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Communication abilities of children with ASD and ADHD

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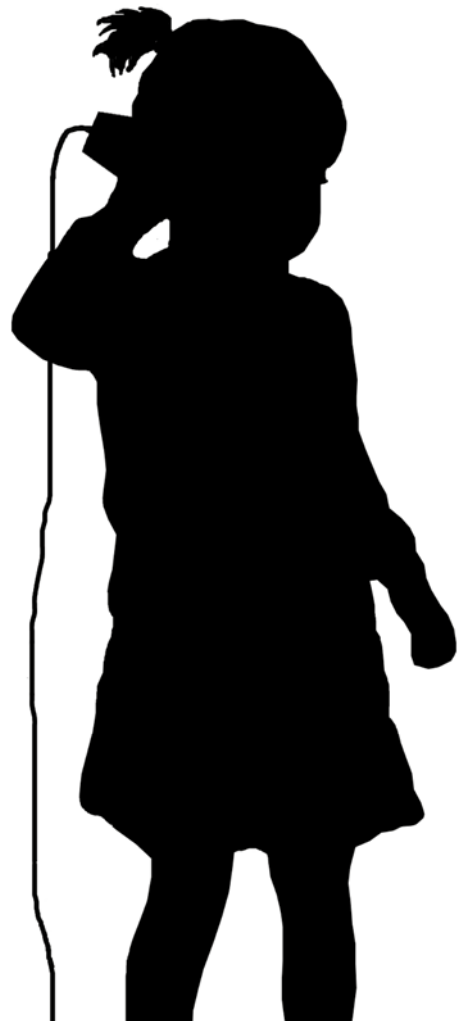
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General introduction



Communication takes place between speakers and listeners. Often it has a social purpose and involves an exchange of thoughts and beliefs of people about other people. As such, it is a complex process which entails the speaker's awareness of the knowledge and thoughts of the listener, and vice versa. This complexity can lead to confusing situations, which are commonplace in situational comedies. In one episode of the sit-com *Friends*, for example, two friends (Monica and Chandler) have a covert relationship. When two of their other friends (Phoebe and Rachel) discover this secret, a hilarious as well as confusing plot is revealed. At the end of the episode, Phoebe points out the following to her friend Rachel:

“Wait, they don't know that we know they know we know!”

Both the number of distinct points of view and the potentially ambiguous pronoun *they* make this sentence extremely complex. Nevertheless, people engrossed in the plot of this episode are able to interpret this sentence appropriately. This example demonstrates that knowing the thoughts and motives of other people helps enormously with successful communication.

In order for communication to be successful, the listener should identify the speaker's intended meaning. Also, speakers must adapt their speech to what the listener already knows and what the listener still needs to know. For example, when a speaker wants to tell the listener about her trip to Paris, she will talk in a different way about it to someone who lives in Paris than to a friend who has never been there. The first one knows a lot about the city's highlights, while the latter does not. Hence, the speaker can talk in more detail about, for example, the Notre Dame to the person who lives in Paris than to her non-French friend.

Communication thus involves taking into account one's conversational partner. A fundamental aspect of communication that may require that speakers and listeners take into account the other person's perspective is the choice and interpretation of referring expressions. Reference is one of the most important functions of language. When communicating, speakers constantly make decisions about how specific they wish to be in their choice of referring expressions. The less specific a referring expression is, the more ambiguous it usually is. In order to decide how specific the speaker should be, he must take into account the knowledge of the listener. Vice versa, in order to identify the intended referent when encountering a referring expression, the listener may also need to take into account the speaker's perspective.

Individuals who are assumed to have problems with perspective taking, such as children with autism spectrum disorder (ASD), may encounter difficulties with communication: as a listener they may encounter difficulties in identifying the speaker's intentional meaning, and, as a speaker, they may encounter difficulties in adapting their speech to the listener's needs. Various mechanisms may be needed for

perspective taking in communication, such as Theory of Mind and executive functions (e.g., working memory or inhibition) (Martin & McDonald 2003). Children with ASD often encounter problems with Theory of Mind and executive functioning (e.g., Baron-Cohen, Leslie, & Frith, 1985; Pennington & Ozonoff, 1996). These problems may relate to their communication deficits.

Children with attention-deficit/hyperactivity disorder (ADHD) show deficits in cognitive and social functioning that overlap with those of children with ASD (Demopoulos, Hopkins, & Davis, 2013; Johnson, Gliga, Jones, & Charman, 2015; Nijmeijer et al., 2010; Rommelse, Geurts, Franke, Buitelaar, & Hartman, 2011; Bishop & Baird, 2001). ASD and ADHD are among the most common psychiatric disorders in childhood, with prevalence rates of around 1% for ASD and 5% for ADHD (Baird et al., 2006; Polanczyk, De Lima, Horta, Biederman, & Rohde, 2007), and frequently co-occur (Rommelse, Franke, Geurts, Hartman, & Buitelaar, 2010; Ronald, Simonoff, Kuntsi, Asherson, & Plomin, 2008). The overlap between ASD and ADHD in social and cognitive functioning raises the question whether children with ADHD and children with ASD also have comparable deficits in communication and, more specifically, in perspective taking in communication. Recent studies using parental and teacher questionnaires suggest that children with ADHD indeed have language and communication problems (for an overview, see Green, Johnson & Bretherton, 2013). Their language problems may partly overlap with the language problems observed in children with ASD (e.g., Geurts & Embrechts, 2008). Also, preliminary results based on small groups of participants suggest that there may be shared impairments in the language used by children with ASD and children with ADHD (Rumpf, Kamp-Becker, Becker, & Kauschke, 2012).

This dissertation focuses on language production and comprehension by children with ASD and children with ADHD. It examines which language difficulties these two groups may encounter, and, more specifically, whether children with ASD and children with ADHD are capable of taking into account the other person's perspective in communication. Furthermore, the cognitive mechanisms that may play a role in language production and comprehension are investigated.

The present chapter briefly introduces several topics that are relevant for this dissertation. I will start by discussing attested problems in language and cognitive mechanisms in children with ASD and children with ADHD. Next, three linguistic theories on perspective taking in communication will be discussed. Then, the role of perspective taking in the production and comprehension of referring expressions will be considered, and possible cognitive mechanisms that underlie perspective taking in communication are discussed. Finally, the research questions, design of the study, and the outline of the dissertation are presented.

Autism spectrum disorder

ASD is a neurodevelopmental disorder characterized by deficits in social communication and interaction and by restricted interests and repetitive behavior (DSM-5 (American Psychiatric Association, 2013)). In children with autism spectrum disorders a great variety of language problems can be seen. Pragmatics has been identified as the aspect of language that is most impaired in children with ASD (Baltaxe, 1977; Tager-Flusberg, Paul & Lord, 2005; Tager-Flusberg & Anderson, 1991; Loveland & Tunali, 1993). Pragmatics includes initiating and sustaining a conversation, understanding the speaker's intended meaning and adapting one's speech to what the listener needs to know. Other aspects of language may also be impaired, although these impairments are usually less profound than pragmatic impairments. Some studies found evidence for grammatical impairments in (some) children with ASD (Eigsti, Bennetto, & Dadlani, 2007; Kjelgaard & Tager-Flusberg, 2001). In contrast, other studies did not find syntactic impairments in children with ASD (e.g. Bartolucci, Pierce, Streiner, & Eppel, 1976; Tager-Flusberg, 1981).

Attention-deficit/hyperactivity disorder

ADHD is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity (DSM-5 (American Psychiatric Association, 2013)). Communication problems have been reported in children with ADHD as well (e.g., Bishop & Baird, 2001; Geurts & Embrechts, 2008; Helland, Biringier, Helland, & Heimann, 2012). Their pragmatic use of language is found to be impaired (Green et al., 2013). Whether children with ADHD exhibit syntactic impairments is yet unclear. Some studies did not find syntactic impairments (e.g., Geurts & Embrechts, 2008; Geurts et al., 2004; Helland et al., 2012; Kim & Kaiser, 2000; Wassenberg et al., 2010), whereas some other studies did (Oram, Fine, Okamoto, & Tannock, 1999; Pappaliou, Maniadaki, & Kakouros, 2015).

Cognitive mechanisms

It has been proposed that problems in language and communication of children with ASD and children with ADHD are related to deficits in cognitive mechanisms, such as Theory of Mind or executive functioning (e.g., working memory, response inhibition, and sustained attention) (Engelhardt, Ferreira, & Nigg, 2009; Green et al., 2013; Purvis and Tannock, 1997; Tager-Flusberg & Joseph, 2005).

Theory of Mind is the ability to attribute mental states, such as desires, beliefs, and emotions, to oneself and others and to predict behaviour of oneself and others

driven by these mental states (Premack & Woodruff; 1978). A cornerstone in Theory of Mind development is False Belief understanding, which is the understanding that someone can have a belief that does not match reality (Baron-Cohen et al., 1985; Leslie & Thaiss, 1992). False Belief is typically measured with stories in which objects are moved or replaced in the absence of one of the story characters. The participant's task is to differentiate between the character's False Belief and the participant's own knowledge of the real situation. Theory of Mind and language are associated (Milligan, Astington and Dack, 2007). Language problems of children with ASD have been related to their Theory of Mind problems (e.g., Happé, 1993; Tager-Flusberg, 2000). Recent studies also revealed Theory of Mind difficulties in ADHD (Buitelaar, Van der Wees, Swaab-Barneveld, & Van der Gaag, 1999; Caillies, Bertot, Motte, & Raynaud, 2014), although other studies reported an absence of Theory of Mind impairments in ADHD (Charman, Carroll, & Sturge, 2001; Dyck, Ferguson, & Shochet, 2001). It is unclear at this point whether the language and communication problems of ADHD are associated with possible Theory of Mind impairments.

In addition to Theory of Mind, executive functions may be crucial to communication processes (Martin & McDonald, 2003; Kronmüller & Barr, 2007; Lin, Keysar & Epley, 2010). Executive functions involve a range of higher-order cognitive processes, such as working memory and inhibition of responses. Working memory is the process by which information is actively maintained for short periods of time, while performing another task (Baddeley, 1986). Response inhibition is the ability to suppress an initiated response (Nigg, 2000). Most response inhibition tasks require participants to respond as fast as possible to given stimuli, while inhibiting their response to specific stimuli.

Children with ASD and children with ADHD have been found to show deficits in executive functioning (e.g., Geurts, Verté, Oosterlaan, Roeyers, & Sergeant, 2004; Hill, 2004; Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Nydén, Billstedt, Hjelmquist, & Gillberg, 2001; Happé, Booth, Charlton & Hughes, 2006). It has been suggested that these deficits may underlie their communication problems (Engelhardt et al., 2009; Green et al., 2013). Although much less the topic of study than the relation between Theory of Mind and linguistic abilities, recent findings reported associations between executive functioning measures and linguistic abilities (e.g., Friend & Bates, 2014; Green, 2013; Tsimpli, Andreou, Agathopoulou, & Masoura, 2014). However, the relation between executive functioning measures and linguistic abilities needs to be studied more extensively.

Perspective taking in communication

As mentioned, in communication it is crucial that speakers and listeners take into account the other person's perspective. Different theories have been proposed to model perspective taking in communication.

Grice (1975) modeled communication as language users' assumption that in conversations speakers and hearers cooperate to achieve communicative success (the Cooperative Principle). Speakers obeying the Cooperative Principle conform to particular communicative principles: the Maxims of Conversation. Listeners expect that speakers conform to these maxims. Grice distinguished four maxims: the maxim of Quality (truthfulness), the maxim of Quantity (informativeness), the maxim of Relation (relevance), and the maxim of Manner (clarity). In communication, listeners expect that the speaker's utterances are true, relevant, as clear as can be and as informative as possible. Children with ASD show problems with identifying violations of the Gricean Maxims, and these problems are associated with their deficits on Theory of Mind (Surian, Baron-Cohen and Van der Lely; 1996). Although the Gricean Maxims theory of cooperation can be used to explain language problems in, for example, children with ASD, it does not provide explicit predictions (Wilson & Sperber, 2004).

Relevance Theory is more specific about the concept of relevance than Grice is (Sperber & Wilson, 1995; Wilson & Sperber, 2004). According to Relevance Theory, relevant contextual information, such as linguistic information, world knowledge and beliefs about the speaker's assumptions, should all be taken into account in communication. Hearers automatically search for relevant information in order to not have to process all available information, which results in minimal processing effort and maximal cognitive effect. Both Grice and Relevance Theory only model the pragmatic aspects of communication. Other aspects of linguistic behavior, such as grammar, are not addressed in both theories.

A proposed model of the communication between speakers and hearers that combines grammatical and pragmatic aspects of language is bidirectional Optimality Theory (Blutner, 2000). Bidirectional Optimality Theory explicitly distinguishes the roles of speaker and hearer. According to Optimality Theory, the grammar of a language consists of a set of constraints. Speakers must select the optimal linguistic form for a meaning they want to express on the basis of the constraints of the grammar. Listeners, vice versa, select the optimal meaning for the linguistic form they encounter. It has been proposed in Optimality Theory that in communication a speaker takes into account the perspective of the listener and the listener takes into account the perspective of the speaker, a process called bidirectional optimization (Blutner, 2000). Optimization and bidirectional optimization are formally defined procedures to determine the optimal output on the basis of a given input. Hence, compared to Gricean pragmatics and Relevance Theory, Bidirectional Optimality

Theory is more precise and can generate testable predictions about language production and comprehension at different linguistic levels, such as grammar and pragmatics. In this dissertation, Bidirectional Optimality Theory is used to make specific predictions about linguistic difficulties that children with ASD and children with ADHD may encounter.

Referring expressions

A crucial function of language that has been modeled in Bidirectional Optimality Theory is reference (Hendriks, Englert, Wubs & Hoeks, 2008; Hendriks & Spenader, 2006). The use and interpretation of referring expressions is often used to study perspective taking in communication (e.g., Horton & Keysar, 1996). Speakers must be specific enough in order to be understood by their listeners. The use of forms that are not explicit enough may lead to difficulties in interpretation. For example, in a situation in which two characters John and Bill are present, using a pronoun may result in a non-intended interpretation: “John and Bill are in the kitchen. *He* is making an omelet”. Adult speakers generally avoid pronouns in situations in which the use of a pronoun may lead to an unclear or unintended interpretation and use a more specific form (*John* or *Bill*). However, young typically developing children tend to overuse pronouns in these situations, leading to ambiguity for the listener (Hendriks, Koster, & Hoeks, 2014; Karmiloff-Smith, 1985; Wigglesworth, 1997; Wubs, Hendriks, Hoeks, & Koster, 2009).

Hendriks, Englert, Wubs and Hoeks (2008) account for this overuse of pronouns in terms of children’s inability to optimize bidirectionally. They claim that speakers in principle prefer to use pronouns, but take into account the grammatical perspective of the listener to check whether the listener will be able to correctly identify the intended referent. If not, adult speakers will use a more explicit form. It is hypothesized that young typically developing children are not yet able to take the listener’s perspective into account (i.e., to optimize bidirectionally) (Hendriks et al., 2008; Wubs et al., 2009) and therefore overuse pronouns, leading to ambiguity for the listener.

Another well-known problem with referring expressions is the Pronoun Interpretation Problem that is observed in languages such as English and Dutch (Chien & Wexler, 1990; Koster, 1993; Philip & Coopmans, 1996; Spenader, Smits, & Hendriks, 2009; Van Rij, Van Rij, & Hendriks, 2010). In these languages, children up to at least the age of 6 (and perhaps even as old as 11 years old, see Başkent, Van Rij, Ng, Free, & Hendriks, 2013) incorrectly allow the pronoun *him* in sentences like “John is washing him” to be coreferential with the local subject John. Yet, at the same time, these children correctly assign a coreferential interpretation to reflexives such as in the sentence “John is washing himself”.

Hendriks and Spenader (2006) argue that the Pronoun Interpretation Problem is caused by children's inability to take the speaker's perspective into account. When adults interpret the ambiguous form *him* in the sentence "John is washing him", adult listeners consider that the speaker could also have used the form *himself*, which unambiguously refers to John. Because the speaker used *him* instead of *himself*, the speaker probably intended to express the event that John washes Bill.

Although both linguistic phenomena discussed above deal with referring expressions, there is a significant difference between the two phenomena. Children's overuse of pronouns in language production deals with referring expressions in subject position, which are strongly influenced by properties of the preceding linguistic discourse. On the other hand, the Pronoun Interpretation Problem in language comprehension deals with referring expressions in object position. These referring expressions usually occur in sentence-internal position and are hence restricted in their interpretation by the rest of the sentence, (including the subject of the sentence), which is reflected in the important role of syntactic principles (such as Chomsky's binding principles (Chomsky, 1981)).

Despite this difference between the two phenomena, both the production and the interpretation of referring expressions can be modeled in terms of perspective taking in bidirectional Optimality Theory (Hendriks et al., 2008; Hendriks & Spenader, 2006). Specifically, it is claimed that speakers model a hypothetical listener and listeners model a hypothetical speaker, thereby accounting for the coordination of referential choice between speakers and listeners (Hendriks, 2014). Taking the perspective of a *hypothetical* partner, as is assumed here, can be seen as a form of grammatical perspective taking: speakers take the grammatical perspective of their hypothetical listener (or vice versa) and use the grammar to determine the optimal outcome from this opposite communicative perspective. In communication, speakers and listeners also need to take into account the needs of an *actual* conversational partner, which may vary per situation. In contrast, in grammatical perspective taking, the hypothetical listener should be understood as the speaker imagining himself in the role of the listener, and vice versa. This dissertation focuses on grammatical perspective taking, as opposed to taking into account the perspective of an actual conversational partner.

The difficulties that young children encounter with the production and the interpretation of referring expressions are explained by children's inability to take into account the other person's grammatical perspective. Different causes have been proposed to explain this inability. For example, grammatical perspective taking may require Theory of Mind skills (Hendriks, 2014), which develop gradually during childhood. Furthermore, grammatical perspective taking may also involve executive functioning, such as working memory or inhibition. A speaker or listener should hold in mind the possible linguistic options until he has considered the other person's perspective, and should then inhibit suboptimal forms or interpretations.

In children with ASD and children with ADHD, difficulties with Theory of Mind (e.g., Baron-Cohen et al., 1993; Buitelaar et al., 1999), working memory and/or inhibition (e.g., Geurts et al., 2004; Hill, 2004; Martinussen et al., 2005; Nydén, Billstedt, Hjelmqvist, & Gillberg, 2001) have been reported. Thus children with ASD and children with ADHD might show problems in their production and comprehension of referring expressions, since they show deficits in the mechanisms assumed to be necessary for successful communication.

Research questions

This dissertation focuses on language production and comprehension by children with ASD and children with ADHD. The first aim is to investigate the language problems that children with ASD and children with ADHD encounter and to examine similarities and differences in linguistic abilities between these two groups. Different aspects of linguistic abilities, ranging from pragmatic abilities to semantic and syntactic abilities, are investigated in three linguistic studies. The second aim is to investigate which cognitive mechanisms play a role in language production and comprehension.

In the first study on linguistic performance by children with ASD and ADHD, I examine narratives produced by children with ASD and children with ADHD and compare these narratives to those of typically developing children on a broad spectrum of linguistic measures, including their use of referring expressions. This provides a broad profile of the language problems children with ASD and children with ADHD encounter. Also, in this study parental questionnaires on children's communicative performance are included to assess children's linguistic functioning in daily life.

In the second and third study on linguistic performance by children with ASD and ADHD, I examine two linguistic phenomena for which it is hypothesized that grammatical perspective taking is needed: the production of referring expressions in subject position (e.g., *the pirate* versus *he*) and the comprehension of referring expressions in object position (*him* versus *himself*). These two phenomena are studied in controlled language tasks. This enables us to investigate whether children with ASD and children with ADHD have difficulties with grammatical perspective taking per se in a situation in which the influence of other factors, such as a long and complex discourse, is minimized. I hypothesize that children with ASD have difficulties in perspective taking, and therefore have problems in their choice of referring expressions.

With regard to the second aim of this dissertation I focus on Theory of Mind, working memory and inhibition and relate these mechanisms to linguistic performance in the narrative task and to grammatical perspective taking in the two controlled tasks. I hypothesize that Theory of Mind, working memory and inhibition are needed in grammatical perspective taking.

The broad approach of this dissertation aims to provide insight into the similarities and differences in the linguistic difficulties of children with ASD and children with ADHD. An extensive spectrum of language and communication difficulties of children with ASD and ADHD is investigated, varying from pragmatic to syntactic and semantic problems. Children's linguistic functioning is assessed in controlled tasks as well as more natural situations. Furthermore, the inclusion of different cognitive mechanisms can give insight into whether the communication problems of children with ASD and children with ADHD are related to the same or different deficits in cognitive functioning.

Design of the study

The participants in this dissertation are Dutch-speaking children between 6 and 12 years old. In addition to typically developing children, children with a clinical diagnosis of ASD or ADHD (according to DSM-IV-TR guidelines) are included in this study. To confirm ASD diagnosis, the Autism Diagnostic Interview Revised (ADI-R) (Rutter, Le Couteur, & Lord, 2003) and the Autism Diagnostic Observation Schema (ADOS) (Lord, Rutter, DiLavore, & Risi, 1999) are administered by trained psychologists. Likewise, to confirm ADHD diagnosis, the Parent Interview for Child Symptoms (PICS) (Ickowicz et al., 2006) and the Teacher Telephone Interview-IV (TTI-IV) (Tannock, Hum, Masellis, Humphries, & Schachar, 2002) are administered by trained psychologists.

Each child is tested individually on a single day in a quiet testing room with two experimenters present. The children's narratives are obtained during the assessment of the ADOS. Furthermore, children carry out a controlled reference production task (adopted from Hendriks et al., 2014) that deals with children's choice of referring expressions (e.g., *he* versus *the pirate*). Additionally, children's comprehension of *him* and *himself* is assessed with a controlled reference comprehension task. Next, to obtain Theory of Mind, working memory, and response inhibition scores, a verbal and a low-verbal False Belief task (adopted from Hollebrandse, Van Hout, & Hendriks 2014), an n-back task (cf. Owen, McMillan, Laird, & Bullmore, 2005) and a stop-signal task (adopted from Van den Wildenberg & Christoffels, 2010) are used. Furthermore, to obtain an estimation of children's IQ and children's general verbal ability, two subtasks (Vocabulary and Block Design) of the WISC-III-NL (Kort et al., 2002) and the PPVT-III-NL (Schlichting, 2005) are administered.

Children visit the lab together with their parents. While the children are tested, their parents are interviewed in an adjacent room (ADI-R and PICS). Furthermore, parents fill in the Dutch version of the Children's Communication Checklist (CCC-2-NL) (Bishop, 2003; Dutch translation: Geurts, 2007).

Outline of this dissertation

This dissertation starts with an investigation of the Theory of Mind abilities of children with ASD and children with ADHD. Furthermore I investigate which cognitive mechanisms underlie possible deficits on Theory of Mind Tasks in the two groups (**Chapter 2**). Next, **Chapter 3** provides extensive language profiles of children with ASD and children with ADHD and relates their language skills to the cognitive mechanisms under investigation. In **Chapter 4** the production of referring expressions (*the pirate vs. he*) by children with ASD and ADHD is investigated in a structured elicited production task. In **Chapter 5** the comprehension of referring expressions (*him vs. himself*) by children with ASD and children with ADHD is examined in a controlled comprehension task. In the general discussion in **Chapter 6** I present the main findings of this dissertation, discuss limitations and provide directions for future research.

