

Regular Article

The profile of pragmatic language impairments in children with ADHD: A systematic review

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Abstract

This systematic review synthesizes the empirical literature examining pragmatic language in children diagnosed with attention-deficit/hyperactivity disorder (ADHD). Using a taxonomy of pragmatic language, we compared the pragmatic language profiles of children with ADHD to those of typically developing (TD) children and children with autism. Three databases were searched up to October 2019: PsychInfo; PubMed; and CSA Linguistics and Language Behavior Abstracts. We included 34 studies reporting on 2,845 children (ADHD = 1,407; TD = 1,058; autism = 380). Quality and risk of bias assessments included sample size and representativeness; measure reliability and validity; and missing data management. Children with ADHD were found to have higher rates of pragmatic difficulties than their TD peers. Specific difficulties were identified with inappropriate initiation, presupposition, social discourse, and narrative coherence. Children with ADHD appear to differ from those with autism in the degree of their pragmatic language impairments. General language skills contribute to, but do not explain, pragmatic difficulties in samples of children with ADHD. Though the extant evidence is limited, a preliminary profile of the pragmatic language impairments in children with ADHD is indicated. This supports a call for evidence-based interventions that include pragmatic language skills training.

Keywords: ADHD, autism spectrum disorders, communication, pragmatic language

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Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder defined by the presence of elevated levels of inattention, hyperactivity, and impulsivity that impair daily functioning (American Psychiatric Association, 2013). Comorbidity is common, and language impairments are increasingly identified in this population. Children with ADHD are thought to be at a threefold risk of comorbid language difficulties (Sciberras et al., 2014), including deficits in their expressive, receptive, and pragmatic language skills (Korrel, Mueller, Silk, Anderson, & Sciberras, 2017; Redmond, 2004). Despite growing awareness of language difficulties in this population, less than half of the children with ADHD and comorbid language impairments access speech pathology services, and only a quarter receive language support (Sciberras et al., 2014). This is concerning given the central role of language skills in long-term functional outcomes such as literacy, employment, social relationships, and mental health (Duff, Reen, Plunkett, & Nation, 2015; Hebert-Myers, Guttentag, Swank, Smith, & Landry, 2006; Law,

Rush, Schoon, & Parsons, 2009; Matthews, Biney, & Abbot-Smith, 2018; Salmon, O'Kearney, Reese, & Fortune, 2016).

One aspect of language of increasing interest in ADHD is pragmatics. While definitions of pragmatic language are many and varied (see Supplementary Table S1), there is a general consensus that pragmatics encapsulates the social use of language. The overarching construct of pragmatic language can be broken into constituent parts, examples of which include: conversational turn-taking, adapting the tone and content of spoken messages to meet the listener's needs, the initiation, maintenance, and termination of conversations, and producing coherent narratives (Prutting, & Kirchner, 1987; Staikova, Gomes, Tartter, McCabe, & Halperin, 2013). The pragmatic language abilities of children with ADHD have been the subject of two previous reviews (Green, Johnson, & Bretherton, 2014; Korrel et al., 2017). Green et al. (2014) synthesized the findings from 30 questionnaire-based, observational and experimental studies, concluding the pragmatic abilities of children diagnosed with ADHD, or with elevated levels of inattention and/or hyperactivity, are impaired relative to their TD peers. Specific difficulties were identified in conversational reciprocity, excessive talking, the production of coherent speech and possibly higher-level language comprehension. More recently, Korrel and associates (2017) conducted a systematic meta-analytic review of language problems in children diagnosed with ADHD. They identified 21 studies that assessed

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the performance of children with and without ADHD on standardized or validated language measures. Relative to the controls, children with ADHD showed large deficits in expressive, receptive, and pragmatic language skills, although the analysis for pragmatic language included only four studies.

The interest in pragmatic language in children with ADHD has been driven, in part, by growing recognition of the link between pragmatic language difficulties and social impairments in these children (Green et al., 2014). The results of several studies highlight the association between pragmatic language and social function in ADHD, in areas such as peer relationships (Staikova et al., 2013), likeability (Lahey, Schaughency, Strauss, & Frame, 1984), peer rejection (Hubbard & Newcomb, 1991), and social skills (Leonard, Milich, & Lorch, 2011). For example, in a community sample, Leonard et al. (2011) found that pragmatic language use fully (hyperactivity) or partially (inattention) mediated the associations between ADHD symptoms and social skill deficits. Similarly, in a sample of children with ADHD and their TD peers, Staikova et al. (2013) showed that discourse management skills fully mediated the association between ADHD symptom severity and social skills. Together, these findings suggest that pragmatic language is closely related to both ADHD symptoms and social skills, and that a more thorough understanding of pragmatic language in ADHD may have important theoretical and clinical implications.

While pragmatic language impairments have been identified in children with ADHD, thus far, few theories have been proposed to account for why this group is vulnerable to pragmatic difficulties. One hypothesis is that impaired pragmatic language might be expected in children with ADHD as several of the core symptoms of the condition – such as failing to respond when spoken to, talking excessively, difficulty awaiting conversational turns, and interrupting or intruding on others – are synonymous with pragmatic language problems (Green et al., 2014; Kuijper, Hartman, Bogaerds-Hazenberg, & Hendriks, 2017). Alternatively, pragmatic deficits may be a secondary consequence of inattention and hyperactivity/impulsivity on verbal and nonverbal communication (see Camarata & Gibson, 1999, for a detailed discussion). Symptoms of ADHD have also been proposed to contribute to pragmatic language impairments by reducing the opportunities in which children are able to practice their social communication skills (Hawkins, Gathercole, Astle, Holmes, & Team, 2016). In addition, poor social functioning in this population could be directly attributable to pragmatic language difficulties, as pragmatic language skills are critical to achieve effective social interactions (Staikova et al., 2013). While the discourse management aspects of pragmatic language overlap with symptoms of ADHD, the skills involved in presupposition and narrative discourse may not be directly accounted for by ADHD symptoms (Staikova et al., 2013).

Underlying cognitive mechanisms, such as executive dysfunction, and specifically, difficulties with planning, working memory, and emotion regulation, could also contribute to pragmatic language difficulties in ADHD, via both direct and indirect pathways (Blain-Brière, Bouchard, & Bigras, 2014; Hawkins et al., 2016). While executive function problems are likely important for pragmatic language in ADHD, research regarding the links between executive function and the development of pragmatic language skills has yielded mixed findings (Matthews et al., 2018), and several researchers have acknowledged the lack of specificity of this relationship (Green et al., 2014; Matthews et al., 2018). Thus, there are several possible explanations for the pragmatic difficulties in ADHD, including that they arise as a direct consequence of

the core ADHD symptoms; are associated with the widely reported social difficulties of children with ADHD; and may be underpinned by executive dysfunction.

Pragmatic language problems have been observed in a range of neurodevelopmental and psychiatric conditions, including ADHD (Bellani, Moretti, Perlini, & Brambilla, 2011). While there is a general consensus that children with ADHD have pragmatic language impairments, which may be related to core features of the condition, thus far, we have been unable to establish whether there is a pragmatic language profile that is specific to ADHD, or whether the pragmatic difficulties observed in these children overlap with those of other neurodevelopmental conditions. One possible comparison group is autism spectrum disorders (hereafter referred to as autism), a neurodevelopmental condition that is defined by social communication difficulties. Pragmatic language difficulties have long been considered a “hallmark” of autism (Kim, Paul, Tager-Flusberg, & Lord, 2014) and the nature of pragmatic language in autism is relatively well characterized (see Supplementary Material Table S2; Eigsti, de Marchena, Schuh, & Kelley, 2011; Kim et al., 2014; Landa, 2000; Loukusa & Moilanen, 2009). Pragmatic language impairments can also occur separately from autism and historically, children with pragmatic problems that are not of the pattern or severity as seen in autism, are considered to have a profile that is intermediate between autism and developmental language disorder (previously referred to as “specific language impairment”). In recognition of the potential for pragmatic language difficulties to occur in the absence of either a pervasive developmental or language disorder, a new diagnostic category, social (pragmatic) communication disorder (SPCD) was introduced into the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5; see Norbury, 2014, for a practitioner review of SPCD). While the validity of this diagnostic category has been challenged, it represents growing recognition that pragmatic language, and other aspects of language (e.g., Bishop, 2003, 2004, 2014), autistic traits (Bishop, 2003; Bölte, Westerwald, Holtmann, Freitag, & Poustka, 2011), and hyperactivity/inattentiveness (e.g., Greven, Buitelaar, & Salum, 2018), lie on a continuum. The SPCD category acknowledges that there is a subgroup of children who have pragmatic difficulties that are associated with a significant functional impairment, but to a lesser degree than seen in autism. If we consider pragmatic language problems to be a distinct neurodevelopmental phenomenon, then such difficulties can co-occur with any neurodevelopmental disorder.

The level of overlap between neurodevelopmental disorders broadly, and at a constituent symptom level is very high (see Thapar, Cooper, & Rutter, 2017). While the core diagnostic features of autism and ADHD are distinct, these two conditions frequently co-occur (Simonoff et al., 2008; Stevens, Peng, & Barnard-Brak, 2016). Even in the absence of complete comorbidity, children with one of these conditions often show isolated features of the other. For example, empirical evidence indicates that between 30% and 75% of children with autism diagnoses also have ADHD symptoms (Gadow et al., 2005; de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Greene et al., 1996; Johnston et al., 2013; Simonoff et al., 2008; Sprenger et al., 2013), and 20%–60% of those with ADHD have social difficulties that are characteristic of autism (Cooper, Martin, Langley, Hamshere, & Thapar, 2014; Grzadzinski et al., 2011; Grzadzinski, Dick, Lord, & Bishop, 2016; Leitner, 2014; Nijmeijer et al., 2009). Furthermore, children with ADHD are not easily distinguished from those with autism based on the scores obtained from

“gold-standard” diagnostic measures of autism (Grzadzinski *et al.*, 2016). Grzadzinski *et al.* (2016) reported that 21% of their sample of children with ADHD met cut offs for autism on the Autism Diagnostic Observation Schedule (ADOS), and 30% met all autism cut-offs on the Autism Diagnostic Interview (ADI-R). Differentiating autism from ADHD in children who are verbally and intellectually able is a particular clinical challenge (Hartley & Sikora, 2009; Luteijn *et al.*, 2000). Therefore, understanding the ways in which the pragmatic language profile of these two conditions differ, and the distinct underlying mechanisms that may drive pragmatic difficulties in these two groups, may be clinically informative in terms of distinguishing autism and ADHD at a behavioral level. Disaggregating the profile of pragmatic difficulties in ADHD may also direct treatment pathways, as current clinical guidelines for ADHD do not describe evidence-based interventions for co-occurring communication problems that may exist among this group.

Both clinical and empirical evidence indicates that “pragmatic language” is an overarching term that encompasses a broad range of distinct skills. We believe the conceptual framework described by Landa (2000, 2005), originally in the context of Asperger syndrome and later among typically developing children, may be a valuable framework to help clarify and better understand the nature of pragmatic impairments in children with ADHD. In this framework, Landa (2000, 2005) breaks the broader domain of pragmatic language into the subcategories of communicative intent, presupposition, and discourse (social and narrative). Identifying the profile of pragmatic language in ADHD using Landa’s framework will also facilitate the comparison of pragmatic profiles across neurodevelopmental disorders.

While the findings from the two previous reviews that have synthesized the extant literature on the nature of pragmatic difficulties in ADHD are valuable in showing that children with ADHD have pragmatic language difficulties, pragmatic language has either been treated as a unitary construct or the studies reviewed have included children without a clinical diagnosis of ADHD. To date, the pragmatic profiles of children with ADHD and those with autism have not been systematically compared. However, the results of a small number of parent-report studies suggest that the level of pragmatic language impairment among children with ADHD may be less severe than that seen in children with autism (Geurts & Embrechts, 2010). Thus, important next steps are (a) a systematic review of the empirical literature on the sub-domains of pragmatic language in ADHD, which will enable a description of the profile of pragmatic language in children with ADHD, and (b) comparison of the pragmatic profiles of children with ADHD to those with autism, a neurodevelopmental condition defined by deficits in pragmatic language. In this systematic review, we evaluate and compare the pragmatic language profiles of children diagnosed with ADHD and their TD peers, guided by the theoretical framework proposed by Landa (2000, 2005). A secondary goal of this review is to contrast the profile of pragmatic skills in ADHD with those observed in autism, which will allow us to identify similarities and differences in pragmatic language profiles and compare the severity of pragmatic difficulties across the two conditions.

Method

The quality of reporting and conduct of this review is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.

Protocol and registration

The review is registered with the PROSPERO International prospective register of systematic reviews. It is available online at: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=82595.

Study selection criteria

Articles were included in the review if they met the following criteria: (a) the article described an empirical study that assessed at least one aspect of pragmatic language in children with ADHD; (b) the findings from the study provided information on the nature, profile, or severity of pragmatic language difficulties rather than just a comparison at the total score level of a measure capturing a range of pragmatic language skills for example, Pragmatic Protocol. In the case of longitudinal or intervention studies baseline data is considered; (c) participants were aged between 5 and 18 years; (d) the study compared groups of children with ADHD to TD children and/or children with autism and reported the performance of these groups separately; (e) children in the ADHD and autism groups had a confirmed clinical diagnosis of ADHD or autism; (f) the study was published in English in a peer-reviewed journal. Studies were excluded if samples were known to include children with IQ scores below 70; and groups included children with comorbid ADHD and autism, unless data from these children were analyzed and reported separately. Studies that reported on groups of children with comorbid autism and ADHD were excluded from this review due to the aim, which was specifically to compare the pragmatic language abilities of these two groups. It was felt that the exclusion criterion regarding comorbid autism and ADHD would minimize the possible confounding influence of the pragmatic language difficulties in autism when compared to ADHD. There was no such exclusion for studies that included children with autism or ADHD and co-occurring language disorders. The inclusion of such studies allows us to parse out the possible effect of structural language difficulties on pragmatic language, particularly in the ADHD sample. In addition, prior to the introduction of the DSM-5, language impairment (i.e., the delay in, or total lack of development of language) was considered core to the diagnosis of autism, so it was impossible to determine which children had autism and comorbid language disorder unless this was reported explicitly.

Search strategy

Articles were identified by searching PsycInfo, PubMed and CSA Linguistics and Language Behavior Abstracts. PsycInfo and PubMed are considered the two major search engines for clinical psychology literature and use of both is recommended for reviews in this discipline (Wu, Aylward, Roberts, & Evans, 2012). In addition, we added a specialist linguistics database to ensure coverage of language journals. These three databases were chosen to balance the trade-offs between using a broader selection of databases with lower sensitivity and specificity on this topic with the resource capacity of the researchers (Wu *et al.*, 2012). A thorough manual reference list search was conducted to identify additional eligible articles. The following filters were applied where permitted: peer-reviewed journals, English language, human research, and children. There were no limitations on year of publication. A wide range of search terms were used to capture studies that covered all the skills comprising pragmatic language as described

by Landa (2000). Preliminary searches were conducted to establish the necessary key words to ensure sufficient search breadth. In addition to the constituent skills mentioned within Landa's framework, key terms from the broader pragmatic language literature were used to supplement the terms used. The final key words and MeSH terms (Medical Subject Headings) included: pragmatic; communication; gesture; presupposition; theory of mind; narrative; discourse; story telling; conversation; social interaction; inference; context; interpret; comprehension; humor; figurative; ADHD. The full search strategy for each database is presented in Supplementary Materials (Supplementary Table S3). Articles were identified with corresponding search terms in the title or abstract. The first author conducted the final search in October 2019; that is, all eligible articles published up to this date were included, there was no lower bound.

Articles identified from the three databases and from manual searching of reference lists ($n = 2887$) were imported into Endnote X8 and duplicates removed. Article titles and abstracts were screened by SC¹ to identify studies fulfilling the inclusion criteria. Short-listed articles were then separately reviewed and selected by SC and HS. A comparison of studies identified for inclusion resulted in $\kappa = 0.72$. Disagreements regarding eligibility were discussed with the last author, who made the final decision about article inclusion.

Data extraction

Data were extracted into a table by SC and each data point was checked for accuracy by HS. Extracted details included the sample demographics (age, gender, IQ, comorbidities), diagnostic procedures, study design (including measures of pragmatic language, study aims, relevant inclusion/exclusion criteria), analyses, and results relevant to the review questions, and covariates. While baseline performance on pragmatic language measures could have been extracted from intervention studies, no such studies were eligible.

Data synthesis

Given the focus of the research question on exploring the profile of pragmatic language skills, a framework was needed to structure the results that would cover the main subcomponents. This was particularly important given the variation in concepts and methods used across studies. Most definitions of pragmatic language are high level and do not offer a breakdown of specific skills (see Table S1) and other reviews have tended to categorize findings by methodology (Adams, 2002; Green et al., 2014). We used the structure provided by Landa's (2000, 2005) review of pragmatic language, which has previously been used elsewhere (e.g., Staikova et al., 2013). Compared to other definitions, it provides comprehensive coverage of pragmatic skills and when compared alongside other commonly used definitions of pragmatic language, offered a useful structure for our research aims. Thus, study findings were reviewed within the general areas of pragmatic language they addressed: communicative intent, presupposition, social discourse or narrative discourse, or global pragmatic ability. Due to marked heterogeneity in research methods

including data coding and analysis, diagnostic procedures, and changes in diagnostic criteria over time, a meta-analysis was not conducted. Summaries of subscale effect sizes for the studies using the Children's Communication Checklist (CCC/CCC-2) are presented in Table 1 (pragmatic subscales) and Supplementary Table S5 (structural language and autism characteristic subscales).

Quality and strength of evidence assessment

The full list of criteria for the quality and strength of evidence assessment are presented in Supplementary materials. These criteria were adapted from the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (Thomas, Ciliska, Dobbins, & Micucci, 2004) and Cochrane Risk of Bias Criteria (Higgins & Altman, 2008). For the current review, the criteria included: representativeness of the cases and controls; size of the sample; reliability and validity of the measure(s) of pragmatic language; and assessment and management of missing data.

Results

Study selection

The electronic database search yielded 2,879 articles, with a further eight identified through reference list searches. A full article review was conducted for 137 articles; 104 were excluded based on the inclusion and exclusion criteria (the full list of excluded articles is presented in Supplementary Table S4). A total of 33 articles reporting on 34 studies were included (see PRISMA flow chart displayed in Figure 1).

Study characteristics

Of the 34 studies included in this review, 33 compared an ADHD group with a TD comparison group and eight an ADHD group with an autism sample (seven of these included a TD control group, one did not). There were 1,407 participants with ADHD (1,069 boys and 338 girls, ratio 3.2:1, mean age = 9.5 years), 1058 TD participants (805 boys, 251 girls, ratio 3.2:1, 2 unknown, mean age = 9.6 years), and 380 participants with autism (347 boys, 33 girls, ratio 10.5:1, mean age = 10.0 years). One study was a longitudinal design, all others were cross-sectional. Studies covered a range of methodologies for the assessment of pragmatic language, including parent- ($n = 8$), or teacher- ($n = 3$) report, direct/standardized assessment ($n = 7$), social interaction tasks ($n = 9$), study unique methodology ($n = 2$), and narrative production/retelling tasks ($n = 12$). Three of the studies used more than one of these methodologies (Kuijper et al., 2017; Ohan & Johnston, 2007; Staikova et al., 2013).

Summary of findings

We present the findings below using Landa's (2000, 2005) framework. Full details of the results of each study are presented in Table 2. Studies are grouped according to the subdomain of pragmatic language they measured. We did not identify any studies that measured communicative intent. Where only a few studies were identified for a pragmatic subdomain, results are discussed study by study; where the number of studies permitted (predominantly in the area of narrative discourse), results are grouped by pragmatic skill, though where this was possible the number of studies in each subdomain is still relatively small.

¹Available research capacity dictated that screening would be conducted by one researcher and then a two-person screening process at the short-list stage. To minimize the risk for any relevant articles being missed, the researcher responsible for the initial screen was very inclusive in the articles taken through to full text screening.

Table 1. A summary of Cohen's *d* effect size for studies using the Children's Communication Checklist (CCC/CCC-2) for subscales relevant to pragmatic language and pragmatic composite

Study	CCC version/ informant	ADHD versus TD							ADHD versus autism						
		Coherence	Inappropriate initiation	Stereotyped language	Use of context	Nonverbal communication	Conversational rapport	Pragmatic composite	Coherence	Inappropriate Initiation	Stereotyped language	Use of context	Nonverbal communication	Conversational rapport	Pragmatic composite
Geurts et al., 2004 Study 1	CCC/ Parent	-1.34	-1.54	-1.63	-1.71	-	-1.14	-2.05 ^a	0.87	0.07	0.72	0.75	-	1.10	1.01 ^a
Geurts et al., 2004 Study 1	CCC/ Teacher	-0.97	-1.17	-0.71	-1.52	-	-0.35	-1.32 ^a	0.65	0.00	0.83	0.52	-	0.97	0.98 ^a
Geurts et al., 2004 Study 2	CCC/ Parent	-1.30	-2.19	-1.71	-1.90	-	-1.64	-2.28 ^a	0.74	0.06	1.10	0.83	-	0.95	1.72 ^a
Geurts et al., 2004 Study 2	CCC/ Teacher	-0.80	-1.77	-1.18	-1.39	-	-3.72	-1.39 ^a	0.93	0.10	0.58	0.82	-	-1.50	1.09 ^a
Geurts & Embrechts, 2008 – Study 1	CCC-2/ Parent	-0.88	-0.99	-0.53	-0.92	-0.71	-	-0.97 ^b	0.26	0.28	0.44	0.65	0.83	-	0.67 ^b
Staikova et al., 2013	CCC-2/ Parent	-	-	-	-	-	-	-2.26 ^c	-	-	-	-	-	-	-
Timler, 2014	CCC-2/ Parent	-	-	-	-	-	-	-1.19 ^d	-	-	-	-	-	-	-
Vaisanen, Loukusa, Moilanen, & Yliherva, 2014	CCC-2/ Parent	-1.89	-2.61	-1.35	-2.08	-1.62	-	-	-	-	-	-	-	-	-
Kuijper et al., 2017	CCC-2/ Parent	-1.72	-1.86	-1.37	-2.01	-1.64	-	-2.04 ^e	0.33	0.35	0.50	0.92	1.06	-	0.82 ^e

Note. For the ADHD versus TD comparison, a negative effect represents the ADHD group having more difficulties than the TD group. For the ADHD versus ASD comparison, a negative effect represents the ADHD group having more pragmatic language difficulties than the ASD group. Cohen's *d* calculations used pooled standard deviation which incorporated sample size where it differed across the groups.

^aSum of subscale scores for inappropriate initiations, coherence, stereotyped conversation, use of conversational context, and conversational rappings

^bSum of subscale scores for coherence, inappropriate initiations, stereotyped language, use of context, and nonverbal communication

^cSum of subscale scores for coherence, inappropriate initiations, stereotyped language, use of context

^dDerived by taking the mean for six subscales: inappropriate initiations, stereotyped language, use of context, nonverbal communication, social relations, interests. Social relations and interests are reported in Supplementary Table S5.

^eSum of subscale scores for inappropriate initiations, stereotyped language, use of context, and nonverbal communication

ADHD = attention deficit hyperactivity disorder; CCC/CCC-2 = Children's Communication Checklist; TD = typically developing

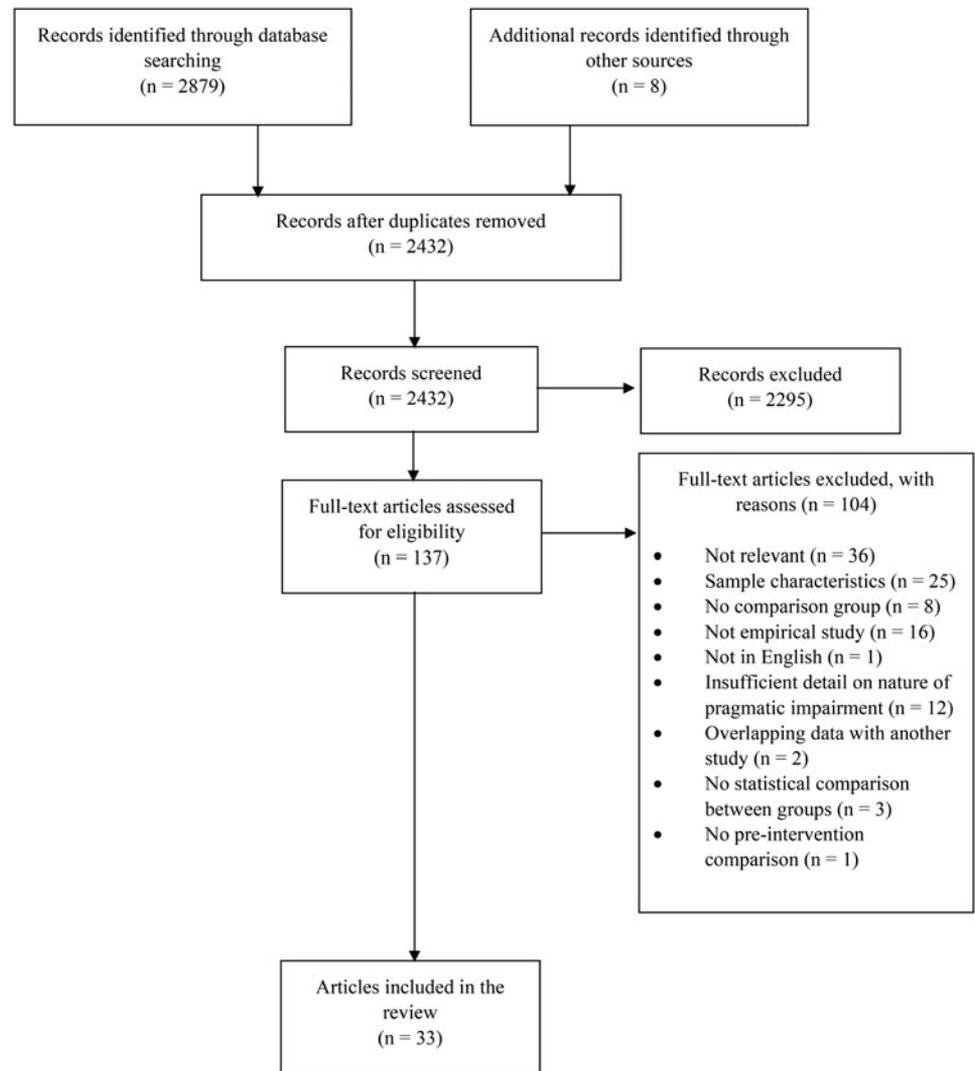


Figure 1. A Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow chart of study selection.

Global pragmatic language skills

We identified eight studies that used standardized language measures (Demopoulos et al., 2013) or parent/teacher-report questionnaires (Geurts et al., 2004; Geurts & Embrechts, 2008; Kuijper et al., 2017; Staikova et al., 2013; Timler, 2014; Vaisanen et al., 2014) to compare the pragmatic language skills of children with ADHD to TD children ($n = 7$) or children with autism ($n = 5$). The results of the seven studies that used either the CCC or the CCC-2 showed that both the subscale and pragmatic language composite scores for children with ADHD indicated less well developed pragmatic skills than their TD counterparts (see Table 1 for a summary of effect sizes) (Geurts et al., 2004; Geurts & Embrechts, 2008; Kuijper et al., 2017; Staikova et al., 2013; Timler, 2014; Vaisanen et al., 2014) (see Table 2). At a subscale level, children with ADHD have greater pragmatic difficulties than TD children on the CCC/CCC-2 coherence (Geurts et al., 2004; Geurts & Embrechts, 2008), inappropriate initiation (Geurts et al., 2004; Geurts & Embrechts, 2008; Kuijper et al., 2017), use of context (Geurts et al., 2004; Geurts & Embrechts, 2008; Kuijper et al., 2017), nonverbal communication (Geurts & Embrechts, 2008; Kuijper et al., 2017), and conversation (Geurts et al., 2004) subscales. Vaisanen et al. (2014)

showed that children with ADHD had greater pragmatic difficulty than their TD peers for all CCC-2 subscales.

The pragmatic language difficulties of children with ADHD have been shown to persist after controlling for comorbid language impairment (LI). For example, Timler (2014) assessed the impact of comorbid language impairment (defined as a score ≤ 85 on the Clinical Evaluation of Language Fundamentals, Fourth Edition [CELF-4] or the Test of Narrative Language [TNL]) on CCC-2 scores for children with ADHD. The children with ADHD + LI had significantly lower pragmatic composite scores than those without LI, who in turn had lower pragmatic scores than the TD group. Staikova et al. (2013) similarly found that, after controlling for general language ability (measured using the CELF-4), children with ADHD had significantly lower CCC-2 pragmatic composite scores than TD children. These findings suggest that pragmatic difficulties in ADHD may be disproportionate to their general language abilities. Results reported by Vaisanen et al. (2014) showed that, relative to the TD group, a significantly higher proportion (58%) of the ADHD group obtained SIDC (Social Interaction Deviance Composite, also referred to as the SIDI, Social Interaction Difficulties Index) scores that indicated pragmatic language impairments (i.e., a mismatch between

Table 2. Systematic review study characteristics and key findings

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
Global measures of pragmatic language								
Demopoulos, Hopkins, and Davis (2013)	CASL	Pragmatic Judgement subtest score	137 autism (123 boys, 10y 4 m) 436 ADHD (293 boys, 271 C-type, 137 I-type, 10y 6 m)	Chronological age	FSIQ ADHD $M = 98.20$, $SD = 14.70$ ASD $M = 88.33$, $SD = 18.86$	Not systematically assessed in the ADHD group. Verbal IQ was reported. ADHD M VIQ = 103.66, $SD = 13.60$ ASD M VIQ = 93.27, $SD = 18.25$	Not reported	ADHD group fewer pragmatic difficulties than autism group ^a
Geurts and Embrechts (2008 – Study 1)	CCC-2	Pragmatic composite ^{b,c} CCC-2 subscale scores ^b	29 ADHD (28 boys, 16 C-type, 3 H-type, 11 I-type, 10y 2 m) 29 autism (28 boys, 10y 1 m) 29 TD (28 boys, 10y 1 m)	Chronological age, sex	Children with intellectual disability were excluded	Not reported	Not reported	Pragmatic composite ^{b,c} : Autism > ADHD > TD Coherence ^b : autism, ADHD > TD. Inappropriate Initiation ^b : autism, ADHD > TD Stereotyped language ^b : autism > TD Use of context ^b : autism > ADHD > TD Nonverbal ^b : autism > ADHD > TD
Geurts et al. (2004 – Study 1)	CCC (completed by parents and teachers)	Pragmatic composite ^{b,d} CCC subscale scores	Parent 50 ADHD (23 boys, 9y 7 m) 50 High-Functioning Autism (HFA) (42 boys, 8y 8 m) 50 TD (35 boys, 8y 7 m) Teacher 41 ADHD (39 boys, 9y 8 m) 50 HFA (47 boys (8y 8 m) 41 TD (39 boys, 8y 7 m)	None reported	Children with FSIQ < 80 excluded	Not reported	Not reported	Pragmatic composite ^{b,d} : HFA > ADHD > TD (parent & teacher) Inappropriate Initiations ^b : HFA, ADHD > TD (parent & teacher) Coherence ^b : HFA > ADHD > TD (parent & teacher) Stereotyped Conversation ^b : HFA > ADHD > TD (parent); HFA > ADHD, TD (teacher) Use of Conversational Context ^b : HFA > ADHD > TD (parent); HFA > ADHD, TD (teacher)
Geurts et al. (2004 – Study 2)	CCC (completed by parents and teachers)	Pragmatic composite ^{b,d} CCC subscale scores	45 HFA (41 boys, 9y 4 m) 23 ADHD (20 boys, 14 C-type, 1 H-type; 8 I-type, 9y 4 m) 35 TD (27 boys, 8y 10 m)	None reported	Children were excluded if estimated FSIQ < 80. Reported FSIQ: ADHD $M = 99.5$, $SD = 13.3$. ASD $M = 97.9$, $SD = 18.3$. TD $M = 109.1$, $SD = 19.4$	Not reported	Not reported	Pragmatic composite ^{b,d} : HFA > ADHD > TD (parent & teacher) Inappropriate Initiations ^b : HFA, ADHD > TD (parent & teacher) Coherence ^b : HFA > ADHD > TD (parent & teacher) Stereotyped Conversation ^b : HFA > ADHD > TD (parent & teacher) Use of Conversational Context ^b : HFA > ADHD > TD (parent & teacher)
Kuijper et al. (2017)	CCC-2 ^e	Pragmatic composite ^{b,f} CCC-2 subscale scores	34 ADHD (28 boys, 18 C-type, 10 H-type, 6 I-type, 8y 11 m) 38 autism (33 boys, 9y 4 m) 36 TD (25 boys, 8y 11 m)	Chronological age, sex		PPVT-III NL WBQ ADHD $M = 100.06$, $SD = 11.32$. ASD $M = 104.61$, $SD = 15.90$. TD $M = 108.72$, $SD = 10.94$	Not reported	Pragmatic composite ^{b,f} : autism > ADHD > TD Coherence and Inappropriate Initiations ^b : autism, ADHD > TD Stereotyped Language, Use of Context and Nonverbal Communication ^b : autism > ADHD > TD
Staikova et al. (2013)	CCC-2 ^g	Pragmatic composite ^{b,h}	28 ADHD (23 boys, 19 C-type, 1 H-type, 8 I-type, 8y 7 m) 35 TD (24 boys, 9y 1 m)	Chronological age, sex	Children were excluded from the study if their estimated VCI was < 80 at age 6 years.	CELF-4 Concepts and following directions, ADHD $M = 9.18$, $SD = 2.09$. TD $M = 10.97$, $SD = 2.07$. CELF-4 Formulated	Two children were prescribed stimulants. Both were medication free on the day of testing.	Pragmatic composite ^{b,h} : both with and without language covaried: ADHD > TD

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
						sentences ADHD <i>M</i> = 9.32, <i>SD</i> = 2.45, TD <i>M</i> = 10.94, <i>SD</i> = 2.28.		
Timler (2014)	CCC-2	Pragmatic composite ^{b, i}	32 ADHD (27 boys, 6y 8 m) 12 TD (6 boys, 6y 8 m)	None reported	FSIQ ADHD <i>M</i> = 100.33, <i>SD</i> = 14.56. NVIQ TD <i>M</i> = 100.18, <i>SD</i> = 15.8	To be included in the study, children were required to pass the phonological screener from the Test of Early Grammatical Impairment. The CELF-4 Core Language scores were used to measure language, with a Core Language score ≤ 85 used as the cut off for Language Impairment. Core Language ADHD <i>M</i> = 97.34, <i>SD</i> = 14.89. TD <i>M</i> = 109.33, <i>SD</i> = 11.13. 10 of the children with ADHD (31%) had ADHD + LI. LI was not identified in any of the TD controls.	Not reported	22 of the ADHD group considered to have language impairment based on CCC-2 scores. Pragmatic composite ^{b, i} . ADHD with LI > ADHD without LI > TD
Vaisanen et al. (2014)	CCC-2	CCC-2 subscale scores SIDC ^l	19 ADHD (15 boys, 9y 7 m) 19 TD (15 boys, 8y 1 m)	None reported	Children with ADHD and co-occurring Intellectual Disability were excluded from the study.	The Token Test for Children– 2nd Edition and the Finnish version of the Test of Word Finding were used to verify that the TD sample had no language problems.	Not reported	ADHD > TD for all subscales ^b including the SIDC ^l . At item level, TD and ADHD could be distinguished on 2/7 Coherence items, all Inappropriate Initiation items, 1/7 Stereotyped Language items, 3/7 Use of Context items, and 2/7 Nonverbal Communication items.
Use of context								
Caillies, Bertot, Motte, Raynaud, and Abely (2014)	Irony stories ^k	Explanations of ironic comments Understanding of speaker's beliefs and attitudes	15 ADHD (10 boys, 8 C-type, 4 H-type, 3 I-type, 9y 0 m) 15 TD (10 boys, 9y, 0 m)	Chronological age, sex, school grade, NVIQ	NVIQ, scores not reported	Verbal Reasoning (Similarities subtest from the WISC-IV) ADHD <i>M</i> = 17.90, <i>SD</i> = 5.51. TD <i>M</i> = 22.87, <i>SD</i> = 4.24	All children were prescribed methylphenidate. Children were not medicated on the day of testing.	ADHD group had greater difficulties explaining ironic comments than TD children ADHD group had less comprehension of the irony speaker's belief than TD children Comprehension of the irony speaker's attitudes: ADHD = TD
Dyck, Ferguson, and Shochet (2001)	Strange Stories Test	Number of mental state explanations	20 Autism (17 boys) 28 Asperger Syndrome (24 boys) 34 Intellectual Disability (18 boys) 35 ADHD (31 boys) 14 Anxiety Disorder (7 boys) 36 TD (27 boys) Mean age 12y 1m	None reported	Not reported	Not reported	All children with ADHD were prescribed stimulant medication. There was no reported requirement to cease medication prior to testing.	Scores on the Strange Stories Test were significantly lower for the Autism group compared to all other groups. ADHD group had significantly higher scores than the Asperger's group, which in turn had higher scores than the Autism and ID groups. No difference between the ADHD and TD groups. When cognitive ability was entered as a covariate, differences between the Asperger's and TD groups became non-significant.

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
Ludlow, Chadwick, Morey, Edwards, and Gutierrez (2017)	Social Inference-Minimal Test from the Awareness of Social Inference Test (TASIT)	Correct identifications of sincerity, sarcasm, and paradoxical sarcasm from short vignettes	22 ADHD (15 boys, 20 C-type, 1 H-type, 1 I-type, 12y 11 m) 22 TD (15 boys, 12y 10 m)	Chronological Age Verbal IQ	Not reported	BPVS-III ADHD <i>M</i> = 90.18, <i>SD</i> = 8.68. TD <i>M</i> = 95.05, <i>SD</i> = 11.64	All ADHD participants were taking prescribed medication for ADHD.	ADHD significantly less accurate than TD children when detecting paradoxical sarcasm and making decisions based on the speaker's feelings. No difference between ADHD and TD groups in understanding sarcasm based on the speaker's intentions and beliefs.
Mary et al. (2016)	Faux Pas Task	Number of correctly identified faux pas	31 ADHD (17 boys, 28 C-type, 3 I-type, 10y 4 m) 31 TD (14 boys, 10y 0 m)	Chronological age	Children were only included in the study if estimated IQ \geq 85. ADHD <i>M</i> IQ = 106, <i>SD</i> = 22; ADHD + LI <i>M</i> IQ = 94, <i>SD</i> = 12. TD group were not administered IQ assessment,	Not reported	Some children with ADHD were taking stimulant medication (<i>n</i> = 14). Medication was suspended for at least 24 hours prior to testing.	Children with ADHD were less accurate than TD children at identifying the faux pas
Staikova et al. (2013)	CASL TOPL-2 ⁶	CASL composite score derived from Nonliteral Language, Inferences, and Pragmatic Judgement subtests TOPL-2 PLU index	28 ADHD (23 boys, 19 C-type, 1 H-type, 8 I-type, 8y 7 m) 35 TD (24 boys, 9y 1 m)	Chronological age, sex	Children were excluded from the study if their estimated VCI was < 80 at age 6 years.	CELF-4 Concepts and following directions, ADHD <i>M</i> = 9.18, <i>SD</i> = 2.09. TD <i>M</i> = 10.97, <i>SD</i> = 2.07. CELF-4 Formulated sentences ADHD <i>M</i> = 9.32, <i>SD</i> = 2.45, TD <i>M</i> = 10.94, <i>SD</i> = 2.28.	Two children were prescribed stimulants. Both were medication free on the day of testing.	Presupposition composite ^a : children with ADHD showed greater impairment than TD children
Social discourse								
Brenzitz (2003)	Recorded speech sample	Measures of vocalisation frequency, vocalisation duration, pause frequency, pause duration, total turn change time, turn change frequency	35 ADHD (35 boys) 35 dyslexia (35 boys) 35 TD (35 boys) Aged 8-10 years	Chronological age, IQ	FSIQ ADHD <i>M</i> = 109.3, <i>SD</i> = 2.7. Dyslexia <i>M</i> = 111.3, <i>SD</i> = 3.6. TD WISC-III subtest scores Vocabulary <i>M</i> = 115.5, <i>SD</i> = 3.1, Block Design <i>M</i> = 112.8, <i>SD</i> = 2.9.	No language measures reported	All ADHD participants had previously taken stimulant medication. Participants had ceased medication for at least one month prior to participating in this study.	ADHD group showed more pauses, less turn-taking, longer delay before speaking than TD group.
Clark, Cheyne, Cunningham, and Siegel (1988)	Peer interactions for mixed (ADHD-TD) and TD (TD-TD) dyads	Measures of functional attention (on-task behaviour) and social behaviour (frequency of positive, negative, and neutral interactions, command strategies, and non-interaction)	10 ADHD (10 boys, 8y, 3 m) 30 TD (30 boys, 8y 4 m)	Chronological age, SES, PPVT IQ used to match TD controls in the TD dyad for each member of the mixed dyad	All children scored within 1SD of the PPVT mean. PPVT verbal IQ scores calculated for each dyad. Mixed dyad <i>M</i> = 115.90, <i>SD</i> = 10.80. TD dyad <i>M</i> = 120.80, <i>SD</i> = 11.76. ADHD versus. Non-ADHD – ADHD <i>M</i> = 104.20, <i>SD</i> = 14.70, TD <i>M</i> = 120.80, <i>SD</i> = 11.26.	Only PPVT scores were reported	Not reported	Mixed dyads (ADHD-TD) had greater verbal reciprocity than TD dyads (TD-TD)
Cunningham and Siegel (1987)	Interactions (free play, cooperative task, simulated classroom task), for mixed (ADHD-TD) and TD (TD-TD) dyads	Percentage of the 90 intervals in which there were positive interactions, controls, solitary activities, positive responses, complies, controlling responses, and ignores	30 ADHD (30 boys, 8y 9 m) 90 TD (90 boys, 8y 8 m)	Within dyads, matched on chronological age and SES	PPVT VIQ Mixed dyads (younger) ADHD <i>M</i> = 112, TD <i>M</i> = 121. Mixed dyads (older) ADHD <i>M</i> = 107, TD <i>M</i> = 119. TD dyads (younger) <i>M</i> = 115, TD <i>M</i> = 119. TD dyads	Not reported	Not reported	Mixed dyads (ADHD-TD) spend a larger proportion of time giving commands, command-questions or negative responses than TD dyads (TD-TD). Mixed dyads were more likely to respond positively to controlling interaction than TD dyads. TD dyads were more likely to observe rather

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
					(older) TD $M = 123$, TD $M = 113$			than overtly respond to a controlling interaction than mixed dyads. Children in mixed dyads were less compliant with peers than TD dyads.
Grenell, Glass, and Katz (1987)	Free play, Cooperative Puzzle Task, Persuasion Task	Peer interaction measures including initiating friendship, giving directions, positive social behavior, negative social behavior etc.	15 ADHD (15 boys, 9y 4 m) 15 TD (15 boys, 9y 4 m)	Chronological age	IQ > 85 for boys with ADHD ($M = 107$)	Not reported	7 out of 15 boys with ADHD received regular stimulant medication. There was a 24 hour wash out period prior to participation in the study.	ADHD group had greater levels of non-communicative speech than TD children during the Cooperative Puzzle Task. ADHD = TD for all categories of behaviour during the Free Play and Persuasion Tasks.
Hubbard and Newcomb (1991)	Free play task that included mixed (ADHD-TD) and TD (TD-TD) dyads.	14 codes that measured solitary and associative play and communicative acts (e.g., greetings, positive, negative and non-communicative verbalizations)	8 ADHD (8 boys, 8y 6 m) 24 TD (24 boys, 9y 4 m)	None reported	Not reported	Not reported	All participants with ADHD received their usual dose of methylphenidate 2 hours prior to testing.	ADHD-TD dyad had less reciprocal conversation than TD-TD dyads ADHD-TD dyad showed less affective expression (positive and negative exclamations) than TD-TD dyads
Mikami, Huang-Pollock, Pffiffer, McBurnett, and Hangai (2007)	Computerized chat room task	Total number of responses; on-topic responses; detection of social cues; proportion of prosocial comments; proportion of hostile statements; memory for peer statements	33 ADHD C-type (26 boys, 10y 1 m) 45 ADHD I-type (32 boys, 9y 6 m) 38 TD (23 boys, 9y 7 m)	Chronological age	Children with IQ < 80 excluded. FSIQ (or estimated FSIQ) ADHD-I $M = 106.99$, $SD = 12.27$. ADHD-C $M = 106.86$, $SD = 11.59$. TD $M = 114.38$, $SD = 11.45$	Not reported	Those taking stimulant medication ($n = 8$) ceased for 24 hours prior to testing. Discontinuation was not required for those taking non-stimulant medications ($n = 3$)	Total number of statements: ADHD-I produced fewer than ADHD-C, ADHD-C = TD Proportion of off-topic responses: ADHD-I = ADHD-C. Both ADHD groups produced more than TD Proportion of hostile responses: ADHD-C produced more than TD, ADHD-I = TD, ADHD-I = ADHD-C Proportion of prosocial responses: ADHD-I = ADHD-C = TD
Normand et al. (2011)	Card-sharing and game-choice tasks	Negotiation categories (e.g., proposals, preferences, responses, balance of power, affect)	87 ADHD (67 boys, 66 C-type, 3 H-type, 18 I-type, 10y 3 m) 46 Non-ADHD referred comparison (34 boys, 10y 4 m) 133 TD friends (65 boys, 10y 2 m)	Chronological age, school grade, sex	Children with FSIQ < 80 were excluded.	Not reported	ADHD children taking medications were not required to suspend treatment while participating. 82% of the ADHD sample was medicated during testing.	ADHD group produced more insensitive and self-centred proposals than non-ADHD referred comparison Frequency of altruistic proposals: ADHD = Non-ADHD referred comparison ADHD group made fewer inquiries about their partner's preference than non-ADHD referred comparison ADHD group had a more dominant interaction style than their TD friends.
Ohan and Johnston (2007)	Computerized board game (Girl's Club!) Child Social Behavior Scale (parents and teachers) ¹	Messages in the Girl's Club were coded as: overt aggression, relational aggression, prosocial comments, and awkward comments Subscales on the Child Social Behaviour Scale measure overt aggression,	18 ADHD-only (0 boys, 10y 8 m) 22 ADHD + ODD (0 boys, 10y 6 m) 40 TD (0 boys, 10y 9 m)		Children with Intellectual Disability (parent- and teacher-reported) were excluded	Not reported	17 participants were taking methylphenidate, and five dextroamphetamine. All medication was ceased for 24 hours prior to testing	Frequency of responses in each category: Overt aggression: ADHD + ODD > ADHD-only > TD on all measures of overt aggression Relational aggression: ADHD + ODD > ADHD-only > TD on mother's ratings of relational aggression. ADHD > ADHD-only = TD on teacher ratings of relational aggression. ADHD + ODD = ADHD-only > TD on lab task.

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
		relational aggression, and prosocial behavior						Prosocial behaviour: ADHD + ODD < ADHD-only = TD on mother's ratings of prosocial behaviour. ADHD + ODD < ADHD-only = TD on teacher ratings of prosocial behaviour. ADHD + ODD = ADHD-only < TD on lab task.
Stroes, Alberts, and Van Der Meere (2003)	Conversation and play segments with an unfamiliar adult	Latency of verbal responses, frequency of interrupting, Communicative speech, answers, looking towards another's face, shared eye gaze	20 ADHD (20 boys, 8y 10 m) 19 TD (19 boys, 9y 1 m)	None reported	FSIQ ADHD <i>M</i> = 102, range = 83-120. TD <i>M</i> = 114, range = 86-148	Not reported	Children were not medicated during testing. Seven of the boys with ADHD ceased medication 24 hours prior to testing.	During conversation, the ADHD group showed less eye contact and reciprocity, and spoke for longer durations about the same topic than the TD group. During play, the ADHD group showed more eye contact, higher frequencies of verbal initiations and longer durations of communicative speech, and self-talk than the TD group.
Whalen, Henker, Collins, McAuliffe, and Vaux (1979)	Structured peer communication task	Global ratings of communicative quality, each rated on a 5-point Likert Scale; Communicative content	23 ADHD (23 boys, 9y 7 m) 39 TD (39 boys; 9y 2 m)	None reported	PPVT VIQ ADHD <i>M</i> = 112, range = 85-136. TD <i>M</i> = 122, range = 93-146	Not reported	Children in the ADHD group were treated with methylphenidate. Over the course of the study, half were taking this medication, and half placebo.	ADHD group had more difficulty adapting to the role (Astronaut or Mission Control) than the TD group, was less efficient in communication than TD group. In the Mission Control role, children with ADHD showed less efficient communication than the TD boys. In the Astronaut role, the ADHD boys more frequently disagreed with their partners, and were less likely to ask for confirmation or feedback than the TD boys.
Narrative discourse								
Derefinko, Bailey, Milich, Lorch, and Riley (2009)	Story narration using the wordless picture books, <i>Frog where are you?</i> (Mayer, 1969) and its prequel, <i>A boy, a dog, and a frog</i> (Mayer, 1967)	Scores indicated whether the child included initiating events, attempts to complete the goal, outcomes, GAO sequences, and errors	17 ADHD (14 boys, 17 C-type, 11y 5 m) 25 TD (20 boys, 11y 9 m)	Chronological age	Children with IQ ≥ 80 were included in the study	Not reported	All the children were taking stimulant medication at the time of study participation. This was ceased for 24 hours prior to testing.	The narratives of the ADHD group were less likely to include the positive outcome and completion of the story goal than narratives from TD children. The ADHD group also less frequently included specific attempts linked to the goal. No other group differences emerged.
Freer, Hayden, Lorch, and Milich (2011)	Story production task using picture cues, or no picture cues	Total number of GAO sequences in the story; Global coherence (rated on a scale of 1-4; 1 = <i>not at all coherent</i> , 4 = <i>very coherent</i>)	54 ADHD (42 boys, 9y 0 m) 101 TD (58 boys, 8y 8 m)	Chronological age	Children with "low IQ" excluded from the study.	Oral expression from the OWLS. ADHD <i>M</i> = 94.55, <i>SD</i> = 12.46. TD <i>M</i> = 15.83, <i>SD</i> = 15.17	Children were only included if they were not taking medication, or able to cease medication for 24 hours prior to testing.	TD group more likely to include a higher proportion of Goal-Action-Outcome (GAO) sequences, and more complex sequences, than the ADHD group. Overall, TD stories were more coherent than ADHD stories, even after accounting for expressive language levels.
Kuijper, Hartman, and Hendriks (2015)	Reference production task using four wordless storybooks		46 autism (40 boys, 9y 3 m) 37 ADHD (31 boys, 19 C-type, 12 H-type, 6	Chronological age	Estimated IQ ADHD <i>M</i> = 93.44, <i>SD</i> = 12.67. ASD <i>M</i> = 95.45, <i>SD</i> = 18.73, TD <i>M</i> = 109.02, <i>SD</i> = 13.64	PPVT-III-NL WBQ ADHD <i>M</i> = 100.22, <i>SD</i> = 12.49. ASD <i>M</i> = 104.09, <i>SD</i> = 15.27. TD <i>M</i> = 108.84, <i>SD</i> = 10.72	Children with ADHD were not receiving psychostimulant medication on the day of testing	No group difference in noun phrases when introducing a new character, re-introducing a character, or when maintaining a reference these characters. While the ADHD group

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
			I-type, 8y 9 m) 38 TD (25 boys, 9y 0 m)					produced a lower proportion of noun phrases than the autism and TD groups when two characters were present, there was no difference between these latter two groups.
Kuijper et al. (2017)	Telling a Story from a Book task from the Autism Diagnostic Observation Schedule (ADOS) ^e	Verbal productivity, speech fluency, syntactic complexity, lexical semantics, discourse pragmatics	34 ADHD (28 boys, 18 C-type, 10 H-type, 6 I-type, 8y 11 m) 38 autism (33 boys, 9y 4 m) 36 TD (25 boys, 8y 11 m)	Chronological age, sex	Estimated IQ ADHD $M = 93.04$, $SD = 12.81$. ASD $M = 93.09$, $SD = 17.58$. TD $M = 109.52$, $SD = 13.83$	PPVT-III NL WBQ ADHD $M = 100.06$, $SD = 11.32$. ASD $M = 104.61$, $SD = 15.90$. TD $M = 108.72$, $SD = 10.94$	Not reported	ADHD group was less likely to use full noun phrases to re/introduce a character. The autism and ADHD groups had a higher proportion of interruptions to their stories than the TD group.
Leonard, Lorch, Milich, and Hagans (2009)	Narrative retell using the wordless picture book, <i>Picnic</i> (McCully, 1984)	Story units were coded according to story grammar categories, including settings, initiating events, internal responses, goals, attempts to achieve goals, outcomes, goal completion, and events unrelated to the overall goal	25 ADHD (19 boys, 25 C-type) 39 TD (23 boys) Mean age 7y 6m	Chronological age, sex, verbal ability	WPPSI-R Vocabulary substest. ADHD $M = 10.7$. TD $M = 12.0$.	Not reported	90% of the ADHD group were taking stimulant medication. All participants were medication free on the day of testing.	Children with ADHD produced fewer goal-based events than TD. No group differences in non-goal-based events.
Lorch et al. (1999)	Story recall task using the folktales, <i>The father, his son, and their donkey</i> , and <i>The test of strength</i>	Each story unit rated as recalled or not recalled. Errors were categorised as ambiguous references and embellishments	70 ADHD (47 boys, 9y 5 m) 62 TD (39 boys; 9y 6 m)	Chronological age	Children with IQ < 80 were excluded. IQ ADHD $M = 103.3$, $SD = 16.5$. TD $M = 110.0$, $SD = 15.9$	Not reported	Not reported	The ADHD group made significantly more errors of all types than TD children. There were group differences in the extent to which story structure affected recall, for example, as the number of causal connections to a story unit increased, recall was higher for the TD than the ADHD group. The effects appeared to be moderated by sex and IQ.
Lorch et al. (2010)	Story recall task using 13-minute episodes of the <i>Rugrats</i> cartoon	Temporal coherence (correlation between the order of units as stated by the child and the correct order sequence. Global coherence (rated on a scale of 1-4; 1 = not at all coherent, 4 = very coherent)	57 ADHD (44 boys, 7y 2 m) 98 TD (60 boys; 7y 2 m)	Chronological age	Children with IQ < 80 were excluded. Estimated NVIQ ADHD $M = 10.28$, $SD = 3.77$. TD $M = 12.77$, $SD = 3.40$	Listening Comprehension and Oral Expression subtests from the OWLS. Listening Comprehension ADHD $M = 96.5$, $SD = 15.5$. TD $M = 103.1$, $SD = 12.1$. Oral Expression ADHD $M = 95.0$, $SD = 13.4$. TD $M = 108.6$, $SD = 15.43$.	Children who were prescribed psychostimulant medication did not receive any medication on the day of testing.	Free recall: Both groups showed increased recall over time, but overall, the ADHD group recalled less story units than the TD group. Global Coherence: Ratings of Coherence were higher for the TD relative to the ADHD group. Temporal Coherence: TD children were more able to recall the story in order than the children with ADHD, but this effect diminished after accounting for expressive language level.
Luo and Timler (2008)	Test of Narrative Language (TNL) picture-sequence and single-picture tasks	Each story unit was coded as setting, event, internal response, goal, attempt, and outcome. Goals and outcomes were then used to form GAO units, each of which was classified as complete or incomplete.	6 ADHD-only (4 boys, 10y 9 m) 6 ADHD + LI (4 boys, 9y 11 m) 5 LI-only (3 boys, 10y 10 m) 13 TD (8 boys, 10y 1 m)	Chronological age, sex	Children with IQ < 80 excluded. Estimated IQ ADHD-only $M = 106$, $SD = 22$. ADHD + LI $M = 94$, $SD = 12$. LI-only $M = 91$, $SD = 8$. TD group were not administered IQ tests.	CELF-4 Core Language ADHD-only $M = 103$, $SD = 16$. ADHD + LI $M = 77$, $SD = 5$. LI-only $M = 67$, $SD = 14$. TD $M = 114$, $SD = 8$.	Not reported	No group differences in the number of story grammar components in the picture-sequence task. Group differences in the single-picture task as follows: Total complete GAO units: ADHD + LI produced fewer than TD children. ADHD-only = LI-only = TD

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Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
Papaeliou, Maniadaki, and Kakouras (2015)	Story recall task using the folk tale, <i>The father, his son, and their donkey</i>	Story retelling was assessed using measures of Selective Recall (the proportion of idea units correctly recalled) and Responses to Factual Questions	25 ADHD (17 boys, 25 C-type, 8y 6 m) 25 TD (16 boys, 9y 1 m)	Chronological age, performance IQ	PIQ ADHD $M = 99$, $SD = 16.6$. TD $M = 106.6$, $SD = 11.9$.	Verbal IQ Test (Stavrakaki & Tsimpli, 2000). Vocabulary Production ADHD $M = 19.5$, $SD = 2.6$. TD $M = 19.5$, $SD = 2.2$. Grammar Comprehension ADHD $M = 48.2$, $SD = 4.4$. TD $M = 52.9$, $SD = 1.6$. Grammar Production ADHD $M = 16.9$, $SD = 4.4$. TD $M = 16.3$, $SD = 3.0$. Sentence Recall ADHD $M = 19.9$, $SD = 1.4$. TD $M = 51.3$, $SD = 5$.	Participants had no history of medication use.	Complete superordinate GAO units: ADHD + LI produced fewer than TD. ADHD-only = LI-only = TD Children with ADHD recalled fewer story units than TD children. As thematic importance increased, recall increased less for the ADHD than the TD group.
Purvis and Tannock (1997)	Story retelling task using the folk tale, <i>The father, his son, and their donkey</i>	Selective recall (number of story idea units correctly recalled); Responses to comprehension questions; Errors in sequencing; Ambiguous references; Misinterpretations; Inappropriate word substitutions	14 ADHD (14 boys, 8y 8 m) 14 ADHD + RD (14 boys, 8y 8 m) 8 RD (8 boys, 9y 3 m) 14 TD (14 boys, 9y 2 m)	Chronological age, Estimated IQ	Children with IQ < 80 were excluded. Estimated IQ ADHD $M = 104.9$, $SD = 9.4$. ADHD + RD $M = 101.6$, $SD = 12.2$. TD $M = 109.0$, $SD = 8.1$.	The Word Test (Jorgeson, Barrett, Huisingsh & Zachman, 1981; measure of expressive vocabulary). ADHD $M = 50.0$, $SD = 2.2$. ADHD + RD $M = 47.6$, $SD = 3.2$. RD $M = 43.2$, $SD = 5.0$. TD $M = 60.5$, $SD = 3.9$. Language Processing Test (Richard & Hanner, 1985; measure of semantic aspects of language). ADHD $M = 49.6$, $SD = 5.0$. ADHD + RD $M = 46.2$, $SD = 6.1$. RD $M = 43.1$, $SD = 8.6$. TD $M = 50.8$, $SD = 5.4$.	Four boys were being treated with stimulant medication. Treatment was withdrawn for 48 hours prior to testing.	Recall of total idea units: TD had a significantly higher proportion of total units recalled than all other groups. Narrative errors (sequence errors, misinterpretations, substitutions): ADHD > all other groups
Renz et al. (2003)	Story narration using the wordless picture book, <i>Frog, where are you?</i> (Mayer, 1969)	Measured settings, initiating events, internal responses, GAO sequences (attempts linked to goal, attempts linked to goal and location, negative outcomes, positive outcomes), and resolution of overall goal. Errors (within-clause errors, whole-clause errors, repetition errors)	22 ADHD (22 boys, 22 C-type, 12y 2 m) 44 TD (44 boys; 11y 7 m)	Chronological age	WISC-III Block Design ADHD $M = 9.76$, $SD = 3.83$. TD $M = 10.57$, $SD = 4.20$. WISC-III Vocabulary ADHD $M = 9.33$, $SD = 3.54$, TD $M = 12.70$, $SD = 4.20$.	None reported	Boys in the ADHD group were medication-free on the day of testing.	Relative to the TD group, a smaller proportion of the ADHD group provided completion of the overall story goal, but no group difference in Attempts Linked to Goal. No group differences in descriptions of positive or negative outcomes. The ADHD group committed more Within-Clause and Repetition errors than the TD group.
Rumpf, Kamp-Becker, Becker, and Kauschke (2012)	Telling a Story from a Book task from the Autism Diagnostic Observation Schedule (ADOS)	Grammatical complexity, Story length, Cohesion, Coherence, Speaker's perspective, and Narrative style	11 Asperger Syndrome (AS) (11 boys, 10y 6 m) 9 ADHD (8 boys, 9y 10 m) 11 TD (10 boys, 9y 1 m)	Chronological age, IQ, mean length of utterance	IQ ADHD $M = 104.4$. Asperger Syndrome $M = 109.4$. Scores for the TD group were in the normal range.	Not reported	Not reported	AS and ADHD groups produced significantly shorter narratives than the TD group. A significantly higher proportion of the AS and ADHD groups failed to convey the main aspects of the story than the TD group.

(Continued)

Table 2. (Continued.)

Reference	Pragmatic language task	Measure of pragmatic language	Participants <i>n</i> per group (number of boys, ADHD subtypes, mean chronological age)	Matching	Intellectual ability	Language skills	Medication use	Key findings
Staikova et al. (2013)	Narrative Assessment Profile ^g	Topic maintenance, event sequencing, and referencing were used to derive a Narrative Discourse composite score	28 ADHD (23 boys, 19 C-type, 1 H-type, 8 I-type, 8y 7 m) 35 TD (24 boys, 9y 1 m)	Chronological age, sex	Children were excluded from the study if their estimated VCI was < 80 at age 6 years.	CELF-4 Concepts and following directions, ADHD <i>M</i> = 9.18, <i>SD</i> = 2.09. TD <i>M</i> = 10.97, <i>SD</i> = 2.07. CELF-4 Formulated sentences ADHD <i>M</i> = 9.32, <i>SD</i> = 2.45, TD <i>M</i> = 10.94, <i>SD</i> = 2.28.	Two children were prescribed stimulants. Both were medication free on the day of testing.	Children with ADHD showed greater impairment than TD children
Tannock, Purvis, and Schachar (1993)	Story retelling task: Story 1: <i>The father, his son, and their donkey</i> Story 2: <i>The test of strength</i>	Comprehension measured by thematic sensitivity (recall scores as a function of the thematic importance of story units) and adequacy of children's responses to questions that probed for factual and inferential information. Production was measured as the total number of story units recalled. Errors (sequencing story events, cohesion, misinterpretations, inappropriate word substitutions, embellishments)	30 ADHD (30 boys, 9y 1 m) 30 TD (30 boys, 9y 5 m)	Chronological age, IQ	Children with FSIQ < 80 excluded. FSIQ ADHD <i>M</i> = 110.20. TD <i>M</i> = 114.50	Not reported	Five boys in the ADHD group were receiving stimulant medication, which was discontinued for 48 hours prior to testing.	ADHD group recalled less than TD children overall, but equally sensitive to thematic importance and no difference in comprehension scores. Children with ADHD produced fewer idea units than TD children. The ADHD group also made significantly more sequence and cohesion errors than the TD group.

Note. Studies are listed first by the subcategory of pragmatic language measured, and secondly by alphabetical order. Relevant findings from Staikova et al. (2013) and Kuijper et al. (2017) are reported in more than one section. ADHD – attention deficit hyperactivity disorder; ADOS – Autism Diagnostic Observation Schedule; AS – Asperger syndrome; BPVS – British Picture Vocabulary Scale; CASL – Comprehensive Assessment of Spoken Language; CCC/CCC-2 – Children's Communication Checklist; C-type (ADHD-C) – ADHD combined-type; FSIQ – Full Scale Intelligence Quotient; GAO – Goal-Attempt-Outcome units; GAO Sequences – sequences that include an initiating event to set up the character's overall goal, actions that explicitly or implicitly connect to the goal (attempts), and outcomes that are the result of the protagonist's action in relation to the goal. HFA – high-functioning autism; H-type – ADHD hyperactive-type; I-type (ADHD-I) – ADHD inattentive-type; LI – language impairment; NVIQ – Nonverbal Intelligence Quotient; ODD – oppositional defiant disorder; OWLS – Oral and Written Language Scales; PLU – Pragmatic Language Usage; PPVT-III-NL Peabody Picture Vocabulary Test 3rd Edition, Dutch translation; SIDC – Social Interaction Deviance Composite; SES – socioeconomic status; TD – typically developing; TOPL-2 – Test of Pragmatic Language, second edition; WBQ – Word Comprehension Quotient; VCI – Verbal Comprehension Index; WISC-III – Wechsler Intelligence Scale for Children, third edition; WISC-IV – Wechsler Intelligence Scale for Children 4th Edition

^aCASL/TOPL scales: higher score indicates greater pragmatic language skill

^bAs the meaning of a higher score differs across versions of the CCC and individual studies, we have reported findings in terms of more/less impairment where “>” means “more impairment than” and “<” means “less impairment than”. These symbols are only used where the difference is significant.

^cSum of subscale scores for coherence, inappropriate initiations, stereotyped language, use of context, and nonverbal communication

^dSum of subscale scores for inappropriate initiations, coherence, stereotyped conversation, use of conversational context, and conversational rapport

^eThe correlation between the two pragmatic language measures used in Kuijper et al., 2017 (CCC-2 and narrative discourse) was -0.21 and was significant at $p < .01$.

^fSum of subscale scores for inappropriate initiations, stereotyped language, use of context, and nonverbal communication

^gCorrelations between the three pragmatic language measures used in Staikova et al., 2013 (CCC-2, presupposition composite and Narrative Assessment Profile) ranged between 0.29 and 0.40. All three correlations were significant at $p < .05$.

^hSum of subscale scores for coherence, inappropriate initiations, stereotyped language, use of context

ⁱThe Social Interaction Deviance Composite (SIDC) identifies children who have pragmatic difficulties that are disproportionate to their structural language skills.

^jDerived by taking the mean for the six CCC-2 pragmatic language subscales: inappropriate initiations, stereotyped language, use of context, nonverbal communication, social relations, interests

^kThe authors created a series of 16 stories, each of which described an everyday situation and ended with an ironic statement. Each ironic story was matched to a corresponding story in which the final sentence was modified to become a literal statement. Every story was followed by three kinds of questions: one requiring an explanation of the ironic statement; and two assessing the child's understanding of the speaker's beliefs.

^lCorrelations between the pragmatic language measures used in Ohan & Johnston, 2007 (computer task, parent report and teacher report) ranged between 0.10 to 0.41. Not all were significant at $p < .05$.

pragmatic and structural language skills, see Ash, Redmond, Timler, & Kean, 2017 for a discussion of this composite score).

Several studies have compared pragmatic language skills in children with ADHD and those with autism (Geurts *et al.*, 2004; Geurts & Embrechts, 2008; Kuijper *et al.*, 2017). Together, the results show that, relative to children with autism, those with ADHD have fewer parent- and teacher-reported pragmatic difficulties at the level of pragmatic composite scores. Children with ADHD also have significantly higher scores (i.e., fewer pragmatic difficulties) than children with autism on direct assessments of their ability to make flexible and pragmatically accurate social judgements (Demopoulos *et al.*, 2013).

While differences between ADHD and autism groups are evident on specific CCC subscales, findings have been mixed. For example, Geurts *et al.* (2004) found that children with ADHD had lower levels of parent-reported difficulties than children with autism on the coherence, stereotyped language, and use of context subscales. In contrast, Kuijper *et al.* (2017) reported that their autism and ADHD groups were indistinguishable on the coherence subscale. The results of this latter study also showed that the ADHD group had fewer parent-rated impairments than the autism group on the use of context and nonverbal communication subscales of the CCC-2. Results consistently show that autism and ADHD groups have similar scores on the inappropriate initiation subscale, with both clinical groups obtaining lower scores (i.e., more impairment) than TD controls (see Table 2).

Evidence from parent- and teacher-report, as well as direct language assessments, suggests that children with ADHD have pragmatic language skills that fall between those of children with autism and their TD peers. Children with ADHD appear to have particular difficulties with making appropriate social initiations, as there are clear distinctions between these children and their TD counterparts in the frequency with which they make inappropriate initiations (e.g., Vaisanen *et al.*, 2014). Accounting for general language skills does not explain the group differences between children with ADHD and TD controls. The results of these studies suggest that pragmatic difficulties in ADHD are frequently accompanied by structural language weaknesses, but the pragmatic difficulties are greater than expected given structural language competencies.

Presupposition

Presupposition can be measured by testing a child's comprehension of nonliteral language (e.g., irony, sarcasm, metaphor) and their ability to use and interpret aspects of the social context to inform their judgements and inferences (Landa, 2000). Altogether five studies were identified that examine presupposition in ADHD (see Table 2).

Using tasks that required children to identify nonliteral language, two studies show that children with ADHD are less able to explain ironic comments (Caillies *et al.*, 2014) and identify social "faux pas" (Mary *et al.*, 2016) than their TD peers.

Difficulties with presupposition in children with ADHD have also been identified on standardized language assessments. Using The Awareness of Social Inference Test, Ludlow and colleagues (Ludlow *et al.*, 2017) found that while children with ADHD did not differ from TD children in their ability to detect sincerity or simple sarcasm (where it is clear that the speaker means something different to the literal statement), those with ADHD were significantly less accurate when detecting paradoxical sarcasm (where the script makes no literal sense unless it is assumed that one speaker is being sarcastic) than the TD children.

Staikova *et al.* (2013) derived a composite measure of presupposition from subtest scores on the CASL (nonliteral language, inferences, pragmatic judgement) and the Test of Pragmatic Language (TOPL-2). After controlling for general language ability (scores on the CELF-4), children with ADHD obtained significantly lower presupposition scores than TD children.

We identified only one study that compared presupposition in children with ADHD, autism, and TD controls (Dyck *et al.*, 2001). In this study, there were no differences in the scores of the ADHD and TD groups. After controlling for IQ, the children with ADHD provided a significantly higher number of accurate mental state explanations than those with autism. These preliminary findings suggest that the presuppositional skills of children with ADHD are stronger than those of children with autism.

The studies described in this section show that overall, the presupposition skills of children with ADHD; that is, their ability to detect sarcasm, irony, and social faux pas, are less well developed than those of their TD peers. The one exception was the study by Dyck *et al.* (2001), with results showing that children with ADHD had similar scores to TD children on the Strange Stories Test. Scores for the TD and ADHD groups were both at ceiling on this measure, so it is possible that the Strange Stories Test is not sensitive enough to detect presupposition difficulties in children with ADHD.

Social discourse

Ten studies were identified that addressed social discourse skills; nine through a social interaction task and one via a recorded speech sample (see Table 2).

Results from computer simulated interaction tasks, and parent and teacher ratings are consistent in showing that the messages of girls with ADHD were less prosocial, more awkward, and more overtly² and relationally aggressive during interaction with peers than TD children (Ohan & Johnston, 2007). These findings may, in part, reflect difficulties interpreting what is acceptable or expected in particular social contexts, but also appear to be driven to some extent by the presence of comorbid oppositional defiant disorder (ODD) in children with ADHD. However, the ODD diagnoses were not independent of ADHD subtype, which may confound the results. Using a computerized chatroom task, Mikami and colleagues (Mikami *et al.*, 2007) found that children with combined (ADHD-C) or inattentive (ADHD-I) type ADHD made significantly more off-topic responses than TD controls. While children with ADHD-C made more hostile responses than both the ADHD-I group and TD controls, there were no differences in the frequency of prosocial responses across the three groups.

Social discourse has also been examined using dyadic interaction tasks. These tasks have involved examining interactions between mixed dyads (i.e., those with one TD and one ADHD child), and dyads that contain two TD children. Within these tasks, outcome measures have included communicative acts, such as noncommunicative speech, reciprocity, assertiveness, and friendliness. Results obtained from studies that include dyads of unfamiliar peers show that, while there are no differences in communicative behavior between boys with ADHD and TD

²Overt aggression was defined as harmful or destructive messages that threatened, bossed or taunted, and relational aggression as harmful or destructive messages that manipulated the victim's relationship with another player. Awkward comments were those that did not fit into the flow of normal social exchange and were out of synchrony with social expectations.

boys when first meeting and interacting with a peer (Grenell et al., 1987), differences emerge over the course of their interactions. Boys with ADHD engage in more noncommunicative speech than TD boys during cooperative tasks and are rated as being less friendly but more assertive during conflict resolution tasks (Grenell et al., 1987). Relative to TD boys, those with ADHD are also less likely to request guidance or information, and more likely to disagree with their peers (Whalen et al., 1979). Within mixed dyads, significantly less verbal reciprocity (Clark et al., 1988; Hubbard & Newcomb, 1991) and affective expression (Hubbard & Newcomb, 1991) has been observed, when compared to TD dyads. Mixed dyads are also characterized by a higher frequency of questions and a more controlling communication style than dyads containing two TD (Cunningham & Siegel, 1987).

Similar results are reported during dyadic interaction tasks that include either a friend or an unfamiliar adult (Normand et al., 2011; Stroes et al., 2003). When interacting with a friend during card sharing and game choice tasks, Normand et al. (2011) rated children with ADHD as making significantly more insensitive and self-centered proposals (though a similar number of altruistic proposals), fewer inquiries as to their partner's thoughts, and as having a more dominant interaction style, relative to comparison children. During structured interactions with unfamiliar adults, children with ADHD talked more, particularly about the same subject, made more verbal initiations and generated more self-talk than TD children (Stroes et al., 2003).

Social discourse has also been examined using speech samples recorded from interviews between children and a researcher. Breznitz (2003) found that boys with ADHD were more likely to pause, take fewer turns and have longer delays prior to speaking than their TD peers. These behaviors may indicate social discourse incoherence in the ADHD sample (Breznitz, 2003), though alternative explanations for such behaviors among individuals with ADHD have also been made (e.g., Bangert & Finestack, 2020).

Together, these 10 studies suggest that children with ADHD have a more dominant and hostile style of social discourse than TD children. However, given the broad range and study specific nature of the tasks used to facilitate social discourse, together with differences in the coding systems used to assess this pragmatic skill, it is difficult to compare the results across studies. While some findings indicate that the style of social discourse may differ depending on the ADHD subtype (e.g., combined vs. inattentive), or in the presence of co-occurring oppositional behaviors, it is premature to draw conclusions about the nature of these differences when so few studies have compared performance between these ADHD subgroups. In addition, no studies were identified that compared the social discourse of children with ADHD with those of children with autism, thus limiting the conclusions we can make about whether the profile of social discourse skills in ADHD resembles the profile seen in autism.

Narrative discourse

Fourteen studies measured narrative coherence and cohesiveness, aspects of pragmatic language essential to narrative discourse, in children with ADHD, TD children, or those with autism. While studies have typically used narrative production tasks, such as story retelling, to measure these aspects of communication, the specific measure of coherence has varied (see Table 2). Measures of narrative coherence included: (a) the frequency of goal-based units; (b) quality of goal-based units; (c) presence of a story resolution; (d) maintenance of a story-line; (e) story

structure; (f) presence of transitions (e.g., words such as and, then, because); (g) use of pronouns when referring to characters; (h) overall number of errors (e.g., in introducing extraneous information, incorrect word substitution, and incorrect/misinterpreted information); and (i) fluency.

Overall, the results of these studies indicate that children with ADHD provide fewer story units of significant thematic importance than TD children (Lorch et al., 2010; Papaeliou et al., 2015; Rumpf et al., 2012). Findings regarding the frequency with which children with ADHD include goal-based units have been mixed. When children with ADHD do provide goal-based units, these are less frequent and of lower quality (e.g., missing key details) than the goal-based units produced by TD children (Derefinko et al., 2009; Freer et al., 2011; Leonard et al., 2009; Renz et al., 2003). In contrast, Freer et al. (2011) reported that, while there are a similar number of goal-based events in the stories of children with ADHD and TD children, those with ADHD produce more stories with no goal-based units than their TD peers. Results of a study by Derefinko et al. (2009) indicate that, relative to the TD children, those with ADHD were less likely to include the story resolution in their narratives. These types of omissions can result in unclear communication and may be confusing for the listener.

The lack of goal-based units is not the only identified area of weakness in the narratives of children with ADHD. For children with ADHD, stories containing at least one goal-based event were rated as less coherent than those of the TD children, marked by poorly maintained storylines, list-like structures, and fewer instances of transitions (Freer et al., 2011). Coherence also requires the speaker to be specific about to whom or what they are referring. The results of three studies indicate that, relative to TD children, those with ADHD are more likely to use ambiguous pronouns, that is, pronouns that are not linked to a specific character or object (Lorch et al., 1999; Purvis & Tannock, 1997), and make reference errors, or errors that result in ambiguity (Renz et al., 2003).

Narrative cohesion and coherence are also affected by the number of errors that the narrator makes. Evidence from several studies indicates that children with ADHD produce stories that are characterized by more errors than those of TD controls. The types of errors observed in these stories include making embellishments (i.e., introducing extraneous information) (Lorch et al., 1999), ambiguous references (Lorch et al., 1999; Purvis & Tannock, 1997; Tannock et al., 1993), inappropriate word substitutions, and incorrect or misinterpreted information (Purvis & Tannock, 1997; Tannock et al., 1993).

It is possible that expressive language skills account for differences in narrative coherence between ADHD and TD groups. The results of some studies indicate that group differences in narrative discourse disappear after controlling for expressive language levels (Freer et al., 2011; Lorch et al., 2010). Luo and Timler (2008) also found that it was only children with ADHD and a co-occurring language impairment (defined as a composite standard score of ≤ 85 on the CELF-4 and a history of receiving speech/language services), who included fewer goal-based units in their narratives than the TD children. In contrast, Staikova et al. (2013) found that, after controlling for general language ability (CELF-4 scores), children with ADHD still had lower narrative discourse scores than TD children. Thus, findings regarding the role of general language abilities in narrative discourse in ADHD are mixed.

Only two studies have examined narrative coherence in children with ADHD, those with autism and TD children.

Rumpf *et al.* (2012) found that, while TD children were more able to convey the key aspects of a story than children with ADHD and those with Asperger syndrome, these latter two groups were indistinguishable. Results reported by Kuijper *et al.* (2017) also suggest that children with autism and those with ADHD are less fluent in their narrations, as they interrupted their stories more often than the TD children. While children with ADHD and those with autism take listeners into account with their choice of referent and use the same referent when introducing or re-introducing characters, those with ADHD made more errors of ambiguity than were recorded for the autism group (Kuijper *et al.*, 2015). This manifested in less specific references to characters.

Thus, across studies looking at narrative coherence, the narratives from children with ADHD were rated as being less coherent than their TD peers, as their stories included fewer goal-based or thematically significant events, a feature that may be similar to the narratives of children with autism. Other indicators of coherence, such as the number of errors and ambiguous references, also distinguished the narratives of children with ADHD from those of TD children. These aspects of narrative coherence may differentiate the narratives of ADHD and autism samples. However, not all indicators of coherence show differences between children with and without ADHD. For example, the provision of contextual information, such as the timing and setting of events, as well as the characters involved and their mental states, have been shown to be similar across ADHD and TD groups (Luo & Timler, 2008; Renz *et al.*, 2003; Rumpf *et al.*, 2012). In addition, findings regarding the impact of language levels on narrative coherence were mixed, thus we are unable to establish, based on the extant literature, whether the differences between the ADHD and TD groups on measures of narrative coherence are accounted for by poor language skills.

Risk of bias and quality assessment

Quality and risk of bias ratings varied across studies. Criteria used are reported in Supplementary materials. Out of 238 individual ratings (34 studies across seven categories), 37% ($n = 87$) were good or low risk of bias, 33% ($n = 79$) as satisfactory or moderate risk of bias, and 15% ($n = 35$) were rated as poor or high risk of bias. Fourteen percent ($n = 34$) could not be rated as the relevant information was not reported and 1% of ratings were not completed as they were not applicable ($n = 3$). Nine studies (26%) had no “poor” or “high risk” ratings. Twenty-five studies (74%) had at least one “poor” or “high risk” rating, of which eight (24%) had two or more. Small sample sizes and non-representative cases were the most common limitations. Table 3 indicates the relative gradings across studies for the categories of bias. A review of the table in relation to study effect sizes does not indicate any obvious relationship between study quality and study outcome.

Discussion

This systematic review synthesizes the empirical literature that examines pragmatic language in children diagnosed with ADHD. Specifically, we review studies comparing the pragmatic language skills of children with ADHD to those of TD children, which incorporate a range of methodologies. By doing so, the review complements and extends the work of previous reviews of pragmatic language in ADHD (Green *et al.*, 2014; Korrel *et al.*, 2017). It also explores the specificity of the profile of

pragmatic language in ADHD through the inclusion of studies that directly compared pragmatic language in children with ADHD to pragmatic language in children with autism. In order to consider the full range of skills encompassed by “pragmatic language”, Landa’s (2000, 2005) conceptual framework of pragmatic language (communicative intent, presupposition, and discourse) is used to examine the various elements of pragmatic competence.

Summary of key findings

In line with previous research, our review shows that studies using global measures of pragmatic language consistently reveal difficulties in children with ADHD, compared to their TD peers (Green *et al.*, 2014; Korrel *et al.*, 2017). When looking at specific subcomponents of pragmatic language, relative to TD children, those with ADHD were found to have difficulties within the domains of presupposition, social discourse, and narrative discourse. Among the small number of studies that compared pragmatic language in ADHD to that in autism, the global pragmatic skills of children with ADHD were consistently reported to be intermediate between the TD children and those with autism, suggesting a difference in the severity of their respective pragmatic language difficulties. However, the modest number of comparative studies limits any conclusions that can be drawn about the similarities and differences in the pragmatic language profiles of the two clinical groups.

Pragmatic language in ADHD

While studies that provide summary pragmatic language scores have been valuable in drawing attention to pragmatic language impairments in ADHD, breaking pragmatic language into subcomponents provides a better indication of specific areas of difficulty in this population. No studies were identified that assessed the communicative intent of children with ADHD (for suggested methodologies see Adams, 2002). However, there was clear evidence that children with ADHD make more inappropriate initiations than their TD peers. In addition, the social interactions of children with ADHD are consistently described as being more hostile and controlling than TD children. The pragmatic language profile in ADHD has also been shown to be characterized by difficulties understanding nonliteral language, for example, irony/sarcasm and less social reciprocity than would be expected for the children’s age. In terms of narrative discourse, children with ADHD are less likely than their TD peers to include goal-based elements in narratives and make more errors of ambiguity when telling stories, thus their narratives are less coherent than those of other children.

The results of this review suggest that children with ADHD have a language profile characterized by pragmatic language difficulties that are disproportionate to their general language skills (e.g., Vaisanen *et al.*, 2014). Evidence supporting this claim comes from studies of global pragmatic language in ADHD, showing that these difficulties persist after controlling for structural language skills (e.g., Staikova *et al.*, 2013). Few of the studies that investigated the subcategories of pragmatic language in ADHD controlled for co-occurring language impairments, so it is difficult to determine whether specific areas of pragmatic difficulty in ADHD are secondary to structural language impairments. In addition, the results of the studies that did account for general language skills were mixed. For example, findings reported by

Table 3. Risk of bias and quality assessment across studies

Study	Cases – quality	Controls – quality	Sample size	Blinding	Validity	Reliability	Missing data
Breznitz (2003)				NR			NR
Caillies et al. (2014)				NR			NR
Clark et al. (1988)				NR			NR
Cunningham and Siegel (1987)				NR			NR
Demopoulos et al. (2013)		NA		NR			
Derefinko et al. (2009)							NR
Dyck et al. (2001)				NR	NA		NR
Freer et al. (2011)							
Geurts and Embrechts (2008 – Study 1)							NR
Geurts et al. (2004 – Study 1)							
Geurts et al. (2004 – Study 2)							
Grenell et al. (1987)							NR
Hubbard and Newcomb (1991)				NR			NR
Kuijper et al. (2015)				NR			
Kuijper et al. (2017)							
Leonard et al. (2009)							NR
Lorch et al. (1999)				NR			NR
Lorch et al. (2010)							
Ludlow et al. (2017)				NR			NR
Luo and Timler (2008)							NR
Mary et al. (2016)					NA		NR
Mikami et al. (2007)							NR
Normand et al. (2011)							NR
Ohan and Johnston (2007)				NR			NR
Papaeliou et al. (2015)				NR			NR
Purvis and Tannock (1997)							
Renz et al. (2003)							NR
Rumpf et al. (2012)							NR
Staikova et al. (2013)							
Stroes et al. (2003)							
Tannock et al. (1993)							NR
Timler (2014)							
Vaisanen et al. (2014)							NR
Whalen et al. (1979)							

Note. Ratings are: good/low risk of bias (light gray), satisfactory/moderate risk of bias (mid gray) or poor/high risk of bias (dark gray). NA = not available; NR = not reported. Validity information was considered not available for two studies where the measurement tool considered in this review to measure pragmatic language was used with the intention to measure theory of mind. The full list of criteria for the quality and strength of evidence assessment are presented in Supplementary Materials. These criteria were adapted from the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (Thomas et al., 2004) and Cochrane Risk of Bias Criteria (Higgins & Altman, 2008).

Staikova et al. (2013) suggest that difficulties with narrative coherence in ADHD are unrelated to language levels. In contrast, expressive language appears to contribute to group differences in narrative discourse (Freer et al., 2011; Lorch et al., 2010). Without accounting for general language levels, which are more likely to be impaired in this population (Korrel et al.,

2017), we cannot establish whether global pragmatic language difficulties, or difficulties with subcomponents of pragmatic language, reflect an overall picture of poor language skills in children with ADHD, or alternatively, represent a specific area of difficulty that is misaligned with general language skills in these children.

Specificity of the pragmatic language profiles of ADHD and autism

Our results build on the findings of a previous review to highlight that children with ADHD and children with autism share a global deficit in pragmatic language (Geurts & Embrechts, 2010). The current findings indicate that the level of impairment in ADHD is less pronounced than seen in children with autism, as most clearly evidenced on the CCC/CCC-2. Fine-grained analyses of the CCC/CCC-2 subscale scores also show that both clinical groups have difficulties with inappropriate initiation, although it is not clear from the literature that these reflect the same underlying processes. The reviewed literature also indicates that children with autism are relatively more impaired than children with ADHD in their use of context and nonverbal communication. However, there appear to be shared difficulties in some aspects of narrative discourse, narrative length, and overall coherence. Overall, the evidence reviewed does not elucidate a specific profile of pragmatic language in ADHD, which can be distinguished from the profile that characterizes autism.

Importantly, we only identified seven studies that directly compared pragmatic language in autism and ADHD. Therefore, while we can identify shared difficulties in the pragmatic profiles of these two conditions, it is difficult to compare the degree of impairment in each discrete component. We can be more confident that there is a difference in the degree of global pragmatic language difficulties in autism and ADHD, as a number of studies have now compared CCC/CCC-2 scores for these two groups. Further studies comparing the two clinical groups are needed to clarify the degree of impairment across the pragmatic profile of these two clinical conditions.

In reviewing the extant literature, another important consideration is the range of dates, which spanned the period in which the DSM changed from the fourth to the fifth edition. In the DSM-IV (Criterion E), ADHD could not be diagnosed if the inattentive/hyperactive symptoms occurred in the presence of a pervasive developmental disorder, such as autism (American Psychiatric Association, 2000). The same criterion did not apply to diagnoses of autism, which did not preclude ADHD as a co-occurring condition. Therefore, for studies that predated the DSM-5, while we can be sure that the ADHD samples did not include children with formal diagnoses of autism, the children with autism may have had comorbid ADHD. This has a confounding influence on our findings, as the presence of ADHD in children with autism may inflate the pragmatic language difficulties observed in these samples. This could occur most obviously through symptoms of inattention and hyperactivity/impulsivity interfering with both the performance and opportunity to practice pragmatics. In addition, for children with both comorbid ADHD and autism, this could obscure any distinctions in the pragmatic language profiles of these two groups.

Strengths and limitations

We present a rigorous systematic review of the literature examining pragmatic language in ADHD. This review extends and complements previous reviews (Green *et al.*, 2014; Korrel *et al.*, 2017). Organizing the review around Landa's framework facilitated the breakdown of the broad concept of pragmatic language into constituent skills, which allows for the inclusion of a wider range of studies than in the previous reviews (see Supplementary Table S6, which shows the additional studies included in the current review,

as compared to the reviews conducted by Green *et al.*, 2014; Korrel *et al.*, 2017); identification of specific areas of pragmatic difficulty for children with ADHD; and highlighting of important gaps in the existing research literature. We also augment previous work by only reviewing studies that included samples of children who had received a clinical diagnosis of ADHD.

Our review is limited by the quality and quantity of the available literature. Across studies, there is a high degree of heterogeneity in the measures used to assess pragmatic language. While some studies have used parent- or teacher- report pragmatic measures, others have used standardized language assessments, and still others developed study-specific tasks. Even when studies have utilized similar measures, the construction of pragmatic language composite scores has varied. For example, among the studies that implemented the CCC-2, each uses different subscales to derive a pragmatic language composite score. Several studies employed study-specific pragmatic language measures, often without establishing the psychometric properties of these tasks. There has been a call for more rigorous investigation of the validity of pragmatic language assessments (Adams, 2002; Geurts & Embrechts, 2010). We rated 47% of the reviewed studies' measures of pragmatic language as having face validity only. In addition, across the studies that used comparable narrative or social interaction tasks, the researchers designed unique and varied coding systems, which prevented us from combining the findings across groups of studies. Therefore, undertaking a formal meta-analysis was not appropriate given the range of methodologies, presentation of the data, and variable aspects of pragmatic language assessed. Consistency of pragmatic measures across future studies will be important in guarding against publication bias and its inflation on risk estimates as this area of research moves toward clinical implementation. In selecting appropriate measures, researchers should consider that standardized measures of overall pragmatic language skills or broader skill sets such as narrative ability may not be sufficiently sensitive to detect some of the subtle difficulties in children with ADHD (e.g., Redmond, Thompson, & Goldstein, 2011).

There are a range of factors that limit the generalizability of our findings. Most of the samples were small and mainly included boys. While this is likely to represent clinical samples, it is unclear how well the findings generalize to girls with ADHD. Furthermore, very few studies controlled for the effects of sex, age, language ability, or cognitive functioning on pragmatic language, making it difficult to disentangle the way in which these developmental factors influence pragmatic language in samples of children with ADHD. Given the preliminary findings that structural language may influence pragmatic language, consideration of wider language skills will be pertinent in future research.

Furthermore, although we took many steps to avoid bias throughout the review, there may be a risk of publication bias. The current review included peer-reviewed studies only, that is, no gray (unpublished) literature, to increase the overall quality of the included studies. This practice may have excluded some studies reporting nonsignificant findings. As the data did not support conducting a meta-analysis, no formal publication bias analyses were conducted. In sum, these aspects may limit confidence in the conclusions that can be drawn from this synthesis of the literature.

Clinical implications

The findings of the current review have important implications for the assessment and management of children with ADHD.

The data indicate that, as a group, children with ADHD have difficulties with pragmatic language. When presenting problems include symptoms of ADHD, clinicians should consider screening for co-occurring pragmatic and structural language difficulties. In the case of a positive screen, consideration should be given to the need for a comprehensive language evaluation. Since anecdotal clinical reports indicate that there is a mismatch between some children's pragmatic knowledge and the application of that knowledge to real-life settings, where possible, clinical evaluations should include "live" evaluations of pragmatic language skills. From the perspective of intervention, knowledge of any deficits in the language skills of a child with ADHD will help guide the selection and implementation of skills training and educational support/accommodations. Current recommended treatments for ADHD (e.g., pharmacotherapy and behavioral parent training) do not address pragmatic language or structural language impairments. Highlighting the existence and nature of these difficulties will, we hope, increase children's access to speech and language services; encourage research, and facilitate the development of interventions that include tools for pragmatic language skill development in addition to addressing any structural language weaknesses. Such interventions should focus on addressing oral language skills and ways to use these skills in socially meaningful ways.

Future research

The results of this review trigger a call to further research in this area. Firstly, given the consistent findings of pragmatic language difficulties in ADHD, more attention is needed on the functional impact associated with such difficulties (e.g., for social, academic, or mental health outcomes). Given preliminary evidence that pragmatic language mediates the relationship between ADHD and social difficulties, this is an important area of future research (Staikova et al., 2013).

Secondly, while the research reviewed here helps to clarify the profile of pragmatic language impairments in ADHD, it does not address their etiology. While several hypotheses about the underlying mechanisms of pragmatic language impairments in ADHD have been purported, the extent to which pragmatic language is explained by the core symptoms of ADHD, executive function difficulties or other causes is unknown (Camarata & Gibson, 1999; Green et al., 2014; Hawkins et al., 2016). When comparing the pragmatic skills in ADHD and autism, it is possible that the shared difficulties are driven by distinct mechanisms. For instance, in ADHD inappropriate initiation could relate to the core symptom of impulsivity, that is, talking too much, interrupting, and intruding, whereas in autism, scores representing greater levels of difficulty could arise because of restricted interests and rigidity that is, talking repeatedly about the same topic. Research that disentangles the relative contribution of cognitive (e.g., executive function) or behavioral (e.g., impulsivity) factors to pragmatic language problems in ADHD and other neurodevelopmental disorders will help to clarify the etiology of these difficulties. A greater understanding of pragmatic language in different ADHD subtypes, and studies of the impact of commonly co-occurring conditions (e.g., autism or ODD) and structural language skills on pragmatic language in ADHD, will also help to elucidate underlying mechanisms. One area of interest would be to consider the effect of pharmacological interventions that target core ADHD symptoms on pragmatic language. While some preliminary studies have tested the impact of stimulant medication

on pragmatic narrative abilities, mixed results and small samples limit any conclusions that can be drawn (Bailey, Derefinco, Milich, Lorch, & Metze, 2011; Derefinco et al., 2009; Rausch et al., 2017). In turn, such knowledge can support the design of interventions targeting pragmatic language. Some preliminary work has been conducted on developing pragmatic language interventions for children with ADHD; however, the studies are small and the findings are mixed (Cordier et al., 2017; Cordier, Munro, Wilkes-Gillan, & Docking, 2013; Wilkes-Gillan, Cantrill, Parsons, Smith, & Cordier, 2017).

Within the context of the current review, it is important to consider how the changes to the diagnostic criteria for neurodevelopmental disorders introduced in the DSM-5 may influence future research on, or the interpretation of, pragmatic language difficulties in children diagnosed with ADHD. This is especially relevant when children with ADHD are compared to those with clinical diagnoses of autism or S(P)CD, and when considering comorbid communication disorders in the setting of ADHD. Most of the studies included in the current review predate the introduction of S(P)CD, and those that were published after the implementation of the DSM-5 do not address this new diagnostic category. Therefore, we do not know whether any of the children in these studies would meet contemporary diagnostic criteria for S(P)CD and if this would change our findings. It is possible that some children diagnosed with autism might be better described as having S(P)CD, but only if there was no evidence of rigid and repetitive behaviors and restricted interests, a pattern which appears to be relatively uncommon (e.g., Huerta, Bishop, Duncan, Hus, & Lord, 2012). In future samples, care will be necessary to separate autism from S(P)CD and to determine whether children with ADHD have comorbid pragmatic language difficulties causing functional impairment sufficient to reach diagnostic criteria for S(P)CD or alternatively, whether the subthreshold pragmatic difficulties are secondary to ADHD symptoms. This approach will enable the field to compare the pragmatic language profiles of children who meet the criteria for ADHD, S(P)CD, autism, and TD children, together with the effects of comorbidity among these diagnostic groups.

Finally, going forward, we would encourage researchers to ensure they provide sufficient data in their research reports to facilitate calculation of effect sizes (if not reported) including means, standard deviations, and subgroup *n* values, and to provide ready access to raw data to permit secondary data analysis or the combining of data sets. EQUATOR reporting guidelines offer useful recommendations. Furthermore, our risk of bias and quality assessment revealed that future studies would benefit from clearly defined and sufficiently powered samples as well as providing some indication of the validity of their chosen measurement tools.

Conclusions

This review has built on previous research by investigating the profile of pragmatic language impairments associated with ADHD. Breaking pragmatic language into its constituent elements allowed us to compare the pragmatic language skills of children with ADHD to TD children and children with autism. When compared to TD children, there was evidence that children with ADHD make more inappropriate initiations; are more often described as being hostile and controlling during social interactions; can experience difficulties understanding nonliteral language; demonstrate less social reciprocity; and provide less

coherent narratives. Structural language skills did not consistently account for these difficulties. The existing literature is not yet robust enough to draw conclusions about differences in the profile of pragmatic language impairments in children with ADHD and those with autism. However, preliminary evidence indicates that the degree of pragmatic language impairment of children with ADHD falls between TD children and children with autism. This review also highlights the need for further, good-quality research in this area.

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