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Language Impairments in Children With ADHD and in Children With Reading Disorder

Wenche Andersen Helland[1,2], Maj-Britt Posserud[3,4], Turid Helland[5], Mikael Heimann[6,7], and Astri J. Lundervold[5,8,9]

Abstract

Objective: The objective of this study was to investigate language impairments (LI) in a nonclinical sample of children with ADHD, reading disorder (RD), and ADHD + RD, and to explore whether these groups could be differentiated from each other and a control group regarding different aspects of language. **Method:** The groups were derived from a population-based sample of 5,672 children, 7 to 9 years. Language problems and the groups were defined from parent/teacher reports. **Results:** LI was identified in the majority within the ADHD + RD group and in >40% of the ADHD and RD group. More phonological and expressive language problems were seen in the RD than the ADHD group, while receptive language problems were more prominent in ADHD. More pragmatic problems were identified in the ADHD group. **Conclusion:** The present results support findings from clinical samples pointing to a considerable rate of LI both in children with ADHD and in children with RD. *(J. of Att. Dis. 2012; XX(X) 1-XX)*

Keywords

ADHD, comorbidity, epidemiology, reading disorder, language impairments

ADHD and reading disorder (RD) are considered the two most prevalent neurodevelopmental disorders of childhood (Wigal et al., 2012). High rates of comorbidity have been reported for both disorders, with more than 80% of children with ADHD and 60% of children with RD meeting criteria for at least one additional diagnosis (Willcutt, Pennington, Olson, & DeFries, 2007). Depending on the stringency of the criteria used, ADHD is affecting at least 5% of the school-age population (Gillberg, 2010; Hulme & Snowling, 2009; Jitendra, DuPaul, Someki, & Tresco, 2008). These children are characterized by levels of inattention, hyperactivity, and impulsivity that are inconsistent with their developmental age (American Psychiatric Association [APA], 2000; Martinussen & Tannock, 2006).

Although not included in the core diagnostic criteria of ADHD, language impairments (LI), affecting linguistic as well as pragmatic domains, are often present in these children (Bellani, Moretti, Perlini, & Brambilla, 2011; Bignell & Cain, 2007; Mathers, 2006). Hagberg, Miniscalco, and Gillberg (2010) found that 60% of psychiatric clinic attenders with ADHD, autism spectrum disorders (ASD), or a combination of the two showed early manifestations of LI. Furthermore, impaired comprehension for longer and more complex information of the kind that is usually presented in classroom instructions and textbooks, as well as difficulties making inferences, have been reported in children with ADHD (McInnes, Humphries, Hogg-Johnson, & Tannock, 2003). In a study of 30 children and adolescents with ADHD aged 8 to 16 years matched for age, gender, and parental level of education to 30 control participants, Wassenberg and colleagues (2010) found that participants with ADHD were significantly slower and less efficient than the controls in complex sentence comprehension. Cohen, Barwick, Horodezky, Vallance, and Im (1998) investigated 380 child psychiatric outpatients and found that 64% of the sample, aged 7 to 14 years, fulfilled the

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criteria for LI, and out of these children, altogether 46% were given a diagnosis of ADHD. In a Swedish sample of children diagnosed with ADHD (mean age 11 years), LIs were identified in 67% (Bruce, Thernlund, & Nettelbladt, 2006). Furthermore, according to Kibby, Kroese, Krebbs, Hill, and Hynd (2009), subclinical language deficits, particularly regarding comprehension, syntax formulation, and pragmatics, have frequently been reported in children with ADHD, despite intact phonological processing.

Most studies on language difficulties in children with ADHD are based on clinical samples, and although these studies present informative data in well-defined and well-characterized diagnostic categories, the findings probably represent the most severe cases (Sexton, Gelhorn, Bell, & Classi, 2011). However, population-based studies have also revealed a substantial overlap between LIs and ADHD. In a cohort of 3,208 children in the age range 6 to 11 years, Tirosh and Cohen (1998) reported that 45% of the children fulfilled the criteria for both diagnoses. In a community sample of 1,364 Dutch children aged 4 years, Ketelaars, Cuperus, Jansonius, and Verhoeven (2010) found a high negative correlation between pragmatic competence and hyperactivity, claiming that early assessment of pragmatic competence may lead to earlier detection of ADHD. Investigating a nondiagnosed sample of children aged 7 to 11 years identified by their teachers as showing poor attention and/or high hyperactivity, Bignell and Cain (2007) found that these features were associated with impairment related to pragmatic aspects of language.

RD, affecting both reading and writing skills, is characterized by impairments in single word reading, reading comprehension, and fluency (Willcutt & Pennington, 2000). Reported prevalence rates of RD are 10% to 15% among school-age children (Vellutino, Fletcher, Snowling, & Scanlo, 2004). However, as reading is a complex cognitive activity involving several subprocesses, children with RD, like children with ADHD, tend to constitute a heterogeneous group. Children with RD might exhibit different types of reading problems: decoding problems (developmental dyslexia), comprehension problems, or both (Gustafson, Fälth, Svensson, Tjus, & Heimann, 2011). In the present study, the term "RD" is used to refer to children reported as having problems learning to read and write. It is generally well established that a substantial portion of children identified with RD have a history of LI and/or delayed speech, and likewise that many children with LI also go on to develop literacy problems at school age. This suggests that the two disorders could be viewed as points on a continuum of severity (Bishop, 2008).

However, not all children with RD have, or have previously had, LIs, and there are children with LIs who do not develop any problems related to literacy (Bishop, 2008). Dyslexia is defined when the literacy problems are of a constitutional origin (Frith, 1986, 2010). At a cognitive level, impaired phonological processing (Carroll & Snowling, 2004), working memory (Beneventi, Tønnesen, & Ersland, 2009; Beneventi, Tønnessen, Ersland, & Hugdahl, 2010), language comprehension (Bishop & Snowling, 2004; T. Helland, 2007), and impaired visuo-spatial functions (T. Helland & Asbjørnsen, 2003) are typically seen in dyslexia. At a biological level, neuronal networks in the left hemisphere have been found to be impaired in dyslexia (Dehaene, 2009; Temple et al., 2003), and heredity is estimated to be between 30% and 60% (Rejnö-Habte Selasse, Jennische, Kyllerman, Viggedal, & Hartelius, 2005). In sum, these factors constitute benchmarks of dyslexia. These findings indicate the presence of varying degrees of LI in dyslexia (T. Helland, Plante, & Hugdahl, 2011; Pennington & Bishop, 2009; Snowling & Hume, 2012).

ADHD and RD are found to co-occur in clinical as well as in epidemiological samples at a rate that is greater than would be expected by chance, with reported overlap estimates varying from 15% to 40% (Kibby et al., 2009; Martinussen & Tannock, 2006; Wigal et al., 2012). Depending on how ADHD is defined, Vellutino and colleagues (2004) reported that 30% to 70% of children with dyslexia also have ADHD. Whether children are initially assessed for ADHD or RD, the disorders are significantly comorbid (Willcutt & Pennington, 2000). These two groups may demonstrate comparable patterns of deficits regarding language as well as literacy, although perhaps for different reasons. As pointed out by Morton and Frith (1995), developmental disorders reflect processes at three different levels: behavioral, cognitive, and biological, which all interact with environmental conditions. Thus, although problems learning to read and problems expressing oneself clearly or understanding what is said may be manifest in children with RD and in children with ADHD, these problems may be caused by different underlying deficits at the cognitive or the biological level (W. A. Helland, Helland, & Heimann, 2012). In a previous study, we identified LIs in 82.1% of a clinical group of children diagnosed with ADHD (W. A. Helland, Biringer, Helland, & Heimann, 2012). In the present study, we explored whether comparable findings are evident in a nondiagnosed population sample of children with parent- and teacher-reported symptoms of ADHD. To our knowledge, there are no population-based studies reporting on LIs in these two groups. LIs are viewed within the continuum suggested by Bishop from perception to contextual meaning, that is, specific language impairment (SLI) at one end and pragmatic language impairment (PLI) at the other (Bishop, 1997). SLI is usually diagnosed when a child demonstrates significant limitations in his or her language abilities that cannot be explained by other factors, and difficulties mastering structural aspects of language are prominent findings (Whitehouse, Watt, Line, & Bishop, 2009). PLI refers to difficulties with the social use and interpretation of language in different contexts (Adams, 2002). Lorch, Berthiaume, Milich, and van den Broek (2007)

reported problems with inference making and narrating coherent, goal-based stories in children with ADHD, thus pointing to language problems at the PLI end of the continuum.

Our first aim was to investigate LI in a population-derived sample of children with symptoms of ADHD, children with symptoms of RD, children with symptoms of both ADHD and RD, and in children without any of these symptoms (control group). Based on research in clinical samples, we hypothesized that LIs would be more prevalent among children with ADHD, RD, or ADHD + RD than among control children. The second aim was to explore whether these groups could be differentiated from each other regarding different aspects of language within the continuum suggested by Bishop (1997) in her interaction model of "bottom-up" and "top-down" processing model from auditory processing to interpretation of social context (p. 231, Figures 9.4 and 9.5). Accordingly, it was expected that the language problems in children with RD would mainly be seen at the SLI end of the continuum, whereas the language problems of children with ADHD would be mainly observed at the PLI end. The mixed ADHD + RD group would show symptoms of both PLI and SLI.

Method

The Bergen Child Study (BCS)

Data in the present study were derived from the first wave of the BCS. The BCS is described in detail in separate publications (Heiervang et al., 2007; Stormark, Heiervang, Heimann, Lundervold, & Gillberg, 2008) and only a brief description will be provided here. The BCS is an ongoing population-based study of development and mental health in 9,430 children attending second to fourth grade (7-9 years of age) in all primary schools in the city of Bergen, Norway, in October 2002. In the first stage of the first wave, an informed consent form and a screening questionnaire were distributed through schools to teachers and parents of the children. The study was approved by the Regional Ethical Committee on Medical Health Research and the Data Inspectorate.

Participants

The present study included children whose parents consented to participate, and there were corresponding teacher questionnaires (identified children, n = 6,297). Children not speaking Norwegian as their first language, children with more than two missing items on any of the ADHD subscales on either parent or teacher questionnaire, or missing items on the language items were excluded from the analyses (n = 625). Thus, the final sample consisted of 5,672 children. Out of this sample, four groups were derived: children with RD (n = 332; 221 boys), children with ADHD (n = 169; 139 boys), children with ADHD + RD (n = 121; 94 boys), and a control group consisting of all other children (n = 5,050; 2,387 boys).

Study Measures

Several measures were included in the BCS screening questionnaire, covering items assessing a wide range of emotional and behavioral problems as well as associated functional impairment. The questionnaire included a Norwegian translation of the SNAP-IV (Swanson, Nolan, and Pelham-IV) questionnaire (Swanson et al., 2001) where the items correspond to the 18 *Diagnostic and Statstical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; APA, 2000) symptom descriptions for ADHD. In contrast to the original version of SNAP-IV, it was scored on a 3-point Likert-type scale (0 = *not true*, 1 = *somewhat true*, and 2 = *certainly true*). This was done to make the response categories adhere to the other parts of the questionnaire. Presence of an ADHD symptom was defined as a score of somewhat or certainly true. Children scoring ≥6 symptoms on at least one of the two nine-items subscales (SNAP-IV) by both informants were defined as having ADHD. This is consistent with the definition used in Ullebø, Posserud, Heiervang, Obel, and Gillberg (2011), generating an ADHD prevalence of 5.2% in children with parent and teacher reports.

The screening questionnaire included four items relating to LIs and one item relating to reading and writing difficulties (RD) scored on a 3-point scale (0 = *not true*, 1 = *somewhat true*, and 2 = *certainly true*). The items relating to LIs were as follows:

1. cannot pronounce certain words or sounds;
2. cannot elaborate, explain, or express himself or herself;
3. has difficulties understanding things that are being said; and
4. has difficulties having a conversation with others.

Item 1 is considered a measure of phonology, Item 2 a measure of expressive language, Item 3 a measure of receptive language, and Item 4 a measure of pragmatics.

The item related to reading and writing difficulties was as follows:

- has difficulties learning to read and write

Parent and teacher responses were combined, so that children scoring ≥ 2 on the last item were defined as having RD. Thus, a child was defined as having RD if both a parent and a teacher checked "somewhat true" or if either parent or teacher checked "certainly true" on this item.

The Language Composite

A language composite was calculated by summing the scores of Items 1 to 4. This composite was then dichotomized, and LI was defined as a total score of two or more across these four language items. Thus, a child was defined as having LI if parent and teacher both checked "somewhat true" on at least one of the four language items or if either teacher or parent checked "certainly true" on at least one item.

Statistical Analyses

Group differences were analyzed using factorial ANOVAs with group, gender, and grade as fixed factors and the language composite and each of the language items measuring phonology, expressive language, receptive language, and pragmatics as dependent variables. Post hoc comparisons were conducted using Fisher's Least Significant Difference Test (LSD), and significance level was set at .01. The statistical analyses were performed using SPSS version 18.0.

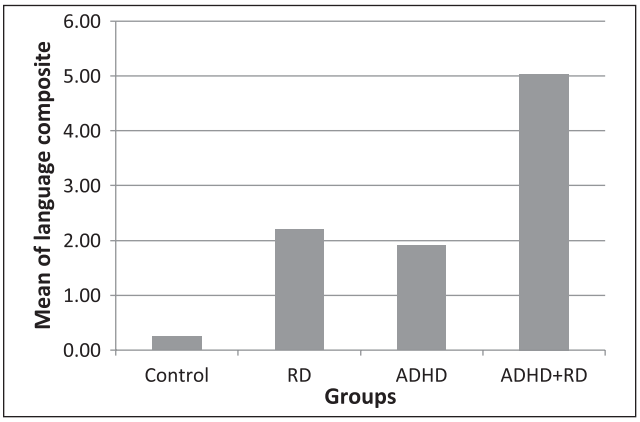

Figure 1. Mean language composite score for the four groups of children: Control, children with symptoms of RD, children with symptoms of ADHD, and children with symptoms of ADHD + RD
Note: RD = reading disorder. High score indicates impairment with the ADHD + RD group scoring significantly higher than the other groups. No significant difference between the RD group and the ADHD group.

Results

LIs Across Groups

A total of 80.7% of the children in the ADHD + RD group were identified with LI, whereas this was true for 46.0% of the RD group, 42.6% of the ADHD group, and 5.7% of the control group. In the total sample, more than twice as many boys as girls were identified with LI (432 vs. 183, respectively). When inspecting all children with symptoms of ADHD (irrespective of comorbid RD), altogether 58.5% fulfilled the criteria for LI. The same was true for 55.7% of the children identified with RD.

The Language Composite Score

Factorial ANOVA with group, gender, and grade (age) as independent variables and the language composite score as dependent variable showed a significant main effect of group, $F(3, 5636) = 651.72$, $p < .001$. The effect size was quite strong, $\eta^2 = .26$ There was also a main effect of gender, $F(1, 5636) = 25.00$, and grade, $F(2, 5636) = 31.80$; both ps < .001. Post hoc tests showed that the ADHD + RD group was the most impaired. Although the score of the RD group was descriptively higher (more impaired) than that of the ADHD group, this difference failed to reach statistical significance ($p = .011$). The control group, not unexpectedly, outperformed the other groups. In the total sample, boys scored significantly higher (more impaired) than girls (Figure 1).

The Separate Language Items

Factorial ANOVAs with each separate language item (measuring phonology, expressive language, receptive language, and pragmatics) as dependent variables revealed a main effect of group for all items ($p < .001$), and the effect sizes were all quite strong with η^2 between .13 and .23. Significant effects of gender were found on all items ($p < .01$), with boys scoring higher (more impaired) than girls. There was also a significant effect of grade, except for the item measuring receptive language (with younger children, Grade 2, scoring higher than older children). Post hoc tests showed significant differences between all groups on phonology and expressive language, the ADHD + RD group being most impaired, followed by the RD group, the ADHD group, and the control group. Significant differences between all groups were also found on receptive language, with the ADHD + RD group being most severely impaired, followed by the ADHD and the RD group. A somewhat different picture was revealed on pragmatics, and although the ADHD + RD group was the most severely impaired and the control group was not, no significant difference was found between the ADHD group and the RD group on this item ($p = .02$; Table 1).

The Effect of ADHD and RD on the Language Composite

To determine whether ADHD or RD was significantly associated with poorer scores on the language composite independent of the other disorder, a factorial ANOVA with symptoms of ADHD (±) and symptoms of RD (±) was conducted. A significant main effect of ADHD indicated that children with ADHD performed worse on that measure than children without ADHD, and a significant main effect of RD indicated that children with RD performed

Table 1. Means and Standard Deviations of the Language Composite and the Language Items in the Four Groups

	RD		ADHD		ADHD + RD		Control			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Main effect	Post hoc
Language composite	2.21	2.86	1.91	2.31	5.03	3.98	0.26	0.84	$F(3, 5636) = 651.73 = \eta^2 = .26$	ADHD + RD > RD, ADHD* > C*
Phonology	0.61	1.02	0.27	0.68	0.98	1.31	0.07	0.32	$F(3, 5648) = 274.07^* = \eta^2 = .13$	ADHD + RD > RD > ADHD > C*
Expressive language	0.55	0.81	0.39	0.68	1.23	1.08	0.07	0.29	$F(3, 5644) = 397.88^* = \eta^2 = .18$	ADHD + RD > RD > ADHD > C*
Receptive language	0.74	0.90	0.86	0.98	1.80	1.18	0.10	0.35	$F(3, 5644) = 557.16\ ^*= \eta^2 = .23$	ADHD + RD > ADHD > RD > C*
Pragmatics	0.32	0.74	0.40	0.68	1.02	1.12	0.03	0.20	$F(3, 5643) = 378.28^* = \eta^2 = .17$	ADHD + RD > ADHD, RD* > C*

Note: RD = reading disorder. A high score indicates poor performance.
*$p < .01$.

worse compared with those children without RD. It was evident that both factors (ADHD and RD), as well as the interaction between them, contributed significantly to the result on the language composite: the ADHD factor, $F(1, 5656) = 714.38$, $p < .001$; the RD factor, $F(1, 5656) = 918.32$, $p < .001$; and the interaction, $F(1, 5656) = 49.31$, $p < .001$.

Discussion

The results from this population-based study indicate that coexisting LIs are highly prevalent in children with ADHD as well as in children with RD. The vast majority (80.7%) of the children in the ADHD + RD group were identified with LIs, whereas the same applied to almost half of both the RD group and the ADHD group (46.0% vs. 42.6%, respectively) compared with a minority (5.7%) of the controls. In the total sample of children with ADHD (regardless of RD status), the majority (58.5%) was identified with LIs. The same pattern appeared for children with RD, as LIs were evident in the majority (55.7%) of these children as well. When the language composite was used as a continuous measure, analyses comparing the groups showed that the ADHD + RD group was the most impaired. The ADHD group and the RD group could not be differentiated from each other, but they both were significantly impaired relative to controls. In line with our hypothesis, LIs were found to be far more prevalent in children with symptoms defining ADHD and/or RD than in control children. Thus, the present findings in this population-derived sample corroborates previous findings in clinical as well as in population-based samples when it comes to children with ADHD (Hagberg et al., 2010; W. A. Helland, Biringer, et al., 2012; Tirosh & Cohen, 1998) as well as to children with RD (Bishop, 2008; Stackhouse, 2000).

When phonology, expressive language, receptive language, and pragmatics were investigated separately, it was evident that the ADHD + RD group was the most impaired, and in line with our hypothesis, this group showed symptoms of both PLI and SLI. The control group, not unexpectedly, outperformed the other groups across all these different aspects of language. All groups differed significantly on measures of phonology, expressive language, and receptive language; however, this finding could not be extended to pragmatics. The finding that the ADHD group performed significantly better than the RD group as to phonology and expressive language is in line with our hypothesis as well as with previous research indicating that children with ADHD tend to show normal development regarding these aspects of language; Geurts and Embrechts (2008) and W. A. Helland, Helland, et al. (2012) reported unimpaired speech and syntax in children with ADHD in studies using the Children's Communication Checklist–Second Edition (Bishop, 2003). Impairments regarding phonology and expression are commonly reported in children with RD as literacy builds on earlier developing language skills (Pennington & Bishop, 2009). However, it is worth noting that in the present study children in the ADHD group performed significantly poorer than did controls. The picture was quite the opposite regarding receptive language, with the ADHD group being significantly more impaired than the RD group. Impaired receptive language in children with ADHD is in line with results from previous studies in clinical samples (W. A. Helland, Biringer, et al., 2012; W. A. Helland, Helland, et al., 2012) where children with ADHD were found to be as impaired as children with SLI on measures of semantics. In line with this, Bruce et al. (2006) also reported that impaired language comprehension was three times as frequent as problems related to expressive language in their study of children diagnosed with ADHD. However, that children with ADHD and children with SLI show similar comprehension problems may be explained in two different ways in line with their different etiologies. In ADHD, comprehension problems are most likely related to general impaired attention, whereas in SLI, they are probably related to specific problems with phonological processing and/or verbal working memory. Some support for this is evident from the data in the present

study, as severity of attention problems was found to correlate significantly with LIs as measured by the language composite.

Pragmatics is an aspect of language that has been reported to be especially vulnerable to disruption in children with ADHD (Camarata & Gibson, 1999; W. A. Helland, Biringer, et al., 2012), and thus it was expected that the language problems of the ADHD group would mainly be seen at the PLI end of the continuum. However, an examination of the means revealed that although there was a clear trend in the direction of the ADHD group to perform poorer than the RD group regarding pragmatics, this difference failed to reach statistical significance with significance level set at $p < .01$. The apparent similarity between the RD group and the ADHD group on this aspect of language was unexpected, as problems related to pragmatics are commonly not reported in children with RD (Griffiths, 2007). However, in their study of students with dyslexia, Riddick, Farmer, and Sterling (1997) reported problems related to pragmatics, and likewise in a study comparing adults with and without dyslexia, Griffiths (2007) found a statistically significant difference between the two groups regarding pragmatics, indicating a correlation between dyslexia and pragmatic impairments. Although our participants were children in the age range 7 to 9 years, the results of older participants reported support for our findings. Moreover, it is unlikely that our results can be explained by any single factor related to teaching or educational setting as the study includes the majority of children aged 7 to 9 years from all primary schools in the city of Bergen, Norway.

Some methodological limitations should be considered when evaluating the results of the present study. The evaluation of the children's behavior, reading, and language was based solely on parent and teacher reports. If additional assessment using standardized tests, including measures of verbal and nonverbal abilities, had been administered, a more nuanced picture would probably have emerged. Furthermore, it is an obvious limitation that only one item is available for assessing each aspect of language (phonology, expressive language, receptive language, and pragmatics). A more comprehensive language screening would have been desirable. However, caretakers' concerns for a child's development are reported to be a reliable indication that the child is at risk (Glascoe, 2000; T. Helland et al., 2011). When interpreting the data, one must also have in mind the fact that the groups were not matched on age or grade and that there is a higher number of boys (where LIs are more frequent) than girls within the RD group, the ADHD group and the ADHD + RD group than in the control group. There is a growing consensus that a high comorbidity exists between autism and ADHD and comorbid autistic features may be associated with LIs. However, inclusion of information about autistic features was considered to be outside the scope of this article. As RD and LIs often run in families (Lyytinen, Poikkeus, Puolakanaho, Richardson, & Viholainen, 2001), completing the questionnaire, although constructed so that the questions should be easy comprehended, may have been linguistically demanding and thus have put some parents at a disadvantage. It might also be considered a limitation that no information about socioeconomic status was available in the study. However, due to high employment rates combined with a universal security system, few residents in Norway are poor compared with other European countries (Bøe, Øverland, Lundervold, & Hysing, 2011; Halvorsen & Stjernø, 2008).

In sum, findings in this large scale population-based study support findings from clinical samples and point to a considerable rate of LIs both in children with ADHD and in children with RD, at least as the groups have been defined in the present study. Considering the pervasive role of language in regulating children's behavior and in their literacy development, these findings underline the importance of assessing language abilities in children who show symptoms of ADHD or RD to develop appropriate treatment plans and provide sufficient educational support.

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