors both in comparison to healthy controls and to children with psychiatric disorders other than ADHD (Buitelaar, van der Wees, Swaab-Barneveld, & van der Gaag, 1999; Hattori et al., 2006; Luteijn et al., 2000; Santosh & Mijovic, 2004). In Table 1, key publications on this subject can be found. The symptoms of ASD that are reported to occur most frequently in children with ADHD are impairments in social interaction, and, more specifically, the inability to conceive other peoples feelings and thoughts (Buitelaar et al., 1999; Clark et al. 1999; Santosh & Mijovic, 2004). Clark and colleagues (1999) found that over 85% of children with ADHD had “a lack of awareness of the feelings of others.”

Symptoms of the two other ASD-core dimensions, qualitative impairments in communication, and restricted repetitive and stereotyped patterns of behavior, interests, and activities, have also been reported in children with ADHD (Clark et al., 1999; Geurts et al., 2004a; Santosh & Mijovic, 2004). These symptoms appear to be present in a larger proportion of children with hyperkinetic disorder (HKD) compared to clinical controls (Santosh & Mijovic, 2004). Communication impairments in children with ASD are often due to problems in pragmatic language, referring to the appropriate use of language within social and situational contexts (Santosh & Mijovic, 2004).

Children with ADHD have been found to show similar problems with certain aspects of pragmatic language, including the appropriate initiation of conversation and use of syntax, as do children with high functioning autism (Bishop & Baird, 2001; Geurts et al., 2004a). The frequent presence of communication problems in children with ADHD has also been reported in the earlier mentioned study by Clark and colleagues (1999) in that the majority of children with ADHD demonstrated “odd forms of speech” and “problems in non-verbal communication.” “Stereotyped hand and body movements” were also present in a majority of children with ADHD (Clark et al., 1999). Similar findings have been reported by Santosh and Mijovic (2004). Interestingly, they furthermore discerned two types of social impairment, with one confirming the importance of comorbid ODD/CD in the social dysfunctioning of ADHD, and the other suggesting that ASD symptoms in children with ADHD may be associated with a separate type of social dysfunctioning. The first type was called “relationship difficulty,” the latter “social communication difficulty.” “Relationship difficulty” appeared to be linked to conduct problems, affective symptoms, and environmental stressors, whereas “social communication difficulty” was shown to be associated with speech and language difficulties, repetitive behavior, affective and conduct problems, and symptoms of ADHD. The authors argued that “social communication difficulty” could reflect autistic impairment, which in this study was found to be more often present in children with ADHD than in both clinical and healthy controls. They interpreted the limited contribution of environmental stressors to “social communication difficulty”
as compared to "relationship difficulty" as a possible larger influence of innate deficits on the former (Santosh & Miovic, 2004). These findings are in line with the strong genetic component that has been established for autistic disorder (Bolton et al., 1994; Folstein & Rutter, 1977; Steffenburg et al., 1989). Conversely, with regard to the social difficulties in children with disruptive and emotional behavioral disorders, commonly the contribution of environmental factors, such as family conflict and lack of family cohesion is underlined (Biederman, Faraone, & Monuteaux, 2002; Harris, 1994).

From the above, it appears that many children with ADHD have symptoms of the three ASD-core dimensions, and that these symptoms may be associated with a distinct type of social dysfunctioning. Research into an ADHD-related condition, namely DAMP (deficits in attention, motor control, and perception), may confirm these findings, as will be discussed in the following section.

**DAMP**

In the context of ASD symptoms in children with ADHD, Gillberg’s concept of DAMP is often referred to. DAMP is now defined as a combination of ADHD plus developmental coordination disorder (DCD; Gillberg, 2003). According to Gillberg (2003), DAMP is often accompanied by autistic features, and reversely, symptoms of DAMP may also often be present in children with ASD (Sturm, Fennell, & Gillberg, 2004). Data supporting the first hypothesis were found in a population-based sample of 42 children with Minimal Brain Dysfunction (MBD; Gillberg, 1983), a term historically used for behavior and dysfunctions very similar to that of DAMP. Eight (19%) children fulfilled a diagnosis of “psychotic behaviour,” a term used previously to describe symptoms nowadays considered ASD symptoms (Gillberg, 1983). In a re-evaluation of the study, one child was diagnosed with autistic disorder as defined in the DSM-III-R (APA, 1987; Gillberg & Gillberg, 1989), and three (7% of the total MBD-group) fulfilled criteria for Asperger’s disorder (Gillberg et al., 1989). It is unclear how many of these MBD/DAMP-children may have shown more subtle variants of ASD-behavior. It is conceivable that this would be the case in the 4 remaining children with “psychotic behavior” (9.5% of the total MBD group), who did not retrospectively fulfill the criteria for either autistic disorder or Asperger syndrome as defined by Gillberg (Gillberg et al., 1989).

As all DAMP children by definition have ADHD, it seems likely that high co-occurrence rates for ASD could also apply to ADHD in general. However, there are at least two reasons why the concept of DAMP should actually be used with care when used to refer to co-occurrence of autistic type problems in children with ADHD. First, in a later study it appeared that DAMP, and not so much ADHD or DCD separately, tended to predict a high risk of ASD (Gillberg, 2003). Second, as previously discussed, DSM-IV and ICD-10 both do not permit the use of the diagnosis of ADHD or HKD, respectively, when present in the course of a ASD. In this regard, Gillberg’s concept of ADHD as part of DAMP differs from our major classification systems. Children who
receive a DAMP-diagnosis and also have serious ASD related problems would in the DSM- and ICD-systems get a ASD diagnosis. However, although there may be differences in the classification-criteria for DAMP on one hand and ADHD on the other, research into DAMP does fit in with the findings of overlap between ADHD and ASD.

ADHD symptoms in children with ASD
Although the number of studies on ASD symptoms in children with ADHD is limited, the investigation of ADHD symptoms in children with ASD has received somewhat more attention. DSM-IV (APA, 1994) notes that features associated with ASD often include hyperactivity, short attention span, and impulsivity, which are the core symptoms of ADHD. Children with ASD have been found to score as high as children with ADHD on questionnaire scales related to hyperactivity and acting out behavior (Jensen, Larrieu, & Mack, 1997). Frazier and colleagues (2006) found that a majority of children with ASD who exhibited ADHD symptoms (82% of their sample) actually met DSM-IV criteria for ADHD. Moreover, the prevalence rates of ADHD subtypes in ASD samples have been found to be similar to non-ASD clinic-referred children (Frazier et al., 2006; Gadow, DeVincent, & Pomeroy, 2006; Lee & Ousley, 2006), and the severity of ADHD symptoms the same for all ASD subtypes (Gadow, DeVincent, & Pomeroy, 2004). In some children, ADHD symptoms dominate the clinical picture to such an extent that an ASD diagnosis can be missed initially (Perry, 1998). These findings may indicate that ADHD symptoms in at least some children with ASD are identical to ADHD in non-ASD children. Nevertheless, there is an ongoing discussion whether ADHD symptoms in the context of ASD represent ‘true’ ADHD or are part of what constitutes ASD. In DSM-IV, as mentioned before, ASD remains an exclusionary criterion for ADHD.

Overlap in Theory of Mind and Executive Functioning in children with ADHD and ASD
Apart from phenomenological studies reporting that many children with ADHD also have ASD symptoms, and vice versa, there are also other sources of information that support the existence of overlap between the two disorders. Results from Theory of Mind and emotion recognition tasks also tend to confirm the findings of a lack of awareness of the feelings of others in children with ADHD (Buitelaar et al., 1999; Yuill & Lyon, 2007). These tasks are designed to discern deficits in information processing that are supposed to underlie the social behavioral abnormalities in autistic disorder. Theory of Mind refers to the ability to attribute mental states, such as beliefs, desires, and intentions to oneself and other people and thereby to understand and predict behavior. Buitelaar and colleagues (1999) found that a majority of children with ADHD were as impaired on these tasks as high-functioning children with autistic disorder.
and PDD-NOS, especially with regard to second order mentalizing skills (the ability to predict beliefs about beliefs). Both healthy and clinical control children (children with dysthymia and conduct disorder) performed better on these tasks than did children with ADHD (Buitelaar et al., 1999). These results, however, need replication in a larger sample, as the number of children with ADHD in this study was limited to 9 subjects. Other indications for overlap between ADHD and ASD stem from studies into executive function (EF). Deficits in EF, commonly described as deficits in mental control processes, have been considered central deficits in both ADHD (Barkley, 1997) and ASD (Geurts, Verte, Oosterlaan, Roeyers, & Sergeant, 2004b). There is still ongoing discussion about the type of EF-profile that may be specific for either ADHD or ASD (Geurts et al., 2004b; Happé, Booth, Charlton, & Hughes, 2006; Nyden, Gillberg, Hjelmquist, & Heiman, 1999; Ozonoff & Jensen, 1999). It has been suggested that an inhibition deficit could be specific to ADHD (Geurts et al., 2004b; Sergeant, Geurts, & Oosterlaan, 2002; Happé et al., 2006; Sergeant et al., 2002) and that children with ASD more often show impairments in planning and flexibility (Hill, 2004). However, these findings have not been consistently replicated. Remarkably, in a recent paper by Jonsdottir and colleagues (2006) EF deficits in children with ADHD were not found to be related to ADHD symptoms, but only to comorbid depressive and autistic symptoms. It would be interesting to further investigate whether children with both ADHD and social impairments have more profound EF deficits than children without social impairments, and what type of EF deficits may be specific for this subgroup. This would aid in defining a socially disabled/ASD-related ADHD subtype.

Genetic overlap between ADHD and ASD?
As previously described, studying underlying cognitive deficits is one way to try to unravel underlying mechanisms for the overlap between ADHD and ASD. Looking into genetic mechanisms may be another valuable approach. Interestingly, genetic linkage findings have partially suggested the same genetic regions of interest in both ADHD and autism, that is 16p13 (Ogdie et al., 2003; Smalley et al., 2002), 17p11 (Ogdie et al., 2003), 15q (Bakker et al., 2003), and 11p15.5 (Yamagata et al., 2002). Thus far, these findings await replication in independent samples. It would be interesting to investigate whether the overlap in linkage findings would be stronger in socially disabled children with ADHD as compared to children with ADHD without social disability. If this would be the case, this would strengthen the hypothesis that the socially disabled phenotype is a distinct ADHD-subtype.

Summary
Summarizing, although DSM-IV and ICD-10 do not allow for a combined diagnosis of ASD and ADHD, in practice there appears to be mutual symptom overlap between the two. Just as a majority of children with ASD appear to have ADHD symptoms,
many children with ADHD have ASD symptoms. Children with ADHD frequently show symptoms of all three ASD core dimensions, that is impairments in social interaction, communication problems, and stereotyped and repetitive behaviors. Apart from symptom overlap there is considerable overlap in cognitive deficits between the two disorders, and it may be hard to discern children with ADHD from children with ASD based on these deficits. Interestingly, there are genetic linkage findings that suggest common genetic underpinnings for both disorders.

**The Prognostic Relevance of Social Problems in Children With ADHD**

In the previous sections, we have described the nature of social problems in children with ADHD, and the role of comorbid ODD/CD and ASD. To get a sense of the relevance of these problems, we will next review what is currently known about the long-term consequences of social dysfunctioning in children with ADHD. Acquiring the ability to adequately interact with other people is a crucial aspect of a child’s development. Children with ADHD have been found to demonstrate problems in social functioning as early as during their pre-school years (Alessandri, 1992; DuPaul, McGrey, Eckert, & VanBrakle, 2001). They also do not necessarily outgrow these problems, as the majority of adolescents and young adults (both male and female) with ADHD have been found to have few friends and difficulties keeping friends (Bagwell et al., 2001; Young, Chadwick, Hepinstall, Taylor, & Sonuga-Barke, 2005a; Young, Hepinstall, Sonuga-Barke, Chadwick, & Taylor, 2005b), the same type of social impairments that are present in childhood.

Other functional impairments associated with ADHD in later life include problems in academic performance (Mannuzza & Klein, 2000; Mannuzza, Klein, Bessler, Malloy, & Hynes, 1997; Lee & Hinshaw, 2006), having trouble keeping jobs, difficulties in financial management, and problems related to sexuality resulting in higher rates of treatment for sexually transmitted diseases and increasing the risk of early parenthood (Barkley, Fischer, Smallish, & Fletcher, 2004, Young et al., 2005b). Furthermore, both boys and girls with ADHD are at increased risk of developing other psychiatric disorders, such as mood and anxiety disorders, antisocial personality disorder, and substance abuse disorder (Biederman et al., 2006; Kadesjo & Gillberg, 2001; Lahey, Loeber, Burke, Rathouz, & McBurnett, 2002, Lee & Hinshaw, 2006; Willcutt et al., 1999). It is conceivable that these impairments in other areas and social dysfunctioning mutually influence each other, given the known long-term risks associated with having either peer problems (Laird, Pettit, Dodge, & Bates, 2005; Ollendick, Weist, Borden, & Greene, 1992; Parker et al., 1987) or ADHD, which are similar in nature.

Greene and colleagues (1996, 1997) have been the first, and as far as we know the
only researchers who have tried to distinguish the influence of social dysfunctioning from that of ADHD per se on the long-term prognosis of children with ADHD. They identified a socially disabled group of children with ADHD, representing 22% of their clinical sample. Social disability was defined by a discrepancy between observed and expected (based on IQ) scores on a measure of social functioning. Socially disabled children with ADHD were characterized by profound deficits in ratings of interpersonal skills and social functioning compared to non-socially disabled children with ADHD and healthy controls. The majority of these socially disabled children had one or more comorbid disorders, especially depression and CD (Greene et al., 1996). The prognostic relevance of discriminating such a socially disabled subgroup was shown by a 4-year follow-up study, where this group (mean age at follow-up 16.1) demonstrated significantly higher rates of psychiatric disorders other than ADHD compared to children with ADHD without social disability, and healthy controls (Greene et al., 1997). For a summary of this study, see Table 1.

Persistence of social dysfunctioning is probably at least in part related to persistence of ADHD (Bagwell et al., 2001). In about 70% of children diagnosed with ADHD the disorder continues to exist in adolescence (Faraone et al., 2006; Spencer, Biederman, & Mick, 2007). Furthermore, as reviewed by Faraone and colleagues (2006), approximately 85% of adults who were diagnosed with ADHD as children, no longer meet the criteria for ADHD at age 25. Still, about half of these adults experience impairing symptoms of ADHD (Faraone et al., 2006; Spencer et al., 2007). Thus, even though symptoms of ADHD tend to decline or change during development, this often does not mean complete remission. The same may be true for functional impairments associated with ADHD, including impairments in social functioning. Currently, however, there is a lack of longitudinal data on social dysfunctioning in ADHD.

As we have reviewed in earlier sections, aggression and rule-breaking behavior play an important role in the social problems of children with ADHD. These behaviors are often found to be present in adolescents and adults with ADHD as well. Follow-up studies of both referred and community populations have shown that ADHD is a risk factor for later delinquency, criminality, CD, and antisocial personality disorder (Barkley et al., 2004; Fergusson & Horwood, 1995; Klein & Mannuzza, 1991; Satterfield & Schell, 1997; Taylor, Chadwick, Heptinstall, & Danckaerts, 1996). In accordance with this, the prevalence rates of ADHD in delinquent adolescents and adults range from 4 up to 73% (Vermeiren, 2003). Furthermore, a substantial minority of children with ADHD (estimates range from 12-18% in adulthood) develop an antisocial personality disorder (Fischer, Barkley, Smallish, & Fletcher, 2002; Rasmussen & Gillberg, 2000). The latter refers to a pervasive pattern of antisocial behaviors, high levels of impulsivity and aggression, and an absence of concern about the feelings the individual’s behavior provokes in other persons. Clinical severity of ADHD (i.e., symptom severity and pervasiveness) and childhood-onset of antisocial behavior (especially when
accompanied by cognitive deficits) appear to be important in predicting these antisocial behaviors later in life (Fergusson et al., 1995; Fergusson, Lynskey, & Horwood, 1997; McArdle, O’Brien, & Kolvin, 1995; Mannuzza, Klein, & Moulton, III, 2002; Moffitt, 1990; Taylor et al., 1996; Wallander, 1988). Thus far, the prognostic relevance of the presence of symptoms of ASD has not been studied in children with ADHD.

Although understudied, it appears that social dysfunctioning in children with ADHD has serious long-term consequences in terms of the development of other psychiatric problems, including internalizing disorders, substance abuse, and conduct disorder (Greene et al., 1997). Furthermore, antisocial behaviors in later life are associated with ADHD, with an increased risk in children with severe ADHD and childhood-onset antisocial behavior. Given these findings, treatments aimed at improving social functioning in children with ADHD are of crucial importance. In the next section, we will review the efficacy of currently used treatment strategies.

**Treatment of Social Dysfunctioning in Children with ADHD**

Surprisingly little is known about the effects of ADHD treatments on social functioning. Pharmacotherapy (mainly stimulant medication) and/or behavioral interventions are ADHD treatments of choice. Although medication reduces inattention and disruptive and non-compliant behavior, it has not been found to increase positive social behavior or normalize peer status (Whalen et al., 1989; Whalen & Henker, 1991). Social skills training would seem a logical intervention in children with ADHD, but its effects are inconsistent. Generalization to home and classroom situations appears poor (Antshel & Remer, 2003; DuPaul & Eckert, 1994) and long-term effects have seldom been investigated. De Boo and Prins (2007) reviewed the effect of ADHD treatments on social skills and found that medication-induced reduction of symptoms was the strongest mediator of social skills improvement. Weak mediators included improvement of social cognitive skills and more effective parenting (de Boo & Prins, 2007). This is in line with results of studies by Abikoff and colleagues (2004) and Van Oord and colleagues (2007), who both found no advantage of social skills training over stimulant medication in improving social functioning in 7-9 and 8-12 year old children with ADHD, respectively. Also, in the multimodal treatment study of ADHD, children receiving medication appeared to have better peer assessed outcomes compared to those receiving behavior therapy and/or community care. However, no treatment modality resulted in normal peer relationships (Hoza et al., 2005a). This is in spite of parents and teachers who reported strong improvement of social skills for children in the combined treatment group (medication plus behavioral intervention; MTA Cooperative Group, 1999). Unfortunately, optimal treatment strategies for treating social problems in children with ADHD are still to be developed. Longitudinal studies
would be helpful to investigate the effects of different interventions on the relationships of children with ADHD with both adults and peers in natural conditions.

**Methods for Assessing Social Behavior**

As reviewed, the area of ADHD and social dysfunctioning is understudied, which may be due to a lack of reliable assessment methods. Although sociometric studies may be a good way to assess social impairment in children, these are impractical and time-consuming in large and clinical samples. Parent reports are now the most frequently used alternative. In the following, we will review currently used parent questionnaires for assessing social problems in children with ADHD.

Often, subscales derived from more general questionnaires aimed at measuring different behavioral and psychological problems, such as the Childhood Behavior Checklist (Achenbach, 1991) or the Conners’ rating scales (Conners, 1997) are used. There are also a few validated questionnaires specifically designed to assess social behavior as such. The Social Skills Rating System (SSRS; Gresham & Elliott, 1990) is one of these instruments. It was developed as a multiple-rater instrument, and assesses social skills, problem behavior, and academic competence in children (Gresham & Elliott, 1990). Internal consistencies for the SSRS are satisfactory, and its concurrent validity is moderate-to-high in comparison with other instruments measuring social competence (Van der Oord et al., 2005). Evidence for discriminant validity between children with ADHD and normal controls was found by Van der Oord and colleagues.

Another rating scale measuring social function is the Social Adjustment Inventory for Children and Adolescents (SAICA; John, Gammon, Prusoff, & Warner, 1987). This is a parent questionnaire consisting of 76 items divided among 12 subscales that assess social difficulties in different social environments (i.e., school, home, and spare-time activities) and in interaction with peers, siblings, and parents. It has sufficient concurrent and discriminant validity (Biederman, Faraone, & Chen, 1993; Greene et al., 1996; John et al., 1987), interrater validity, and internal consistency (Greene et al., 1997).

For studying ASD symptoms in children with ADHD, questionnaires addressing PDDNOS could be more appropriate than instruments for autistic disorder and Asperger’s disorder. The availability of such instruments is limited. Only two instruments have been developed for assessing PDDNOS-symptoms, i.e., the Social Responsiveness Scale (SRS), developed by Constantino and colleagues (2003) and the Children’s Social Behavior Questionnaire (CSBQ; Hartman, Luteijn, Serra, & Minderaa, 2006; Luteijn, Luteijn, Jackson, Volkmar, & Minderaa, 2000). The SRS is a 65-item rating scale that measures the severity of autism spectrum symptoms based on a child’s...
social impairments, social awareness, social information processing, capacity for reciprocal social communication, social anxiety/avoidance, and autistic preoccupations and traits. The SRS scores showed a correlation of around 0.7 with Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) algorithm scores for DSM-IV criterion sets and exhibited an inter-rater reliability around 0.8 (Constantino et al., 2003). The CSBQ contains items referring to behavior problems as seen in children with milder variants of ASD. In its current version the CSBQ consists of 49 items and 6 subscales. These subscales are "not optimally tuned to the social situation", "reduced contact and social interest", "orientation problems in time, place or activity", "difficulties in understanding of social information", and "fear of and resistance to changes". Estimates for internal, test-retest and inter-rater reliability, and for convergent and divergent validity were good (Hartman et al., 2006). The CSBQ appears to differentiate between autism and PDDNOS on the one hand, and PDDNOS and ADHD on the other (Hartman et al., 2006).

Most studies reviewed so far used questionnaires addressing more severe forms of ASD. There are several screening instruments in this category. The Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles, & Bailey, 1999) for instance is a brief instrument to screen for the presence of a ASD-diagnosis and is available in a "Lifetime" and "Current" form. Its content is derived from the ADI-R. The SCQ appears to have good discriminative validity for the discrimination of ASD from non-ASD (Berument et al., 1999). Other instruments in this category are the Autism Behavior Checklist (ABC; Krug, Arick, & Almond, 1980) and the Autism Spectrum Screening Questionnaire (ASSQ; Ehlers, Gillberg, & Wing, 1999).

In summary, validated instruments to assess problems in social functioning in children with ADHD include the SSRS and the SAICA. To assess ASD symptoms, the SCQ, ABC, and ASSQ can be applied. For children with ADHD, however, the SRS and CSBQ could be more useful, as these are the only validated instruments that address more subtle ASD symptoms.

**Concluding Remarks and Suggestions for Future Research**

ADHD is a highly prevalent developmental disorder that in many children is associated with dysfunctional social behavior, thus affecting what may be the most important area of human functioning. The hyperactive behavior of children with ADHD, combined with the often aggressive nature of their interactions may lead to unpopularity and rejection by peers. Social problems may also be present in adolescents and adults who may or may not have outgrown a childhood diagnosis of ADHD. Available research findings suggest that social problems form a significant risk factor for psychopathology other than ADHD. Unfortunately, routine treatment...
modalities have been shown to only marginally improve peer relations in children with ADHD. Treatments involving medication (which is effective only in a subset of children with ADHD) may be the best option to reduce peer problems today. Perhaps friendship interventions such as pairing children with ADHD with a “buddy,” as studied by Hoza et al (2003), may prove to be an effective way to induce protection against peer problems.

Comorbid ODD/CD and ASD symptoms are often present in children with ADHD, but it remains unclear whether these are the sole causes of social dysfunctioning in children with ADHD, or may be merely aggravating factors. The boundaries between these disorders and ADHD are not always clear. The exact role of ODD/CD and ASD symptoms in the social dysfunctioning of children with ADHD, and their influence on its treatment and prognosis needs more attention in future research. Furthermore, much work needs to be done in establishing clear-cut criteria for broader spectrum ASD symptoms and methods of assessing these validly. This would greatly facilitate distinguishing between ASD- and ADHD-related social problems. Another worthwhile focus for further research would be to disentangle the role of environmental and genetic factors on the development and possible persistence of social problems of children with ADHD, ideally by identifying a socially disabled subtype in twin and adoption studies. If a socially disabled ADHD phenotype proves to be a meaningful in terms of prognosis and heritability, this phenotype could be used to reduce heterogeneity in genetic studies, possibly leading to more powerful associations in subsequent candidate gene and gene-environment interaction studies. Perhaps either protective or risk genetic and environmental factors for social problems and their long-term consequences can be identified. Thus, ideally, individualized risk-profiles may be generated, forming a basis to apply tailored treatment strategies.

In summary, the inadequate social behaviors that are often observed in children with ADHD may lead to a range of social problems, including a lack of reciprocal friendships and unpopularity with peers. Identifying these problems in children with ADHD at an early stage is not only important when assessing their current impairments in everyday life, but also for preventive purposes. Longitudinal studies are of major importance to more fully address the impact of social problems of children with ADHD and the outcome associated with different treatment strategies.
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