Language and executive functioning in children with ADHD
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SUMMARY

Children with ADHD can be characterized by their behavioural symptoms, such as inattention, hyperactivity and/or impulsivity. However, there is more to ADHD than these symptoms. In fact, there is some evidence from research that these children also have problems with language. The first aim of this thesis was to examine the language abilities of ADHD children in more detail and to compare them to children who are known to have language problems, namely children with specific language impairment (SLI).

Children with ADHD also often have problems in executive functioning, an umbrella term for various higher order cognitive processes, responsible for goal-directed behaviour. Executive functioning in children with SLI has only recently become a topic of interest, although the diagnosis presupposes that there is no known aetiology for their language problems. Therefore, the second aim of the study was to examine and compare executive functioning in both ADHD and SLI children.

Executive dysfunctioning is possibly linked to problems with language. This link has to date not been empirically demonstrated in typically developing children (TD). Work on children with SLI has concentrated more on exploring whether executive functioning problems exist, rather than seeking an explanation for the language problems in such dysfunctioning. On the other hand, Tannock and Schachar (1996) have proposed that both the behavioural and the
(mainly pragmatic – see below) language problems of children with ADHD are caused by underlying deficits in executive functioning. Consequently, the third and last aim of this study was to explore this possibility in both groups of children.

The three main goals of this thesis, described above, were introduced in Chapter 1. Chapters 2 and 3 provided a further background to the study.

Chapter 2 reviewed the literature about language in children with ADHD and in children with SLI. The SLI group served in this thesis as a benchmark for the ADHD group with respect to language. By definition, language comprehension and production is impaired in children with SLI and this is clearly the case across all language domains. However, problems are sometimes more evident in one domain than another. Children with so-called ‘typical SLI’ (Bishop, 2004), the group of interest in this study, experience most problems in the domain of grammar.

There was less literature available about language in children with ADHD. Mild problems in pragmatic language comprehension have been reported. On the productive side, specific, but not very severe problems in phonology, lexicon and grammar also occur. However, language problems of children with ADHD are most notable in the domain of productive pragmatics. For example, they often have difficulties telling a story coherently, and can introduce protagonists using only pronouns - assuming that the listener knows who they are talking about. Very few studies have compared the language problems of ADHD and SLI children, and, as a consequence, no detailed contrastive profile has to date emerged. The chapter concluded with a brief discussion of the literature on symptom overlap. The association between ADHD and (S)LI is above chance. Moreover, reading problems frequently occur, both in ADHD and in SLI. Therefore, it was decided that problems with reading also had to be assessed in this study.
Chapter 3 focused on the literature about non-verbal executive functioning in children with ADHD and in children with SLI. Five executive functions were reviewed, following the well-known taxonomy by Pennington and Ozonoff (1996). These were inhibition, working memory, planning, cognitive flexibility and fluency. All studies about children with ADHD point to a problem with inhibition. Problems with the other four functions have also been reported, but not consistently so. Only relatively few studies have reported on executive functioning in SLI. Tentatively, we concluded that problems with inhibition were more common than problems with working memory, planning, cognitive flexibility and fluency. It remained unclear, both in ADHD and in SLI, how specific the executive functioning deficits are, and whether or not profile and level differences can be distinguished. Pennington and Ozonoff also referred to this problem, coining it ‘the discriminant validity problem’. The chapter then discussed executive functioning in relation to language and, more specifically, the proposal by Tannock and Schachar (1996), mentioned above, that executive dysfunctioning may account for both the behavioural and the pragmatic language problems of children with ADHD. We decided to explore the issue in this study, and additionally, to extend it to executive functioning in relation to language in children with SLI. The chapter concluded with the research questions and general hypotheses.

Chapter 4 described the research method. All children selected were in the age range of 7;0 to 8;11. The mean age was 8;2. Moreover, they were monolingual Dutch. Children that had problems not associated with the symptomatology of either ADHD or SLI were excluded from the study. The SLI children had been diagnosed as ‘typical SLI’, with predominantly grammatical problems. Children with speech output problems were excluded, and the cut-off point for non-verbal intelligence was set at 80. The
diagnoses of the ADHD children were also checked very carefully. Only children from the combined and from the mainly hyperactive subtypes were included. Co-morbidity of oppositional defiant disorder and conduct disorder was allowed, but monitored with a questionnaire assessing externalizing symptoms, also including ADHD symptoms. Co-morbidity of reading problems was assessed with (non-)word reading tasks. There were 22 children in the TD group, 19 in the SLI group and 26 in the ADHD group.

The children were tested three times. In the first session, they completed a non-verbal intelligence test. The second and third sessions were counterbalanced and focused on language and executive functioning. The language battery included a narrative, elicited with the picture book *Frog, were are you?* (Mayer, 1969). Various grammatical and pragmatic variables were coded in the transcripts. Moreover, the children performed a non-word repetition and a sentence imitation task, and the parents of the children completed the CCC-II-NL, a questionnaire assessing language abilities, focusing in particular on pragmatics. The neuropsychological battery assessed non-verbal executive functioning. Inhibition, working memory, planning, and cognitive flexibility were tested with the CANTAB, an automated testing battery. Fluency was tested with a paper-and-pencil task (see Tables 4-4 and 4-5 for a complete overview of the variables). The results were statistically analyzed (controlling for differences in non-verintelligence) with the help of SPSS.

The results were presented in Chapters 5 to 7. Chapter 5 reported results of the language measures, Chapter 6 reported results of the executive functioning measures and Chapter 7 explored the relation between the language results and the executive functioning results.

Children with ADHD were found to differ significantly in language production in comparison with typically developing children, most notably so when looking at pragmatics. Moreover,
the ADHD group could be differentiated from the SLI group since they did better on phonological and grammatical measures. However, in the case of pragmatics, there was less of a difference between the two clinical groups, both performing more poorly than the typically developing group. These findings were reflected also in within-group and individual comparisons (raw scores). Moreover, a considerable overlap was found for symptoms of inattention/hyperactivity-impulsivity, language problems and reading problems (Chapter 5).

With respect to executive functioning, children with ADHD performed significantly worse than SLI and TD children only on the measure for inhibition. No differences between these three groups were reported for working memory, planning, cognitive flexibility and non-verbal fluency. However, within-group and individual comparisons generally showed that ADHD children had the worst scores, TD children had the best scores, and that SLI children’s scores fell somewhere in between (raw scores). These comparisons also showed that about half of the ADHD group performed relatively well on executive functioning tasks, and we concluded, as others have done (cf. Sonuga-Barke, 2005), that executive dysfunctioning alone cannot account for all of the ADHD symptoms (Chapter 6).

In order to explore the link between executive functioning and language, results of the three groups were taken together and correlations were calculated. Significant correlations were not found; not between executive functioning and pragmatics, and not between executive functioning and grammar. We decided to take a closer look and compared ADHD children with language problems to ADHD children without language problems. In general, the ADHD group with language problems had worse executive functioning scores than the ADHD group without language problems, and likewise, than the SLI group. However, the differences between the groups were not significant and therefore it had to be concluded that the model of
Tannock and Schachar (1996) could not be supported by the results of this study (Chapter 7).
The concluding discussion in Chapter 8 again focused on language, executive functioning, and the link between these two, on the basis of findings from the literature (2-3) and result (5-7) chapters.

Firstly, the profile differences that we found across language domains were discussed (Leonard, 2000). ADHD children were mainly impaired in pragmatics, whereas SLI children were impaired in both grammar and pragmatics.

The pragmatic problems that were found in this study, both in the ADHD group and in the SLI group, would probably fit the criteria of the ‘social communication disorder’, a new diagnosis in the DSM-5. We welcome this diagnosis, because it would further enhance the awareness of pragmatic language problems, occurring as part of the SLI symptomatology, or in addition to psychiatric impairments such as ADHD. On the other hand, the grammar of children with ADHD was relatively spared in comparison with SLI children. However, children in the ADHD group did have lower scores than children in the TD group on some grammatical outcome measures. In other words, individual ADHD children could certainly have grammatical problems, and these were sometimes masked by the group evaluations.

Secondly, we discussed executive functioning, and in particular the ‘discriminant validity problem’. As mentioned above, the assumption of profile differences could be a solution to this problem (Pennington and Ozonoff, 1996). This study did find a profile difference: children with ADHD performed poorly on inhibition in comparison with SLI children, although we expected on the basis of the literature that we would find inhibitory problems in both groups. The result for the SLI children may be due to several factors. Of the studies discussed, most involved older children, possibly implying a more severe form of language impairment.
Moreover, different tasks were used. Further research is thus necessary to investigate possible problems with inhibition in SLI children and to compare their performance to that of ADHD children.

Thirdly, a specific association between pragmatic language problems and problems with executive functioning, as predicted by the model of Tannock and Schachar (1996), was not found. The model could therefore not be supported. Looking at individual scores however, we found that problems with executive functioning were more common in children who also exhibited symptoms of inattention/hyperactivity-impulsivity, language problems and reading problems. This clustering of symptoms should get more attention in clinical practice as well as in future research. In clinical practice because children with clustered symptoms tend to be more severely impaired (e.g. Leonard, 2000); treatment aimed at all symptoms instead of just one or two might enhance their functioning. In future research, a longitudinal perspective is preferable, to study from early infancy onward how alternative developmental pathways might lead to particular phenotypical outcomes (see also Karmiloff-Smith, 1998).