Issues in the acquisition of binding, control and raising in high-functioning children with autism*

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Abstract

In this study, we test 12 high-functioning children with autism (HFA), aged 12-16, on a picture-selection task assessing comprehension of binding and compare their performance on this construction with that on an already conducted, similarly designed task, testing comprehension of obligatory control (Janke & Perovic, submitted). We compare the children's performance on these two tasks to that of a younger gender- and verbal MA-matched typically developing (TD) group. No difference between the groups' performance was found, with both performing at ceiling on the two tasks. By comparing comprehension of two constructions which share a number of syntactic properties, these results provide further corroboration for the claim in Janke and Perovic (submitted) and Perovic, Modyanova and Wexler (2013a) that certain syntactic dependencies in high-functioning individuals with autism are intact. This contribution is of clinical import, as it provides practitioners with a more precise profile of advanced grammatical abilities. The paper's theoretical significance lies with its division between binding and control on the one hand and raising on the other. While binding and obligatory control pattern together in our sample, research using the same paradigm on a different sample of children, also high-functioning and with an age range of 10-16, show an impaired comprehension of raised structures relative to unraised structures and fillers (Perovic, Modyanova & Wexler, 2007). We hypothesise that the source of this difference lies with the extra degree of complexity in raising that is absent from binding and control: raising involves argument displacement.
Keywords: autism, acquisition, binding, control, raising.

1 Introduction

Linguistic development in Autism Spectrum Disorders (ASD) has only recently started to attract the much needed attention from linguists. A number of studies have now investigated different aspects of sophisticated syntactic, pragmatic and semantic knowledge in ASD, both in English and crosslinguistically (for a review, see, e.g., Durrleman and Zufferey (2009), Janke and Perovic (submitted)). The emerging picture is far from clear however. Pragmatic impairments have continued to be the defining feature of individuals on the autism spectrum, however, even here some traditionally accepted truths have been questioned. For example, contrary to the standard literature which shows impairments in comprehension of figurative language (e.g., Norbury (2005)), methodology that controls for vocabulary knowledge and minimizes the cognitive demands of the interpretation process has revealed successful interpretation of novel metaphors in children with autism, on a par with younger controls (Pouscoulous & Perovic, in preparation). The established view of grammar being relatively intact in autism has also been questioned by new research, though different patterns have been reported in the knowledge of high-functioning children[1] compared to those who are

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[1] High-functioning usually refers to individuals on the spectrum with a non-verbal IQ of at least 70 (e.g., Howlin (2003)), though in studies focusing on language development it is more common to use this term to

more readily described as low functioning. Low-functioning children with autism exhibit wide ranging impairments in both vocabulary and syntax[2], while high-functioning children can show an intact mastery of sophisticated grammatical knowledge, though variation is reported even in this population (Kjelgaard & Tager-Flusberg, 2001). Development of morphosyntax is one area that has been shown to be susceptible to impairment in autism in both early (Bartak, Rutter & Cox, 1975; Bartolucci, Pierce & Streiner, 1980) and more recent studies (Kjelgaard & Tager-Flusberg, 2001). An incomplete, or deficient, mastery of a number of advanced syntactic structures has recently been reported in both children and adults with autism across the spectrum: relative clauses (English: Riches, Charman, Simonoff & Baird, 2010; French: Durrleman & Franck, 2012), wh-questions (French: Zebib, Tuller, Prévost & Morin, 2013), and binding, raising and passives (English: Perovic, Modyanova and Wexler (2007), Perovic, Modyanova and Wexler (2013a, 2013b), where the latter study distinguished between low- and high-functioning children with autism). We are still far away from a theoretical account that might explain the patterns evident in this heterogeneous population, but one way of attempting to make sense of the patterns is to compare comprehension of structures whose interpretative dependencies are determined by the same syntactic regulations, but which also have additional or different properties that distinguish them. We can then examine whether the children's performance on the tasks investigating the relevant structures can be isolated to a particular property.

In this study, we replicate the task on binding, reported in Perovic et al. (2013a, 2013b) on a sample of British English speaking teenagers with autism, who are high-functioning. In a task that uses the same methodology, we then contrast their knowledge of binding with that of obligatory control, a syntactic relation which exhibits many of the properties of anaphoric binding (Koster, 1986; Manzini, 1983; Borer, 1989; Janke 2007, 2008). Here we build on the results on obligatory control from these same children, who were part of a larger sample of children with autism in Janke and Perovic (submitted). Against the backdrop of these two structures we briefly discuss a third construction, raising, which though also syntactically regulated, is derived via A-movement, thereby increasing its complexity and so, too, the burden on the language-learning child. These comparisons show that our participants' performance on binding and obligatory control pattern similarly: the children do not show difficulties interpreting reflexive binding, nor do they show difficulties interpreting obligatory control structures. We compare this result to what is known about this population's problems with raising, namely that the construction does cause interpretative difficulties (Perovic et al., 2007), and consider the reasons for their lower performance on this particular construction. Specifically, although binding, obligatory control and raising are all examples of local syntactic dependencies, only the latter construction involves displacement (contra Hornstein (2001)).

refer to participants whose scores on standardised measures of cognitive functioning are within the 'normal range', i.e., 80 and above (e.g., Norbury (2005)).

[2] It is difficult to disentangle the effects of general cognitive deficits on linguistic skills in the low-functioning population with autism: Boucher (2009) argues that low linguistic skills correlate with low cognitive skills, though most studies report exceptions from this generalisation. In the language development literature, researchers have begun to distinguish between individuals with and without language impairment: following e.g., Tager-Flusberg (2006), many use labels such as *ALI* vs. *ALN*: ALI denotes 'Autism plus Language Impairment', while ALN denotes 'Autism Language Normal'.

2 Binding and Control
2.1Binding and its acquisition

The conditions regulating the interpretation of pronominal elements are set out most clearly in the standard Binding Theory of Chomsky (1981, 1986).[3] Reflexives, governed by the Principle A require local, agreeing and c-commanding antecedents,[4] where in (1a) below, 'himself' must refer to 'dad' and not to 'Bart'.

(1) a. Bart's dad washes himself.
b. Bart's dad washes him.

In contrast, pronouns, governed by Principle B in the same framework, require non-local antecedents, thus 'him' in (1b), cannot refer to 'dad', but only to 'Bart'.

Typically developing (TD) children correctly interpret structures containing reflexive pronouns early, at least by the age of four (Jakubowicz, 1984; Chien & Wexler, 1990). In contrast, they find personal pronouns difficult to interpret even at age six – a phenomenon termed the Delay of Principle B Effect (DPBE) (see Guasti (2002) for a review of a wide range of literature). A well-known explanation (Chien & Wexler, 1990) invokes the different nature of constraints governing the interpretation of reflexives as opposed to personal pronouns, to account for this phenomenon. Reflexives, being subject to syntactic binding, are always interpreted as bound variables. Pronouns, however, have two guises. They can either be interpreted as bound variables, in which case they are subject to syntactic binding, or their interpretation may be guided by coreference, rendering them subject to pragmatic (Chien & Wexler, 1990) or processing (Grodzinsky & Reinhart, 1993) constraints. Syntactic constraints are acquired early, thus children are not expected to show difficulties with the correct interpretation of reflexives (or pronouns, when they are bound variables), but their interpretation of pronouns interpreted extra-syntactically will be vulnerable to failure (though see, e.g., Elbourne (2005) for a different interpretation of the data).

Reflexive binding can be described as a litmus test for a grammatical deficit in a population. Populations not known for severe syntactic impairments, such as individuals with Williams syndrome, exhibit good comprehension of these structures (Ring & Clahsen, 2005; Perovic & Wexler, 2007). In those populations with known morphosyntactic deficits, such as Down syndrome (Perovic, 2001, 2006; Ring & Clahsen, 2005) and low-functioning children with autism, comprehension of structures containing reflexives is often impaired.[5] Thus children classified as ALI in Perovic et al. (2013a), or low-functioning in Perovic et al. (2013b) achieved exceptionally low scores on examples such as (1a), repeatedly choosing a picture of *Bart*, and not Homer, as the antecedent for *himself*.

2.2 Control and its Acquisition

[3] Newer instantiations of Binding Theory do not contradict its central tenets (see Janke and Neeleman (2012)) so for the sake of concreteness we continue to express the syntactic restrictions in the older GB-terminology.

[4] Node A in a phrase-marker c-commands node B if the lowest node that dominates A also dominates B.

[5] There are conflicting reports on the knowledge of reflexive binding in Specific Language Impairment, one of the most well researched language impaired populations: while van der Lely and Stollwerck (1997) reported difficulties with binding overall, more recent studies show no particular problems with reflexive binding, but persisting difficulties with the interpretation of personal pronouns (Novogrodsky & Friedmann, 2010; Perovic, Modyanova & Wexler, 2012).

Like reflexives, the null subject in obligatory control structures also requires a local and c-commanding antecedent, where in (2a), 'Homer' and not 'Bart' is the purported dog walker, and in (2b) 'Bart's dad' and not 'Bart' is:

(2) a. Bart persuaded Homer$_i$ [Θ_i to walk the dog].[6] DOUBLE-COMPLEMENT OBJECT CONTROL
b. Bart's dad$_i$ tried to [Θ_i to walk the dog]. SINGLE-COMPLEMENT SUBJECT CONTROL

For neither reflexives nor obligatory control is it possible to force a discourse referent, a resilience that places their regulation firmly within the grammar (see Janke (in prep.)). In (3a) and (3b), despite the preceding context, the reflexive and null subject must still refer to 'Homer'.

(3) a. Bart desperately wanted a wash. Bart got into the bath. Bart said that Homer$_i$ washed himself$_i$
b. Bart desperately wanted a walk. Bart took out the dog lead. Bart persuaded Homer$_i$ [Θ_i to walk the dog].

In typical development, single-complement subject control and double-complement object control are found in the production of children as young as three, yet chance performance on object control, where children opt for either a subject or an object reading, has been found at age five (Tavakolian, 1978). Eisenberg and Cairns (1994) noted that children up to the age of five would still accept a sentence-external referent for an obligatorily controlled null subject if it had been mentioned in the preceding discourse. This was more likely in a single-complement structure (4a) than in double-complement structure (4b).

(4) a. Grover decides [to pat Big Bird].
b. Big Bird tells Ernie [to jump over the fence].

The slightly diverging developmental rates between reflexives and obligatorily controlled null subjects make sense if we also pay attention to their differences. A reflexive is always a direct argument of a transitive verb and is strictly anaphoric in the sense that we saw in (1b). Once the child has grasped these structural requirements, interpretation is predictable. This is not so for null subjects, which form part of a wider set of null elements with differing properties. They can be obligatory, in which case they are syntactically regulated and their antecedent is the matrix subject (e.g., *try*) or the matrix object (e.g., *persuade*), but they can also be 'non-obligatory', in which case their reference can be discourse-determined, as in (5a) or arbitrary as in (5b).

(5) a. A. The headmaster phoned .
B. What did he say?
A. He said [Θ_i to introduce yourself$_i$ to the class before he arrives]
b. A. Did you lock your door?
B. Oh, I've nothing [Θ_{arb} to steal].

[6] In Janke (2007), the control relation is represented without PRO. Although there is no PRO, the subject properties of controlled clauses are retained by a path created by the external theta-role introduced by the infinitive verb. The details do not affect our argumentation here, but we follow this work by representing the null subject with this (unassigned) role.

Note that whereas the null subject in obligatory control structures is set, and thus impervious to pragmatic manipulation, this is not so for a non-obligatory controlled null subject whose reference can be switched, given sufficient cues in the preceding discourse. In (6a) below, most speakers (Janke, in prep.) prefer a local (object) reading of the null subject in the infinitival, although there is some variability in preferences.
In (6b), however, the preceding sentences favour a long-distance reading in which the null subject's interpretation is linked to the matrix subject:

(6) a. Peter$_1$ said to John$_2$ that [$\Theta_{1/2/3}$ baking the cake quickly was a big mistake].
b. Peter$_1$ was having a party. He decided that as he was the host, he should prepare all of the food himself that day. Later, Peter1 said to John2 that [Θ1 baking the cake quickly was a big mistake].

The greater number of interpretative possibilities in control point to a more complex learning task. But once the child recognises an obligatory control verb, the pattern of the antecedent-dependent relation is also predictable. On the basis of what is known then in typical development, we expect TD children compared on reflexive binding and obligatory control to exhibit a similar timing in development, although where a difference between the two is observed, we expect the order of mastery to be 'reflexives < obligatory control', not 'obligatory control < reflexives'.

To our knowledge, aside from Janke and Perovic (submitted), there are no published studies on the acquisition of control in any of the atypically developing populations.

2.3 Raising and its acquisition

At this point it is worth noting the trajectory of another syntactically regulated construction, which arguably is still more complex, namely raising. A raised construction involves argument displacement, where the subject of the embedded clause moves to the subject position of the main clause as in (7).

(7) [Homer$_i$ seems to Marge[t_i to be driving a car]].

This is one of the latest constructions to be mastered in TD. It is not until about the age of nine or ten that children's responses on raising tasks are robust (Hirsch & Wexler, 2007), a fact which is unsurprising, in light of its greater complexity (but see Hornstein, 2001, for the claim that obligatory control can be reduced to move). Given its later development in typical children, we might expect it to be problematic in atypical development, and research conducted thus far suggests that this is so. Perovic et al. (2007) found that the raised construction in (7) posed greater difficulties than its non-raised counterpart in (8) in children with autism aged six to sixteen, where no such movement operation has occurred.

(8) It seems to Marge that Homer is driving the car.

In relation to the current report, the literature gathered thus far on raising is important. If the operations underlying obligatory control are a different set from those that regulate raising, in not involving A-movement (Brody, 1999, 2000), we expect our current population's performance on obligatory control to pattern far nearer to binding than raising. That is, for this task, we do not expect to find children succeeding with binding yet failing absolutely with obligatory control. This would be predicted if obligatory control reduced to NP-

movement: the time gap between the mastery of reflexive binding and that of obligatory control should be huge (a gap of at least five years in typical development) as it is in raising.

The impetus for this study is twofold. In an effort to build a more complete picture of syntactic abilities in autistic children functioning at a higher level, we would like to see if the same children who succeed on reflexive binding also succeed with obligatory control. An affirmative result will substantiate our claim that certain syntactic dependencies are intact: the children understand the obligatory, structurally local relation between an antecedent and its dependent, be that dependent an overt reflexive or a null subject. Further, if high-functioning children's performance on binding and control is significantly better than what is known for this population's performance on raising, we are a step nearer to isolating the component that causes problems in some areas of complex syntax: like binding and control, raising involves an obligatory, structurally local relation between its antecedent and dependent, but unlike binding and control, it involves movement. If the theoretical distinctions supported here between binding and control on the one hand, and raising on the other, are valid, we expect visible repercussions in the performance of children with autism.

3 Experiment

3.1 Participants

Thirteen children[7] with a confirmed clinical diagnosis of ASD (APA, 2000) were recruited as a part of a bigger experiment on obligatory and non-obligatory control. Their age ranged from 12-16;4, *M*=14;3 (SD=1;4) (see Table 1 for scores on standardised measures of language and cognitive abilities). They were all monolingual speakers of British English and attended the same specialist secondary school for children with ASD in Kent, UK. On the basis of their scoring 80 or above on the Matrices subtest of Kaufman Brief Intelligence Test (KBIT) assessing non-verbal intelligence, all the children in the sample are classified as high-functioning. One 13-year-old boy, whose performance on binding is reported here, did not complete the control task or any of the standardised tasks, due to inattention. On the basis of his school grades and teachers' reports, he was classified as high functioning.

For the majority of the children, their performance on receptive language, as measured by Test of Receptive Grammar 2 (TROG-2) and British Picture Vocabulary Scales II (BPVS II), also places them in a relatively high-functioning end of the spectrum: the standard scores on these language measures were all above 80 for nine children.[8] Eleven of the thirteen children are the same children whose performance on control is reported in Janke and Perovic (submitted).

Typical controls, all monolingual speakers of British English, were chosen from a larger pool of participants recruited from two schools in greater London. Ten boys and one girl, aged 5;8-15, *M*=10;3 (SD=2.6) were matched to the children with autism on BPVS raw scores.

HFA **TD**

[7] One girl, aged 14;2, completed only one standardised task in the battery due to repeated absences from testing sessions and was thus excluded from the sample.

[8] Two children in the sample can be classified as ALI, following the terminology of Tager-Flusberg (2006) or Perovic et al. (2013a) discussed earlier. Their standard scores on the measure of language were clearly in the impaired range: one of these boys scored 54 on BPVS, 78 on TROG but 82 on KBIT, while the other scored 47 on BPVS, 55 on TROG and 89 on KBIT. Due to the small sample of participants, it was not possible to divide the children into ALI vs. ALN, thus the high-functioning autism label, as referring to non-verbal cognitive functioning, is used.

	***n*=12**	***n*=11**[9]
Chronological Age in Years (SD)	14;3 (1.4)	10;3 (2.6)
Range	12;0-16;4	5;8-15
BPVS-II Standard Scores (SD)	85.36 (19.75)	110.09 (10.97)
Range	47-111	99-139
BPVS-II Raw Scores (SD)	**109.36** (20.47)	**108.73** (19.91)
Range	68-137	70-138
KBIT Matrices Standard Scores (SD)	103.95 (15.64)	
Range	80-144	
KBIT Matrices Raw Scores (SD)	32.59 (7.48)	
Range	18-48	
TROG 2 Raw Scores (SD)	102.91 (26.23)	
Range	53-149	
TROG 2 Standard Scores (SD)	102.91 (26.23)	
Range	53-149	

Table 1: Participants' ages and mean scores (standard deviations) on standardised tests of language and cognition. The measure on which the groups were matched is in bold. BPVS-II: British Picture Vocabulary Scales, 2nd edition. KBIT: Kaufman Brief Intelligence Test. TROG 2: Test for Reception of Grammar, 2nd edition.

3.2 Method

2.2.1 Binding. The binding task was identical to that used in Perovic et al. (2013a, 2013b) and Perovic and Wexler (2007). It was presented on a laptop computer, where the child was shown two pictures, and asked to point to the picture that 'goes best' with the sentence uttered by the experimenter. The pictures employed characters from the Simpson family engaged in actions described by four verbs: *wash*, *touch*, *point to* and *dress* (the verbs were selected following Wexler and Chien (1985)). Each verb was used twice in the four conditions: Name Pronoun (NP), Name Reflexive (NR), Control Possessive (CP) and Control Name (CN). The experimental conditions involved a possessive subject, e.g., Bart's dad, in the subject position, and either a pronoun or a reflexive in the object position: '*Bart's dad is pointing to him*' (NP) vs. '*Bart's dad is pointing to himself*'(NR). Possessive subjects were used in order to provide two potential antecedents for the pronoun/reflexive: Bart's dad (Homer), which c-commands the pronoun/reflexive, and Bart, the possessor, which does not c-command it. The control condition CP contained a possessive subject but no pronouns or reflexives in the object position. This controlled for c-command independently of binding: '*Bart's dad is pointing to Bart*' (CP). The control condition CN included only proper names in subject and object positions: '*Bart is pointing to dad*' (CN).

The task was preceded by a trial session where participants were familiarized with each character and shown the 4 actions described by the verb. Item presentation was randomized automatically, and location of the correct picture was balanced throughout (left or right) (see Perovic et al, (2013a, 2013b), for more details about the procedure).

[9] No match could be used for the one child from the autism group who failed to complete the standardised tests.

2.2.2 Control. The control experiment also employed a picture-selection task, very close in format to the binding task. It included a number of test items in addition to the two control types we have used for comparisons here (e.g., adjunct control and *promise*) but here we recount only the procedure for single-complement subject control (e.g., *try*) and double-complement object control (e.g., *persuade*) (please see Janke and Perovic (submitted) for more details of the task and procedure).

The single-complement subject-control condition (*try*) used four examples depicting the main-clause subject performing an action on an inanimate object, while another unmentioned character stood by, and four examples depicting the main-clause subject performing an action on the animate object of the infinitival clause. So '*Bart tried to eat the sandwich*' was accompanied by a corresponding picture in which Bart was engaged in sandwich-eating with Lisa standing next to him, and a foil in which Lisa was eating the sandwich and Bart stood by. This tested whether the child would ever choose a visually depicted unmentioned referent as the agent of 'eat' (Lisa) over a visually depicted sentence-internal referent. The picture accompanying the sentence '*Homer tried to wash Bart*' showed Homer washing Bart, and a foil in which Bart was washing Homer. This provided the child with an opportunity of choosing an incorrect referent on the basis of a 'last-heard referent' strategy. The double-complement object-control condition (persuade) depicted the matrix object engaged in an action, while the matrix subject stood near. The foil showed the matrix subject engaging in the action. For '*Homer persuaded Marge to drive the car*', the corresponding picture depicted Marge in the car, with Homer standing next to it, whereas in the foil, Homer was in the car, with Marge standing by (see Janke and Perovic (submitted) for the complete list of sentences used). A filler condition with a simple SVO structure, was also included. Each sentence type included 8 items. Prior to the trial, the children sat a vocabulary pre-test in order to check their understanding of the verbs independently of control. As with the binding task, the children were shown two pictures involving the Simpson family characters on a laptop and asked to choose the picture that best matched the sentence they heard.

3.3 Results

The data were analysed using the generalised linear mixed model (GLMM) function with a logit link in SPSS 20, a model suitable for our binary outcome variable which involved repeated measures for each participant in the two groups (Jaeger, 2008; Quene & van den Bergh, 2008). The fixed effects built into the model were Group, Sentence Type, and Group*Sentence Type interaction. Two separate analyses were carried out for the two tasks.

2.3.1 Results on binding. The model revealed no significant effect of Group ($F(1, 3)=0.096$, $p=.757$), just about significant effect of Sentence Type ($F(1, 3)=2.732$, $p=.049$), and no significant Group*Sentence Type interaction, $F(1, 3) = 0.149$, $p=.930$. Estimated mean probabilities correct and standard error are given for each sentence type on the binding task are given in Table 2.

Sentence Type	**HFA**		**TD**	
	Mean	***SE***	***Mean***	***SE***
NP	0.92	(0.05)	0.93	(0.04)
NR	0.98	(0.02)	0.98	(0.02)
CP	0.99	(0.01)	0.99	(0.01)
CN	0.99	(0.01)	0.98	(0.02)

Table 2. Results on the binding task. CP- Control Possessive, CN – Control Name, NP - Name Pronoun, NR – Name Reflexive. HFA: children with high functioning autism; TD – typically developing control children; SE: Standard Error.

A look at individual data reveals consistently high performance for children in both groups, across the four sentence types. In the autism group, all the children performed at ceiling on CN and CP, with a maximum performance of 8 out of 8 correct (one child scored almost at ceiling, with 7 out of 8 correct). A ceiling performance was also observed on the NR condition: 11 of the 12 children scored 8 out of 8 correct, while only one child scored 6 out of 8. On the NP condition, two children performed at chance: 5 out of 8 correct, and 4 out of 8 correct. TD controls showed a parallel performance: On CP, CN, and NR 9 out of 11 children scored 8 out of 8 correct, and two children scored 7 out of 8. On the NP condition, 3 children scored less than 8 out of 8 correct: 7, 6 and 5 correct.

2.3.2 Results on obligatory control. The analysis of the obligatory control results revealed no significant effects or interactions: Group ($F(1, 2)=0.366$, $p=.547$), Sentence Type ($F(1, 2)=0.470$, $p=.627$), Group*Sentence Type interaction, $F(1, 2) = 0.098$, $p=.906$. Estimated mean probabilities correct and standard error are given in Table 3.

Sentence Type	**HFA**		**TD**	
	Mean	***SE***	***Mean***	***SE***
obj_PERS	0.97	(0.03)	0.97	(0.03)
sub_TRY	0.99	(0.01)	0.98	(0.02)
Filler SVO	0.99	(0.01)	0.98	(0.02)

Table 3. Results on the control task. Obj_PERS: Object control 'persuade', sub_TRY: subject control 'try'. HFA: children with high functioning autism; TD – typically developing control children; SE: Standard Error.

In this task, as in the previous task on binding, a ceiling performance is observed in both the autism group and TD group on reflexives. Individual data for the autism group show that on the filler SVO condition, all the children scored 8 out of 8 correct. On the *try* sentences, one child scored 7 out of 8 correct, where the remaining children scored the maximum 8. On the *persuade* sentences, one child scored 6 out of 8 correct, one child scored 7 out of 8 correct, and the remaining children scored the maximum, 8. Similarly, all but one TD child scored 8 out 8 correct on the SVO condition, who scored 6 out of 8 correct. The same child also scored 5 out of 8 correct on *persuade*, and 7 out of 8 correct on *try*. The remaining children scored 8 out of 8 on *persuade* and *try*, with one child scoring 7 out 8 on *try*.

4 Discussion

Our study compared binding and obligatory control in a British sample of high-functioning children with autism. The children, all boys aged 12-16, showed an excellent performance on all experimental conditions. In line with the American high-functioning children of Perovic et al. (2013a), who showed no issues with reflexive binding, our English participants, all achieved a ceiling performance on this identical task. At the same time, two of our twelve children gave a chance performance on coreference, once again supporting results of Perovic et al. (2013a), whose ALN group showed a ceiling performance on the NR condition, but struggled on the NP one.

As reported in Janke and Perovic (submitted), the same children performed excellently on obligatory control. This was so for single-complement subject control and double-

complement object control. The parallel performance found with this population on reflexives and obligatory control patterns with our expectations. Reflexives, being the direct arguments of transitive verbs, form a homogeneous set, requiring a local, c-commanding antecedent. The null subjects of obligatory control share these structural restrictions, but the child has also to determine whether or not a verb selects an obligatorily controlled complement. The set of null elements in non-finite clauses also includes those that are non-obligatorily controlled, which as we saw in (6), receive a value from outside of the syntax. On the basis of these similarities and distinctions, we did not expect to find a child who had succeeded on control to fail on binding, although we did not rule out the possibility of the alternative order occurring, namely binding < obligatory control. The children's results bore this out, but to strengthen this point, similar testing on a younger sample is essential.

A comparison of our results on binding and control described here with those of Perovic et al. (2007) on raising is also suggestive. All the children with ASD in that study, including those who were high-functioning aged ten to sixteen (*M*=15), performed significantly worse on raised (example in 7 above) than they did on the unraised sentences (example in 8 above) or filler sentences ('Marge thinks that Homer is driving a car'), which were at ceiling. Recall that raising is acquired late in TD, where children only demonstrate complete knowledge by nine to ten years of age. This group of children, then, demonstrate an impaired performance relative to TD. But most interesting for our purposes is that children with ASD in one group are performing excellently on binding and control, whereas children with ASD in another group are performing poorly on raising. The children in both groups were of a similar age range, and the tasks all employ the picture selection method. This speaks not only to the question of whether children with ASD are following a similar trajectory as TD but also to the issue of whether the theoretical divide supported here between control and binding on the one hand, and raising on the other, is reflected in children's success with the constructions. We believe this is a possibility worth pursuing further by testing all three constructions on the same group of children. Further, we suggest that it is the displacement/move operation of raising, which suffices to cause the child difficulty. That is, it is not only long-distance operator movement (such as seen with object-relatives and wh-questions, reported in Riches et al. (2010), Zebib et al. (2013)) that are problematic but operations involving A-movement, too.[10]

Considering that the ASD population is known for its heterogeneity in both cognitive and language functioning, the homogeneity in children's responses is quite striking. Our attempt to make the sample as close in age and cognitive functioning, in addition to their identical school environment (recall that these were all students at the same school specialised for children with ASD), could be relevant here. However, there were two children (aged 14 and 16) who showed a chance performance on the experimental condition testing comprehension of personal pronouns. Variation in responses to this sentence type was also observed in the TD group, though these children were younger: a 5-year & 8-months'-old child scored just above chance on NP, at 6 out of 8 correct, and a 10-year-old scored 5 out of 8 correct.

Children with autism are known to be deficient in their interpretation of pronouns, however, it is not clear whether this is a full-blown 'Delay of Principle B Effect' in the two participants in our autism group or the further two in our TD group. If we consider the explanation proposed in the literature for TD cases, which is that pronoun interpretation difficulties stem from an inability to implement constraints that rule out illicit coreference

[10] Interestingly, in both Williams syndrome and ASD, there are also indications that another example of A-movement is problematic, namely the passive construction. The same sample succeeded in binding (see Perovic & Wexler; 2007; 2010 for WS, and Perovic et al 2012 for ASD).

(which are, according to Chien and Wexler (1990), pragmatic in nature), a stronger variant of 'DPBE' in a population known for pervasive pragmatic impairments is unsurprising. In relation to this, it is worth keeping in mind that the patterns observed in our sample with autism are comparable to those observed in younger TD children – thus there is nothing that appears 'deviant' or particularly 'deficient' – the pattern is the same, but the rate of development may not be.

However, if we adopt this tack, how do we explain the other ten children's *good* performance on the NP condition? If this majority have successfully ruled out illicit coreference, then we cannot appeal to that crucial diagnostic of people on the autism spectrum - namely an overarching general pragmatic deficit - for the poor performance on the NP condition by the previously discussed two children in our ASD group. Note that problems in ruling out illicit coreference are also reported in other populations, such as Williams syndrome and in SLI (see Perovic et al. (2013a) for a review). It may be useful to follow the line of argumentation outlined in Perovic et al. (2013), itself based on Schaeffer (2003), that 'the pragmatics that relates to social rules may be differentially affected in children than the pragmatics that relates more directly to language, the pragmatics, for example, that is part of the governing conditions for reference' (p. 149).

Within linguistic research, the term pragmatics is reserved for those skills that relate directly to the interpretation of linguistic material in contextually driven circumstances, rather than to turn-taking in conversation, for example, which is often the case in the clinical literature on ASD. A further division is made between primary and secondary pragmatics (see Carston (2002), Recanati (2007)), where primary pragmatics relates to the way in which literal interpretations of linguistic encodings are arrived at on the basis of contextual cues, and secondary pragmatics to inferences used to derive a figurative meaning from a literal source. An example of the former would be referent choice, and an example of the latter would be metaphor interpretation. Future research that would feed into the question left open here is the extent to which primary pragmatics is affected in high-functioning autistic individuals (see Janke and Perovic (in prep.)).

To conclude, the present study confirms that certain syntactic dependencies are intact in HFA: our participants demonstrated mastery of the obligatory, structurally local relation between antecedents and their dependents. This was so for both overt and null variants, namely reflexives and infinitival null subjects respectively. The comparison of these two relations builds a more complete picture of syntactic abilities in children with autism functioning at a higher level, a result of import to a readership motivated by clinical concerns. It also provides provisional (same-sample testing is crucial) empirical support for the theoretical distinction drawn between binding and control on the one hand, and raising on the other. This is not to conflate reflexive binding and obligatory control absolutely (see Lasnik (1992) for example, although Janke (2007) responds to these concerns), but the tasks employed here do distinguish between these relations, and the results corroborate this initial divide. This allows us to make testable predictions as to whether other constructions involving local A-movement will also be problematic in this population, which will enable further distinctions to be drawn between A- and A-bar related dependencies, as well their local and non-local instantiations, in this population.

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