Comprehension of reflexive pronouns in language impaired children with ASD: the acquisition of the locality constraint

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ABSTRACT
Almost 3% of children aged four to twelve are diagnosed with Autism Spectrum Disorder (ASD) in the Netherlands. Some of these children have language impairments, referred to as Autism Language Impaired (ALI). Studies by Perovic et al. (2013a; 2013b) show that the comprehension of reflexive pronouns is impaired in these children. It is hypothesized that children with ALI do not have full knowledge of the constraints on the binding of reflexives, known as Principle A (Chomsky, 1986). However, the nature of this impairment remains unknown, as only the c-command constraint of Principle A has been tested. The locality constraint of Principle A remains uninvestigated. This article proposes methodology to bridge this gap in knowledge and answer the following question: 'Do children with ALI have knowledge of the locality constraint on the interpretation of reflexives?' It is expected that children with ALI lack all knowledge of principle A. The proposed research will result in valuable insights into the linguistic symptomatology of children with ALI, and thus has clinical implications. Moreover, it has a theoretical contribution by implicitly examining the notion of binding and its underlying constructs, through investigating which syntactic constraints are impaired in children with ALI and thus group together.

1. Introduction

Almost 3% of children aged four to twelve are diagnosed with a form of Autism Spectrum Disorder (ASD) in the Netherlands[9]. This population is highly heterogeneous, but a distinction is generally made between ASD individuals with preserved language abilities, known as Autism Language Normal (ALN) and ASD individuals with language impairments, known as Autism Language Impaired (ALI) (First argued for by Kjelgaard & Tager-Flusberg, 2001). The latter group shows symptomatology included in the general autism criteria in the DSM-5 (e.g. social interaction deficits and repetitive behavior without the presence of global developmental delays; see American Psychiatric Association, 2013). Children with ALI

9 As found by the Centraal Bureau voor Statistiek, in their yearly report on the wellbeing of children aged 4-12 in the Netherlands: CBS. (2018). Ervaren gezondheid, gebruik en leefstijl bij kinderen tot twaalf jaar. Retrieved from:http://statline.cbs.nl/Statweb/publication/?VW=T&DM=SLNL&PA=83716ned&D1=12&D2=a&D3=0&D4=0&D5=0-3&HD=180627-1313&HDR=T&STB=G1,G2,G3,G4.

can language-wise be distinguished from children with other developmental disorders that lead to language problems, such as Developmental Language Disorder (DLD), mainly because children with ALI show a more severely impaired ability to use gestures and have greatly impaired language comprehension. Children with ALI have better language production than comprehension, while children with DLD and Specific Language Impairment (SLI) do not show this dissociation (e.g. Paul, Chawarska & Volkman, 2008).

Most research on children with ALI is concerned with pragmatic and social impairments, whereas little is known about other linguistic subsystems and the causes of their problems with language comprehension. However, there has been a recent interest in the (morpho)syntactic abilities of children with ALI. For example, difficulties have been found with the comprehension of grammatical morphemes marking tense (Eigsti & Bennetto, 2009; Roberts, Rice & Tager-Flusberg, 2004). In addition to this, there are indications that children with ALI have impaired comprehension of reflexive pronouns (Perovic, Modyanova & Wexler, 2013a; 2013b). Perovic et al. (2013a; 2013b) argue that this is caused by a 'Principle A deficit'; children with ALI do not have complete knowledge of the binding Principle A (as proposed by Chomsky, 1986), which restricts the binding of reflexive pronouns. Reflexives require local, c-commanding and agreeing antecedents. However, Perovic et al.'s (2013a; 2013b) research only tested children with ALI's knowledge of the c-command constraint on the binding of pronouns, and did not investigate the locality constraint. There thus remains a gap in knowledge on the nature of the impaired comprehension of reflexive pronouns in children with ALI: 'Do children with ALI have a locality constraint on the interpretation of reflexives?'

This paper proposes research to answer this question. It is expected that children with ALI do not have any knowledge of Principle A, including the locality constraint. The proposed research will provide insights into the linguistic symptomatology of children with ALI, and could thus have clinical implications for treatment. It could both help in clinical assessment and diagnosing ALI, and in indicating what sort of treatment regarding reflexives is feasible. Moreover, this research will give us insights in typical development and even deliver a theoretical contribution by implicitly examining the notion of binding and its underlying theoretical constructs, c-command and locality, through investigating which syntactic constraints are impaired in children with ALI and thus group together.

This article is organized as follows: In section 2, the binding of reflexives and its acquisition in typically developing children and in children with ALI are discussed. Section 3 contains some methodological considerations, followed by a description of the research question and hypotheses in section 4. Section 5 includes an overview of the proposed methodology for this study, followed by a discussion of the analysis and anticipated results in section 6. This leads to the conclusion in section 7.

2. The binding of reflexives and its acquisition

2.1 Principle A and its acquisition in typically developing children

As discussed in the introduction, the comprehension of reflexives is restricted. According to Chomsky (1986), in the Universal Grammar framework, reflexives are bound by their antecedent. The binding of reflexives is governed by Principle A and they require local, c-commanding and agreeing antecedents (Chomsky, 1986).

(1) John's dad washes himself.

(2) John wants Peter to paint himself.

The c-command constraint on binding can be explained using example (1). In this sentence, *himself* must refer to *John's dad* and not to *John*, because *John* does not c-command the reflexive. Example (2) illustrates the locality constraint on the binding of reflexives. Here, the reflexive *himself* is not bound by the c-commanding NP *John*, because this antecedent is not in the same clause as the reflexive. *Himself* has to be bound locally, by the c-commanding NP *Peter*.

The current study is concerned with the Dutch language. Since the 1990's several studies have shown that Dutch children have knowledge of the constraints on the interpretation of reflexive pronouns from around the age of four (i.e. Bergmann, Paulus & Fikkert, 2009; Sigurjónsdóttir & Coopmans, 1996; Spenader, Smits & Hendriks, 2009; Van Koert, Hulk, Koeneman & Weerman, 2013; Van Rij, Van Rijn & Hendriks, 2010) .

(3) Bert zegt dat Ernie zich/hem krabt.
Bert says that Ernie himself/him scratches.
'Bert says that Ernie scratches himself/him.'

For example, Sigurjónsdóttir & Coopmans (1996) used a truth-value judgement task with sentences like the one in (3). Their results showed that four- and five-year-olds had the right interpretation of 73% and 78% of the sentences, respectively, and six-year-olds had adult-like interpretations for all stimuli.

2.2 The acquisition of Principle A in ALI children

The acquisition of Principle A in children with ALI has only been studied experimentally by Perovic et al. (2013a; 2013b), as far as I am aware. In their first study on binding in children with ASD, Perovic et al. (2013a) tested fourteen children with ALI, aged six to sixteen. A picture selection task (PST) was used. Children saw a screen with two pictures on it, heard a sentence, and were asked to point to the picture that showed the meaning of the sentence. An example of the experimental stimuli used is the following:

(4) Bart's dad is pointing to himself.

As sentence (4) illustrates, knowledge of Principle A was tested by providing sentences with reflexives and possessive subjects. As explained in section 2.1, under Principle A the embedded NP *Bart* in (4), inside the subject *Bart's dad*, does not bind the reflexive, because *Bart* does not c-command *himself*. The children heard a total of eight sentences containing reflexives. The results showed that the children performed at chance level. This means that the children with ALI wrongly chose the embedded NP as the antecedent of the reflexive around 50% of the time. They made considerably more mistakes than the control group with typically developing (TD) children.

Based on the results of their first study, Perovic et al. (2013b) conducted a follow-up study. This study included more syntactic phenomena than just reflexives; the comprehension of raising and object control structures was included as well. 48 children with ASD were tested in total. 26 of these children were categorized as ALI and 22 as ALN, based on their scores on language production and perception tests. The participants completed exactly the same PST as described for Perovic et al.'s (2013a) earlier study. The results of the follow-up study showed that the children with ALI performed around chance level, just as in Perovic et al.'s (2013a) earlier study. The ALN children, however, behaved like the control group of TD children and did not show a Principle A deficit. Thus, as expected, children with ALI show problems in the comprehension of reflexives, whilst ALN children do not.

2.3 Proposed explanations for the Principle A deficit

Based on their studies, Perovic et al. (2013a; 2013b) propose two main explanations for the principle A deficit found in children with ALI. As illustrated above, the only part of Principle A tested in Perovic et al.'s (2013a; 2013b) studies is the c-command constraint. Perovic et al. (2013a; 2013b) only tested sentences like (4), and not sentences like (2), with a possible local and a possible distant antecedent. Therefore, nothing can be concluded about possible knowledge of the locality constraint in the ALI population. Perovic et al. (2013a; 2013b) propose that children with ALI are at least insensitive to the c-command constraint of Principle A. They hypothesize that children with ALI might have a different version of Principle A, with only the locality constraint. This would mean that they only require an antecedent to be in the same clause as the reflexive, but do not require the antecedent to be c-commanded by its referent.

However, an insensitivity to c-command raises many questions related to other syntactic phenomena that rely on c-command relationships. If children with ALI do not show sensitivity to the c-command constraint in binding constructions, the question would be if they do show sensitivity to c-command in other structures. Importantly, Perovic et al.'s (2013a; 2013b) experiments did show that children with ALI performed well on another structure which interpretation depends on c-command: possessive sentences without reflexives (e.g. 'Bart's dad is petting a dog'). They showed the right interpretation of 77% of these sentences, which suggests some knowledge of c-command. Thus, the hypothesis that children with ALI

lack the c-command constraint on binding leads to problems related to learnability. It should be noted, however, that knowledge of c-command in the ALI population has not been investigated apart from Perovic et al.'s (2013a; 2013b) studies, as far as I am aware.

The second hypothesis Perovic et al. (2013a;2013b) propose is that children with ALI might not have knowledge of Principle A at all. Children with ALI lack a filter on the binding of reflexives and allow a range that is too big. This would mean that children with ALI might have knowledge of the general principles of c-command and locality, but do not know to apply these principles as constraints to the interpretation reflexives. In order to understand this hypothesis, consider the results of the picture selection task used in both of Perovic et al.'s (2013a; 2013b) studies. Children with ALI performed at chance level. Under the hypothesis that these children have no constraints on the binding of reflexives, this could be explained in the following way: Children with ALI allow both possible interpretations in the picture selection task. So, if they hear sentence (4) and see a picture where Bart points at himself and a picture where Bart's father points at himself, both pictures are actually depictions of sentence (4) for them.

3. Methodological considerations

It should be noted at this point that the studies by Perovic et al. (2013a; 2013b) had multiple methodological drawbacks. First of all, their PST consisted of pairs of only two pictures, showing two possible interpretations and giving children a 50% chance at a correct answer. This absence of fillers is problematic. Furthermore, the use of a PST is unfitting to answer Perovic et al.'s (2013a; 2013b) research question. A PST only tests which interpretation is preferred by participants. Perovic et al. (2013a; 2013b) did not test if their participants actually allow both interpretations of a given sentence like (4). However, in order to test whether children have a certain linguistic constraint, it is vital to test if multiple interpretations are possible for them. The children need to be put in a position where they can deny the appropriateness of a sentence given an ambiguous situation.

An experimental method that allows participants to be put in this position is the Truth Value Judgement Task (TVJT) (first proposed by Crain & McKee, 1985). The fundamental characteristic of this task is that it requires the child to give a binary (yes/no) judgement about whether target statements provide an accurate description of a particular situation. TVJT's are widely used to test knowledge of constraints, including binding, in TD children (e.g. Baauw, Zuckerman, Ruigendijk & Avrutin, 2011; Spenader et al., 2009; Van Koert et al., 2015; Van Rij et al. 2010). TVJT's are used to test the ASD population as well (e.g. on c-command and binding in High-Functioning children with ASD, Khetrapal & Thornton, 2017; and on scope, Durrleman et al., 2016).

4. The current study

Perovic et al. (2013a; 2013b) cannot exclude either of their possible explanations discussed above, because they did not test the locality constraint on the binding of reflexives. Therefore, the nature of the deficit in the comprehension of reflexives is still unknown. In order to breach this gap in knowledge, the current research proposal proposes methodology to investigate the following question: 'Do children with ALI have knowledge of the locality constraint on the interpretation of reflexives?' The two possible explanations for the Principle A deficit in children with ALI discussed in section 2.3 lead to the following hypotheses regarding sentences like (2), with both a possible local and distant antecedent:

H0: Children with ALI have no locality constraint and lack knowledge of Principle A altogether. This is reflected in high acceptance rates of both distant and local antecedents for reflexives.

H1: Children with ALI do have a locality constraint on the binding of reflexives, and thus have an altered version of Principle A. This is reflected in high acceptance rates of local referents for reflexives and low acceptance rates of distant antecedents for reflexives.

5. Method

5.1 Participants

The current study includes 40 monolingual Dutch speaking children, aged six to twelve. Half of these children have been diagnosed as ALI. The other half are the TD control group. The children with ALI are recruited from schools for special education and treatment centers. They are categorized as 'ALI' based on their diagnosis of language problems, shown by scores below the tenth percentile on language production and perception tests taken during their diagnostic process (following Perovic et al., 2013b). The TD children are recruited from schools and daycares.

5.2 General design and Procedure

The design of the study is a reward/punishment variation of the Truth Value Judgement Task (TVJT). This is in contrast to the design used by Perovic et al. (2013a; 2013b), for the reasons explained in section 3. Target sentences are presented with short stories. These stories are presented by acting them out with toys. After the story a puppet describes the situation that was just acted out. The children are instructed to either reward or punish the puppet if he describes the situation correctly/ incorrectly. The stories are checked for (pragmatic) felicity in a pretest with adults and TD children. The experiment takes place during three sessions, in order not to strain the children. All sessions start with a training phase, in which children are introduced to the task by showing them two practice stories. This is meant to ensure the child understands the task. The order of the stories is semi-randomized in each session; making sure that the child does not hear too many sentences with the same characters and sentence types in a row.

5.3 Experimental materials

5.3.1 Target sentences

Dutch has two reflexive pronouns, *zichzelf* and *zich*. The primary reflexive is *zichzelf*. *Zich* occurs only with inherently reflexive predicates (e.g. *zich schamen*, 'to be ashamed') (Wijnen & Verrips, 1998). There is no gender marking on the Dutch reflexives, as there is in English. To keep the stimuli consistent only *zichzelf* is used in the sentences; since differences in the comprehension of the two reflexives have been found in children, related to verb types (Sigurjónsdóttir & Coopmans, 1996).

The experimental stimuli are eight Dutch sentences with reflexives and a possible distant and local antecedent, as in examples (5) to (7).

(5) Elsa vraagt Sneeuwwitje om zichzelf te schilderen.
Elsa asks Snow White to herself to paint.
'Elsa asks Snow White to paint herself.'

(6) Dora zegt dat Assepoester een broodje voor zichzelf moet smeren.
Dora says that Cinderella a sandwich for herself must butter.
'Dora says that Cinderella has to make herself a sandwich.'

(7) Olaf vraagt Kristoff om zichzelf te wassen.
Olaf asks Kristoff to himself to wash.
'Olaf asks Kristoff to wash himself.'

The reflexive '*zichzelf*' ('herself') in example (5) can be bound by the local antecedent '*Sneeuwwitje*' ('Snow White'), but under the locality constraint of Principle A, the reflexive cannot be bound by the distant antecedent '*Elsa*'. The structure of the sentences is loosely based on a study by Chien & Wexler (1990) in which they tested the locality constraint on the binding of reflexives in TD children, using an act-out task. The Dutch equivalents of three verbs used by Chien & Wexler (1990) are used, '*vragen*'('ask'), '*zeggen*'('say') and '*willen*' ('want'). This way, the stimuli include both finite and infinitival sentences. Additionally, the stimuli are balanced on having an extra object in the story, like in (6).

Ten control sentences are used with a similar structure as the experimental stimuli, but the reflexive is replaced by either an animate or an inanimate object. The sentences are specifically constructed not to contain any of the morpho-syntactic structures that have been found to be problematic for children with ALI (such as raising or object control; see Perovic et al., 2013b). An example of a control sentence is the sentence in (8):

(8) Dora wil dat Ariel de kroon op haar hoofd zet.
Dora wants that Ariel the crown on her head puts.
'Dora wants Ariel to put the crown on her head.'

5.3.2 TVJT Stories

All stories in the TVJT are similar in size and set-up. All eight target sentences described above are accompanied by two stories; one corresponding to an interpretation of the sentence in which the reflexive refers to the local referent (hereafter: local stories) and one corresponding to the interpretation of the sentence in which the reflexive refers to the distant referent (hereafter: distant stories). I will illustrate the story types with sentence (5), repeated here:

(5) Elsa vraagt Sneeuwwitje om zichzelf te schilderen.
Elsa asks Snow White to herself to paint.
'Elsa asks Snow White to paint herself.'

In the local story Elsa asks Snow White to paint herself (Snow White), whereas in the distant story Elsa asks Snow White to paint her (Elsa). These stories containing the experimental target sentences are complemented by stories containing the ten control sentences. Four of these stories show a correct interpretation of the sentence, and the other six clearly deviate from the content of the sentence. This ensures that some of the stories elicit a 'no'-response in the children, regardless of their ability to comprehend reflexives. This way, a possible yes-bias (or no-bias) is controlled for.

The design thus incorporates three different conditions: stories for control sentences (control condition), stories which represent an interpretation in which a reflexive is bound by a local referent (local condition) and stories which represent an interpretation in which a reflexive is bound by a distant referent (distant condition). Apart from in the target sentences, no reflexives are used in the stories, to ensure this will not hamper general understanding of the story.

6. Analyses and anticipated results

The data are analyzed by taking two factors into account; Locality and Group. Locality refers to the type of story (distant or local), and Group refers to the experimental group of children with ALI and the control group of TD children. Within each Group, the mean percentages of correct judgements for both the local, distant and control stories are compared. The Locality means are compared using Mann-Whitney tests[1], to test whether the differences are statistically significant. These comparisons show how accurate Children with ALI and TD children are in their judgements of the target sentences, and, if their ability to judge the sentences correctly differs between sentence type. In the next step, the group means for the ALI Group are compared to that of the TD control Group, to test whether there is a difference in correct judgements between the groups.

What is expected is that if the null hypothesis holds true, there is no locality constraint on the interpretation of reflexives by children with ALI. This is the most

1 The Mann-Whitney test is a non-parametric test, primarily used to compare means of ordinal variables.

likely outcome, as discussed in section 2.3. Remember that, under the locality constraint, all distant stories should elicit a 'no'-response and all local stories should elicit a 'yes'-response. The crucial difference between the two hypotheses will thus be found in the correctness percentages of the stimuli presented with distant stories. To illustrate, I once again use example (5).

(5) Elsa vraagt Sneeuwwitje om zichzelf te schilderen.
Elsa asks Snow White to herself to paint.
'Elsa asks Snow White to paint herself.'

The distant story, where Snow White paints Elsa, has the correct response no. The local story, where Snow White paints herself, has the correct response yes. If children do not have a locality constraint, this means that they will accept distant referents for reflexives as well as local referents. The children will thus have high acceptance rates for both distant and local stories, and a significantly lower correctness score on the distant stories than on the local stories.

If the experimental hypothesis holds true, there is a locality constraint on the interpretation of reflexives in children with ALI. This means that the children with ALI will accept the stimuli presented with local stories significantly more often than those presented with distant stories. Their overall correctness percentages for both categories thus will be high, and there will not be a significant difference between these mean scores. This pattern of results is expected for the TD group as well, as they are expected to have knowledge of the locality constraint. A pretest of the proposed material with three TD children shows that this is indeed the case.

Additionally, individual patterns should be considered to check whether all children with ALI pattern the same and whether they show understanding of the task, or a yes-bias, in the control sentences.

7. Conclusion

This paper proposed research into the comprehension of reflexives in children with ALI. Research by Perovic et al. (2013a; 2013b) indicates that children with ALI have problems understanding reflexive pronouns. However, the extent to which reflexive pronouns are problematic and the cause of these problems remain unknown. The studies by Perovic et al. (2013a; 2013b) only investigated one aspect of the comprehension of reflexives; they must be c-commanded by their antecedents (Chomsky, 1986). A second important constraint, the locality constraint, has not yet been investigated in the ALI population. Moreover, the studies by Perovic et al. (2013a; 2013b) have some methodological drawbacks, resulting from the use of methodology that does not allow testing of possibly ambiguous interpretations.

The proposed research aims to investigate the comprehension of the locality constraint in children with ALI, whilst overcoming the methodological drawbacks of Perovic et al.'s (2013a; 2013b) studies. The proposed research has both clinical

as well as theoretical contributions, providing knowledge on the linguistic symptomatology of children with ALI and indicating which syntactic constraints group together in first language acquisition. ■

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