

Comprehension of Relative Clauses vs. Control Structures in SLI and ASD Children

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1. Introduction

In this paper we investigate the comprehension of relative clauses and control structures in children diagnosed with Specific Language Impairment (SLI) and children diagnosed with Autism Spectrum Disorders (ASD). Several studies have explored a syntactic deficit in SLI children, and particularly a deficit in comprehension and production of object relative clauses (Friedmann & Novogrodsky, 2004; Novogrodsky & Friedmann, 2006; a.o.), a case in which an intervention effect is created as a result of A-bar moving an object DP which crosses a subject. However, less is known about the performance of SLI children in the comprehension of control structures which may also correspond to a configuration justifying an intervention effect, if control is analysed as A-movement (see Hornstein, 1999). This is the case of subject control with *promise*-type verbs.

In addition, some recent studies suggested similarities between SLI and ASD children in the comprehension and production of relative clauses, but very few recent studies have looked at the performance of ASD children in the case of control structures (Perovic & Janke, 2013 and Janke & Perovic, 2015 are exceptions).

In this paper, our aim is twofold: we add to our knowledge of linguistic impairment in SLI and ASD children, by comparing the performance of the two groups in the comprehension of relatives and control structures; we use this comparison to contribute to the discussion concerning the nature of control structures.

1.1. SLI & ASD: syntactic impairment, differences and similarities

The term SLI refers to a condition characterized by language difficulties in the absence of a clinical condition that might explain the atypical pattern of language acquisition. For this reason, SLI is defined excluding neurological or

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sensorial deficits, with results in terms of non-verbal IQ above 85 (Leonard, 1998). In contrast, according to DSM-V (American Psychiatric Association, 2013), ASD is a condition whose symptoms are present in the early developmental period, and it is characterized by deficits in social interaction and communication, associated with a pattern of restricted interests and repetitive behaviour.

There is now a large set of studies exploring the performance of SLI children in the production and comprehension of different syntactic structures and justifying the identification of a particular subset of children suffering from Syntactic SLI (SY-SLI). Studies centred on this subgroup of children describe prolonged difficulties with structures involving A'-movement, such as relatives (Novogrodsky & Friedmann, 2006) and *wh*-questions (Friedmann & Novogrodsky, 2011). Particular problems with object relatives and object *wh*-questions are explained as the result of intervention effects (Friedmann & Novogrodsky, 2008; for European Portuguese, see Costa, Lobo, Silva & Ferreira, 2009). In addition, SLI has been associated to difficulties in other structures with noncanonical word order, which involve A-movement, namely passives (Van der Lely, 1996).

On the other hand, and regardless of the fact that language impairment is not considered central to the characterization of ASD and not encompassed in the diagnostic criteria, only a small fraction of children with ASD exhibit a history exempted from any reference to language disabilities (Tager-Flusberg, Paul, & Lord, 2005). This fact assumes even a higher importance since disorders in the process of language acquisition are often the first forewarning signs for parents of children later diagnosed with ASD that suggest the possibility of some noncompliance with the normal course of development (Kurita, 1985; Short & Schopler, 1988; De Giacomo & Fombonne, 1998).

For several years, the literature focused mainly in pragmatic deficits, considered central in the ASD language profile. Consequently, the formal grammatical aspects of language were disregarded. Nevertheless, problems with some grammatical structures were recently identified in the ASD population. So, different studies suggest problems with relatives (Riches, Loucas, Baird, Charman, & Simonoff, 2010), passives (Durrleman, Delage, Tuller, & Prévost, 2016) and raising (Perovic & Janke, 2013), thus emphasising handicaps also in formal aspects of language, such as syntax, and specially suggesting problems in structures involving A-bar and A-movement.

A particular set of studies aimed directly at comparing the linguistic performance of SLI and ASD groups. Some studies suggested similarities in the linguistic profiles of children diagnosed with SLI and of certain children diagnosed with ASD, justifying the interest in comparing these two populations (Leyfer et al., 2008; Ruser et al., 2007; Bishop, 2010). Tager-Flusberg & Joseph (2003) identified performances in formal language tests in children with ASD that resemble the performance of SLI children, namely deficits in non-word repetition and tense marking. However, other studies revealed lower performances in SLI children, thus undermining the idea of shared genetics argued for in previous

studies (Whitehouse, Barry, & Bishop, 2008). Despite similar language global scores, it seems that SLI children obtain lower scores in the repetition of long nonwords, whereas the errors made by children with ASD were scattered, regardless of the number of syllables of the word (Whitehouse, Barry, & Bishop, 2008). Also in the production of wh-questions, a structure involving A-bar movement and thus directly related to the present study, ASD children differed from SLI children in terms of error types. The former produced more inappropriate questions, which are attributed to a pragmatic deficit, a core characteristic of ASD (Tuller, Prevost, Morin, & Zebib, 2011). However, the same study highlights the fact that, like SLI children, ASD children also tend to avoid structures with higher levels of complexity.

These results should draw our attention to the nature of a possible syntactic impairment in ASD children, co-occurring with the well-known pragmatic deficit, and should justify further comparison of the two populations, particularly in areas already identified as possible markers of linguistic impairment.

1.2. Acquisition of relative clauses and control clauses

Certain relative clauses are included among late acquired syntactic structures (Friedmann & Novogrodsky, 2004; see Costa, Lobo, Silva, & Ferreira, 2009 for the case of European Portuguese). In particular, an asymmetry between subject and object relatives has been widely described in literature, and in the case of linguistically impaired populations, these difficulties are described as persistent over time. According to Friedmann, Belletti, & Rizzi (2009), the crucial difference between subject and object relatives lies in the fact that only object relatives may involve a dependency in which a lexically restricted DP (in italics in (1b)) intervenes between the moved operator and its extraction site (see (1)).

- (1) a. Subject relative: This is the boy_i that ____i hugs the monkey
 b. Object relative: This is the boy_i that *the monkey* hugs ____i

Therefore, greater difficulties with structures in which an object is A-bar extracted have been explained as a result of an intervention effect. This hypothesis provides an explanation for prolonged and specific difficulties revealed by SLI children in the comprehension and production of object relatives, in different languages, including European Portuguese (EP) (Costa, Lobo, Silva, & Ferreira, 2009). More recently, this asymmetry has been reported also in ASD children (Durrleman, Marinis, & Franck, 2016), thus justifying the debate on the relevance of intervention effects to explain prolonged difficulties with relatives in other cases of atypical acquisition.

However, if difficulties with object relatives are after all not a mere result of a generalized difficulty with structures involving A-bar movement, and if the problem is intervention, we would expect the following:

- (i) Only some relatives should be a source of difficulties, prolonged in the case of atypical development;
- (ii) In other structures, where intervention can be argued to be also at stake, similar effects should be expected.

Moreover, if these difficulties can be generalized to any type of movement, then it makes sense to investigate whether this pattern occurs in structures involving A-movement.

This topic is of particular relevance, given the movement theory of control (Hornstein, 1999). Indeed, if control involves A-movement, we could expect problems with control structures involving an intervening DP, similar to the ones we find in object relatives (see also Belletti & Rizzi, 2013 on this topic). Subject control with ditransitive verbs, namely *promise*-type verbs is precisely such a case (see 2a): in this type of structure, the object (*Peter* in 2a) intervenes between the controller (the subject of the superordinate clause) and the controlled embedded subject. This contrasts with object control (2b), a type of structure where no DP intervenes between the controller and the embedded controlled subject.

- (2) a. John_i promised *Peter* [_i to cook dinner].
- b. John told *Peter*_i [_i to cook dinner].

A difficulty in control with *promise*, corresponding to a general preference for object control, was already identified by C. Chomsky (1969) in typically developing (TD) children acquiring English. In the case of EP, Agostinho (2014) also describes non-adult interpretations of control with *prometer* “promise” in TD children. Even at the age of 5 years, these children misanalysed subject control with an intervening DP, proving that this syntactic structure stabilizes late.

However, the acquisition of control structures in populations with atypical development is still underexplored. An exception is Janke & Perovic (2015), a study aiming at contrasting ASD children’s performance in control and binding with their performance in passives and raising. The authors found good performance in control structures in general, except for double-complement subject control (the case of *promise*). The authors attribute this result to the exceptional status of control with *promise*, without further discussion.

Extending the hypothesis of Orfitelli (2012) concerning the possibility of intervention effects in structures involving A-Movement, we will discuss in this paper whether problems with subject control across an intervening DP are of the same nature of problems with object relatives. If it is the case, we expect to find parallel difficulties with object relatives and subject control with *promise*-type verbs in the same groups of linguistically impaired children. We will specifically compare the performance of children diagnosed with SLI and (high-functioning) children with a diagnosis of ASD, adding to the discussion concerning the comparability of linguistic impairment in the two populations.

2. The Study

2.1. Research Questions

Driven by the results obtained in the aforementioned studies, we aim at answering the following research questions:

- (i) Which similarities and differences can be found between ASD children, SLI children and TD in what concerns comprehension of object relatives and subject control with an intervening DP?
- (ii) What does (i) tell us about the nature of ASD and SLI?
- (iii) What does (i) tell us about the nature of control (namely, with respect to the movement theory of control)?

2.2. Participants

The participants in this study were 80 TD European Portuguese monolingual children, who were recruited from kindergartens and primary schools. All the TD children in the study meet the following inclusion criteria: absence of hearing, neurological or cognitive impairment and no diagnoses or history of abnormal language development. In order to confirm the absence of any syntactic impairment, all the children in the TD groups were evaluated with the *Schlichting Test for Sentence Development – PT* (Vieira, 2011) and performed at age level or, in the case of older children, at ceiling. Children in the control group were divided into four different groups according to age (see Table 1 below). The older TD group matched in age the two experimental groups (SLI and ASD).

The children in the SLI group were independently diagnosed by speech therapists and meet the exclusion criteria for the condition. In addition, all the SLI children were tested with the *Schlichting Test for Sentence Development – PT* (Vieira, 2011) and only those for whom a syntactic impairment was confirmed were included in the study. SLI children included in the group performed at the same level as TD children between 4.0-4.5, at percentile 50¹.

As for the children in the ASD group, they were all diagnosed by independent qualified clinicians according to the established criteria described in the DSM – IV TR (American Psychiatric Association, 1994). Additionally, the diagnoses were confirmed by the Autism Diagnostic Interview–Revised (ADI-R) (Lord, Rutter, & LeCouteur, 1994) or the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000). Similarly to SLI children, also the children in the ASD group were tested with the *Schlichting test for sentence development – PT* (Vieira, 2011) and, in this case, children scored at the same level as TD children between 5.0-5.5, at percentile 50. Taking these results into consideration, we can safely say that all the children in the ASD Group can be considered as cases of

¹ The *Schlichting Test for Sentence Development – PT* (Vieira, 2011) is the only standardized test for pre-school population that allows specific syntax assessment. Since no similar standardized test is available for school age children, we used this test and compared older children with TD children at percentile 50.

Autism plus Language Impairment (ALI) (Tager-Flusberg, 2006). The details of each group are summarized in Table 1.

Table 1. Participants

Group 1	Group 2	Group 3	Group 4	SLI Group	ASD Group
3 years old Mean= 3;7	4 years old Mean= 4;5	5-7 years old Mean= 5;11	8-11 years old Mean 9;4	8-11 years old Mean= 9;0	8-11 years old Mean= 9;6
N= 15	N= 11	N= 24	N=30	N=11	N=11

2.3. Method

Two comprehension tasks were designed to provide answers to our research questions, an act-out task and a reference judgment task. Four conditions were tested in each task: subject and object relative clauses (SR and OR, respectively); subject and object control (SC and OC, respectively) in structures containing verbs with two internal arguments.

In the case of subject and object relative clauses, the crucial difference between the two types of relatives tested relies on the fact that only object relatives involve a configuration in which a constituent intervenes between the moved operator and its original position (see (3a) for an EP subject relative and (3b) for an EP object relative, in this case with the intervening DP in *italics*).

- (3) a. Este é o cavalo_i [que _i lambeu o cão].
 this is the horse_i [that _i licked the dog]
 ‘This is the horse that licked the dog.’
- b. Este é o porco_i [que o cão lambeu _i].
 this is the pig_i [that the dog licked _i]
 ‘This is the pig that the dog licked.’

Regarding the case of control structures, the matrix verbs which were used were the directive *dizer para* “tell to” (4a) in the case of object control and *prometer* “promise” (4b) as a subject control verb. Paralleling object relatives, only in the subject control structure a DP (in *italics* in (4b)) intervenes between the controller, the subject of the superordinate clause, and the controlled embedded subject.

- (4) a. O porco disse [ao cavalo_i] [para _i saltar].
 the pig told the horse_i [PREP _i to jump]

- b. O porco_i prometeu [ao cavalo] [____i saltar].
 the pig_i promised the horse [____i to jump].

In what follows, a more detailed explanation of each task is presented.

2.3.1. Act-out Task

The act-out task was often used to test relatives, and involves a play situation in which a child manipulates toys according to sentences presented by the experimenter. In order to act-out the sentences, the children were given several toys. In the case of relative clauses, the relative antecedent always corresponds to two toys of the same type (e.g. two horses in Figure 1), in order to meet the felicity conditions for acting-out a relative clause. Hamburger & Crain, 1982 argued that children's performance improved when the felicity conditions for the use of relatives were met).



Figure 1 - Set of objects for acting out a relative clause

2.3.2. Judgment task

In this task, the experimenter asks the children to give an explicit judgment of the sentence concerning reference of the embedded subject. This is a task initially designed for control structures (McDaniel & Cairns, 1990), which we extend to testing relatives. In the case of this task, the experimenter asked the children about restrictions on reference, questioning them about their interpretation of the relative clause or the controlled subject. See below the examples for sentences in (3) and (4).

For (3a) or (3b) “Who licked?”

For (4a) and (4b) “Who is going to jump?”

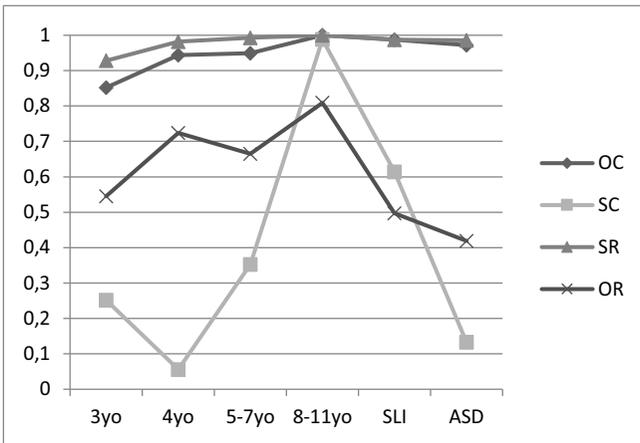
3. Results

In this section we present the results obtained in the two tasks. For the statistical analysis we applied a Generalized Linear Mixed Model (GLMM), performed in SPSS 22. Fixed factors entered into the model were Group (defined in terms of age in the case of typically-developing children), Condition (Subject Relative (SR), Object Relative (OR), Subject Control (SC) and Object Control (OC)) and an interaction between Group and Condition. The factor subject was included in the model as a random factor.

3.1. Act-out Task

In the case of the act-out task, the model revealed significant effects both of condition ($p=.016$) and the group by condition interaction ($p<.001$). The results obtained are represented in Figure 2.

Figure 2 - Estimated marginal means in the act-out task



First of all, the results obtained revealed that, as expected, the problematic conditions are Object Relative (OR) and Subject Control (SC). Interestingly, it is also possible to note that in the case of SC and considering TD groups, there is a clear and faster progression starting at 5-7 years and reaching ceiling results in the group of 8-11 years. In contrast, in the case of OR, we identify a steadier behaviour in the case of TD groups.

Furthermore, it is possible to observe that the ASD and SLI groups reveal a clearly different pattern of behaviour: the ASD group performs at a very low level in the case of SC, contrasting with better performance in OR; in the case of the SLI group, not only the difference is less pronounced but slightly better results are attained in the case of SC.

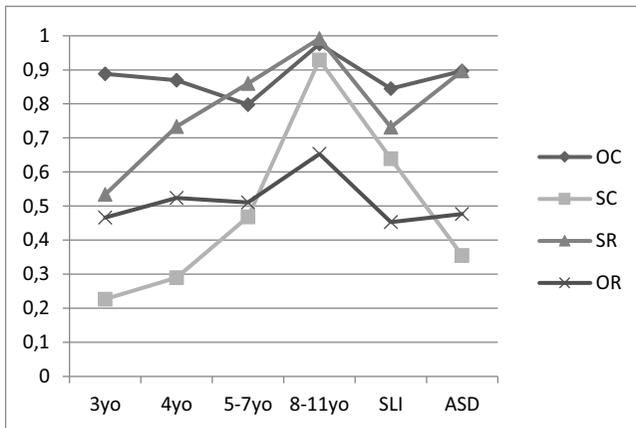
Sidak-corrected pairwise comparisons included in the model confirmed that subject control is only problematic for the three younger TD, as well as for the SLI and ASD groups. It is possible to verify that the 8-11 TD group significantly differs from all the groups in this condition. When comparing the two atypical groups, the model showed significant group differences between ASD vs. SLI in the SC condition $t(1608)=-3.552, p=.004$.

As for the OR condition, difficulties were found in all age groups and the model revealed no significant differences between groups. The exception to this is the comparison between the older TD group and the ASD group, which reached statistical significance ($t(1608)=2.981, p=.043$).

3.2. Judgment task

The results in the judgment task resemble the results obtained in the act-out task. To analyse the data obtained in this task, we also used a GLMM. We again tested the same set of fixed factors: subject (random), group, condition and a group by condition interaction. The model identified significant effects of group, condition and the group by condition interaction (all $p<.001$). The results are presented in Figure 3.

Figure 3 - Estimated marginal means in the reference judgement task



Globally, the results of this task confirm that children have more difficulties in the OR and SC conditions. However, this does not mean a similar developmental path in the two conditions: the problem with SC is solved by the age of 8-11 years. However, the difficulties with OR are prolonged during childhood, with even the older TD group performing below ceiling. In addition, a different pattern is identified in SLI and in ASD children: whereas ASD children show lower performance in the SC condition, in the case of SLI children OR is the most problematic condition.

We now report the results of some Sidak-corrected pairwise comparisons included in the model. In the SC condition, the 8-11 TD group significantly differs from all the younger TD groups, as well as from the linguistically impaired groups (ASD and SLI) ($p < .01$), thus confirming the results obtained in the act-out task. In addition, the ASD group does not significantly differ from all the younger TD groups. The SLI group significantly differs from the 3 year-olds and the 4 year-olds (both $p < .05$), but does not significantly differ from the 5-7 year-olds. In the case of object relatives (OR condition), exactly as it happened in the case of the act-out task, difficulties were found in all age groups, in this case with no significant differences between the groups.

4. Discussion

One of the main goals of the present study was to determine how ASD children, specifically ALI (Autism plus Language Impairment), and SLI children perform in the comprehension of object relatives and subject control with an intervening DP (control with *promise*-type verbs).

In light of the results obtained, some conclusions must be highlighted. First, our results indicate that both SLI and ASD children show lower performance in the comprehension of object relatives and subject control with *prometer* 'promise' than age matched controls. This is a first conclusion suggesting that delayed acquisition of subject control in double-complement structures may be a marker of linguistic impairment, along with the well-known case of object relatives.

However, a more detailed analysis of the results also showed not only that each linguistically impaired group does not behave similarly in the two problematic conditions (SC and OR), but also that the SLI and ASD groups display different performances, suggesting that their syntactic impairment is not equivalent. These facts allow us to provide answers to the research questions presented in 2.1.

Let us first address the difference between the two linguistically impaired groups and specifically the fact that the difference between the two groups is especially salient in the act-out task. This is probably a task effect, expected in the case of ASD. Nevertheless, the task effect is visible when associated with particular syntactic structures and not across conditions. The ASD group attains ceiling results when acting out subject relatives and object control. It therefore must be the case that the task difficulty exacerbates the linguistic difficulty in those conditions identified as problematic (OR and, especially, SC).

In addition, the dissociation between the syntactic impairment in SLI and ASD children is clear in our results and independent of the task: in both tasks the two groups showed different patterns of performance, with the OR condition proving to be the most problematic for SLI children and the SC condition the most problematic for ASD children. As other authors have argued before, it seems that the syntactic difficulties in ASD and SLI are distinct in nature (Tuller et al., 2011; Durrleman & Zufferey, 2009; see also Martins, Santos, & Duarte, 2017).

Regarding the case of comprehension of relative clauses by SLI subjects, it has been largely discussed that intervention effects in A'-movement structures, such as object relatives, are a core aspect of syntactic impairment (Friedmann, Belletti, & Rizzi, 2009). In the case of EP-speaking SLI children, Costa, Lobo, Silva, & Ferreira (2009) report a prolonged asymmetry in the comprehension of subject and object relative clauses. The results obtained by the SLI group are in agreement with these previous studies. However, what is interesting about our results is that the children in the ASD group also showed this prolonged asymmetry, when compared with TD children matched in age. These results confirm the findings of Durreleman, Marinis, & Franck (2016), who describe difficulties in the comprehension of object relatives in children diagnosed with ASD. The authors outline a pronounced difficulty with structures involving movement and intervention in the case of ASD children when compared with TD children matched in non-verbal IQ.

Nevertheless, the most important results of this study are the results on comprehension of control and on the comparison between the subject's behaviour in the SC and the OR conditions. Our results show that children in both the SLI and the ASD groups struggle with subject control with *prometer* "promise". To the best of our knowledge, the literature concerning atypical acquisition of control is still scarce. However, our results not only are in line with Janke & Perovic (2015), who found lower comprehension of subject control with *prometer* "promise" by the ASD children tested, but also allow to extend to SLI children this type of difficulty. We can therefore establish that prolonged difficulties in both object relatives and subject control with *promise* may be clinical markers of linguistic impairment for both SLI and ASD children. However, these two markers do not show similar effects in the two groups: object relatives are more problematic for SLI children, in line with previous literature, and subject control is more problematic for ASD children. This argues not only for a difference in the nature of the linguistic impairment of the two groups but also for the different nature of the comprehension difficulty in the two structures.

A broader analysis of our data, taking into account the TD groups and the linguistically impaired groups, adds to our knowledge of the nature of control. Looking at the four TD groups, we can see that subject control with *promise* is not acquired until 5-7 years, but by 8-11 years children reach ceiling performance in this condition. In contrast, in the case of object relatives, comprehension difficulties are prolonged until at least 8-11 years. We would like to argue that this different developmental path for the two structures is an argument provided by language acquisition against the movement theory of control: even though difficulties with object relatives result from intervention, difficulties with subject control are unlikely to be of similar nature. The sudden development of comprehension of subject control seems compatible with a case of late lexical (or lexical semantics) acquisition, possibly particularly difficult for ASD subjects.

To sum up, the different acquisition patterns of OR and SC with *prometer* "promise", visible in the case of typical language development and in the dissimilar performance in the ASD and the SLI groups in the OR and the SC

conditions, lead to the conclusion that relatives and control do not involve the same mechanisms, an argument against the movement theory of control. They also argue against the similar nature of the impairment in SLI and ASD.

As a more general remark, we highlight that not only structures involving movement are affected in high-functioning ASD children but also certain types of control structures may be problematic for this population.

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