

Discourse reference in children with Autism Spectrum Disorder

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II. Abstract

It has been observed in previous research that children with Autism Spectrum Disorder (ASD) often seem to have difficulty with discourse reference. In this thesis, it is hypothesized that these difficulties follow from a mapping problem in children with ASD between nominal syntactic constituents on the one hand, and discourse representations on the other hand. Because associating a linguistic representation with its corresponding discourse referent is problematic, it is predicted that children with ASD prefer to introduce constituents as new referents in the discourse. In order to test this prediction, the production of scrambling is examined in children with ASD. In Dutch, direct object noun phrases whose referents have been mentioned in the discourse tend to appear before sentential adverbs (the *scrambled* word order), while direct objects that introduce referents appear in a position following these adverbs (the *non-scrambled* word order). In an elicited production task involving scrambling with a group of 28 Dutch-speaking children with ASD, aged 6-14 years old, a matched control group and a group of adults, it was found that the children with ASD produced fewer scrambled word orders and more non-scrambled word-orders than the control group in contexts eliciting referential direct objects. In a subsequent study, the comprehension of Dutch personal and reflexive pronouns was examined in a group of 13 children with ASD and matched controls by means of a picture-selection task. It was predicted that children with ASD assigned more deictic interpretations to personal pronouns than the control group, since these interpretations introduce new referents in the discourse. It is argued that these interpretations possibly lead to reflexive readings of direct object personal pronouns. Both groups interpreted reflexive pronouns correctly, but made mistakes interpreting personal pronouns. While the results did not differ between the groups, it was found that the control group showed an increase in correct responses between the ages of 6 and 10 and perfect scores after the age of 10. The children with ASD however gave incorrect responses up until the age of 14. It is argued that the children in the control group made mistakes because they are still in the process of cognitive and linguistic development, while the children with ASD did so because of the hypothesized mapping problem between linguistic representations and discourse referents.

Keywords: Autism Spectrum Disorder, Language development, Discourse reference, Direct object scrambling, Pronoun comprehension.

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1. Introduction

When we speak, we combine words to sentences. In each sentence we utter, we can linguistically relate its words to words in other sentences. That way, a cohesive *discourse* is formed. Creating links between elements of different sentences generally occurs in a communicative setting. In order to make meaningful relationships between sentences, a speaker has to take into account the background knowledge of himself and the interlocutor, and potential differences between the two. Natural language provides different tools to make use of overlap in background knowledge on the one hand, and to overcome differences in the background knowledge of the speaker and hearer on the other hand. In English for instance, a speaker can make use of personal pronouns such as *he*, *she*, *him* and *her*, if the speaker is sure that the hearer is able to infer to which person he refers. So, when using personal pronouns, a speaker makes use of overlap in background knowledge between speaker and hearer. When the speaker knows that the hearer does not know an individual he wants to refer to, the speaker might use indefinite noun phrases (NPs) such as *a man* or *a woman* in order to take the difference in background knowledge into account. In Dutch sentences, direct objects whose referents have been mentioned earlier in the conversation typically appear before sentential adverbs, e.g. *Ik heb het boek vlug gelezen*, 'I read the book quickly'. Direct objects that introduce characters, items or events into the conversation however typically occur in a position following these adverbs, e.g. *Ik heb vlug een boek gelezen*, 'I read a book quickly'. Thus, not only the words of a sentence, but also its structure reflects whether a speaker represents specific entities as being known or being unknown, or in other words, whether a speaker relates a syntactic constituent to its corresponding discourse representation or introduces a constituent's referent in his model of the discourse.

It has been observed in previous literature that children who are diagnosed with Autism Spectrum Disorder (ASD) often seem to have difficulty with these processes of reference. For instance, in an early study Christiane Baltaxe (1977) noted in the language of five teenagers with autism that they referred to persons by means of indefinite noun phrases where personal pronouns would have been appropriate. In another study, Baltaxe and D'Angiola (1992) found in conversations with autistic children that, compared to typically developing children and language impaired children, they made more errors in their use of pronouns in order to refer to previously mentioned referents. Curiously though, other linguistic skills such as phonological, lexical and syntactic abilities seem to be unimpaired in many children with ASD (e.g. Eigsti et al., 2011). If no general linguistic deficits are causing these referential problems, this brings up the following question: *what type of cognitive impairment may be involved in the difficulties with discourse reference observed in children with ASD?*

This question will be addressed in this thesis. It is hypothesized that the difficulties with discourse reference in children with ASD follow from a mapping problem between linguistic representations on the one hand, and discourse representations on the other hand. In other words, it is difficult for children with autism to link nominal syntactic constituents to their corresponding mental representations in the discourse model. It is predicted that if this type of discourse reference is problematic, other reference strategies might be adopted by children with ASD, resulting in patterns of language production and language comprehension that are deviant from those of typically developing children. Specifically, this hypothesis will be tested by looking at two aspects of the language of Dutch-speaking children with ASD. The first aspect is direct object scrambling, i.e. the word order variation exemplified above, in which the discourse status of a direct object's referent is crucially involved in the direct object's syntactic position. The second aspect is the comprehension of personal and reflexive pronouns, which concerns reference assignment on the basis of either syntactic or discourse considerations.

This thesis is organized as follows. In chapter 2, the theoretical background of the present study is discussed, including results of previous research relating to discourse reference in children

with ASD. The topic of chapter 3 is Dutch direct object scrambling. In this chapter, an elicited production experiment with a group of 28 children with ASD and a typically developing control group is presented. Chapter 4 concerns pronoun comprehension in children with ASD and includes an experiment with 13 children with ASD and a typically developing control group investigating the comprehension of personal and reflexive pronouns. Also, chapter 4 includes a comparison of the results of the direct object scrambling study and the pronoun comprehension study. In chapter 5, a conclusion and suggestions for future research are presented.

2. Theoretical Background

2.1 Language in children with Autism Spectrum Disorder

The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-V; American Psychiatric Association, 2013) defines Autism Spectrum Disorder (ASD) as a neurodevelopmental disorder, associated with deficits in social communication and social interaction on the one hand, and restrictive, repetitive patterns of behavior, interests or activities on the other hand. These symptoms occur early in life, impair everyday functioning, and cannot be explained by global developmental delay or intellectual disabilities, although the latter frequently co-occurs with ASD. Persons with ASD do not form a homogeneous group; the severity of the symptoms vary widely across individuals. Hence the term *spectrum* is used.

According to the DSM-V, verbal and non-verbal communicative impairments in persons with ASD are constituted differently, depending on factors such as chronological age, intellectual abilities and treatment history. Many persons with ASD have problems with language, ranging from complete absence of speech to delays in language development, comprehension difficulties and use of overly literal language. Most importantly however, the DSM-V states that even when formal linguistic skills such as vocabulary and grammar are intact, the use of language for communicative purposes is impaired in ASD.

Language acquisition studies involving children with autism largely support this description of language and language development in ASD, although mixed results have been reported. Tager-Flusberg et al. (1990) for instance investigated in a longitudinal study the spontaneous speech of a group of autistic children and compared its grammatical complexity, in terms of mean length of utterance (MLU), with the speech of a group of children with Down syndrome, matched on non-verbal age, and typically developing controls, and did not find significant differences in their development, although the children with autism showed a delayed onset of their development. Other studies investigating the acquisition of grammatical morphemes also suggest that the grammatical development of children with ASD is largely typical (e.g. Bartolucci, Pierce and Streiner, 1980; Howlin, 1984). In a more recent study by Eigsti, Bennetto and Dadlani (2007) however, it was found that children with autism produced language that was syntactically less complex than the language of typically developing controls, matched on lexical knowledge and nonverbal IQ. Eigsti et al. (2011) however note that these different findings might be due to methodological issues, such as the use of spontaneous speech versus structured tasks.

As for phonological development, the literature seems to suggest that in most individuals with ASD this linguistic component is intact (Eigsti et al., 2011). Bartak, Rutter and Cox (1975) for example found in a study involving both structured and spontaneous speech settings that children with ASD had few articulatory problems, compared to dysphasic controls, matched on non-verbal IQ. Kjelgaard and Tager-Flusberg (2001) obtained similar results in a study involving 89 high-functioning children with ASD (i.e. ASD without intellectual impairments). This group of ASD children scored within the normal range of an articulation test.

Pragmatic and discourse functions however, commonly acknowledged as the most socially involved aspects of language, appear to be impaired in children with ASD almost uniformly. Pragmatics relates to the use of language in a communicative context and encompasses for instance appropriate turn-taking, choosing a specific register in addressing a hearer and understanding non-literal meaning. It has been noted in the literature that children with ASD frequently use pedantic language, that is, overly informative language that appears to violate Grice's (1975) conversational maxims of relevance and quantity (Ghaziuddin and Gerstein, 1996). Also, it is known that autistic children often have

difficulty in understanding utterances that are metaphorical, ironic or sarcastic (e.g. Adachi et al., 2004) and sometimes adopt a socially inappropriate style (Volden, 2002).

Discourse studies typically investigate utterances consisting of multiple clauses and the relations between those clauses. Discourse functions can be considered part of pragmatic functions, in the sense that they require the speaker's acknowledgement of the intentions, representations, (world) knowledge and other qualities of the hearer (Eigsti et al., 2011). Thus, discourse functions have a substantial social requirement and can therefore be expected to be problematic in children with ASD. Indeed, Kelley et al. (2006) found in a narrative production experiment that high-functioning children with ASD provide significantly fewer descriptions of causal relations between events and motivations and goals of characters and significantly more incorrect or redundant information than typically developing peers, while performing equally well on tasks testing morphosyntactic knowledge. A number of studies also found difficulty in discourse reference abilities in individuals with ASD. Baltaxe (1977) found in interviews with autistic adolescents that they tended to refer to discourse referents using full indefinite NPs rather than personal pronouns. She concluded that these adolescents had a pragmatic impairment in formally distinguishing between old and new information. Fifteen years later, Baltaxe and D'Angiola (1992) found in semi-structured conversations that compared to typically developing (TD) children and children with Specific Language Impairment (SLI), children with autism have difficulty in correctly using *referential cohesive ties*, i.e. using pronominals, demonstratives or comparatives in order to refer to previously mentioned entities in the discourse. These difficulties were manifested in different ways, varying from unclear pronominal reference and agreement errors to complete omission of pronouns. In a follow-up study, Fine et al. (1994) found that a group of children and adults with ASD made less reference to the previous discourse by means of nominal cohesive links than a control group. Instead, they referred more to aspects of the physical environment. More recently, Arnold, Bennetto and Diehl (2009) found that high-functioning children with autism made less use of pronouns and *zeros* (.. and \emptyset ran; .. while \emptyset running) than TD matched controls. Instead, they make use of explicit descriptions of referents by means of names or definite noun phrases (NPs¹). The results of these studies will be discussed in more detail below. For now, it suffices to conclude that in the literature difficulties with discourse management, and discourse reference in particular, have been frequently attested in ASD.

In short, children with autism have communicative impairments that are most evidently manifested in their pragmatic and discourse functioning. While children with ASD may have other linguistic deficits, e.g. in the domain of syntax, this is not necessarily the case. More specifically, it has been shown in various studies that children with autism often have difficulty in discourse reference. For instance, it has been observed that children with ASD use pronouns incorrectly more often than typically developing children. In the next section, these findings will be related to observations from neurological studies which suggest that Autism Spectrum Disorder is associated with lower levels of coordination between different brain regions, also called the *underconnectivity hypothesis*.

2.2 Neural underconnectivity in ASD

Recent neuroimaging studies suggest that autism is a disorder of brain underconnectivity (Minshev and Williams, 2007; Just et al., 2012). These studies have shown that synchronization of activation between different brain regions is lower in ASD. For instance, Just et al. (2004) found in a functional Magnetic Resonance Imaging (fMRI) study that during written sentence comprehension, the degree of

¹ There is controversy in the linguistic literature as to whether nominal constituents should be syntactically analyzed as determiner phrases (DPs) or noun phrases (NPs). In this thesis, these constituents will be neutrally referred to as NPs.

coordination of activation between different cortical areas was lower in participants with ASD than in control participants. Other neuroimaging studies found similar cortical underconnectivity patterns in persons with ASD when performing tasks involving social cognition (Castelli et al., 2002), working memory (Koshino et al., 2005) and problem solving (Just et al., 2007). The patterns of neurological underconnectivity in autism have been proposed as an explanation for the unrelatedness of the main symptoms of Autism Spectrum Disorder, i.e. social and communicative impairments on the one hand, and restricted and repetitive patterns of behavior and interests on the other hand (Just et al., 2012). Importantly, according to the underconnectivity hypothesis, individuals with ASD are likely to experience difficulty in processes that involve high levels of information integration and require coordination of multiple neural systems, whereas cognitive abilities that involve local neural networks and that require low levels of information processing are intact (Minshew and Williams, 2007).

In terms of linguistic capacities, these findings have been related to impaired 'higher order' language abilities and intact 'formal' language skills in adults with autism (Minshew, Goldstein and Siegel, 1997) and high-functioning autistic children (Williams, Goldstein and Minshew, 2006). The linguistic abilities that are categorized as 'higher order' in these studies are almost exclusively pragmatic or discourse abilities, such as comprehension and creation of story themes, metaphors, inferences and idioms, while vocabulary and basic syntactic abilities, such as being able to parse a sentence structure, are considered 'formal' language skills. What crucially differentiates these different types of linguistic capacities is that higher-order abilities require high levels of information integration and involve multiple neural systems, while formal abilities demand low levels of information integration and are processed locally (Minshew and Williams, 2007).

In the previous section, several studies were discussed that showed that the communicative impairments that are present in children with autism can be observed in their discourse functioning. Specifically, there are indications that compared to typically developing children, children with ASD experience difficulty in discourse reference. This linguistic ability can be considered a high order skill, in the sense that it involves integration of different types of information. More precisely, discourse reference relates to processes of mapping linguistic descriptions to representations of individual entities in the mental model of the world. The underconnectivity hypothesis predicts that these integration processes are problematic in people with ASD, but also that the syntactic operations that constitute the basis upon which discourse processes can act, are unimpaired. In this thesis, it is hypothesized that while the syntactic skills of high-functioning children with autism are intact, the ability to link linguistic representations to discourse representations is impaired in children with ASD. In the next section, a model of the syntax-discourse interface will be discussed, which can make this hypothesis theoretically more explicit and can provide predictions for the behavior of children with autism regarding pronoun comprehension and direct object scrambling.

2.3 The syntax-discourse interface

2.3.1 Indexation and reference: the filing system

Several theoretical approaches to the representation of discourse referents, such as Discourse Representation Theory (Heim, 1982), Information Packaging (Vallduví, 1994) and F-structure Theory (Erteshik-Shir, 1997), make use of a metaphor involving a filing system in order to clarify the mechanisms of discourse reference. Karttunen (1971) was among the first to point out the similarities between keeping records in a file and mentally storing representations of individual items, persons or events that occur in a text. Heim (1982) extended this metaphor by equating each referent occurring in a discourse with a numbered file card. In other words, each individual entity is matched to an abstract mental representation that has a unique number. Therefore, the complete file consists of file

cards, which represent all the discourse referents that are known to a certain speaker. Using definite NPs, such as pronouns and nouns preceded by a definite determiner, a speaker typically refers to an entity that is familiar to all discourse participants, i.e. that has its own card in the file. Indefinite NPs however generally introduce entities that are unfamiliar. Therefore, they create new cards in the file that receive their own unique number. Consider for instance (1):

(1) John saw a man. The man was wearing a coat.

In (1) *a man*, being an indefinite NP, introduces a new card containing the information that the referent is a man and that John saw him. When *the man* in the consecutive sentence is encountered during the processing of the sentence, the card matched to *a man* is retrieved from the file and updated with the information that this very man was wearing a coat. According to Avrutin (1999), this retrieval is based on *indexation*. Each noun leaving the lexicon carries a variable index. In the syntax-discourse interface, this variable index is instantiated with a constant, i.e. the unique number of a file card. When two noun phrases are co-indexed, i.e. they carry an identical index, they are instantiated with the same file card number. Therefore, co-indexed constituents refer to the same entity in the discourse. In sum, utterances can be viewed as a set of instructions for the hearer to update and organize the cards so that the complete file contains all the information the speaker wishes to communicate (Erteshik-Shir, 1997).

2.3.2 Incorporation and accommodation

According to Heim (1982), there are two ways of linking a definite NP to a file card, i.e. to a discourse referent. The first way is *incorporation*: associating a NP with an old file card. In case of incorporation, the definite NP is related to a referent that is already present in the discourse. In case of example (1), *the man* is linked to an already represented referent, namely the man who is introduced in the preceding sentence. In terms of the filing metaphor, upon hearing *The man was wearing a coat* the hearer retrieves the old file card of the man and updates the information associated with it.

The other way of relating a definite NP to a discourse referent is called *accommodation* (Prince, 1978; Lewis, 1979). In case of accommodation, a new file card is introduced on the basis of the already present discourse. Consider (2), adopted from Avrutin (1999):

(2) I attended a wedding recently. The bride was wearing a white dress.

A wedding is an indefinite NP and introduces a new file card. *The bride* however is a definite NP, but cannot be linked to the same card as *a wedding*, since this would imply that the wedding was wearing a white dress. Therefore, in this case *the bride* introduces a new discourse referent on the basis of an existing discourse referent, namely the wedding. This process is called *accommodation by bridging*, and is only allowed if a speaker can ensure that the hearer can 'create the same bridge', i.e. if the hearer can introduce a new discourse referent as well. In this case, the bridging would depend on the referent introduced by *a wedding* and the world knowledge shared by hearer and speaker that weddings typically involve brides. Note that if the hearer does not possess this knowledge, and the speaker is aware of this, the use of the definite NP *the bride* in (2) would be pragmatically infelicitous. In addition, Avrutin (1999) argues that even when there is no linguistic antecedent, definite NPs can be accommodated on the basis of specific, permanently available file cards. Consider for instance (3):

(3) I wonder where the city hall is.

According to Avrutin (1999), when uttering sentence (3) in the context of being in an unfamiliar town, the definite NP *the city hall* is bridged to a so-called *Situation Card*. The Situation Card represents the constant encyclopedic knowledge associated with the non-linguistic context in which a sentence is uttered. In case of (3) for example, the Situation Card encompasses the knowledge that cities usually have town halls. The NP *the city hall* therefore introduces a new file card on the basis of the permanently available Situation Card.

Furthermore, Avrutin (1999) argues that inside the Situation Card, there is another card called the *Visual Situation Card*. This card represents a speaker's knowledge of the spatio-temporal circumstances of an utterance. In other words, the card corresponds to the immediate visual context of an utterance. In contrast to the remainder of the knowledge represented by the Situation Card, the content of the Visual Situation Card is variable and is constantly updated, since utterances are always manifested in a different point in space and/or time. The Visual Card is involved in the interpretation of deictic NPs. For example, consider (4):

(4) I like this cat. (pointing)

In (4), the deictic NP *this cat* is interpreted on the basis of the situational context of the utterance. It introduces a new file card, i.e. a new discourse referent, on the basis of the Visual Situation Card. Obviously, this process of introducing a new referent will only make sense if there is an actual cat in the immediate visual context. Importantly though, according to Avrutin (1999), the deictic use of a definite NP must be accompanied by a pointing gesture and/or stress in order to ensure that the hearer of the accommodation of the NP. In case of a deictic NP, pointing or the use of stress can inform a hearer to introduce a new file card on the basis of the Visual Situation Card.

The reason for this constraint on accommodation is economy. Avrutin (1999) reasons that the smaller a complete file is, the easier it is to keep track of the individual cards. Therefore, speakers will avoid the introduction of new cards unless it is necessary. Moreover, any hearer will assume that the speaker will take into account these economy considerations. As for the interpretation of definite NPs, the economy considerations imply that speakers will rely on incorporation by default. In accordance, hearers will assume that speakers will indeed do so and that in case of accommodation, speakers will make them aware that insertion of a new file card is necessary in order to interpret the utterance.

In summary, definite NPs can either be incorporated, i.e. linked to old file cards, or accommodated. Accommodation involves introducing a new file card on the basis of an old one. This old file card can either be the file card of another referent (accommodation by bridging), or the Situation Card, i.e. the card corresponding to the constant encyclopaedic knowledge of the non-linguistic context (world knowledge accommodation), or the Visual Situation Card, i.e. the card corresponding to the spatio-temporal context of the conversation (deictic accommodation). However, accommodation is a disfavored strategy of discourse reference from an economical point of view. It is more economical to relate definite NPs to existing discourse referents than to construe new ones, regardless whether new file cards are inserted on the basis of another card, or out-of-the-blue (e.g. in case of indefinite NPs). Therefore, in case of accommodation, the speaker needs to ensure pragmatically that the hearer is able to infer that a new card is inserted in the file. In the next section, it will be discussed how these mechanisms of discourse reference might work differently in children with ASD.

2.3.3 Mapping difficulty in children with ASD

In the previous section, it was argued that incorporation is typically the preferred strategy of discourse reference in order to interpret definite NPs. Linking syntactic constituents to old file cards is more economical than introducing new cards in the file. However, it was discussed earlier that pragmatic and discourse functions, requiring high levels of information integration, are problematic in children with ASD, possibly because of neural underconnectivity. It can thus be expected that children diagnosed with Autism Spectrum Disorder experience difficulty in discourse reference, because it involves relating syntactic constituents to their corresponding referents in the representation of the discourse. Note that this potential problem is particularly a mapping problem in the syntax-discourse interface, because in Autism Spectrum Disorder, neither syntactic abilities, necessary to build syntactic constituents, are impaired (Tager-Flusberg, 1981; Tager-Flusberg et al., 1990), nor working memory (Russell, Jarrold and Henry, 1996; Ozonoff and Strayer, 2001; Koshino et al., 2005), which is necessary to represent, remember and retrieve discourse referents. However, in the context of communication, children with ASD may have problems in connecting syntactic representations with representations of entities in the discourse. Considering the processes of indexation and reference, another way of formulating this hypothesis is that autistic children might have difficulty in instantiating the variable index of a syntactic constituent with the constant number of an existing discourse referent. In particular, the mapping process concerns nominal constituents, because these constituents correspond to (mental representations of) entities in the real world. Verbal constituents do not refer to individual entities and therefore, do not correspond to file cards. Rather, they provide the information with which the file cards are updated.

Because of the potential difficulty of incorporation, children with ASD may be inclined to interpret definite NPs on the basis of accommodation rather than incorporation, because in case of accommodation one can introduce a new card in the file, that is, a new referent in the discourse. That way, definite syntactic constituents can be interpreted in discourse without retrieving and updating old file cards, i.e. without demanding processes of information integration. Note however that this strategy is in conflict with the abovementioned economy considerations. Introducing new file cards all the time makes it hard to maintain the complete file. So, in children with ASD there are potentially two issues in competition. The first is the hypothesized mapping difficulty, favoring the introduction of new discourse referents. The second is economy, favoring the use of old discourse referents. Therefore, whereas typically developing children are predicted to rely on incorporation of definite NPs as much as possible, children with ASD might sometimes interpret definite NPs on the basis of incorporation and sometimes on the basis of accommodation.

With this prediction in mind, consider the previously mentioned findings of Baltaxe and D'Angiola (1992). They found that in semi-structured conversations, children with autism made more errors than typically developing controls in their use of pronominals, demonstratives or comparatives in order to refer to previously mentioned entities in the discourse. The authors present (5a-c) as examples of correctly used referential cohesive ties of each type.

- (5) a. Pronominal: *John* is out. *He*'ll be back at five.
- b. Demonstrative: The dog is *in the kitchen*. His food is *there*.
- c. Comparative: *Six* men approached, the *last* ran.

Baltaxe and D'Angiola (1992) argue that the referential cohesion in these examples lies in the semantic identity of the presupposed and presupposing elements. In other words, cohesion is achieved in these examples, because the speaker refers twice to the same entity (or in case of 5c, a member of a specific set of entities). In addition, the authors present (6) as an example of a referential tie error.

(6) Who gave you this book? *He*.

According to the authors, in this example, the referent of *he* is not clear and cannot be interpreted on the basis of the preceding discourse. It might be the case that these examples of unclear pronominal use are in fact deictic interpretations, without the speaker taking into account the interlocutor's need for additional cues for a deictic use of the pronoun. In other words, these examples could be instances of accommodation without the speaker taking into account the associated pragmatic constraint, that is, ensuring that the hearer can also introduce a new card in his file. Unfortunately however, errors of this type were collapsed in the analysis with different errors in pronoun use, such as agreement errors. Therefore, it is not completely clear what proportion of the autistic children's errors were potentially deictic uses like (5), and whether or not the autistic children produced more of these unclear pronominal references than typically developing children.

Building on the results of Baltaxe & D'Angiola (1992), Fine et al. (1994) conducted a study in which cohesive references in similar recorded conversations with children and adults with autism, and a control group were analyzed. In order to control for effects of social deficits associated with ASD, the control group included children and adolescents with varying types of social impairment such as conduct disorders and social anxiety. Interestingly, in their analysis of the conversation the authors distinguished between references based on incorporation and references based on different types of accommodation, although they adopted different terminology for the different types of reference. The authors differentiated between *endophoric references*, i.e. references that are interpretable on the basis of previous verbal context (cf. incorporation), and *exophoric references*, references that are interpretable on the basis of the non-verbal context of the conversation (cf. deictic accommodation). The endophoric references were further divided between *explicit references*, e.g. personal or possessive pronouns referring to a previously mentioned character, and *bridging references*, i.e. references that are interpretable on the basis of world knowledge inferences. As an example of the latter subcategory, the authors present (7).

(7) I saw John's new house. The door was painted green.

In (7), *the door* is interpretable on the basis of *John's new house*. Note that in the previous section, this type of discourse reference was considered accommodation. The authors however argue that since *the door* is interpretable on the basis of the preceding *verbal* context, it can be considered a type of endophoric reference. As a separate category, the authors distinguished *cultural references*, i.e. references whose antecedent information is shared by all members of the culture, such as 'the queen' and 'the president' (cf. world knowledge accommodation). The authors found that the autistic children and adults produced more exophoric references and more cultural references than the control group, but significantly fewer endophoric references. Within the category of endophoric references, it was found that the amount of bridging references did not differ between the groups, suggesting that the control group only produced more explicit, pronominal references than the ASD group. The authors conclude that the group of individuals with autism referred less to the preceding verbal context and more to aspects of the physical environment. These findings precisely match the predictions following from the hypothesis of the matching problem between syntactic constituents and their discourse referents. If processes of incorporation are difficult for children with ASD, then it is predicted that they avoid non-deictic pronominal references and make more use of accommodation as an alternative strategy of discourse reference.

In addition to these results, recall that Baltaxe (1977) found in conversations with autistic adolescents, aged 14-21 years old, that they referred to introduced discourse referents using full indefinite noun phrases rather than e.g. pronouns. As an example, the author presents (8).

(8) Q: Have you ever seen a lovely lady that you thought you might like to have as your wife?

A: No, *I haven't seen a lovely lady like that* but I am going to keep meeting lots of *nice looking nice lovely ladies* close to my age hopefully.

(target: No, I haven't, but hopefully I am going to keep meeting lots of *them* close to my age)

In this example, the question introduced a new file card for *a lovely lady*. Instead of referring to the same file card via pronouns or ellipsis, in his response the adolescent introduced new file cards by means of indefinite noun phrases. This apparent over-specification might be the result of the proposed avoidance of retrieving and updating old file cards.

Consider again the results of Arnold, Bennetto and Diehl (2009). The authors found in a narrative production experiment that children with ASD, aged 11 years old, made less use of pronouns and zeros (.. and \emptyset ran; .. while \emptyset running) in their stories than typically developing age peers. Instead, the children with autism used more proper names and definite NPs in order to refer to the characters in the story. Note that while both full definite NPs and pronouns might be used to refer to previously mentioned discourse referents and to new referents on the basis of direct visual context (i.e. deictic reference), zeros can only refer to already represented discourse referents, because they need to be interpreted on the basis of other linguistic material. To put it differently, in contrast to full definite NPs and personal pronouns, zeros cannot refer deictically, and therefore cannot introduce new discourse referents since they necessarily rely on other linguistic expressions. Unfortunately, the study does not allow a further distinction between zeros and pronouns, because again, the elements are taken together as a single category. Nevertheless, it is interesting to see that children with autism make less use of referring expressions in the category containing elements that necessarily refer to old file cards.

Furthermore, Arnold, Bennetto and Diehl (2009) found that compared to typically developing controls, the autistic children made more use of the other category; the category consisting of full definite descriptions and names. Like personal pronouns, full definite NPs may refer to old discourse entities or deictically to new discourse entities. Names however generally refer to entities that are familiar and represented by a file card. At first sight, this may sound odd from the perspective of the theory and hypotheses discussed above. If both categories (pronouns and zeros vs. definite descriptions and names) consist of two elements, of which one can refer to both old and new file cards, and the other only to old file cards, there seems to be no reason why children with autism, preferring new file cards, choose one category over the other. However, recall that children with ASD might not have difficulty with referring to old file cards per se, but rather with instantiating the variable indices of definite NPs with the constant numbers of existing file cards. Names differ from definite NPs in that they refer to one unique individual rather than individual members of a set. If one says *I see John*, this speaker really says he sees a specific, unique individual, known by both speaker and hearer as John. If one says *I see the cat*, the reference of *the cat* depends on the status of the discourse; in principle *the cat* could refer to any cat. Therefore, there is a direct link between a name and a discourse referent, but not between a definite NP and a discourse referent. Names do not have variable indices that have to be instantiated by the number of a retrieved file card, they are inherently fixed to a specific referent. Therefore, they may be more easily processed in individuals with ASD than linguistic units that have to instantiate their variable index with the number of a file card. This processing facilitation of names, together with the interpretation of zeros that is necessarily based on existing discourse referents, could explain why the group of ASD children used more names and definite descriptions as referential

devices than pronouns and zeros, compared to TD controls in the narrative production experiment of Arnold, Bennetto and Diehl (2009).

In another narrative production experiment, Tager-Flusberg (1995) found that children with autism used fewer indefinite NPs to introduce characters in their story than typically developing children. Instead, they tended to make use of full definite NPs and pronouns to refer to the characters on first mention. Arnold, Bennetto and Diehl (2009) pointed out that these results might be due to deictic interpretations of the pronouns and definite NPs in the utterances of the children with autism. Indeed, while in the study of Arnold, Bennetto and Diehl (2009) the children told a narrative on the basis of a short movie that was presented to them beforehand, the children in the study of Tager-Flusberg (1995) told their story on the basis of pictures that were shown to them while they were narrating. So, in contrast to the narrative elicitation task in Arnold, Bennetto and Diehl (2009), the experimental set-up in Tager-Flusberg (1995) provided the children with a direct visual context of the story, which makes the use of deictic terms more likely. If the character introductions of the children with autism were indeed based on deixis, these findings might indicate that for children with autism, there is a free choice between using indefinite NPs or accommodating definites to introduce new referents in their discourse representation. For the typically developing children, this is not a free choice, because accommodation is associated with the pragmatic constraint of ensuring that the other speaker knows that a new referent needs to be introduced. Therefore, they rely mostly on the use of indefinite NPs, which does not involve such a pragmatic condition. Children with autism however might be less sensitive to the pragmatic constraint associated with accommodation. Therefore, introduction of new file cards can be brought about via indefinite NPs and deictic definite NPs, without one of the two strategies being preferred.

In summary, in this section, it was hypothesized that children with autism have difficulty mapping syntactic constituents to referents in their representation of the discourse. More specifically, instantiating the variable index of a syntactic constituent with the number of a file card is hypothesized to be problematic in children with ASD. It was therefore predicted that children with autism prefer to interpret definite NPs via accommodation rather than incorporation, despite the fact that the latter is argued to be more economical. The results of previous research that is related to discourse reference in children with ASD were discussed in light of this hypothesis and prediction. While these studies investigated referential strategies by children with ASD in conversations and narratives, the hypothesis put forth in this section will be tested more precisely in the present study by examining autistic children's performance in two structured experiments, involving direct object scrambling and pronoun comprehension.

3. Direct object scrambling in Dutch-speaking children with ASD

In this chapter, a specific pattern of discourse-related word-order variation in Dutch called *direct object scrambling* will be investigated in children with ASD. Specifically, the hypothesis of a mapping problem between nominal syntactic constituents on the one hand, and discourse representations in children with ASD on the other hand will be tested by looking at the production of scrambled and non-scrambled sentence structures by children with autism. Section 3.1 concerns the theoretical background of Dutch direct object scrambling. In particular, the relationship between scrambling and the theory of incorporation and accommodation that was presented in the previous chapter, and the acquisition of direct object scrambling by typically developing children are discussed. In section 3.2, an elicited production experiment investigating the production of scrambling by children with ASD is presented. In section 3.3, an intermediate summary of this thesis is given.

3.1 Theoretical background

3.1.1 Direct object scrambling and discourse representation

In Dutch, direct objects can occur before and after sentential negation and adverbials in the middle field. Consider e.g. (1ab) adopted from Van Gelderen (2003):

- (1) a. Iedereen weet dat Jan het boek op zondag heeft gelezen.
Everyone knows that Jan the book on Sunday has read
b. Iedereen weet dat Jan op zondag het boek heeft gelezen.
Everyone knows that Jan on Sunday the book has read
'Everyone knows that Jan read the book on Sunday.'

In (1a), the definite direct object *het boek*, 'the book' precedes the PP *op zondag*, 'on Sunday', while the reverse order occurs in (1b). In the literature, the order in which the direct object occurs to the left of the adverbial, as in (1a), is called the *scrambled* order, while the order in which the direct object is on the right of the adverbial, as in (1b), is called the *non-scrambled* order.

It has been noted that scrambling of definite direct objects is preferred if the referent of the direct object is available in the discourse (e.g. Schaeffer, 1997; De Hoop, 2003). Consider (2) and (3), adopted from Schaeffer (2012).

- (2) A: Wat zei je dat Saskia met de krant gedaan heeft?
What said you that Saskia with the newspaper done has
'What did you say Saskia did with the newspaper?'

B: a. Ik zei dat ze de krant waarschijnlijk gelezen heeft.
I said that she the newspaper probably read has
'I said that she probably read the newspaper.'
??b. Ik zei dat ze waarschijnlijk de krant gelezen heeft.
I said that she probably the newspaper read has
- (3) A: Wat zei je dat Saskia gedaan heeft?
What said you that Saskia done has?
'What did you say Saskia did?'

- B: ??a. Ik zei dat ze de krant waarschijnlijk gelezen heeft.
 I said that she the newspaper probably read has
 b. Ik zei dat ze waarschijnlijk de krant gelezen heeft.
 I said that she probably the newspaper read has
 'I said that she probably read the newspaper.'

If the referent of a definite direct object is directly available in the discourse, as in (2), scrambling is obligatory, or at least strongly preferred, while the scrambled word order is strongly disfavored if the referent of the object is not available, as in (3). De Hoop (2000) however presents the following data:

- (4) a. omdat ik gisteren de koningin zag
 since I yesterday the queen saw
 b. omdat ik de koningin gisteren zag
 since I the queen yesterday saw
 'since I saw the queen yesterday'

According to De Hoop, the direct object *de koningin*, 'the queen', can appear in both the scrambled and non-scrambled position, without being previously mentioned. This optionality shows, according to De Hoop, that scrambling does not mark the topicality of the direct object, i.e. the status of the direct object's referent as a contextually given entity about which the sentence provides information. Ertshik-Shir (2007) however argues that referents such as *the queen*, *the sun* and *the Bible* are permanently available topics, that is, they do not need to be mentioned in the preceding discourse to acquire their topicality, because of their status as fixtures in the (model of the) world. Therefore, such definite noun phrases can occupy either a scrambled or non-scrambled position. In addition, Ertshik-Shir (2007) notes that deictic referents such as *that chair* have a similar inherent topic status, provided that there is a chair in the visual context to which the speaker is pointing. This classification leads to the prediction that, while non-deictic pronouns scramble obligatorily, deictic NPs can appear non-scrambled as well. Schaeffer (1997) shows that this prediction is borne out:

- (6) A: Welke taart zei je dat Saskia waarschijnlijk gekozen had?
 Which cake said you that Saskia probably chosen had
 'Which cake did you say that Saskia had probably chosen?'

- B: Ik zei dat Saskia waarschijnlijk DEZE gekozen had.
 I said that Saskia probably this chosen had
 'I said that Saskia had probably chosen this one.'

There is a strong parallel between these data and the processes of discourse reference discussed earlier. Recall from the previous chapter that NPs such as *the queen* and deictic NPs are both interpreted in the discourse via accommodation. In terms of the file card metaphor, they introduce new cards in the file on the basis of an already present card. Noun phrases such as *the queen* are accommodated on the basis of the Situation Card, while deictic NPs are accommodated on the basis of the Visual Situation Card, a specific card inside the Situation Card, which represents the speaker's knowledge of the spatio-temporal context of an utterance (Avrutin, 1999). If all accommodated definite NPs can felicitously appear in a scrambled word order, without being previously mentioned in the discourse (cf. 3a), then definite direct object NPs that are accommodated on the basis of an existing discourse referent (i.e. accommodation by bridging) should be able to appear in a scrambled position as well. This prediction is borne out too:

- (7) Binnenkort ga ik naar een bruiloft. Ik heb de bruid vandaag ontmoet.
 Soon go I to a wedding. I have the bride today met.
 'I will attend a wedding soon. I have met the bride today.'

In (7), *de bruid*, 'the bride' is accommodated on the basis of the discourse referent introduced by *een bruiloft*, 'a wedding'. Uttering (7), the speaker presumes that the hearer is aware of the relation between weddings and brides and that, because of this knowledge, the hearer can introduce a new file card on the basis of *een bruiloft*. Similar to definite NPs that are accommodated on the basis of the (Visual) Situation Card, the definite direct object *de bruid* can appear felicitously in a scrambled word order, without being previously mentioned in the discourse. Thus, it seems that incorporated NPs, i.e. NPs whose referent is available in the discourse, prefer to appear in scrambled positions, while accommodated NPs may appear in both scrambled and non-scrambled positions.

As for indefinite direct objects, it has been shown that scrambling is associated with a difference in meaning. Consider for instance (8) and (9), adopted from Schaeffer (1997) and De Hoop (2000), respectively.

- (8) a. dat Bettina *geen* (= *niet + een*) *boek* heeft gelezen
 that Bettina no (= not + a) book has read
 'that Bettina read no book'
 b. dat Bettina *een boek* niet heeft gelezen
 that Bettina a book not has read
 'that Bettina didn't read a book'
- (9) a. dat ik gisteren twee krakers heb gesproken
 that I yesterday two squatters have spoken
 b. dat ik twee krakers gisteren heb gesproken
 that I two squatters yesterday have spoken
 'that I talked to two squatters yesterday'

According to Schaeffer (1997), the non-scrambled direct object in (8a) means 'not any book', while the scrambled direct object in (8b) refers to one specific book. Similarly, according to De Hoop (2000) the scrambled direct object in (9b) has a partitive ('two of the squatters') or referential ('those two squatters') meaning, while the non-scrambled direct object in (9a) can have an existential reading too.

Note that the referential indefinites in (8b) and (9b) refer to members of a context-specified set. So, uttering (8b), the speaker assumes that the hearer has a particular set of books in mind. Therefore, he can refer to a specific member of this set of books. Similarly, in (9b) the common ground between speaker and hearer contains a representation of a group of squatters. Therefore, the speaker can refer to two unique members of this group. In other words, in order to refer to individual members with referential indefinites, the set needs to be introduced in the discourse. Recall from the previous chapter that indefinite NPs introduce new discourse referents (Heim, 1982; Avrutin, 1999). Arguably, this generalization does not hold for referential indefinites, such as the direct objects in (8b) and (9b). Because the context requires the discourse-specified set to be represented, discourse referents for the individual members of the set are available for reference too (cf. Erteshik-Shir, 2007: 52). Therefore, referential indefinites do not introduce new discourse referents, but refer to already represented ones. In contrast, indefinites with an existential reading such as *twee krakers* in (9a) do introduce new cards in the file. Indefinites such as *geen boek* do not refer to individual entities, so there are no cards in the file to which they are related.

In short, Dutch definite direct objects have a preference for occurring before sentential negation or adverbials, i.e. the scrambled position, when they refer to an entity that has been introduced in the discourse. If the referent of a definite direct object is not directly available, the direct object occupies the position following the negation or adverbial, i.e. the non-scrambled position. So, incorporated definite noun phrases prefer to appear in a scrambled position. Like definite NPs, referential indefinite NPs have a variable index that has to be instantiated by the constant number of a file card. The file cards whose numbers instantiate these indices are those of the individual members of a context-specified set. In other words, referential indefinite NPs can be interpreted via incorporation too and occur in scrambled structures. Indefinite NPs with a non-specific or existential reading can appear only in non-scrambled position. For accommodated NPs, such as deictic noun phrases, scrambling is optional; these NPs may appear in both scrambled and non-scrambled positions. Thus, there seems to be a strong relationship between incorporation of a direct object and scrambling, although accommodated NPs may scramble too. In the next section, an analysis is presented, based on Neeleman and Reinhart's (1994) account of scrambling.

3.1.2 Analysis of Dutch direct object scrambling

Various analyses for Dutch scrambling have been proposed in the literature. These analyses can be divided into analyses that argue that some syntactic or PF movement of the direct object is involved in scrambling (e.g. Bennis and Hoekstra, 1984; Vikner, 1994; Schaeffer, 1997) and analyses that argue that scrambled and non-scrambled structures result from the base generation of the constituents in different orders (e.g. Neeleman, 1994; Neeleman and Reinhart, 1998). Not all analyses however take into account the effects of the direct object's discourse status.

In the account of Neeleman and Reinhart (1998) however, the discourse status of the direct object is of crucial importance. They argue that the information structure of an utterance is the motivation behind the word-order variation that is scrambling. According to the authors, at PF, information structure is taken into account by means of stress assignment and linear order. They follow Cinque (1993) in assuming that stress is assigned to the most deeply embedded constituent. Any constituent that contains this primary stress will be in focus. In Dutch, the most deeply embedded constituent is the object in non-scrambled structures and the verb in scrambled structures. It follows that non-scrambled objects are typically in focus, while scrambled objects are not. According to Neeleman and Reinhart (1998), if a direct object is in focus because of its position in the sentence structure, but is in fact a topic, there are two possibilities. Either stress-shifting rules have to apply, or the constituents will be base generated in another word order, i.e. the scrambled order. According to the authors, base generation is more economical than shifting stress and is therefore preferred in deriving the correct word order. In English however, scrambling is not available. Therefore, English has to rely on stress shifting. Consider (10) and the Dutch translation in (11), adopted from Neeleman and Reinhart (1998):

- (10) a. I have READ the book yesterday, and did not tear it up.
 b. #I have read the BOOK yesterday, and did not tear it up.

- (11) a. Ik heb het boek gisteren GELEZEN, en niet verscheurd.
 I have the book yesterday read, and not torn-up
 b. ??Ik heb gisteren het BOEK gelezen, en niet verscheurd.
 I have yesterday the book read, and not torn-up

In (10), stress is initially assigned to the direct object, being the most deeply embedded constituent. However, it is a topic, so stress-shifting has to apply, since scrambling is not available in English. The verb *read* has to be stressed and the direct object *the book* has to be de-stressed. In Dutch, the direct object can avoid the stress assignment by means of scrambling. In (11a) the most deeply embedded constituent is the verb, so it is in focus. In (11b) the direct object is the most deeply embedded constituent, receives stress and is therefore infelicitously in focus.

Now consider the following. Incorporated NPs are necessarily topics, because they refer to entities that are known to the speaker and hearer from the discourse, and the file cards that they are associated with are updated with information expressed by the remainder of the utterance. If the instantiation of an NP's variable index with the constant number of a file card takes place at PF, then what might trigger scrambling might be the retrieval of cards in the file system. Recall that when incorporating a definite NP or a referential indefinite NP, one is both retrieving and updating an old file card. Because this process of discourse reference is incompatible with focus assignment, scrambling is triggered immediately, i.e. the direct object is either moved to or base-generated in the scrambled position. Indefinite NPs that introduce new discourse referents do not retrieve cards from the file, so scrambling is not triggered. Instead, these NPs appear in a non-scrambled position, to which focus is assigned, highlighting the introduction of new referents. Accommodated NPs however are ambiguous with respect to the distinction between old and new information. Recall that in case of accommodation one is retrieving an old file card, which can be the (Visual) Situation Card or the card of an existing discourse referent, and introduces a new card on the basis of the retrieved one. In contrast to incorporation, accommodation is not necessarily incompatible with focus assignment. By using focus, the introduction of a new discourse referent is marked, while by leaving it out by means of scrambling, the retrieval of a card in the file is marked. Therefore, NPs that are interpreted on the basis of accommodation can occur in both the scrambled and the non-scrambled position. In other words, in accommodation there is a mixture of using knowledge that is shared by speaker and hearer and introducing new information. This mixture is reflected in the optional scrambling behavior of accommodated noun phrases.

So, if a direct object occurs in a scrambled position, an old file card is retrieved. Therefore, every scrambled direct object is at least to some extent topical; it is interpreted on the basis of information shared by speaker and hearer. This idea is compatible with the suggestion of Erteschik-Shir (2007) that the purpose of Dutch scrambling is to mark subordinate topics, the subject being typically the main topic. Note that for the purposes of the present study, it is irrelevant whether scrambling involves the base-generation of different word-orders (Neeleman and Reinhart, 1998) or a movement operation in syntax or at PF (cf. Van Gelderen, 2003). Most importantly, scrambling is driven by the discourse status of the direct object. In the next section, some studies involving the acquisition of direct object scrambling by typically developing children will be discussed.

3.1.3 Direct object scrambling in typically developing children

It has been observed in both spontaneous speech and experimental settings that typically developing children perform adult-like in scrambling definite direct objects from about age 3 on. Hoekstra and Jordens (1994) for instance investigated the spontaneous speech of two- and three-year-old children and found that at 2;1, children fail to scramble definite direct objects. The authors provide the following examples:

- (12) a. ik mag niet modewijzer (2;1)
 I may not fashion.designer
 'I may not have {the/a} fashion designer.'

- b. ik kan niet Maria zoeken (2;1)
 I can not Mary search
 'I can't find Mary.'
- c. ik wil niet dit (2;1)
 I want not this
 'I don't want this.'

According to Hoekstra and Jordens (1994), the acquisition of scrambling is correlated with the acquisition of determiners. Pronouns are the first to appear scrambled in child language and proper names second. These elements are not preceded by a definite determiner, unlike nouns. As soon as children have acquired determiners, they perform adult-like in scrambling.

Schaeffer (1997; 2000) conducted an experimental study with typically developing children, acquiring Dutch. The experimental methodology in Schaeffer (1997) is adopted in the present study and will be discussed below. In line with Hoekstra and Jordens (1994), Schaeffer (1997; 2000) found that at age 3, typically developing children consistently scramble definite direct objects whose referents are available in the discourse. She argues that 2-year-old children do not always scramble definite direct objects in contexts in which this is preferred, because they lack the *Concept of Non-Shared Knowledge*, that is, the pragmatic knowledge that speaker and hearer assumptions are always independent. According to Schaeffer, this pragmatic concept is a requirement for establishing reference to discourse-related entities. If discourse reference is not established, scrambling does not take place. Instead, the children interpret the direct objects deictically, assigning direct reference to an entity in the real world. Although the analysis presented in Schaeffer (1997) differs somewhat from the approach adopted in the present study, there are two important similarities. First, reference to discourse-related entities is argued to trigger scrambling and second, if an impairment or lack of certain pragmatic knowledge hinders this discourse reference, direct objects may be interpreted deictically, resulting in a non-scrambled word order.

In her L1-L2 acquisition study, Unsworth (2005) adopted the same experimental methodology as Schaeffer (1997) with both Dutch-speaking adult participants and a group of typically developing 5-year-old participants, acquiring Dutch as their L1. She found, in line with Schaeffer (1997), that 5-year-old Dutch-acquiring children are adult-like with regard to scrambling definite NPs. In her analysis, she also differentiated between referential indefinites and non-referential indefinites. Both the adults and children consistently scrambled referential indefinites. As for non-referential indefinite NPs, adult participants never produced scrambled word orders in this condition, while the five-year-olds produced scrambled word orders a few times. The author argues however that in these few instances, the non-referential direct objects might have been interpreted as referential. She concludes therefore that at age 5, typically developing children who are acquiring Dutch as their L1 are aware of the interpretive constraints on scrambled direct objects.

Importantly, these studies show that typically developing children are already adult-like with regard to scrambling at a young age. Any potential difficulties with scrambling in children with ASD, aged 6 to 14 years old, can therefore not be attributed to a global delay in language development, since this would predict that their general language level is below the level of 3-year-old typically developing children, which clearly cannot be the case if the children with autism are not diagnosed with language impairment. In the next section, an experimental study is presented, in which the methodology of Schaeffer (1997; 2000) and Unsworth (2005) is adopted. In this study, a group of children with ASD is compared to a group of typically developing children, matched on gender and age.

3.2 Experiment 1: Direct object scrambling in children with ASD

Experiment 1 investigates direct object scrambling in Dutch-speaking children diagnosed with ASD, compared to a group of typically developing children and a group of adults, by means of an elicited production task. This task is based on Schaeffer's (1997) scrambling production experiment. In section 3.2.1, the hypotheses and predictions with regard to this experiment are described. The adopted methodology will be discussed in 3.2.2. Results are presented in section 3.2.3 and will be discussed in section 3.2.4.

3.2.1 Hypotheses and predictions

Recall from chapter 2 that children with ASD often have difficulty in discourse reference, while their syntactic abilities are intact. It was hypothesized that an impairment in mapping linguistic descriptions to existing discourse referents may be involved in this difficulty. More specifically, incorporation of noun phrases, i.e. instantiating the variable index of a syntactic NP constituent with the number of an old discourse file card, may be problematic in children who are diagnosed with ASD. Because of this difficulty, it is hypothesized that children with ASD have a preference for introducing new referents in the model of the discourse, for instance on the basis of accommodation.

As for direct object scrambling, recall that scrambling is preferred when the referent of a direct object is available in the discourse. In other words, definite and referential indefinites are likely to occur in a scrambled word order, when they are interpreted on the basis of incorporation. If the referent is not (yet) present as a referent in a speaker's representation of the discourse, scrambling does not take place, for instance in case of non-referential indefinites and indefinites with an existential reading.

On the basis of previous studies (Hoekstra and Jordens, 1994; Schaeffer, 1997; Unsworth, 2005) typically developing children, aged 6 to 14 years old, are predicted to perform like adults in producing scrambled word orders. More specifically, both adults and typically developing children are predicted to scramble definite NPs and referential indefinite NPs in contexts favoring scrambled structures, and to produce non-referential indefinites in a non-scrambled word order.

It is predicted however that children with ASD fail to scramble direct objects in scrambling-favoring contexts more often than their typically developing age peers. If children with ASD rely on (deictic) accommodation more often than typically developing children, they will produce more definite direct objects in non-scrambled word orders, despite accommodation being less economical than incorporation and despite scrambling being optional for accommodated NPs. Also, it is predicted that children with ASD fail to produce scrambled referential indefinite NPs more often than typically developing children, because it requires incorporation. It is predicted that instead, they produce non-scrambled non-referential indefinite NPs in contexts eliciting referential indefinite NPs, because these indefinites are not linked to specific discourse referents and thus do not require incorporation. Children with ASD however are predicted to perform like adults and typically developing children in producing non-referential indefinite NPs in a non-scrambled word order in a context that specifically elicits these NPs, because again, the interpretation of these NPs does not require incorporation. Moreover, they are aware of the constraints and interpretive effects associated with scrambling. Therefore, the children with ASD do not scramble direct objects at random.

In short, it is hypothesized that children with Autism Spectrum Disorder:

- have intact syntactic abilities;
- have difficulty with incorporation of syntactic constituents;
- have a preference for introducing new discourse referents.

It is predicted that children with Autism Spectrum Disorder:

- fail to scramble definite and referential indefinite direct object NPs in scrambling-favoring contexts more often than typically developing children;
- produce non-referential indefinite direct object NPs in non-scrambled word orders as often as typically developing children and adults.

3.2.2 Methodology

3.2.2.1 Participants

A total of 56 children and 16 adults participated in the present study. Among the children, 28 were clinically diagnosed with autism or a disorder in the autism spectrum (Asperger's Syndrome or Pervasive Developmental Disorder Not Otherwise Specified). The other 28 children were typically developing children, who were matched to the children diagnosed with ASD on the basis of gender (5 female; 23 male) and chronological age. The children with ASD ranged in age from 5;8 to 14;6 ($M = 10;5$) and the TD children from 6;5 to 14;8 ($M = 10;4$). Children diagnosed with Specific Language Impairment were excluded from the study. The adult group consisted of 10 female and 6 male subjects, varying in age from 20 to 53 years ($M = 34$). All participants were native speakers of Dutch.

3.2.2.2 Materials and procedure

In the present study, the participants produced sentences containing sentential negation and a direct object noun phrase. The sentences were elicited in three conditions, in which the target sentence contained either a definite direct object NP or a referential indefinite direct object NP or a non-referential indefinite direct object NP. Per condition, 6 sentences were elicited, i.e. 18 items in total. The experimental items were presented among 30 filler items in a fixed pseudo-random order, presenting at most two experimental items in different conditions directly after each other.

Participants were seated next to an experimenter (A), in front of a laptop screen. Another experimenter (B) was sitting at the other side of the screen. The participants were instructed to watch the pictures shown on the screen and listen to the story told by experimenter A. Also, they were told that experimenter B is not always paying attention and that they had to correct experimenter B if he said something wrong. The target sentences were elicited in the following way. Consider (13), an example of a trial in the definite direct object condition.

(13) *A picture of an object (a book) and a cartoon character (Patrick) is shown on the laptop screen*

Experimenter A: Patrick verveelt zich en kijkt of er iets leuks te doen is. He, zegt Patrick, een boek! Maar ik houd niet van boeken.

'Patrick is bored and he is looking for something to do. Hey, Patrick says, a book! But I don't like books'.

Dus dat ga ik NIET lezen.

So that will I NOT read.

'So I am not going to read that.'

Experimenter B: Ik weet het! Het boek gaat Patrick WEL lezen!

I know it! The book will Patrick *we* read!

'I know! Patrick is going to read the book!'.

Child: **Nee!**
 'No'.

Experimenter A: **Nee, he? Wat gebeurt er echt?**
 No huh? What happens there really?
 'No? What's really happening?'

Child: **Patrick gaat het boek NIET lezen.**
 Patrick will the book not read
 Patrick gaat NIET het boek lezen.
 Patrick will not the book read
 'Patrick will not read the book.'

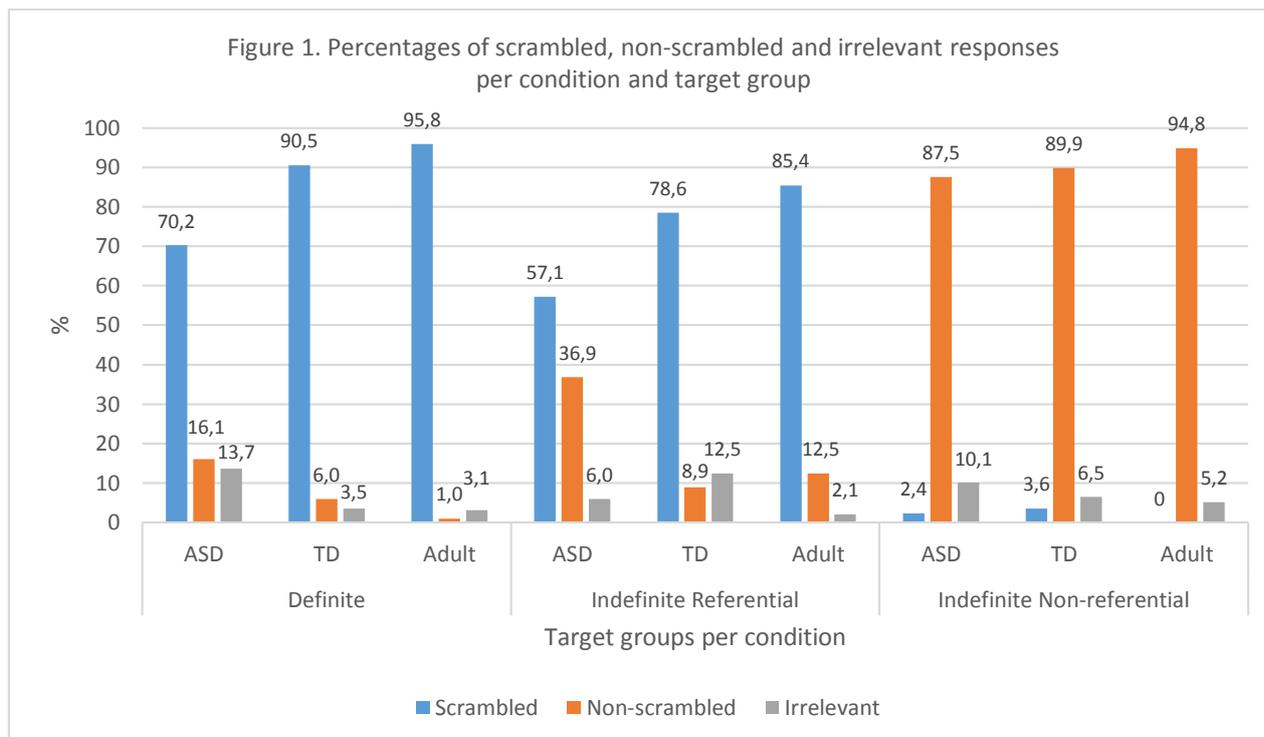
In the definite direct object condition, experimenter A told a story, leading to the statement that the cartoon figure shown on the laptop screen would NOT perform a particular action to the object that was also shown on the screen. In case of (13) for instance, the experimenter said *dus dat* [i.e. het boek lezen] *ga ik niet doen*, 'so I am not going to do that [i.e. read the book]'. Experimenter B would reply to this statement by telling the exact opposite, namely that the figure is going to perform the action for sure. In (13) for example, experimenter B replies by saying *Het boek gaat Patrick WEL lezen*, 'Patrick is going to read the book'. The child then was required to correct experimenter B by uttering a sentence that started with the subject and that contained both sentential negation and the definite direct object. In order to avoid effects of priming or echoing in the participants' utterances, the direct object in the trigger sentence uttered by experimenter B was topicalized.

In the referential indefinite condition, instead of one object, three identical objects were shown on the laptop screen, e.g. three magazines. Experimenter A then told that the figure would not perform an action with regard to two of the objects, e.g. by saying *Twee tijdschriften gaat Dora niet lezen*, 'Dora will not read two magazines'. The remainder of the trial was similar to those in the definite condition, leading to an utterance containing sentential negation and an indefinite referential direct object *twee X*, 'two X', e.g. *Dora gaat twee tijdschriften niet lezen*, 'Dora will not read two specific magazines'.

In the non-referential indefinite condition, no objects were shown. Only the cartoon figure was presented. Experimenter A then told a story similar to those in the definite and referential indefinite conditions, but referred to the direct object by means of a non-referential indefinite direct object, e.g. *een vogel tekenen*, 'draw a bird'. Instead of claiming the opposite, experimenter B said he was not paying attention and asked the participant what the figure is not going to do. The target sentence contained sentential negation and a non-referential indefinite direct object, e.g. *Octo gaat niet een vogel tekenen*, 'Octo will not draw a bird'. A complete overview of the experimental trials is presented in appendix A.

3.2.3 Results

In Figure 1, the percentages of (non-)scrambled and irrelevant utterances per condition and target group are represented visually. Irrelevant responses in the definite condition included those in which non-referential indefinite NP's and personal pronouns were used as direct objects instead of full definite NPs. In the indefinite conditions, irrelevant responses included those in which definite and demonstrative NPs, and PPs were used instead of indefinite direct object NPs. Other irrelevant responses included utterances that contained topicalized direct objects and utterances that did not contain sentential negation.



In the definite condition, the number of scrambled responses ($H(2) = 12.33, p = 0.002$), non-scrambled responses ($H(2) = 7.54, p = 0.023$) and irrelevant responses ($H(2) = 7.38, p = 0.025$) differed significantly between the groups. In the indefinite referential condition, similar results were observed for the scrambled responses ($H(2) = 8.67, p = 0.013$) and non-scrambled responses ($H(2) = 11.84, p = 0.003$). Irrelevant responses did not differ significantly in this condition. In the indefinite non-referential condition, there were no significant differences between the groups.

Post-hoc Mann-Whitney tests were used to find out between which groups these differences were significant. Adopting a Bonferroni correction ($\alpha = 0.01$), it appeared that the group of children with ASD produced significantly fewer scrambled responses in the definite condition than the group of TD children ($U = 233, z = -2.87, p = 0.004$). The differences in number of non-scrambled ($U = 302, z = -1.85, p = 0.064$) and irrelevant responses ($U = 274, z = -2.43, p = 0.015$) between these groups were marginally significant. In the indefinite referential condition, the group of children with ASD produced significantly more non-scrambled responses than the group of TD children ($U = 244, z = -2.76, p = 0.006$). The difference in number of scrambled responses in this condition was marginally significant ($U = 267, z = -2.15, p = 0.031$).

3.2.4 Discussion

This study investigates direct object scrambling in Dutch-speaking children with Autism Spectrum Disorder by means of an elicited production experiment. Recall that it was predicted that these children would fail to scramble definite and referential indefinite direct object NPs in the scrambling-favoring contexts of the experiment more often than typically developing children. This prediction is borne out, since in the definite condition the children with ASD produced significantly fewer scrambled word orders than their typically developing age peers. Note that the difference in produced non-scrambled word-orders is only marginally significant. However, the relatively high amount of irrelevant responses needs to be taken into account here. It was hypothesized that mapping syntactic NPs to existing discourse referents is difficult for children with autism. Therefore, these children may interpret

definite NPs on the basis of deixis, because this way, they can introduce a new file card rather than make use of an old one. Another way of avoiding processes of incorporation is using non-referential indefinites. Out of all 22 irrelevant responses given by the children with ASD in the definite condition, 20 included a non-referential indefinite NP as a direct object rather than a definite direct object, e.g. *Dora gaat geen laars vangen*, 'Dora will catch no boot', instead of *Dora gaat de laars niet vangen*, 'Dora will not catch the boot'. In section 3.1.1. it was argued that these NPs do not have a specific referent. Therefore, they cannot be linked to an existing file card. Thus, by using non-referential indefinites, incorporation is not needed in order to interpret the direct object. This idea of an alternative avoidance strategy is in line with the interpretation of Tager-Flusberg's (1995) results presented in section 2.2.3, namely that for children with autism, there is a free choice between using (existential) indefinite NPs or accommodating definite NPs to introduce new referents in their discourse representation. While in typically developing children the use of accommodated NPs is pragmatically constrained, children with ASD can freely opt for this strategy of discourse reference, thereby evading processes of incorporation. In short, both the non-scrambled word orders and the vast majority of the irrelevant responses can be interpreted as strategies to avoid discourse reference by means of incorporation.

As for the referential indefinite direct objects, it appeared that children with ASD produced more non-scrambled word-orders than the TD children. So, instead of the scrambled word order *twee X niet*, 'two X not', the children produced more often than the TD children the non-scrambled word order *niet twee X*, 'not two X'. Whereas the direct object is referential in the scrambled variant, meaning 'two specific X', it is non-referential in the non-scrambled word-order, meaning 'any two X'. Like the non-referential indefinite NPs that the children with ASD produced in the definite condition, the non-scrambled indefinites that the children with ASD produced in this condition did not correspond to a specific referent (or rather, two specific referents) in the discourse model. Therefore, incorporation is not involved in their interpretation and the children can use these NPs without any difficulty.

Note that while the use of non-referential indefinites may be pragmatically infelicitous in the experimental context of the definite condition, it is felicitous in the referential indefinite condition. In the definite condition, a response containing a definite NP is more precise than a response containing a non-referential indefinite NP, e.g. saying that one is not going to read a specific book is more precise than saying one is going to read no books at all. In the indefinite referential condition, the non-referential indefinite can be used more felicitously. Note that in this condition, the presented picture contained three objects, e.g. three magazines. If it is true that out of these three magazines two specific magazines are not going to be read (which is given in the pre-amble), it follows that any two magazines cannot be read either, because there is only one left. Therefore, the non-referential use of the indefinite NP is in principle legitimate in the given context. This might explain why two adults consistently produced non-scrambled word orders in this condition, resulting in a higher relative amount of non-scrambled utterances compared to the TD children. In order to rule out this option, future studies might simply present four or five objects instead of three. That way, the context rules out the use of a non-referential indefinite NP. To illustrate, when five magazines are presented and it is given that two of them will not be read, it is not necessarily the case that any combination of two magazines will not be read, whereas this is the case when three magazines are presented. In this case, children with ASD may still use non-referential indefinite NPs, even though they are pragmatically infelicitous, in order to avoid incorporation of referential indefinites, while adults are pragmatically forced to make use of referential indefinite NPs.

In the referential indefinite condition, the difference in number of scrambled word orders between the TD children and the children with ASD is only marginally significant. Again however, the irrelevant responses need to be taken into account. Note that in this case, the TD children produced

about twice as much irrelevant responses as the children with ASD. Whereas the irrelevant answers of the children with ASD included utterances that did not contain sentential negation, e.g. *Dora gaat er één lezen*, 'Dora will read one', about half of the irrelevant responses of the TD children included a definite direct object rather than an indefinite referential one, e.g. *Elmo gaat de twee kranten niet lezen*, 'Elmo will not read the two newspapers'. It might be the case that for typically developing children, updating file cards from a context-specified set by means of a referential indefinite is more difficult than updating independent file cards through ordinary incorporation. If this is the case, TD children might be inclined to use a definite NP rather than a referential indefinite NP. Thus, whereas children with ASD look for possible ways to avoid incorporation, TD children might seek for ways to use it.

Because children with ASD tend to use non-referential indefinites in both the definite and the referential indefinite condition, one might argue that these children are not aware of the conditions under which definite and indefinite NPs can be used felicitously. However, this account would predict that the children would also produce definite NPs in the indefinite non-referential condition. This is not the case. Moreover, their scrambling behavior does not differ from TD children and adults in this condition. This is explained by the hypothesis that using non-referential indefinites does not involve incorporation. Therefore, the children with ASD do not need to interpret the direct object differently than typically developing children or adults. These results show that the children with autism do not produce scrambled word orders at random. They are aware of the constraints associated with scrambling, but behave differently from their typically developing age peers because of a mapping problem between syntactic constituents and corresponding discourse referents.

Comparing the results of the definite and referential indefinite conditions for the children with ASD, one can observe an important difference and an important similarity. The difference is that the children with ASD produced a larger amount of non-scrambled word orders in the indefinite referential condition than in the definite condition (36,9% vs. 16,1%). The similarity is that still in both conditions, the majority of the direct objects were scrambled (57,1% vs. 70,2%). Recall from section 3.1.1 that accommodated definite NPs may appear in both scrambled and non-scrambled position, while incorporated NPs only appear in scrambled position and non-referential indefinite NPs only appear in non-scrambled position. If the children use both accommodation and non-referential indefinites in the definite condition, but only non-referential indefinites in the indefinite referential condition as strategies to avoid incorporation, then every instance of avoidance in the indefinite referential condition results in a non-scrambled word-order, since non-referential indefinites only appear in a non-scrambled structure. In the definite condition however, incorporation avoidance via accommodation may result in either a scrambled or a non-scrambled word order. The consequence of this difference is that while the proportion of utterances that involve a strategy to avoid incorporation may be equal in both conditions, the amount of produced non-scrambled word orders is larger in the referential indefinite condition than in the definite condition. Despite the instances of avoidance however, the majority of the direct objects in the autistic children's responses were scrambled. This finding may indicate that the children with ASD did incorporate a large number of direct objects, despite the difficulty these children have with discourse reference on the basis of incorporation. What might have boosted the number of scrambled direct objects in these conditions is the economy advantage associated with incorporation. It was argued in the previous chapter that the economy advantage of referring to represented entities in the discourse instead of introducing new referents is in competition with the difficulty that children with ASD might have with incorporating syntactic constituents. A consequence of this competition could be that sometimes children with ASD make use of incorporation and sometimes they make use of accommodation or non-referential indefinite NPs. If incorporation leads to scrambled direct objects and accommodation in some cases too, the result might be that the vast majority of direct objects ends up in a scrambled position in this condition.

One could argue that the observed results are not caused by an impairment of discourse functions, but that instead the unscrambled word orders were only instances of constituent negation rather than sentential negation. Definite direct object NPs can felicitously appear in a non-scrambled position, when the negation applies to the NP rather than to the complete sentence (Haeseryn et al. 1997). Note however that in the context provided by the experimental set-up, the use of constituent negation is quite unlikely. In the example of Patrick and the book in (13) in section 3.2.2.2 for instance, constituent negation would lead to the interpretation that Patrick will read something, but not the book. However, the context, i.e. the picture and the story, does not provide any alternative objects, that is, other objects that might be read, such as magazines. Moreover, the story does not lead to the assumption that Patrick will read anything at all; he is bored and might do anything. Therefore, the use of constituent negation is ruled out in the provided context.

In conclusion, the predictions for this study are borne out. The children with ASD produced fewer scrambled word orders with definite direct objects and more non-scrambled word-orders with indefinite referential direct objects than their age-matched peers. Both groups performed adultlike in the indefinite non-referential condition, i.e. both typically developing children and children with ASD produced non-scrambled word orders as often as adults. These findings provide support for the hypothesis that children with autism have difficulty in mapping syntactic constituents to referents in their representation of the discourse.

3.3 Intermediate summary

In chapter 2, it was discussed that children with autism have communicative impairments which are manifested in their pragmatic and discourse functioning. More specifically, several studies have shown that children with ASD have problems with discourse reference. Next, it was hypothesized that an impairment in mapping syntactic constituents to entities in the representation of the discourse might be involved in these problems. In terms of the file card metaphor, instantiating the variable index of a syntactic noun phrase with the constant number of an old file card might be problematic in children with autism. Therefore, these children may avoid this strategy of discourse reference and instead, if possible, introduce new discourse referents when processing syntactic constituents, despite this strategy being uneconomical. In other words, compared to typically developing children, children with ASD may rely more on accommodation than incorporation in their interpretation of definite linguistic descriptions in the model of the discourse.

In the present chapter, it was argued that in Dutch, accommodated direct object NPs may appear both in scrambled position, i.e. pre-adverbially, and in non-scrambled position, i.e. post-adverbially, while incorporated NPs only appear in scrambled position, because they cannot receive focus. It was predicted that if children with autism interpret definite NPs on the basis of accommodation more than typically developing children, they should produce more utterances with a non-scrambled word order than typically developing age peers in an elicited production experiment. This prediction was put to the test and borne out. Compared to typically developing children, matched on gender and chronological age, children diagnosed with ASD produced fewer scrambled word orders with definite direct objects and more non-scrambled word-orders with indefinite referential direct objects. In contrast, both groups performed adultlike in producing non-scrambled non-referential indefinite direct objects. These NPs are argued to have no specific referent and are not interpreted on the basis of incorporation. Therefore, children with ASD do not perform differently from both typically developing children and adults.

The results of this experiment, involving Dutch direct object scrambling, support the hypothesis of a mapping problem between syntactic units and discourse referents in children with autism. In the next chapter, the deviating treatment of discourse reference in children with ASD will

be investigated further by looking at their comprehension of personal and reflexive pronouns. This seemingly unrelated area of linguistic knowledge could provide further support for the mapping problem hypothesis put forth in this thesis.

4. Pronoun comprehension in Dutch-speaking children with ASD

In this chapter, the comprehension of personal and reflexive pronouns in children with autism is examined. It was discussed in the previous chapters that children with ASD often experience problems with discourse reference, while having intact phonological, lexical and syntactic abilities. It is hypothesized that a cognitive impairment in connecting nominal syntactic constituents to discourse representations is involved in these problems. In order to test this hypothesis, the children's interpretation of the Dutch pronouns *zich(zelf)*, 'himself/herself', *hem*, 'him' and *haar*, 'her' is investigated. In section 4.1, the theoretical background of this study is presented, including the relationship between pronoun comprehension and discourse reference, and the comprehension of pronouns in typically developing children. Also, previous research concerning pronoun comprehension in English-speaking children with ASD is discussed in this section. In section 4.2, a picture-selection experiment investigating the interpretation of personal and reflexive pronouns in Dutch-speaking children with ASD is presented. In section 4.3, the results of this experiment are compared to the results of the scrambling experiment discussed in the previous chapter.

4.1 Theoretical background

4.1.1 Pronouns and discourse reference

In the literature, it has been proposed that personal pronouns such as *he*, *she*, *him* or *her* can be interpreted in two ways. The first way is syntactically motivated and involves *binding*, the second way involves discourse reference. Consider for instance (1):

- (1) a. Mary_i said that she_i read a book.
b. *Mary_i touches her_i.
c. Mary_i said that she_k read a book.
d. Mary_i touches her_k.

In (1a), *she* refers to the person Mary. In this case, the personal pronoun is interpreted on the basis of binding, according to Binding Theory (Chomsky, 1981)². Binding relates to the grammatical principles that govern the distribution and interpretation of anaphoric elements such as personal and reflexive pronouns. An anaphoric element is bound by an antecedent when it shares the index of the antecedent (i.e. when it is co-indexed with the antecedent, cf. section 2.3.1) and when it is c-commanded by the antecedent³. So, in (1a) *she* refers to Mary, by virtue of being co-indexed with and c-commanded by *Mary*. In addition, Binding Theory formulates two principles, Principle A and Principle B, that constrain the distribution of reflexive and personal pronouns in sentence structural terms:

Principle A: A reflexive pronoun must be locally bound.

Principle B: A personal pronoun must be locally free.

The local binding domain (roughly) corresponds to the clause containing the anaphoric element. Note that in (1a) *she*, being a personal pronoun, has to be free in its local domain, according to Principle B. In this case, this principle is obeyed, because *Mary* is a non-local antecedent for *she*, i.e. the

² For a comprehensive overview of Binding Theory, see Büring (2005).

³ C-command is a hierarchical relation between constituents in a sentence structure (Reinhart, 1976). A node X c-commands node Y iff neither dominates the other and every node that dominates X also dominates Y.

subordinate clause containing *she* does not contain *Mary*. In sentence (1b) however, the pronoun *her* is bound by the local antecedent *Mary*. Local binding of pronouns is in violation of Principle B, which states that pronouns must be free in their local domain. Therefore, sentence (1b) is ungrammatical. In (1c), *she* has a different index than *Mary*. So, *she* does not have the same referent as *Mary*. In this case, the interpretation of *she* involves the mechanisms of discourse reference that were discussed in chapter 2. So, *she* can be interpreted by means of *incorporation*, i.e. linking the syntactic constituent to an old file card, or by means of *accommodation*, i.e. introducing a new card on the basis of an old card. For instance, if someone uttering (1c) is involved in a conversation concerning a third person known by both speaker and hearer, for example *Mary's sister*, then *she* will refer to *Mary's sister* on the basis of incorporation: the file card of *Mary's sister* is retrieved and updated with the information expressed by (1c). If the speaker uttering (1c) uses the pronoun deictically and points to some female in the scene of the conversation, then *she* will be introduced as a new discourse referent on the basis of accommodation: a new card is inserted in the file on the basis of the Visual Situation Card. Sentence (1d) shows that if *her* and *Mary* receive different indices, i.e. if they have different referents, the sentence is grammatical, in contrast to (1b). In (1d), the pronoun is not bound by *Mary*. Instead, *her* is interpreted on the basis of incorporation or accommodation, similar to (1c).

However, recall from chapter 2 that if, for example, the pronoun *she* is used deictically, it can refer to any female in the situational context. In case of *Mary touches HER* for instance, *her* could in principle refer to *Mary*, provided that she is present in the scene of the conversation. So, if in (1b) *her* refers to *Mary* and *her* in (1d) possibly refers to *Mary* too, why is the former ill-formed and the latter well-formed? Heim (1998) addresses this issue and argues that there is a difference between co-reference, i.e. sharing the same real-world referent, and co-indexation, i.e. having the same index assigned. Consider for example (2), adopted from Reinhart (1983).

(2) A: Who is this speaker?

B: It must be *Zelda*. She praises her to the sky. No other candidate would do it.

According to Heim (1998), in (2), the pronouns *she* and *her* refer to the same person *Zelda*, but under different *guises*. Whereas *she* refers to *Zelda* as a person in the immediate spatio-temporal context, *her* refers to the mental representation of *Zelda*. Each guise is associated with its own file card, i.e. each guise serves as a separate discourse referent. So in the real world there is one referent, but in the discourse representation, there are two. Because the different guises are treated as separate discourse referents, different guises of the same referent are not co-indexed. Therefore, the deictic interpretation of *her* in (1d) as referring to *Mary* and B's response in (2) are no violations of Principle B such as (1b).

Nevertheless, in order for accommodation (and thus, deictic readings) to be available, the speaker needs to ensure pragmatically that the hearer can yield the same interpretation (cf. section 2.3.2). In other words, the hearer needs a cue that a new discourse referent is introduced on the basis of another file card. In case of (2), the context of a referent appearing under different guises (*Zelda* as the speaking person and *Zelda* as the person known to speaker and hearer) makes the accommodated reading of the pronoun *she* available. This context being known to both speaker and hearer, the pronoun *she* can receive a different index than *her*, and therefore no violation of Principle B occurs. Whenever such a context is not present however, for instance when sentences like *Mary washes her* are presented in isolation, the hearer needs another indication that the pronoun is used deictically. Stress on the pronoun (*Mary washes HER*) and/or a pointing gesture might provide such a cue, instructing the hearer to introduce a new discourse referent, based on the visual context.

So, the interpretation of non-co-indexed personal pronouns involves processes of discourse reference, i.e. incorporation or accommodation. The interpretation of co-indexed reflexive pronouns such as *himself* and *herself* however is argued to depend solely on syntactic factors. Consider (3):

- (3) a. Mary_i touches herself_i.
b. *Mary_i said that John touches herself_i.

In (3a), the reflexive pronoun *herself* is locally bound by *Mary*, because *herself* is c-commanded by *Mary* and has the same index as *Mary*, an antecedent in the same clause as *herself*. In (3b), *herself* is non-locally bound, in violation of Principle A of Binding Theory, which states that a reflexive pronoun such as *herself* has to be bound locally. A reflexive anaphor, by definition, receives its meaning from another NP in the sentence. In contrast to personal pronouns, reflexives cannot refer independently. Therefore, interpretations on the basis of accommodation are unavailable to reflexive pronouns.

This difference between reflexive pronouns, being interpreted on the basis of syntax, and non-co-indexed personal pronouns, being interpreted on the basis of discourse reference, has been interpreted in the literature as the underlying reason for children's so-called *Delay of Principle B Effect*. In the next section, this phenomenon will be discussed.

4.1.2 Comprehension of reflexive and personal pronouns in typically developing children

It was first noted by Jakubowicz (1984) that children's comprehension of reflexives precedes their comprehension of pronouns. She showed in an act-out experiment that typically developing children as young as 3 years old do not make errors in the interpretation of reflexive anaphors. So, 3-year-old English-acquiring children correctly interpret sentences such as (3a), repeated below as (4a). However, the author noticed that pronouns are misinterpreted even by 5-year-old children. So, children perform at chance in interpreting sentences such as (1d), repeated below as (4b). Frequently, they assign the same meaning as (4a) to (4b), namely that Mary is touching herself, rather than another female person.

- (4) a. Mary touches herself.
b. Mary touches her.

In subsequent studies, it was found that up until 6 years old, children perform at chance in interpreting pronouns and that between 6 and 10 years old, children gradually start to become adultlike in their comprehension of pronouns (Koster, 1993). Since it appears in these studies that children allow violations of Principle B, in the literature this phenomenon has been termed the *Delay of Principle B Effect (DPBE)* and has been attested in a number of languages other than English, including Russian (Avrutin and Wexler, 1992), Icelandic (Sigurjónsdóttir and Hyams, 1992), Dutch (Philip and Coopmans, 1996) and Hebrew (Friedmann, Novogrodsky and Balaban, 2010). The acquisition of binding principles has been extensively studied in language acquisition literature. In the remainder of this subsection, two accounts of the DPBE will be discussed, namely those presented in Chien and Wexler (1990) and Avrutin (1999). For a more comprehensive review of studies investigating the acquisition of binding principles, and most notably, Principle B, see for instance Guasti (2002), Elbourne (2005) and Conroy et al. (2009).

Chien and Wexler (1990) replicated the results of Jakubowicz (1984) in an experiment in which children ranging from 2;6 to 6;6 carried out a Yes-No Judgement task. They found that up until age 6, children accept sentences such as *Mary washes her* in contexts in which Mary is washing herself, while the children from very early on correctly reject sentences such as *Mary touches herself* in contexts in which Mary is touching somebody else. The authors argued that the children lack the knowledge of a

specific pragmatic principle, which they called *Principle P*. According to this Principle P, two constituents that have the same real-world referent are co-indexed, unless the context specifies otherwise. Thus, this principle ensures that adults rule out a reading of sentences such as *Mary touches her* in which Mary touches herself, because in this case *her* and *Mary* have the same referent and are therefore co-indexed. Consequently, *her* is locally bound by *Mary*, in violation of Principle B. However, in contexts where Heim's (1998) different guises of the same referent come into play (also called *Evans-style contexts*; named after Evans, 1980), assigning different indices is allowed. In those cases, the pronoun is not bound and the sentence is grammatical. According to Chien and Wexler (1990), children do not have this pragmatic bias toward co-indexation and can freely assign different indices, even when the context does not require this. Therefore, they can assign different indices to pronouns, making binding unavailable and yielding grammatical structures.

Avrutin (1999) takes on the perspective of Chien and Wexler (1990), but argues that the pragmatic principle that rules out co-referential readings follows from economy considerations. It was discussed in chapter 2 that, according to Avrutin (1999), speakers avoid the introduction of new cards, i.e. new discourse referents, in order to facilitate the maintenance of the complete file for themselves and their interlocutors. So, in case of *Mary touches her*, an adult speaker preferably interprets *her* as being co-indexed with *Mary*, in order to avoid the introduction of a new discourse referent. However, the pronoun cannot receive the same index as *Mary*, i.e. refer to the same file card, because of Principle B. Therefore, *her* receives a different index and is incorporated to another old file card representing a female individual that is not Mary. If there is no available file card, e.g. because there is no other woman present in the given context, the introduction of a new file card on the basis of accommodation is necessary. Unless there is a context that indicates that this new file card represents a different guise of the person Mary, this new referent must represent another female individual. Therefore, by default adults interpret *Mary touches her* as Mary touching somebody else, rather than herself.

Consider now the DPBE. Whereas adults exclude a co-referential reading of sentences such as *Mary touches her* in the absence of a context forcing such a reading, for children this interpretation is readily available. According to Avrutin (1999), the reason for this difference is that in contrast to adults, children can freely assign deictic interpretations to the pronouns. When interpreted deictically, pronouns such as *her* can refer to any female in the immediate spatio-temporal context, including Mary. For adults, a deictic reading of *her* in *Mary touches her* is unavailable, because in absence of a context that makes this interpretation accessible, stress and/or pointing gestures are needed to ensure that any hearer can perform the process of accommodation. In other words, without an additional cue, *her* can only be interpreted by adults via incorporation. For children however, deictic readings are available, because children up until age 6 lack the cognitive resources to make inferences with respect to other people's discourse representations, according to Avrutin. Therefore, they do not take into account the pragmatic constraint that a speaker has to guarantee that a hearer can introduce a new file card. Without these inferences, children can interpret pronouns deictically without the use of pointing or stress. Avrutin argues that Broca's aphasics show similar behavior with respect to pronoun comprehension, because they too lack the cognitive capacities to make the appropriate inferences. Whereas this lack of cognitive resources is due to an immature brain in children, it is due to brain injury in people with Broca's aphasia. Both children and Broca's aphasics therefore have all the relevant syntactic and pragmatic knowledge, but because evaluating other people's minds is difficult for both groups, sometimes they will conclude that the pragmatic constraints are satisfied, allowing a deictic reading, and sometimes they conclude that the constraints are not satisfied and therefore do not allow a deictic reading.

In short, typically developing children interpret reflexive pronouns correctly at an early stage in their language acquisition, while the comprehension of personal pronouns is delayed. It has been

proposed that in contrast to adults, children interpret pronouns on the basis of accommodation rather than incorporation. More specifically, they assign deictic readings to pronouns and therefore allow a co-referential interpretation. Whereas such interpretations are syntactically and pragmatically blocked for adults, children do not have the cognitive capacities to evaluate the minds of their interlocutors. Therefore, they do not take into account the pragmatic constraints for deictic interpretations of pronouns. It has been argued that from age 6 on, typically developing children gradually start to perform like adults in their comprehension of pronouns, because their brains are matured enough to make inferences with respect to other people's discourse representations.

Recall that the main hypothesis of this thesis states that incorporation of NPs in the syntax-discourse interface is impaired in children with ASD. Therefore, like young TD children, children diagnosed with ASD tend to rely on accommodation instead of incorporation, despite accommodation being a less economical strategy of discourse reference. If it is indeed the case that children with ASD make more use of accommodation, this different method of discourse reference should be evident in their interpretation of pronouns. Two recent studies, conducted by Perovic, Modyanova and Wexler (2013a; 2013b), provide some insight into this issue. In the next section, this study will be discussed.

4.1.3 Comprehension of reflexive and personal pronouns in English-speaking children with ASD

Whereas the comprehension of pronouns and the acquisition of binding principles has been widely investigated in typically developing children over the past 30 years, only recently this domain of research has been extended to the language development of atypical children. So far only two studies have looked at binding principles in children diagnosed with Autism Spectrum Disorder, namely Perovic, Modyanova and Wexler (2013a) and Perovic, Modyanova and Wexler (2013b), although these two can be considered one single study, since the latter includes the data of the former (to be discussed below). It is surprising that pronoun comprehension in children with ASD is so scarcely investigated, since it has been argued for a long time that pragmatic knowledge is involved in the interpretation of personal pronouns (cf. section 4.1.1). Children with autism, in general showing difficulty with pragmatics, could provide support for this hypothesis.

Perovic, Modyanova and Wexler (2013a) started out from this idea and investigated the comprehension of English personal and reflexive pronouns in a group of 14 children with autism, aged 6;6-17 years. The authors conducted a picture selection experiment, adapted from Wexler and Chien (1985). The children were presented with two pictures showing two different scenarios, for instance one picture showing a father washing a child and one picture showing the same father washing himself, with the child standing by. The experimenter then uttered a test sentence, which contained a personal or reflexive pronoun as a direct object, for instance *Bart's dad is washing him* or *Bart's dad is washing himself*. The children were asked to point to the picture that matched the sentence uttered by the experimenter. Note that in these sentences the subject is a possessive NP, containing two male referents: the possessor (Bart) and the possessee (the father). The authors argue that since possessive NPs appear early in typically developing children, any interpretation difficulties in sentences such as *Bart's dad is washing himself* should be due to binding principles and not to possessive NPs per se. However, since little is known about grammatical knowledge in children with autism according to the authors, two control conditions were added to the reflexive and personal pronoun sentences. In one control condition, the children heard sentences containing a possessive NP subject, but with an indefinite direct object instead of a reflexive or personal pronoun, e.g. *Bart's dad is petting a dog*. It was predicted that if the children had difficulty to point to the correct picture in the reflexive or personal pronoun conditions due to the possessive subjects, they should have difficulty in this condition too. In the other control condition, the children heard sentences containing names as arguments instead of possessive NPs or pronouns, e.g. *Bart is washing Dad*. It was predicted that if the

children had difficulty with the task itself, they should fail to point at the correct picture in this condition too. In short, in each trial the children were presented with two pictures and a sentence in one of four conditions: the reflexive condition, the pronoun condition, the possessive control condition and the name control condition.

Apart from the children with ASD, two groups of typically developing (TD) children participated in the experiment, whose results were compared to those of the ASD group. The first group of TD children, aged 4 to 9 years old, was matched to the ASD group on the basis of their performance on a non-verbal IQ-test (Kaufman Brief Intelligence Test; KBIT). The second group of TD children, aged 3 to 5, was matched to the ASD group on the basis of their performance on a receptive grammar test (Test for Reception Of Grammar, second edition; TROG-2).

It was found that in general, both TD control groups had no difficulty in picking the right pictures in the control conditions and in the reflexive condition, but did show difficulty in the personal pronoun condition. In other words, the Delay of Principle B Effect was found in both groups of TD children. In the group of ASD children, the same effect was found; the children with ASD did not differ from both groups of TD children in their performance in the pronoun condition. In addition however, the interpretation of reflexives in children with ASD was significantly worse than both TD control groups. According to the authors, the autistic children's performance on pronouns is the result of general language delay and pragmatic deficits, which are commonly present in ASD. As for the interpretations of reflexives, the observed results indicate a syntactic impairment in children with autism, according to the authors. More specifically, they hypothesize that principle A of binding theory is missing or misrepresented. The authors argue that especially the c-command subpart of binding appears to be problematic and that instead, the children could be relying on a linear rule to assign the antecedent to the reflexive, for instance a rule like "the antecedent of a reflexive is a preceding NP in the same clause", which could be both referents in the possessive NP. As a suggestion for future research, the authors propose to investigate binding of reflexives in Dutch autistic children, because Dutch makes a distinction between strong and weak reflexive elements (*zichzelf* and *zich*, respectively). The authors suggest that children with autism treat these elements differently.

It is unclear however if, and if so, how the autism spectrum disorder itself has any influence on the children's interpretations of reflexives. It is more likely that these difficulties stem from a more general language impairment. Note for instance that the ASD children are matched on receptive grammar to TD children who are on average 7 years younger. Clearly, the grammatical development of these children with ASD cannot be deemed typical. Severe linguistic deficits are not uncommon in ASD (cf. section 2.1), but are more likely to be co-morbid than defining characteristics of Autism Spectrum Disorder.

It is interesting to note that in a follow-up study, Perovic, Modyanova and Wexler (2013b) make a distinction in ASD participant groups: children with autism with language impairment (ALI) and children with autism with normal language (ALN). The authors note that the data of the 14 children with ASD, reported in Perovic, Modyanova and Wexler (2013a), are taken into account in the study under discussion. Hardly surprising, all 14 children were categorized as Autism Language Impaired, along with 12 other children with ASD. The other category of ASD children, those with normal language, consisted of 22 children. The authors carried out three background language tests in order to determine the category to which each child with ASD belonged, namely the TROG-2, the vocabulary subtest of KBIT and the Peabody Picture Vocabulary Test, third edition (PPVT-3). If a child's scores on at least two of these tests were below the 10th percentile, the child was categorized as language impaired. The two groups of children with autism were matched to each other on the basis of gender and chronological age. In turn, each of these two groups was matched to a group of TD children, based on gender and non-verbal reasoning (scores on the KBIT). In addition, a group of children that were diagnosed with William's Syndrome (WS) participated in the study. These children were matched to

the ALN group on the basis of chronological age, and to the ALI group on the basis of chronological age and non-verbal IQ. The data of the WS group were reported earlier in Perovic and Wexler (2007).

The same materials and design that were used by Perovic and Wexler (2007) and Perovic, Modyanova and Wexler (2013a) were adopted in testing all five participant groups. It was found that all groups had difficulty in interpreting pronouns, performing equally on the pronoun condition. In addition, the language impaired autism group performed at chance in the reflexive condition, in line with Perovic, Modyanova and Wexler (2013a). Crucially though, the group of autistic children that was classified as having normal language skills did not have any difficulty in the reflexive condition, indicating that autism itself is not the direct cause of the Principle A difficulties demonstrated by the ALI group. The ALN group is presumed to have intact syntactic abilities and to be able to interpret reflexives through binding.

However, consider the pronoun condition. The two groups of TD matches display the DPBE, since they scored almost perfectly in the control conditions and the reflexive condition, but appeared to have difficulty in the interpretation of personal pronouns. The authors state that “considering the chronological age of these two groups, with half of the children below the age of 6;6 (the approximate upper bound of the age at which DPBE is still observed), this was to be expected” (Perovic, Modyanova and Wexler, 2013b: 145). Yet, the average age of the TD ALI group (the group of TD children matched to the ALI group) is around 6 years old (age range 3;8 – 10;8), while the average age of the TD ALN group is around 10 years old (age range 4;6 – 16;9). So in one group of TD children, the average age is below or at least around the age at which TD children start to improve in their pronoun comprehension, while in the other group the average age is considerably above this boundary. Still, they display the DPBE to an equal extent, with no significant differences between both groups. Now consider the average age of the ALN group, 11 years, and the age range of this group, 6;1 - 18;6. Since both the ALN and the TD ALN and the TD ALI group display the DBPE to an equal extent, it appears that the children with autism were in general older than both groups of TD children. The authors however conclude that the performance of the children in the ALN group was perfectly typical considering their age and general level of functioning. They add that in none of the five groups, the pragmatic abilities that are required to interpret pronouns non-co-referentially appear to be crucially impaired.

In short, Perovic, Modyanova and Wexler (2013b) do not provide an explanation as to why the group of children with ASD who are not language impaired have trouble interpreting pronouns, despite the fact that on average they are older than both groups of typically developing children. Also, they are on average older than 10 years old: the age at which the development of TD children’s pronoun comprehension is generally completed (Koster, 1993). Note that according to Perovic, Modyanova and Wexler (2013a) the difficulty that the children with ASD had in interpreting personal pronouns was due to general language delay and pragmatic deficits. In the follow-up study though, the authors explicitly mention that the ALN group was presumably not language delayed, since a number of children in this group were diagnosed with Asperger’s Syndrome, which they argue does not involve language delay at all. Nevertheless, pragmatic deficits may be involved in the performance of the children with ASD. It is still unclear however, what kind of pragmatic deficit or lacking pragmatic knowledge is causing this ‘extended’ DBPE.

It is hypothesized in the present study that children with ASD have difficulty in linking definite syntactic constituents to existing discourse referents and, as an avoidance strategy, tend to introduce new discourse referents on the basis of accommodation. Recall from the previous chapter that young typically developing children interpret pronouns on the basis of accommodation too. More specifically, they assign deictic interpretations to the pronouns, which can result in a co-referential reading. Unlike children with ASD, young TD children assign these readings because they cannot make inferences with respect to other people’s minds, therefore failing to rule out processes of accommodation, such as interpretation on the basis of deixis. Perovic, Modyanova and Wexler (2013a; 2013b) show that

children with ASD allow co-referential readings of pronouns, up to a relatively old age. In order to investigate whether typically developing children and children with ASD behave differently with respect to pronoun comprehension when they are matched on chronological age, an experiment was conducted, adopting the methodology of Perovic and Wexler (2007) and Perovic, Modyanova and Wexler (2013a; 2013b). In the next section, this experiment will be discussed.

4.2 Experiment 2: Pronoun comprehension in children with ASD

Experiment 2 investigates the comprehension of reflexive and personal pronouns in Dutch-speaking children with ASD, compared to a group of typically developing children, matched on chronological age and gender. A picture selection experiment was conducted, adopting the methodology from Perovic and Wexler (2007) and Perovic, Modyanova and Wexler (2013a; 2013b). In section 4.2.1, the hypotheses and predictions for this experiment are described. The methodology will be discussed in 4.2.2. The results are presented in section 4.2.3 and will be discussed in section 4.2.3.

4.2.1 Hypotheses and predictions

As discussed in chapter 2, it has been argued that children with Autism Spectrum Disorder have unimpaired syntactic abilities, but experience difficulty in discourse reference. It was hypothesized that an impairment in associating syntactic material to active discourse representations may be involved in their difficulties in discourse reference. Furthermore, it was proposed that as a consequence, children with autism tend to create new discourse referents on the basis of accommodation for syntactic constituents rather than to make use of existing ones, i.e. incorporation.

In section 4.1.1, it was discussed that pronouns that are not co-indexed with an antecedent can be interpreted on the basis of (deictic) accommodation or incorporation. When interpreted on the basis of incorporation, a pronoun is linked to a discourse referent that is salient in the given conversation, but crucially not the referent of a NP that is local to the pronoun. When it is accommodated, a pronoun introduces a new referent on the basis of the established discourse. In case of accommodation, it is possible that a pronoun refers to a different guise of the same real-world referent as a local antecedent, resulting in apparent principle B violations. However, accommodation is pragmatically constrained, because it is an uneconomical strategy of discourse reference. If the context does not make an accommodated reading available, speakers need an additional cue such as a pointing gesture or stress on the pronoun in order to indicate that it introduces a new referent.

It was argued in section 4.1.2 that young children lack the cognitive resources to make such inferences with respect to the minds of their interlocutors. Therefore, interpretations of pronouns on the basis of deixis (i.e. accommodation on the basis of situational context) are readily available to them, whereas these are pragmatically blocked for adult speakers. This availability of accommodated readings has been proposed as the underlying cause of the Delay of Principle B Effect. Around the age of 6, the cognitive development of typically developing children enters the phase in which the pragmatic constraints associated with accommodation can start to be taken into account.

However, if discourse reference on the basis of incorporation is problematic in children with autism, these children may be inclined to interpret personal pronouns deictically, even while they have passed the age at which typically developing children's comprehension of pronouns starts to resemble adult's comprehension. Since these interpretations may result in co-referential readings, it is predicted that children with autism above the age of 6 display the DPBE to a greater extent than typically developing children, who perform (nearly) like adults in their interpretations of pronouns. Reflexive pronouns on the other hand are argued to be interpreted through binding. Already at 3 years old,

typically developing children interpret reflexives correctly. If children with ASD have intact syntactic abilities, it is predicted that they do not have difficulty in interpreting reflexives either.

In short, it is hypothesized that children with Autism Spectrum Disorder:

- have intact syntactic abilities;
- have difficulty with incorporation of syntactic constituents;
- have a preference for introducing new discourse referents.

It is predicted that children with Autism Spectrum Disorder:

- assign deictic co-referential interpretations to personal pronouns more often than typically developing age peers;
- interpret reflexive pronouns correctly as often as typically developing children.

4.2.2 Methodology

4.2.2.1 Participants

A total number of 26 children participated in the present study. Among these children, 13 were clinically diagnosed with autism or a disorder in the autism spectrum (Asperger's Syndrome or Pervasive Developmental Disorder Not Otherwise Specified). These children were selected from the group of ASD children who participated in the scrambling production experiment reported in chapter 3. Specifically, the children who failed at producing scrambled sentence structures in the previous experiment were selected. To be precise, all 14 children who produced both non-scrambled structures in the indefinite referential condition and non-scrambled structures or indefinite non-referential direct objects in the definite condition were selected. For one of these 14 children, parental consent was not obtained, which makes the total number of participants in the ASD group 13. These children were matched on the basis of gender (3 female; 10 male) and chronological age to 13 typically developing children, who did not participate in the direct object scrambling study. Among the children in the ASD group, 9 children differed 1 month or less in age from the TD children to which they were matched. Two of the remaining 4 children with ASD differed 2 months from their TD match and the other two differed 3 months in age. The children with ASD ranged in age from 6;2 to 14;10 ($M = 10;5$) and the TD children from 6;3 to 15;1 ($M = 10;5$). All participants were native speakers of Dutch.

There are three arguments for considering the group of children with ASD as having normal language, in accordance with the ALN group in Perovic, Modyanova and Wexler (2013b). First of all, children with a formal diagnosis of Specific Language Impairment were excluded from the study. Second, the group of children with ASD included children diagnosed with Asperger's Syndrome. Children with this diagnosis were included in the ALN group in Perovic, Modyanova and Wexler (2013b), as they are argued not to be language delayed, according to authors. Third, the overall language skills of the children in the ASD group were measured by means of a standardized language assessment test, the CELF-4-NL (Dutch version of Clinical Evaluation of Language Fundamentals, fourth edition; Semel, Wiig and Secord, 2003). In their categorization of language impaired children with autism, Perovic, Modyanova and Wexler (2013b) adopt scores in their standardized language measures below the 10th percentile as a norm for including a child in the language impaired group, in line with previous literature. All children with ASD in the present study but one obtained scores above this cut-off point. As for the single child whose score on the CELF-4-NL was below the 10th percentile, see below.

4.2.2.2 Materials and procedure

Prior to the actual experiment, the children were instructed that they were about to see pictures concerning a family. Next, they were familiarized with the five members of this family and their names

(*Papa*, 'Dad', *Mama*, 'Mom', *Bart*, *Nina* and *Anne*). In five practice items, their familiarity with the names was tested. In each of these items the child was presented with two pictures, each showing a member of the family. The child was asked to point to the picture showing the character that matched the name uttered by the experimenter. Four additional practice items followed these five items, in which both the child's familiarity with the names was tested and the Dutch verbs used in the test sentences were introduced, i.e. *wassen*, 'to wash', *aankleden*, 'to dress', *wijzen naar*, 'to point to' and *aanraken*, 'to touch'. In each of these four items a picture was shown involving one of the actions expressed by the verbs, with one of the characters as agent and one as patient. The child was asked who the patient was, e.g. *Op dit plaatje is Bart iemand aan het wassen. Wie is Bart aan het wassen?*, 'In this picture, Bart is washing somebody. Who is Bart washing?'

Before starting the experimental phase, the children were instructed that again, they would see two pictures and that at the same time, they would hear a sentence. The children were asked to point to the picture that matched the sentence they heard. Unlike Perovic and Wexler (2007) and Perovic, Modyanova and Wexler (2013a; 2013b), the sentences were not uttered by the experimenter but recorded beforehand in a neutral female voice, in order to avoid intonation differences between subjects. Each recorded sentence was played simultaneously with the presentation of the two pictures.

The experimental phase consisted of 32 trials, in each of which two pictures and a sentence were presented. Each trial was presented in one of four conditions, each consisting of 8 trials. In the first experimental condition, Name Reflexive (NR), the test sentence involved a reflexive pronoun as a direct object, e.g. *Barts papa wast zich*, 'Bart's dad washes himself'. Following the suggestion of Perovic, Modyanova and Wexler (2013a), in order to check for any effects of strong (*zichzelf*) vs. weak (*zich*) reflexive pronouns, four of each type were included in this condition. In the second experimental condition, Name Pronoun (NPr), the test sentence involved a personal pronoun (*hem*, 'him' or *haar*, 'her') as direct object, e.g. *Barts papa wast hem*, 'Barts dad washes him'. The remaining two conditions were control conditions. Sentences in the first control condition, Control Possessive, involved a possessive subject, identical to the subjects in the experimental test sentences, e.g. *Barts vader aait een hond*, 'Barts dad is petting a dog'. These sentences involved different transitive verbs and a non-human direct object. Sentences in the other control condition, Control Name, contained the same verbs as the experimental sentences, but involved the names of the characters as subject and direct object, e.g. *Bart wast Papa*, 'Bart washes Dad'. A complete list of the original test sentences of Perovic and Wexler (2007) and Perovic, Modyanova and Wexler (2013a; 2013b) and the Dutch translations used in the present study is presented in Appendix B.

In each trial, the two pictures depicted the action, expressed by the verb in the test sentence. In the two experimental conditions, one of the two presented pictures showed either the father or the mother as an agent and one of the child characters as patient (e.g. the father washing Bart), while the other picture showed the father or mother performing the action to himself or herself, with the same child character standing by (e.g. the father washing himself and Bart standing by). In the control possessive condition, each trial involved one picture showing one of the three children as agent and one picture showing one of the parents as agent. In the control name condition, one picture depicted the father or mother as the agent and one of the child characters as the patient of the action (e.g. the father washing Bart), while in the other picture the thematic roles were reversed (e.g. Bart washing his father). In each trial, one picture was presented at the left side of the screen and the other on the right. Half of the pictures that matched the presented sentence were presented on the left and the other half were presented on the right, in order to avoid any visual bias. The trials were presented in a fixed random order, showing at most two trials in the same condition and three trials in the experimental conditions consecutively. Five adults completed the task and yielded perfect scores in all conditions.

4.2.3 Results

In Figure 2, the percentages of correct responses of the typically developing children and the children with ASD are represented per condition. Recall that the four conditions were named Control Name (CN), Control Possessive (CP), Name Pronoun (NPr) and Name Reflexive (NR). In Table 1 the number of correct responses for the NPr condition are presented per child and target group.

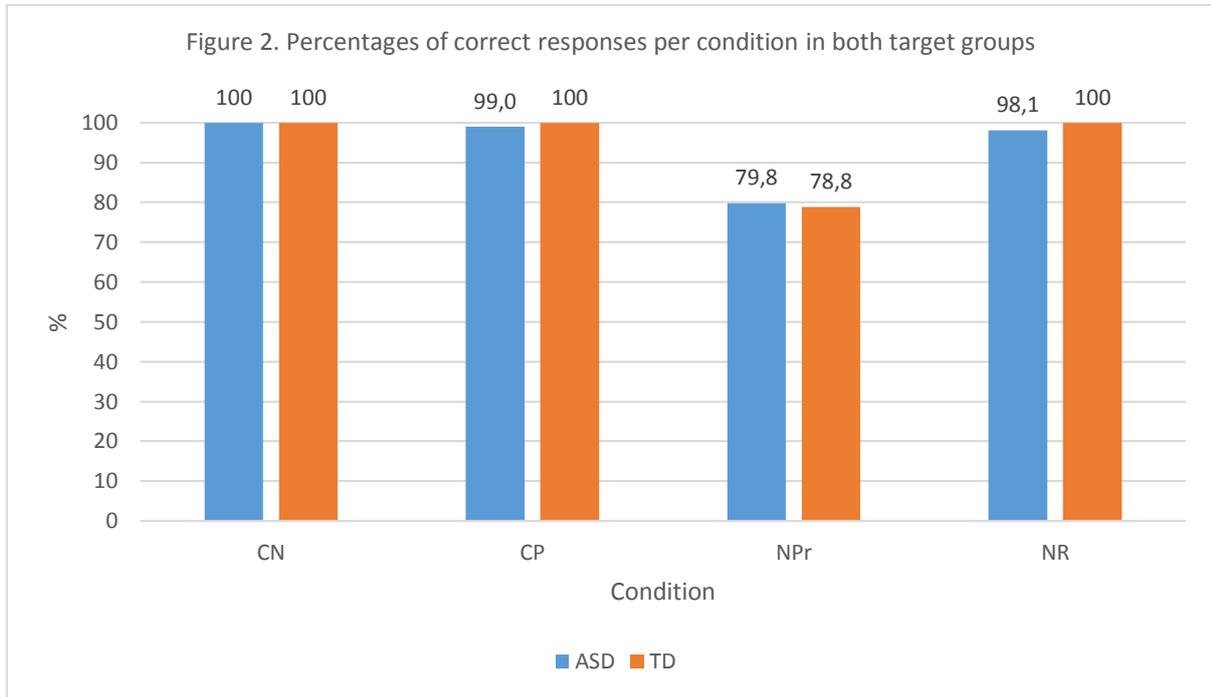


Table 1. Number of correct responses in the NPr condition per child and target group

ASD		TD	
Age (yr;m)	Number of correct responses (max. 8)	Age (yr;m)	Number of correct responses (max. 8)
6;2	6	6;3	5
6;7	6	6;6	5
7;4	6	7;3	6
9;1	7	9;1	4
9;11	2	9;10	6
10;3	8	10;3	6
10;6	7	10;4	7
10;8	7	10;7	7
11;6	6	11;5	8
11;9	8	11;10	4
14;2	8	14;0	8
14;5	5	14;8	8
14;10	7	15;1	8
Total	83	Total	82

In the ASD group, the number of correct responses was significantly lower in the NPr condition than in the CN condition ($T = 0$, $p = 0.005$), the CP condition ($T = 0$, $p = 0.007$) and the NR condition ($T = 3.5$, $p = 0.005$). The TD children also made significantly more mistakes in the NPr condition than in the CN

condition ($T = 0, p = 0.007$), the CP condition ($T = 0, p = 0.007$) and the NR condition ($T = 0, p = 0.007$). In all conditions there were no significant differences between both groups.

Because one child in the ASD group obtained a score below the 10th percentile of the standardized language assessment test CELF-4-NL (cf. section 4.2.2.1), another analysis was run without this child. Similar results were observed though. The children with ASD pointed to the correct picture significantly less in the NPr condition than in the CN condition ($T = 0, p = 0.007$), the CP condition ($T = 0, p = 0.010$) and the NR condition ($T = 3.5, p = 0.012$). In no condition, significant differences were found between both groups.

4.2.4 Discussion

This study investigates the comprehension of personal and reflexive pronouns in children with ASD and typically developing children by means of a picture-selection task. Both participant groups appeared to have difficulty interpreting pronouns, but no difficulty whatsoever in interpreting reflexives and control items. Since the performance of both groups in the control conditions was virtually perfect, it can be concluded that the task itself was not problematic for either group of children. Moreover, it can be concluded that the children correctly interpreted the possessive subjects, which were tested in the CP condition. As for the experimental conditions, it was predicted that children with ASD assign more co-referential readings to personal pronouns than typically developing children and that children with ASD interpret reflexive pronouns correctly as often as typically developing children. As for the reflexive pronouns, the prediction is borne out. The children with ASD did not opt for the wrong picture significantly more often than the TD children did; both groups performed almost perfectly in this condition. This finding suggests that unlike the children with ASD in Perovic, Modyanova and Wexler (2013a) and the ALI group in Perovic, Modyanova and Wexler (2013b) the autistic children participating in the present study were not language impaired and did not suffer from severe syntactic deficits. In addition, it is interesting to note that there was no difference at all between the interpretation of strong '*zichzelf*' and weak '*zich*' reflexives. Both types were misinterpreted only once in the ASD group.

The prediction for the NPr condition however was not borne out. Although both groups made significantly more mistakes in this condition than in all other conditions, no significant difference between both groups was found. Obviously, one can argue that the pronoun comprehension of non-language-impaired children with ASD is typical and that any deficits in pragmatic or discourse functions that are present in children with autism do not manifest itself in the interpretation of personal pronouns. On closer inspection however, it seems that the distribution of wrong answers differs between both groups. Table 1 shows that the TD children performed at large in line with the literature, showing a steady increase in correct responses between the ages of 6 and 10 and perfect scores from the age of 11 onward. However, the children with ASD gave incorrect responses in the NPr condition along the complete age range from 6 to 14 years. This finding suggests that problems in the interpretation of personal pronouns in children with ASD persist until at least the age of 14, while typically developing children are completely adultlike in their pronoun comprehension at age 11.

The hypothesized impairment in the syntax-discourse interface in children with ASD might explain why children with ASD older than 11 years still have difficulty interpreting personal pronouns, whereas TD matches generally perform like adults in experiments testing the DPBE. Co-referential readings are unavailable for the TD children at that age, but children with ASD may still have difficulty with processes of incorporation and use accommodation as an avoidance strategy. It is interesting to note that most of the participants with ASD in the previous discourse studies, that were discussed in chapter 2 (Baltaxe, 1977; Baltaxe & D'Angiola, 1992; Fine et al., 1994; Tager-Flusberg, 1995; Arnold, Bennetto and Diehl, 2009), were 11 years or older. The results of these studies are also interpretable

in terms of the hypothesized mapping problem (cf. 2.3.3). Still, the results of the present study show some individual variation, because two children in the TD group yielded lower scores in the NPR condition than one would expect on the basis of their age. Future research might therefore provide more decisive answers whether children with ASD have more difficulty interpreting pronouns, for instance by focusing specifically on teenagers with ASD and by using a larger amount of test items.

4.3 General discussion

Consider the results of the scrambling production experiment discussed in the previous chapter and the results of the pronoun comprehension experiment discussed in this chapter. In the former study, the group of TD children performed differently from the children with ASD, whereas in the latter study, they did not. As suggested above, a key solution of this asymmetry in results may be found in individual variation; a different group of typically developing children participated in each experiment. It might be the case that the TD children in the scrambling production task were simply more advanced in their development of discourse reference skills than the children in the pronoun comprehension study. However, assuming that the groups of TD children did not differ in this respect, an alternative explanation could lie in the fact that the scrambling experiment concerned language production, while the pronoun experiment concerned language comprehension. Whereas an impairment in linking syntactic constituents to discourse referents would have impact on both production and comprehension, it might be the case that in typically developing children, the discourse reference mechanisms work slightly differently in language comprehension, compared to language production. For instance, it has been observed that in spontaneous speech, typically developing children use pronouns and reflexives correctly already at age 3, whereas chance performance in pronoun comprehension experiments can still be observed at age 6 (Bloom et al. 1994). In language production, it is important to construct an utterance in an economical, yet interpretable way. A child can choose for himself the most easy and cognitively least demanding way of expression. In terms of the discussed mechanisms of discourse reference, the economical option of incorporation is an obvious default strategy that a child can adopt, resulting in scrambled utterances in an elicited production experiment, for instance. In language comprehension however, it is important to acquire a meaningful interpretation of the perceived utterance. The ways in which these interpretations are gained might differ from those chosen in language production, in order to achieve the goal of constructing a meaningful interpretation (Avrutin 1999). When confronted with an utterance such as *Bart's father washes him*, the default option in both adults and children might be to try and interpret *him* on the basis of binding. However, since Principle B blocks such an interpretation, *him* has to be interpreted on the basis of discourse reference. Note that in language production, one might choose to express either possible interpretation via reflexives, e.g. *Bart's father washes himself*, or proper names, e.g. *Bart's father washes Bart*, in order to avoid ambiguous references in an economical way. In language comprehension however, a hearer has no choice but to try and make sense of the words that are presented.

Consider for example the sentence *Bart's father washes him*. If co-indexation does not yield a grammatical structure, *him* is assigned a different index. Note that in adults, a different index implies that the discourse referent to which *him* is linked cannot be the guise of the father, because if this were the case, *him* and *Bart's father* would share the same index. Therefore, adults interpret *him* as referring to a character other than the father. Children in the age range of 6 to 10 years old are argued to rely mainly on incorporation as discourse reference strategy too, but whereas they do know that co-indexed NPs share the same referent (cf. Principle P; Chien and Wexler 1990), they may not yet always infer that non-co-indexed units have different referents. In other words, like adults, older typically developing children might interpret personal pronouns such as *him* on the basis of

incorporation, i.e. they link each pronoun to a referent in their discourse representation, but in contrast to adults they do not exclude the referent of a possible local binder from the interpretation. In this case, the children search in their discourse representation for a male referent that is salient in the given discourse. The local binder being a suitable salient referent as the subject of the sentence, the variable index of *him* might be instantiated by the constant number of the subject's discourse referent.

To some extent, this approach to pronoun comprehension in children aged 6 to 10 years old resembles the theory of Rule I (Grodzinsky and Reinhart, 1993). Rule I is a pragmatic principle that rules out co-referential readings that are identical to interpretations based on binding. In case of *Bart's father washes him* for example, Rule I rules out the co-referential reading in which Bart's father washes himself, because the same interpretation can be acquired by means of binding, which in itself is ruled out because of Principle B. Young children are argued not to be able to hold both a bound variable interpretation and a co-referential interpretation in mind. Therefore, they cannot compare the two readings and apply rule I. The idea that older children do not always infer that constituents that bear different indices have different referents is similar to the theory of Rule I, because in both approaches children are argued to allow co-referential interpretations of personal pronouns, because they do not apply some form of pragmatic knowledge that rules out these readings. However, the theory of Rule I argues that children lack the cognitive resources to process two derivations simultaneously. Arguably, children in the age range of 6 to 10 years old should be able to maintain and evaluate two representations at the same time. It is more likely that a pragmatic inference failure rather than the cost of syntactic processing is involved in the co-referential readings assigned by these children. Thus, when children in this age range acknowledge economy considerations and interpret pronouns on the basis of incorporation, in some cases they might not take indexation into account, leading to randomly picking a suitable discourse referent.

One might argue that this incorporation ambiguity might be troubling children with ASD too and that therefore, they do not perform differently from TD children in the pronoun comprehension experiment. This account would not explain however why the exact same children produce non-scrambled structures in the scrambling study. Recall that incorporation is associated with topicality and that therefore scrambling is obligatory when a given NP is linked to an existing discourse referent. If the children with ASD do rely on incorporation as much as TD children, the prediction that follows is that they do not differ in their production of scrambled and non-scrambled structures. It is shown in chapter 3 that this is not the case.

Yet, whatever processing errors or pragmatic knowledge or other factors are involved in the co-referential readings of personal pronouns in relatively old typically developing children, it is only relevant in processes of language comprehension. In language production, determining the referent of a personal pronoun is not an issue, because a speaker determines any referent a priori. Simply put, a speaker does not say *him* and wonder what man he is referring to. It is hypothesized however that in children with ASD, processes of incorporation itself are difficult, no matter whether it takes place during language production or language comprehension. Therefore, it is predicted that in both cases they adopt different discourse reference strategies. This pattern of behavior can be observed in the data of the scrambling production study and the pronoun comprehension study. In addition, recall that children with ASD along the complete age range display the DPBE, while typically developing children seem to be gradually improving when they become older. This finding supports the idea that children with ASD older than 10 make mistakes in pronoun comprehension because of an impairment, while typically developing children between 6 and 10 years old do so because they are still in the process of cognitive and linguistic development.

In short, random variation and different participant groups might account for the asymmetry in the results observed in both experiments, but the difference between discourse reference in

language production and discourse reference in language comprehension might be involved too. Specifically, the interpretation of pronouns on the basis of incorporation might work differently in language comprehension than in language production for typically developing children. Children with ASD however are argued to have difficulty with processes of incorporation and avoid these in both production and comprehension, thus providing a possible explanation for the observed patterns in the results of this group in both studies.

5. Conclusion and suggestions for future research

This thesis started out from the observation that, compared to typically developing children, children with Autism Spectrum Disorder often seem to have difficulty with discourse reference, while having normal phonological, syntactic and lexical knowledge. The question that follows from this observation is what cognitive impairment is involved in these referential problems, if children with ASD are not specifically language impaired. It is hypothesized in this thesis that the observed difficulties follow from a mapping problem between linguistic representations on the one hand and discourse representations on the other hand. Specifically, it is proposed that for children with ASD, processes of incorporation are problematic, i.e. instantiating the variable index of a syntactic constituent with the constant value of a discourse referent. Because this process of discourse reference requires high levels of information integration, it was suggested that neural underconnectivity in children with ASD might be involved in incorporation problems. If other linguistic processes such as syntactic operations require less integration of information, these might be less problematic for children with autism. It is predicted that if discourse reference on the basis of incorporation is problematic, children with ASD adopt other strategies of reference, such as accommodation, i.e. introducing a new referent on the basis of something familiar to both speaker and hearer, i.e. another referent, world knowledge or spatio-temporal context (deixis). In order to test the mapping problem hypothesis, direct object scrambling and comprehension of personal and reflexive pronouns in children with ASD are investigated.

It is argued in chapter 3 that in Dutch, incorporated direct object noun phrases (NPs) typically appear before sentential adverbs and negation. Accommodated definite NPs can appear both before sentential adverbs and negation, i.e. scrambled, and after sentential adverbs and negation, i.e. non-scrambled. Non-referential indefinite NPs appear only in non-scrambled position. If children with ASD make use of accommodation and non-referential indefinite NPs as strategies of discourse reference more than typically developing children, it is predicted that they produce more sentences with non-scrambled direct objects in contexts favoring incorporation of the direct object. This prediction was tested by means of an elicited production experiment, in which a group of children with ASD, aged 5;8 to 14;6, a group of typically developing children matched on gender and age and a group of adults participated. It was found that the children with ASD produced more sentences with non-scrambled direct objects than the typically developing children in incorporation-eliciting contexts. In addition, it was found that the children with ASD often produced non-referential indefinite NPs as direct objects in contexts where definite or referential indefinite NPs would be appropriate. Because non-referential indefinite NPs do not have a specific referent and therefore do not require interpretation on the basis of incorporation, producing non-referential indefinites can be considered an alternative strategy to avoid relating a syntactic NP to a certain discourse referent. These results provide support for the hypothesis that incorporation is problematic in children with ASD.

In chapter 4, comprehension of pronouns is discussed. It is argued that while the interpretation of personal pronouns depends on incorporation or accommodation, the interpretation of reflexive pronouns is based on syntactic binding. It has been shown in the literature that because of this interpretational difference, typically developing children interpret reflexive pronouns correctly from about age 3 on, while their comprehension of personal pronouns becomes adultlike between the age of 6 and 10, a phenomenon known as the *Delay of Principle B Effect*. More specifically, children can assign reflexive readings to personal pronouns such as *him* and *her* when they interpret them on the basis of accommodation. In adults, such interpretations are grammatically and pragmatically blocked. Instead, adults interpret these pronouns on the basis of incorporation, leading to a non-reflexive interpretation. If children with autism have intact syntactic abilities, but have difficulty with incorporation and adopt accommodation as a discourse reference strategy instead, it is predicted that they interpret reflexive pronouns correctly, but make mistakes in their comprehension of personal

pronouns. Moreover, because typically developing children in the age range of 6 to 14 years are on their way to reach adultlike comprehension of pronouns, but children with autism along this age range are hypothesized to have difficulty with incorporation, it is predicted that children with autism make more mistakes in their comprehension of personal pronouns than typically developing age peers. This prediction was tested by means of a picture selection experiment, in which a group of Dutch-speaking children with ASD, aged 6;2-14;10, and a group of typically developing children matched on gender and age participated. It was found that indeed, the children with ASD had no difficulty interpreting reflexives, but did make mistakes in interpreting personal pronouns. However, they did not differ in any respect from the typically developing children. The typically developing children also interpreted reflexives correctly, but assigned reflexive interpretations to the Dutch pronouns *hem*, 'him', and *haar*, 'her'. Yet, on closer inspection it appeared that while typically developing children gradually perform better in their pronoun comprehension as they become older, reaching adultlike behavior around 11 years old, the children with ASD made mistakes along the complete age range, even at 14 years old. It is argued that although TD children in the age range of 6 to 14 years make use of incorporation as a strategy of discourse reference, they may not always infer that non-co-indexed constituents correspond to different referents in the discourse model. Therefore, in some cases they assign co-referential readings to personal pronouns.

In sum, although not all predictions for the pronoun comprehension experiment were borne out, the results revealed an interesting pattern that is consistent with developmental progress in typically developing children and an impairment in discourse functions in children with ASD. Still, firm conclusions cannot be made on the basis of the findings in this study; future research could aim at investigating whether there is a difference in pronoun comprehension between typically developing teenagers and teenagers with ASD. If this future research finds that teenagers with ASD still make mistakes in their comprehension of personal pronouns, while typically developing children's comprehension is no different from adult's, these results provide additional evidence for the mapping problem hypothesis put forth in this thesis.

In addition, future research might provide more insight into the problems with discourse reference displayed by children with autism by looking at the production and comprehension of other linguistic elements and configurations that require integration of syntactic and discourse representations. For instance, it would be interesting to investigate the interpretation of logophoric elements in children with autism. Logophors are argued to be co-referential anaphors, whose interpretation is not established syntactically, but depends on the status of the discourse (Reinhart and Reuland, 1993). If linking syntactic constituents to discourse representations is problematic in children with autism, as hypothesized in this thesis, then it is predicted that children with autism might experience difficulty in interpreting logophors too.

Another approach future research might take is to investigate corpora of autistic children's speech, from the perspective of the hypothesized mapping problem. So far, linguistic research involving children and adults with ASD has identified problems with discourse reference mainly on the basis of short interviews, narratives and, to a lesser extent, structured experiments. It might be interesting to look specifically at longitudinal data to see whether incorporation problems occur in the everyday speech of children with autism, and if so, what strategies are adopted to deal with difficulties in this type of discourse reference. The advantage of this methodology is that, in addition, the within-subject development of referential abilities can be investigated and can be compared to the patterns of language acquisition attested in typically developing children. Longitudinal speech data of children with ASD has previously been used to study their general linguistic development (e.g. Tager-Flusberg et al., 1990), but not specifically their discourse reference abilities. Although the available data is not abundant, there are some databases, such as the CHILDES database (MacWhinney, 2000), which include some speech data of children diagnosed with ASD.

Finally, if more findings support the hypothesis of a mapping problem between linguistic and discourse representations in children with ASD, future research might investigate the neurological basis for these incorporation problems, for instance by means of neuroimaging. Specifically, studies of this type might find out whether neural underconnectivity is involved in the discourse referential problems in children with autism, as suggested in this thesis.

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Appendices

Appendix A: direct object scrambling scenario's

Scenario's eliciting definite direct objects

(1) *A picture of Patrick and a book is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Patrick!

'Patrick!'

Experimenter A: Patrick verveelt zich en kijkt of er iets leuks te doen is. He, zegt Patrick, een boek! Maar ik houd niet van boeken.

'Patrick is bored and he is looking for something to do. Hey, Patrick says, a book! But I don't like books'.

Dus dat ga ik NIET lezen.

So that will I NOT read.

'So I am not going to read that.'

Experimenter B: Ik weet het! Het boek gaat Patrick WEL lezen!

I know it! The book will Patrick *wel* read!

'I know! Patrick is going to read the book!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Patrick gaat het boek NIET lezen.

Patrick will the book not read

'Patrick will not read the book.'

(2) *A picture of Octo and a sandwich is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Octo!

'Octo!'

Experimenter A: Octo heeft zin in iets lekkers. He, zegt ie, een boterham. Bah, die lust ik niet.

'Octo fancies a snack. He, he says, a sandwich. Yuck, I don't like that one'.

Dus die ga ik NIET opeten.

So that will I NOT eat.

'So I am not going to eat that one.'

Experimenter B: Ik weet het! De boterham gaat Octo WEL opeten!

I know it! The sandwich will Octo *wel* eat!

'I know! Octo is going to eat the sandwich!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Octo gaat het boek NIET lezen.

Octo will the sandwich not eat

'Octo will not eat the sandwich.'

(3) *A picture of Boots and a giraffe is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Boots!

'Boots!'

Experimenter A: Boots wil iets natekenen. He, een giraffe! Wat een grote giraffe. Maar die is echt te groot.

'Boots wants to draw something. Hey, a giraffe! What a big giraffe. But that one is really too big.'

Dus die ga ik NIET natekenen.

So that one will I NOT draw.

'So I am not going to draw that one.'

Experimenter B: Ik weet het! De giraffe gaat Boots WEL natekenen!

I know it! The giraffe will Boots *wel* draw!

'I know! Boots is going to draw the giraffe!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Boots gaat de giraffe NIET natekenen.

Boots will the giraffe not draw

'Boots will not draw the giraffe.'

(4) *A picture of Dora and a pond containing a boot is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Dora!

'Dora!'

Experimenter A: Dora heeft een nieuwe hengel gekregen. Ze wil er iets mee vangen. Maar er zwemmen geen vissen in de vijver. Er ligt een laars in de vijver. He, zegt Dora, een laars. Maar die kun je niet eten.

'Dora got a new fishing rod. She wants to catch something with it. But there are no fish in the pond. A boot lies in the pond. He, Dora says, a boot. But you cannot eat that.'

Dus die ga ik NIET vangen.

So that one will I NOT catch.

'So I am not going to catch that one.'

Experimenter B: Ik weet het! De laars gaat Dora WEL vangen!

I know it! The boot will Dora *wel* catch!

'I know! Dora is going to catch the boot!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Dora gaat de laars NIET vangen.

Dora will the boot not catch

'Dora will not catch the boot.'

(5) *A picture of Paddington Bear, who is holding flowers, and one big flower is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Paddington!

'Paddington!'

Experimenter A: Paddington wil bloemen plukken voor zijn moeder. Hij heeft al een paar bloemen. He, zegt Paddington, nog een bloem. Maar die vind ik te groot.

'Paddington wants to pick flowers for his mother. He already has some flowers. Hey, Paddington says, another flower. But that one I find too big.'

Dus die ga ik NIET plukken.

So that one will I NOT pick.

'So I am not going to pick that one.'

Experimenter B: Ik weet het! De bloem gaat Paddington WEL plukken!

I know it! The flower will Paddington *we* pick!

'I know! Paddington is going to pick the flower!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Paddington gaat de bloem NIET plukken.

Paddington will the flower not pick

'Paddington will not pick the flower.'

(6) *A picture of Spongebob and a drawing of a teddy bear is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Spongebob!

'Spongebob!'

Experimenter A: Spongebob is aan het knutselen. Hij wil iets uitknippen. He, zegt hij, een teddybeer.

Nou, die vind ik helemaal niet mooi.

'Spongebob is doing crafts. Hij wants to cut out something. Hey, he says, a teddy bear. Well, I don't like that one at all.'

Dus die ga ik NIET uitknippen.

So that one will I NOT pick.

'So I am not going to pick that one.'

Experimenter B: Ik weet het! De teddybeer gaat Spongebob WEL uitknippen!

I know it! The teddy bear will Spongebob *we* pick!

'I know! Spongebob is going to pick the teddy bear!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Spongebob gaat de teddybeer NIET uitknippen.

Spongebob will the teddy bear not pick

'Spongebob will not pick the teddy bear.'

Scenario's eliciting referential indefinite direct objects

(1) *A picture of Elmo and three newspapers is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Elmo!

'Elmo!'

Experimenter A: He, zegt Elmo, drie kranten: 1, 2, 3. Twee kranten ga ik NIET lezen.

Hey, says Elmo, three newspapers: 1, 2, 3. Two newspapers will I NOT read

'Hey, Elmo says, three newspapers: 1, 2, 3. Two newspapers I am not going to read.'

Experimenter B: Ik weet het! Twee kranten gaat Elmo WEL lezen!

I know it! Two newspapers will Elmo *we* read!

'I know! Elmo will read two newspapers'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Elmo gaat twee kranten NIET lezen.

Elmo will two newspapers not read

'Elmo will not read two newspapers.'

(2) A picture of Paddington Bear and a drawing of three balloons is shown

Experimenter B: Wie is dit?

'Who is this?'

Child: Paddington!

'Paddington!'

Experimenter A: He, zegt Paddington, drie ballonnen: 1, 2, 3. Twee ballonnen ga ik NIET uitknippen.

Hey, says Paddington, three balloons: 1, 2, 3. Two balloons will I NOT cut.out

'Hey, Paddington says, three balloons: 1, 2, 3. Two balloons I am not going to cut out.'

Experimenter B: Ik weet het! Twee ballonnen gaat Paddington WEL uitknippen!

I know it! Two balloons will Elmo *wel* cut.out!

'I know! Elmo will cut out two balloons!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Paddington gaat twee ballonnen NIET uitknippen.

Paddington will two balloons not cut.out

'Paddington will not cut out two balloons.'

(3) A picture of Spongebob and three cars is shown

Experimenter B: Wie is dit?

'Who is this?'

Child: Spongebob!

'Spongebob!'

Experimenter A: He, zegt Spongebob, drie auto's: 1, 2, 3. Twee auto's ga ik NIET natekenen.

Hey, says Spongebob, three cars: 1, 2, 3. Two cars will I NOT draw

'Hey, Spongebob says, three cars: 1, 2, 3. Two cars I am not going to draw.'

Experimenter B: Ik weet het! Twee auto's gaat Spongebob WEL natekenen!

I know it! Two cars will Spongebob *wel* draw!

'I know! Spongebob will draw two cars!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Spongebob gaat twee auto's NIET natekenen.

Spongebob will two cars not draw

'Spongebob will not draw two cars.'

(4) A picture of Patrick and three cupcakes is shown

Experimenter B: Wie is dit?

'Who is this?'

Child: Patrick!

'Patrick!'

Experimenter A: He, zegt Patrick, drie cakejes: 1, 2, 3. Twee cakejes ga ik NIET opeten.

Hey, says Patrick, three cupcakes: 1, 2, 3. Two cupcakes will I NOT eat

'Hey, Patrick says, three cupcakes: 1, 2, 3. Two cupcakes I am not going to eat.'

Experimenter B: Ik weet het! Twee cakejes gaat Patrick WEL opeten!

I know it! Two cupcakes will Patrick *wel* eat!

'I know! Patrick will eat two cupcakes!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Patrick gaat twee cakejes NIET opeten.

Patrick will two cupcakes not eat

'Patrick will not eat two cupcakes.'

(5) *A picture of Dora and three magazines is shown*

Experimenter B: Wie is dit?

'Who is this?'

Child: Dora!

'Dora!'

Experimenter A: He, zegt Dora, drie tijdschriften: 1, 2, 3. Twee tijdschriften ga ik NIET lezen.

Hey, says Dora, three magazines: 1, 2, 3. Two magazines will I NOT read

'Hey, Dora says, three magazines: 1, 2, 3. Two magazines I am not going to read.'

Experimenter B: Ik weet het! Twee tijdschriften gaat Dora WEL lezen!

I know it! Two magazines will Dora *wel* read!

'I know! Dora will read two magazines!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Dora gaat twee tijdschriften NIET lezen.

Dora will two magazines not read

'Dora will not read two magazines.'

(6) *A picture of Octo and three jellyfish is shown*

Experimenter B: Wie is dit?

'Who is this?'

Child: Octo!

'Octo!'

Experimenter A: He, zegt Octo, drie kwallen: 1, 2, 3. Twee kwallen ga ik NIET vangen.

Hey, says Octo, three jellyfish: 1, 2, 3. Two jellyfish will I NOT catch

'Hey, Octo says, three jellyfish: 1, 2, 3. Two jellyfish I am not going to catch.'

Experimenter B: Ik weet het! Twee kwallen gaat Octo WEL vangen!

I know it! Two jellyfish will Octo *wel* catch!

'I know! Octo will catch two jellyfish!'

Child: Nee!

'No'.

Experimenter A: Nee, he? Wat gebeurt er echt?

No huh? What happens there really?

'No? What's really happening?'

Target: Octo gaat twee kwallen NIET vangen.

Octo will two jellyfish not catch
'Octo will not catch two jellyfish.'

Scenario's eliciting non-referential indefinite direct objects

(1) *A picture of Octo is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Octo!

'Octo!'

Experimenter A: Mmmmm, zegt Octo, ik heb zin om iets te tekenen. Ik wil eigenlijk wel een vogel natekenen, maar dat is heel moeilijk. Ik denk niet dat ik dat kan.

'Mmmmm, Octo says, I would like to draw something. Actually, I would like to draw a bird, but that is very difficult. I don't think I can do that.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Octo niet doen?

Oh, I have it not well heard. What will Octo not do

'Oh, I didn't hear it. What will Octo not do?'

Target: Octo gaat NIET een vogel tekenen.

Octo will NOT a bird draw

'Octo is not going to draw a bird.'

(2) *A picture of Paddington Bear and a library is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Paddington!

'Paddington!'

Experimenter A: He, zegt Paddington, de bibliotheek. Daar zijn heel veel boeken. Ik wil heel graag een boek lezen. Maar ik ben mijn bril vergeten.

'Hey, Paddington says, the library. There are lots of books over there. I would love to read a book. But I forgot my glasses.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Paddington niet doen?

Oh, I have it not well heard. What will Paddington not do

'Oh, I didn't hear it. What will Paddington not do?'

Target: Paddington gaat NIET een boek lezen.

Paddington will NOT a book read

'Paddington is not going to read a book.'

(3) *A picture of Patrick is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Patrick!

'Patrick!'

Experimenter A: Mmm, zegt Patrick, ik zou graag heel moedig zijn en een boef vangen. Maar dat durf ik niet.

'Mmm, Patrick says, I would like to be very brave and catch a crook. But I don't dare to.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Patrick niet doen?

Oh, I have it not well heard. What will Patrick not do

'Oh, I didn't hear it. What will Patrick not do?'

Target: Patrick gaat NIET een boef vangen.

Patrick will NOT a crook catch

'Patrick is not going to catch a crook.'

(4) *A picture of Spongebob is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Spongebob!

'Spongebob!'

Experimenter A: Mmmmm, zegt Spongebob, ik heb zin om iets te eten. Ik kan een snoepje eten, maar dat is slecht voor je tanden.

'Mmmmmm, Spongebob says, I would like to eat something. I can eat a sweet, but that is bad for your teeth.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Spongebob niet doen?

Oh, I have it not well heard. What will Spongebob not do

'Oh, I didn't hear it. What will Spongebob not do?'

Target: Spongebob gaat NIET een snoepje eten.

Spongebob will NOT a sweet eat

'Spongebob is not going to eat a sweet.'

(5) *A picture of Boots with a piece of paper and a pair of scissors is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Boots!

'Boots!'

Experimenter A: Mmmmm, zegt Boots, ik heb zin om iets te knippen. Ik kan een vliegtuig knippen, maar dat vind ik te moeilijk.

'Mmmmmm, Boots says, I would like to cut something. I can cut out an airplane, but I find that too difficult.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Boots niet doen?

Oh, I have it not well heard. What will Boots not do

'Oh, I didn't hear it. What will Boots not do?'

Target: Boots gaat NIET een vliegtuig knippen.

Boots will NOT an airplane cut

'Boots is not going to cut out an airplane.'

(6) *A picture of Dora is shown*

Experimenter B: Hé, wie zie je op het plaatje?

'Hey, who do you see in the picture?'

Child: Dora!

'Dora!'

Experimenter A: He, zegt Dora, ik heb zin om naar een tuin te gaan en een bloem te plukken. Maar dat mag niet zomaar.

'He, Dora says, I would like to go to a garden and pick a flower. But that is not allowed.'

Dus dat ga ik NIET doen.

So that will I NOT do

'So I am not going to do that.'

Experimenter B: Oh, ik heb het niet goed gehoord. Wat gaat Dora niet doen?

Oh, I have it not well heard. What will Dora not do

'Oh, I didn't hear it. What will Dora not do?'

Target: Dora gaat NIET een bloem plukken.

Dora will NOT a flower pick

'Dora is not going to pick a flower.'

Appendix B: Test items pronoun comprehension experiment

Condition	English (Perovic and Wexler 2007; Perovic, Modyanova and Wexler 2013a; 2013b)	Dutch
1. Name Reflexive	Bart's dad is touching himself. Lisa's mom is touching herself. Bart's dad is pointing to himself. Lisa's mom is pointing to herself. Bart's dad is washing himself. Maggie's mom is washing herself. Maggie's mom is dressing herself. Lisa's mom is dressing herself.	Barts papa raakt zichzelf aan Nina's mama raakt zichzelf aan Barts papa wijst naar zichzelf Nina's mama wijst naar zichzelf Barts papa wast zich Annes mama wast zich Annes mama kleedt zich aan Nina's mama kleedt zich aan
2. Name Pronoun	Bart's dad is touching him. Lisa's mom is touching her. Bart's dad is pointing to him. Lisa's mom is pointing to her. Bart's dad is washing him. Maggie's mom is washing her. Maggie's mom is dressing her. Lisa's mom is dressing her.	Barts papa raakt hem aan Nina's mama raakt haar aan Barts papa wijst naar hem Nina's mama wijst naar haar Barts papa wast hem Annes mama wast haar Annes mama kleedt haar aan Nina's mama kleedt haar aan
3. Control Name	Bart is pointing to Dad. Lisa is touching Mom. Bart is washing Dad. Mom is dressing Maggie. Dad is pointing to Bart. Mom is touching Lisa. Mom is washing Maggie. Mom is dressing Lisa.	Bart wijst naar Papa Nina raakt Mama aan Bart wast Papa Mama kleedt Anne aan Papa wijst naar Bart Mama raakt Nina aan Mama wast Anne Mama kleedt Nina aan
4. Control Possessive	Lisa's mom is waving a flag. Bart's dad is petting a dog. Maggie's mom is petting a dog. Lisa's mom is driving a car. Lisa's mom is playing with blocks. Bart's dad is eating an ice cream. Maggie's mom is eating an ice cream Bart's dad is licking a lamp post.	Nina's mama zwaait een vlaggetje Barts papa aait een hond Annes mama aait een hond Nina's mama rijdt in een auto Nina's mama speelt met blokken Barts papa eet een ijsje Annes mama eet een ijsje Barts papa likt een lantaarnpaal