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Comparison of modalities in SLI syntax: A study on the comprehension and production of non-canonical sentences

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ABSTRACT

This study is a linguistic investigation of four preschool-aged Italian children with SLI (4:5–5:9), using more than one linguistic modality, with the aim of analyzing their performance with relative clauses (subject and object relatives). Linguistic abilities in comprehension and production do not overlap in children with SLI and in typical developing children, revealing characteristics related to distinctions between the modalities as well as certain properties of language impairment. While comprehension by children with SLI is comparable to age-matched peers, their production shows a wider range of variation, providing a useful source with which to evaluate syntactic competence. Typically developing children adopt many different strategies to avoid the more complex, object relative clauses. Children with SLI, however, do not and are unable to construct any kind of relative clause.

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1. Introduction

It is well-known that the comprehension and production of relative clauses depends on the nature of the syntactic computation involved, subject relatives (SR) being *less complex* than object relatives (OR) (for typically developing children see Arosio et al., 2006; for SLI see Friedmann and Novogrodsky, 2007 and quoted literature; for processing in adults see Schriefers et al., 1995; for aphasic comprehension see Grodzinsky, 1990; for production see Garraffa and Grillo, 2008; Friedmann, 2005). Children seem to master production of pseudorelatives and subject relative clauses very early (2–3 years of age: Guasti, 2002; Labelle, 1990) while object relatives appear later (Friedmann and Novogrodsky, 2004), children being unable to comprehend them until the age of 4–5 (Adani, 2009). To process both structures equally well, a mature cognitive system is needed to support the highly demanding processing of ORs (2), as they feature long distance movement with the extraction of the object argument and a non-canonical word order.

- (1) Subject relative: La bambina che <la bambina> lava la giraffa
 the-fem child-fem that the-fem child-fem washes the-fem giraffe-fem
 “The child that <the child> washes the giraffe”

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- (2) Object relative: La giraffa che la bambina lava <la giraffa>
 the-fem giraffe-fem that the-fem child-fem washes the-fem giraffe-fem
 “The giraffe that the child washes <the giraffe>”

We will assume that the lack of a “canonicity pattern”¹ in adult speakers has a cost in terms of elaboration. Many psycholinguistic studies have found specific electrophysiological components or longer reaction times associated with the comprehension of non-canonical sentences (see Schriefers et al., 1995). In L1 acquisition the canonicity pattern is manifested in children’s adoption of various strategies to avoid both comprehension and production of sentences with non-canonical word order.

A recent study on the acquisition of various types of relative clauses in Hebrew showed that young children rely on a precise set of predictions to distinguish between relative clauses (Friedmann et al., 2009). Not all object relatives were equally difficult for the children tested (aged 3;07–5;00): the degree of difficulty depended on structural similarities between the DPs in the structure. Children can, therefore, comprehend certain sentences with non-canonical word order and can distinguish between different kinds of dependencies, as predicted by the models outlined in descriptive works on natural languages (Rizzi, 1990) and subsequently extended to the domain of acquired disorders (Grillo, 2008).

In these studies (Grillo, 2008; Friedmann et al., 2009) a complex sentence is defined as one that contains a structural link between two discontinuous positions. While there is no discontinuity between the antecedent and its gap in the chain in a subject relative (see (3)), there is an intervening step in the derivation of an object relative where the different features of elements in similar positions must be recognized in order to construct the relevant dependency (4).

- (3) La bambina che < la bambina > lava la giraffa
 the-fem child-fem that the-fem child-fem washes the-fem giraffe-fem
 (N,sing-fem,Subj) (N,sing-fem,Subj) (N,sing-fem,Obj)
 “The child that < the child > washes the giraffe”

- (4) La giraffa che **la bambina** lava < la giraffa >
 the-fem giraffe-fem that the-fem child-fem washes the-fem giraffe-fem
 (N,sing-fem,Obj,rel) (N,sing-fem,Subj) (N,sing-fem,Obj,rel)
 “The giraffe that the child washes <the giraffe>”

Grillo (2008) proposed that under certain circumstances (processing limitations) it is not possible to recognize all the different features of constituents in non-local relations (such as those which engender Relativized Minimality effects, see Rizzi, 1990). The result is a more generalized minimality effect in all non-local dependencies and if this configuration is not mastered properly the canonicity pattern surfaces, as in (5), giving rise to performance at chance level in comprehension tasks involving thematic assignment.

- (5) La giraffa che la bambina lava < la giraffa >.
 (N,sing-fem,...) (N,sing-fem,...) (N,sing-fem,...)

Although the asymmetry between subject and object relatives is well documented across populations, it is hard to find in the literature a full set of data on phenomena tested in both comprehension and production in the same population.

The aim of the present study is twofold. First of all, we want to examine the canonicity pattern in two populations of Italian children, typically developing and linguistically impaired. Secondly, we want to analyze the various types of linguistic strategies adopted in comprehension and production, all of which we posit to be related to the syntactic computation involved in relative clauses (for an analysis of strategies adopted by typically developing children see Belletti, 2008; for children with SLI see Jakubowicz, 2003).

In the present study, we assume that both comprehension and production are affected by syntactic complexity due to intervention (Friedmann et al., 2009; Garraffa and Grillo, 2008). However, it is predicted that the tasks will be facilitated differently in the two modalities.

On the one hand, by gathering data on typically developing Italian children we aim to investigate the development of non-canonical sentences and to give a grammatical account of the strategies adopted to facilitate the tasks faced by the production and comprehension systems. On the other hand, by comparing data from atypical development across modalities we aim to observe the extent to which SLI diverges from typical development. Moreover, the non-standard performance of a group of Italian children with SLI will show us inconsistencies that reflect the simplifications made by an impaired performance system.

¹ “Canonicity pattern” refers to the asymmetry between sentences where thematic hierarchy and grammatical role are aligned and sentences where they are not, the former being more difficult and prone to error than the latter. In object relatives NP1 = Patient and NP2 = Agent.

The paper is organized in four sections. Section 2 presents the literature and the theoretical framework. Section 3 describes the participants and the experimental tasks. In section 4 we present the main significant results. In section 5 we discuss the data and present a qualitative analysis of the production and imitation tasks. The last section is dedicated to general conclusions.

2. The canonicity pattern in typical and atypical acquisition

Focusing now on the canonicity pattern, there is a certain amount of evidence to support a temporal distinction in the acquisition of subject and object relatives (Adani, 2009; Arosio et al., 2006; Friedmann and Novogrodsky, 2004; on comprehension of interrogatives, De Vincenzi et al., 1999; on production of interrogatives, Guasti et al., 2009).

The analysis of the comprehension and production of relative clauses in typically developing Italian children shows an asymmetry between subject and object relatives, with the former earlier mastered with respect to the latter (Adani, 2009; Arosio et al., 2006; Utzeri, 2007).

However, no difference between the comprehension and production of SRs seems to emerge in child language. Similarly, comprehension and production of ORs do not differ in typical language development.

Therefore, even though the two sets of structures do not have a symmetrical development in child language, no asymmetry between comprehension and production is at stake when exactly the same structures are compared (comprehension vs. production of Subject's; comprehension vs. production of Object's). This finding is replicated in the present study. Besides, we argue that a grammatical approach (Friedmann et al., 2009; Garraffa and Grillo, 2008; Grillo, 2008) can account for this syntactic development.

Concerning the performance of children with SLI with respect to syntactically complex sentences, several studies have described difficulties in both comprehension and production of *wh*-questions and relative clauses, that is, sentences involving *A'* movement. Some authors have ascribed the poor performance of children with SLI to the absence or optionality of *A'* movement (Marinis and van der Lely, 2007; Stavrakaki, 2002; Van der Lely, 1998, 2003) or to a deficit in assigning a Theta role to the trace of the moved element (Friedmann and Novogrodsky, 2004; Novogrodsky and Friedmann, 2006). Other researchers have instead concluded that the deficit in SLI is due to a more general processing problem (Deevy and Leonard, 2004; Stark and Tallal, 1988; Tallal, 1980) or to a structural problem which surfaces with the omission of the complementizer (Håkansson and Hansson, 2000; Leonard, 1995; Schuele and Dykes, 2005; Schuele and Tolbert, 2001; Schuele and Nichols, 2000).

None of the studies on preschool children compared the different strategies adopted by children with SLI nor were differences between modalities investigated.

2.1. Linguistic modality and complexity driven variations

It is possible that in natural languages not all linguistic knowledge is automatically used to facilitate the task of comprehension or production. Variations in the output can be due to production pressure. In the context of production there are a number of possibilities for arriving at a comprehensible output. Variations in the input can be due to extralinguistic knowledge, such as heuristic-based computations, plausibility of the event or linear thematic assignment (NP1 = Agent).

Comprehension and production are selective, as humans possess limited processing abilities. We argue that comprehension and production are closely linked in language development, although this relationship does not exclude some qualitative differences between the two modalities. For example, the role of production in feeding language acquisition probably covers a more extended period. From the earliest stages of their lives, children exercise their production system with babbling to get advantage of its complete feedback skill. Nevertheless, we think that a good method for investigating the development of comprehension and production is to examine the degrees of difficulty which age-matched subjects experience with the same linguistic structure in both modalities.

Concerning children with SLI, Jakubowicz's (2003) study on French investigated the comprehension vs. production of agreement. She found that, like typically developing children, children with SLI have longer response times in comprehension tasks when determiner-noun or subject-verb agreement is incorrect. On the other hand, production of agreement showed that children with SLI made verb tense omissions (around 25%) not attested in typically developing controls. Therefore, even though children with SLI are sensitive to violations in comprehension, unlike typically developing children they exhibit difficulties with production.

As we will see in the present study, correct comprehension can coexist with various strategies in production that reflect the maturation of processes involving several syntactic variables.

We will turn now to a description of our experimental subjects and our control group.

3. Methods

Three groups of subjects participated in the study: a group of 4 Italian children with SLI (4;5–5;9) and two control groups of typically developing Italian children.

Table 1

Individual results for children with SLI on standard language tests.

	TCGB		PPVT-R		SRT	
	ES	EA	SS	SD	RS	SD
S.S (4;5)	16	4;6–5;0	60	–2.3	04	–4.3
M.V. (5;0)	15	4;6–5;0	91	–0.6	13	–6.4
F.T. (5;4)	10	5;0–5;6	75	–1.6	11	–5.1
F.V. (5;9)	16.5	4;6–5;0	87	–0.9	10	–5.8

Note: TCGB = Grammatical Comprehension Test for Children (Test di Comprensione Grammaticale per bambini, *Chilosi and Cipriani, 1995*), PPVT-R = Peabody Picture Vocabulary Test-Revised (*Dunn and Dunn, 1981*), SRT = Sentence Repetition Test (*Vender et al., 1981*), ES = error score, EA = equivalent age, SS = standard score, SD = standard deviation, RS = raw score.

Table 2

Individual results for TD children on standard language tests.

	TCGB		PPVT-R		SRT	
	ES	EA	SS	SD	RS	SD
TD-I						
A.G. (4;5)	18	4;6–5;0	97	–0.2	14	–1
V.E. (4;11)	20	4;0–4;6	96	–0.3	16	–1.3
L.F. (5;1)	16.5	4;6–5;0	88	–0.8	17	–1.4
V.L. (5;5)	10.5	5;0–5;6	79	–1.4	18	–0.1
TD-II						
G.T. (3;7)	32	3;6–4;0	87	–0.8	17	+0.7
P.C. (3;9)	16	4;0–4;6	101	+0.6	18	+1
S.G. (3;11)	42	3;6	93	–0.4	16	+0.5
T.V. (3;10)	23.5	4;0	90	–0.6	9	–1.3

Note: TCGB = Grammatical Comprehension Test for Children (Test di Comprensione Grammaticale per bambini, *Chilosi and Cipriani, 1995*), PPVT-R = Peabody Picture Vocabulary Test-Revised (*Dunn and Dunn, 1981*), SRT = Sentence Repetition Test (*Vender et al., 1981*), ES = error score, EA = equivalent age, SS = standard score, SD = standard deviation, RS = raw score.

The group with SLI consisted of 4 boys aged 4;5 to 5;9 with non-verbal IQ between 92 and 109 measured with the WIPPSI Scale (Wechsler Scale for children under 6 years of age). They have a normal threshold for hearing, no obvious signs of neurological and emotional disorders, and have been diagnosed by speech and language therapists as having severe difficulties with expressive language.

Two standard tests were administered to measure their receptive vocabulary (PPVT-R) and receptive grammatical abilities (TCGB). The children were also given a standard Sentence Repetition Test (*Vender et al., 1981*) to obtain an overview of their expressive abilities.

We selected children with SLI who scored more than 2 SD below the mean for age on at least one of the standard tests. Three children in the group (S.S., M.V., F.T.) performed within age limits on the receptive grammar test and three of them (M.V., F.T., F.V.) performed within age limits on the receptive vocabulary test. All the children with SLI, however, performed poorly in the standard Sentence Repetition Test, with scores of between 4.3 and 6.4 SD below the mean for age (*Table 1*).

The first control group (TD-I) is composed of 4 Italian children (two boys and two girls) with typical language development (TD), age-matched to the children with SLI (4;6 to 5;5). The children were randomly selected from a public school.

The second control group (TD-II) is composed of four Italian children aged 3;7 to 3;11 with typical language development, selected from a public school. The purpose of selecting a second control group was to observe if and to what extent younger children's performance in the comprehension and production of relative clauses resembles that of children with SLI. The comparison with these four children, from 7 to 11 months younger than the children with SLI, will therefore reveal whether the children with SLI are simply delayed or whether they have a deviant pattern of comprehension and production.

The TD children in both groups score within age limits on standard language tests² (see *Table 2*).

3.1. Comprehension

Comprehension of SRs and ORs was tested with a binary picture comprehension task adapted from *Friedmann and Novogrodsky (2004)*. Each subject was presented with two pictures and asked to choose the one that matched the sentence read by the experimenter. The first of each pair of pictures showed a figure carrying out an action on another, while the second picture showed the same figures with the roles reversed. Comprehension of 60 sentences was tested: 20 right-branching subject relatives (6), 20 right-branching object relatives (7), and 20 simple SVO sentences (8):

² We chose –2 SD as a threshold to select TD children. Concerning the Sentence repetition test, which is the only available for Italian children of the subjects' age, it does not provide a qualitative analysis of the subject's performances. Because of the scarce sensitivity of the test, we decided to include in the TD groups also children who had a lower performance on this test (three children of TD-I group score –1 SD or below on the Sentence Repetition Test).

- (6) Mostrami la bambina che lava la giraffa
Show-me the-fem child-fem that washes the-fem giraffe-fem
“Show me the child that is washing the giraffe”
- (7) Mostrami la bambina che la giraffa lava
Show-me the-fem child-fem that the-fem giraffe-fem washes
“Show me the child that the giraffe is washing”
- (8) Mostrami la bambina lava la giraffa
Show-me the-fem child-fem washes the-fem giraffe-fem
“Show me the child is washing the giraffe”

All the sentences were semantically reversible and the noun phrases were always animate. They were presented in random order. SVO declaratives were used as filler items.

3.2. Production

Production of SRs and ORs was tested with two tasks: a picture description and a preference task, both adapted from Novogrodsky and Friedmann (2006).

In the picture description task, pairs of pictures, each featuring two figures, were presented. One picture showed one of the figures carrying out an action on the other, while the second picture showed the same figures with the roles reversed.

The experimenter described the two scenes using simple sentences, then asked the child a question about one of the figures in order to elicit either an SR (9) or an OR (10):

In these pictures there are two girls. In one picture the girl is washing the giraffe and in the other picture the giraffe is washing the girl.

Which girl is this (pointing to the first picture)? Start with “This is the girl..”

- (9) Target answer: La bambina che lava la giraffa
the-fem child-fem that washes the-fem giraffe-fem
“The child that is washing the giraffe”

And now which girl is this (pointing to the second picture)? Start with “This is the girl..”

- (10) Target answer: La bambina che la giraffa lava
the-fem child-fem that the-fem giraffe-fem washes
“The child that the giraffe is washing”

In the Preference Production task, the experimenter presented two situations, in each of which a child is carrying out an action. The participants had to choose which child they would rather be.

Examples of test items eliciting SRs and ORs are given in (11) and (12), respectively:

- (11) There are two children. One child is drawing a singer; the other child is drawing a policeman. Which child would you rather be? Start with: “I would rather be the child ..”
Target answer: (Vorrei essere) il bambino che disegna un cantante/un poliziotto
would be the child that draws a singer/a policeman
“(I would rather be) the child who is drawing a singer/a policeman”
- (12) There are two children. The grandfather is looking for one child, and the grandfather finds the other child. Which child would you rather be? Start with: “I would rather be the child..”
Target answer: (Vorrei essere) il bambino che il nonno cerca/trova
would be the child that the grandfather looks for/finds
“(I would rather be) the child that the grandfather is looking for/finds”

Questions eliciting SRs and ORs were presented in random order.

3.3. Repetition

The repetition task consisted in repeating 30 sentences with SRs and 30 with ORs. The sentences, presented in random order, were the same as the target relative clauses in the production tasks (see examples (9)–(12)).

3.4. Coding

The children with SLI were tested individually during their weekly speech therapy session. The experiment was similarly administered to the TD children in individual sessions in a separate, quiet room in their school. All the participants' responses were recorded and transcribed after each session. Unintelligible utterances were discarded.

For the comprehension task, we counted the number of correct responses given by the participants. Data from the elicited production tasks were analyzed together for each group, as there were no quantitative/qualitative differences between the individual results.

For the elicited production and imitation tasks, target SRs, such as (13), were counted as correct. In addition, we counted as correct those ORs with a pre-verbal subject within the relative clause and a gap (14), and those with a clitic pronoun (15) or a DP (16) resuming the head of the relative clause.³ Although resumption is not allowed as a relativization strategy in standard Italian (Belletti, 2008; Utzeri, 2007), it is in fact attested cross-linguistically in children's production.⁴

- (13) (La bambina)⁵ che lava la giraffa
the-fem child-fem that washes the-fem giraffe-fem
“(The child) that is washing the giraffe”
- (14) (La bambina) che la giraffa lava
the-fem child-fem that the-fem giraffe-fem washes
“The child that the giraffe is washing”
- (15) (La bambina) che (la giraffa) la lava (la giraffa)
the-fem child-fem that the-fem giraffe-fem her-CL washes the-fem giraffe-fem
“The child that the giraffe is washing her”
- (16) (La bambina) che la giraffa lava la bambina
the-fem child-fem that the-fem giraffe-fem washes the-fem child-fem
“The child that the giraffe is washing the child”

4. Results

In this section we present the main results of the study. We will refer to group scores and give individual statistics in the footnotes. These results will then be discussed in section 5.

4.1. Comprehension

SRs were understood better than ORs by children with SLI and TD-I, the older control group. The difference between SRs and ORs is significant for children with SLI ($\chi^2(1) = 40.272, p < .0001$) and aged-matched controls (TD-I: $\chi^2(1) = 24.740, p < .0001$).⁶

The children with SLI do not differ significantly in their comprehension of SRs and ORs from TD-I group (SR: $\chi^2(1) = 1.12, p = .29$; OR: $\chi^2(1) = 0.10, p = .75$). Moreover, they score significantly better than TD-II on SRs and comparably on ORs (SR: $\chi^2(1) = 13.29, p < .0003$, OR: $\chi^2(1) = 1.60, p = .20$).

³ In resumptive ORs, the subject of the relative clause might be either pre-verbal or post-verbal. However, a post-verbal subject within a relative clause has an ambiguous reading in Italian in the following cases: (i) when both the head and the subject of the relative clause share the same number feature, (ii) when a resumptive pronoun is not present. Ambiguous ORs with post-verbal subjects were counted separately as occurrences of VS order (see section 4.2.1).

⁴ For child Italian also see: Guasti and Cardinaletti (2003); child English: McDaniel et al. (1998); de Villiers (1988); child French: Guasti and Cardinaletti (2003); Guasti et al. (1996); Labelle (1990); child Spanish: Ferreiro et al. (1976).

⁵ We counted the utterances as correct relative clauses when the head of the relative was: (i) explicit, (ii) non-explicit, (iii) a demonstrative pronoun “quello/a” (that-one-masc/fem).

⁶ At the individual level, comprehension of SRs and ORs differs significantly for all participants with SLI (S.S.: $\chi^2(1) = 5.584, p < .018$; F.V.: $\chi^2(1) = 13.850, p < .0002$; F.T.: $\chi^2(1) = 12.274, p < .0005$; M.V.: $\chi^2(1) = 13.789, p < .0002$) and in three of the age-matched control children (V.E.: $\chi^2(1) = 7.619, p < .006$; L.F.: $\chi^2(1) = 4.80, p < .03$; V.L.: $\chi^2(1) = 14.545, p < .0001$). There are no significant differences in the comprehension of SRs and ORs by the control participant A.G. in TD-I ($\chi^2(1) = 1.290, p = .256$) and by all children in the TD-II group (G.T.: $\chi^2(1) = 0.102, p = .74$; P.C.: $\chi^2(1) = 1.905, p = .16$; S.G.: $\chi^2(1) = 0.440, p = .50$; T.V.: $\chi^2(1) = 0.625, p = .42$).

Table 3

Individual scores in the comprehension task: percentages of correct SRs, ORs and SVO.

	SR	OR	SVO
SLI			
S.S.(4;5)	85	50	90
M.V.(5;0)	95	40	85
F.T. (5;4)	95	60	85
F.V. (5;9)	95	30	90
TD-I			
A.G. (4;5)	85	70	85
V.E. (4;11)	90	50	70
L.F. (5;1)	90	60	100
V.L. (5;5)	100	20	90
TD-II			
G.T. (3;7)	45	40	75
P.C. (3;9)	80	60	90
S.G. (3;11)	70	60	80
T.V. (3;10)	85	75	85

Table 3 shows the individual results of the three groups in the comprehension task.

Three of the four children with SLI performed at chance level in the comprehension of ORs (S.S., $p = .58$; M.V., $p = .86$, F.V., $p = .97$).⁷ Similarly, three of the four age-matched control children perform at chance with ORs (V.E., $p = .58$; L.F., $p = .25$, V.L., $p = .99$) and one child's score is close to chance (A.G., $p = .057$). Finally, in the TD-II group, three of the four participants performed at chance level with ORs (V.E., $p = .58$; L.F., $p = .25$, V.L., $p = .99$).

With SRs, all children with SLI and TD-I controls performed above chance level. In the TD-II group, two participants scored above chance with SRs, one child scored at chance level (G.T., $p = .74$), and one child's score is close to chance (S.G., $p = .057$).

4.2. Production

Table 4 summarizes the individual percentages of subject and object relatives produced by the three groups in the elicited production tasks.

The performance of children with SLI was poorer than that of the control participants with both SRs and ORs. The children produced significantly fewer target SRs than both control groups (TD-I: $\chi^2(1) = 117.89$, $p < .0001$; TD-II: $\chi^2(1) = 132.02$, $p < .0001$) and significantly fewer target ORs (TD-I: $\chi^2(1) = 85.10$, $p < .0001$; TD-II: $\chi^2(1) = 36.06$, $p < .0001$).

Furthermore, the unimpaired children produced significantly more target SRs than target ORs (TD-I: $\chi^2(1) = 16.82$, $p < .0001$; TD-II: $\chi^2(1) = 71.11$, $p < .0001$).

4.2.1. Qualitative analysis of the utterances

Qualitative analyses of the utterances produced when a subject or an object relative was expected are presented in Tables 5 and 6.

In Table 5, the high percentages of SRs produced by both control groups strongly contrasts with the poor performance of the group with SLI.

Sometimes the TD children produce SRs with a resumptive DP in subject position (TD-I: 3.3%; TD-II: 2.5%), as in (17), or they produce an OR instead of an SR (TD-I: 9.1%; TD-II: 5%), as in (18).

Target SR: Il nonno che bacia il bambino
the grandfather that kisses the child
"The grandfather that is kissing the child"

- (17) Che il nonno bacia il bambino
that the grandfather kisses the child (TD-I: V.E. 4;11)
"(The grandfather) that the grandfather is kissing the child"

Target SR: La bambina che lava la giraffa
the-fem child-fem that washes the-fem giraffe-fem
"The child that is washing the giraffe"

⁷ The p values were obtained using a binomial distribution, on the assumption that participants were guessing in a random, unbiased way.

Table 4
Individual scores in the production tasks: percentages of correct SRs and ORs.

	SR	OR
SLI		
S.S (4;5)	–	–
M.V. (5;0)	33.3	6.7
F.T. (5;4)	16.6	6.7
F.V. (5;9)	–	–
TD-I		
A.G. (4;5)	86.6	53.3
V.E. (4;11)	70	60
L.F. (5;1)	76.6	70
V.L. (5;5)	96.6	50
TD-II		
G.T. (3;7)	93.3	33.3
P.C. (3;9)	93.3	43.3
S.G. (3;11)	76.6	33.3
T.V. (3;10)	83.3	23.3

Table 5
Results of SRs produced in the elicitation tasks.

	SLI	%	TD-I	%	TD-II	%
Correct SR	15/120	12.5	99/120	82.5	104/120	86.6
SR with resumptive DP	–	–	4/120	3.3	3/120	2.5
CP substitution	6/120	5	–	–	–	–
Declarative clause	31/120	25.8	1/120	0.8	3/120	2.5
No response	63/120	52.5	–	–	3/120	2.5
OR instead of SR	–	–	11/120	9.1	6/120	5
Other utterances	5/120	4.1	5/120	4.1	1/120	0.8

Table 6
Results of ORs produced in the elicitation tasks.

	SLI	%	TD-I	%	TD-II	%
Correct OR	3/120	2.5	34/120	28.3	19/120	15.8
OR with resumptive DP	1/120	0.8	10/120	8.3	9/120	7.5
OR with resumptive clitic	–	–	26/120	21.6	12/120	10
OR with VS order	–	–	26/120	21.6	37/120	30.8
Ambiguous OR	6/120	5	2/120	1.6	7/120	5.8
Omission of CP	1/120	0.8	–	–	–	–
Declarative clause	33/120	27.5	2/120	1.6	21/120	17.5
Declarative non-target-like	12/120	10	7/120	5.8	5/120	4.1
No response	63/120	52.5	–	–	4/120	3.3
SR instead of OR	–	–	9/120	7.5	2/120	1.6
Other utterances	1/120	0.8	4/120	3.3	4/120	3.3

- (18) Che la bambina lava
that the-fem child-fem washes
“That the child is washing” (TD-I: L.F. 5;1)

Children with SLI either give “no response” or produce declarative clauses instead of SRs, as in (19). It is interesting to note that declarative clauses could also be analyzed as CP omissions, and we will come back to this issue in section 5. In some contexts where a SR is expected, the complementizer is substituted by an incompletely pronounced element (20). Substitutions of this type are found with the group with SLI (5%) but not with the control participants.

Target SR: Il bambino che pettina il re
the child that combs the king
“The child that is combing the king” (i.e. that is combing the king's hair)

- (19) Il bambino pettina il re
the child combs the king
“The child is combing the king” (Group with SLI: M.V., 5;0)
Target SR: Il bambino che lava il pinguino
the child that washes the penguin
“The child that is washing the penguin”
- (20) Il bambino [e] lava il pinguino
the child washes the penguin
“The child [e] is washing the penguin” (Group with SLI: F.T., 5;9)

As Table 6 shows, TD children of both groups produce lower percentages of ORs than SRs. They also extensively use non-standard ORs: ORs with a resumptive DP, as in (21), and ORs with a resumptive pronoun, as in (22).

- Target OR: Il bambino che il papà/vicino pettina
the child that the father/neighbor combs
“The child that the father/neighbor is combing”
- (21) Che il papà pettina la bambina
that the father combs the-fem child-fem
“(The child) that the father is combing the child” (TD-II: S.G., 3;11)
Target OR: Il bambino che il papà pettina/abbraccia
the child that the father combs/hugs
“The child that the father is comb/hugging”
- (22) Che il babbo lo abbraccia
that the father him-cl hugs
“(The child) that the father is hugging him” (TD-II: P.C., 3;9)

Moreover, another type of relative clause often produced by both control groups (TD-I: 21.6%; TD-II: 30.8%) is an OR with a post-verbal subject (VS order), as in (23). This kind of sentence is ambiguous between a subject and an object relative interpretation.

- Target OR: Il dottore che il soldato dipinge
the doctor that the soldier paints
“The doctor that the soldier is painting”
- (23) Il dottore che dipinge il soldato
the-masc doctor that paints the-masc soldier
“The doctor that is painting the soldier/that the soldier is painting” (TD-I: V.L., 5;5)

Furthermore, when an OR is expected, TD children sometimes produce declarative clauses (declaratives: TD-I: 1.6%; TD-II: 17.5%; non-target-like declaratives: TD-I: 5.8%; TD-II: 4.1%), as (24) and (25).

- Target OR: Il bambino che il maestro/nonno fotografa
the child that the teacher/grandfather photographs
“The child that the teacher/grandfather is photographing”
- (24) Il nonno fotografa l'altra bambina
the grandfather photographs the-fem other-fem child-fem
“The grandfather is photographing the other child” (TD-I: V.L., 5;5)
- Target OR: Il bambino che la doccia riscalda/rinfresca
the child that the shower warms up/refreshes
“The child that the shower warms up/refreshes”

- (25) Il bambino con l'acqua calda
 the child with the-fem water hot-fem
 "The child with hot water" (TD-I: L.F., 5;11)

Control participants of both groups substitute ORs with the easier SRs (TD-I: 7.5%; TD-II: 1.6%). SRs result from either inversion of the characters (26) or an alternative description the picture/action, as in (27).⁸

Target OR: Il bambino che il maestro/nonno fotografa
 the child that the teacher/grandfather photographs
 "The child that the teacher/grandfather is photographing"

- (26) Il nonno che fotografa la bambina
 the grandfather that photographs the-fem child-fem
 "The grandfather that is photographing the child" (TD-I: V.E., 4;11)

Target OR: Il bambino che il nonno tira
 the child that the grandfather pulls
 "The child that the grandfather is pulling"

- (27) Il bambino che sta dietro al nonno
 the child that is behind the grandfather
 "The child that is behind the grandfather" (TD-II: T.V., 3;10)

In Table 6, relative clauses classified as *ambiguous* might be either an OR with a null subject within the relative clause or a subject relative. This kind of ambiguous OR, an example of which is given in (28), is produced both by the children with SLI (ambiguous ORs: 5%) and by the TD children (TD-I: 1.6%; TD-II: 5.8%).

Target OR: Il cane che il bambino spinge
 the dog that the child pushes
 "The dog that the child is pushing"

- (28) Che spinge
 "That is pushing" (Group with SLI: F.T., 5;9)

Children with SLI either give "no response" or produce a declarative clause in most of the cases where an OR is expected. These declarative clauses, produced at a higher rate by children with SLI than the control groups, either describe the picture/action (27.5%), as in (29), or give other details, not relevant to the target answer⁹ (10%), as in (30).

Target OR: Il bambino che l'ippopotamo asciuga
 the child that the hippo dries
 "The child that the hippo is drying"

- (29) L'ippopotamo asciuga il bambino
 the hippo dries the child
 "The hippo is drying the child" (Group with SLI: M.V., 5;0)

Target OR: La bambina che la giraffa lava
 the-fem child-fem that the-fem giraffe-fem washes
 "The child that the giraffe is washing"

⁸ As has been shown for Italian school-age children (6–11 years old) by Belletti (2008) and Utzeri (2007), the control group aged 4;5–5;5 did not produce SRs with a passive verb (either causative or verbal) instead of ORs. See also Belletti and Contemori (2010) for similar results and for individual variability in the emergence of passives in pre-school typically developing children.

⁹ Utterances counted as "non-target-like declaratives".

- (30) Fa il bagno
makes the bath
“(She) is taking a bath” (Group with SLI: F.T., 5;9)

4.3. Comprehension vs. production

We compared comprehension with production of SRs and ORs for all the groups.¹⁰

There is no significant difference between comprehension and production of SRs by TD-I, neither at the group level nor at the individual level.

The difference with respect to SRs is significant at the group level for TD-II (TD-II: $p < .0063$), while with respect to ORs is not significant at the group level for TD-I but it is significant for TD-II (TD-II: $p < .0003$).

The results for the children with SLI differ slightly from their age-matched group. At the group level, the difference between comprehension and production of SRs is significant ($p < .0001$) and we obtained the same value with respect to ORs ($p < .0001$).

Similarly, the differences between comprehension and production by children with SLI at the individual level are significant both for SRs (all children $p < .0001$) and for ORs (S.S./F.V./F.T. $p < .0001$, M.V. $p < .009$).

4.4. Repetition

Table 7 shows that while the TD groups score quite well on repetition of both SRs and ORs, the group with SLI performs poorly with both structures.

Children with SLI repeated significantly fewer target SRs than the controls (TD-I: $\chi^2(1) = 202.56$, $p < .0001$; TD-II: $\chi^2(1) = 161.77$, $p < .0001$) and also significantly fewer target ORs (TD-I: $\chi^2(1) = 282.08$, $p < .0001$; TD-II: $\chi^2(1) = 152.38$, $p < .0001$).

Tables 8 and 9 present qualitative analyses of the sentences produced by the three groups in the elicited imitation task. The group with SLI repeat relatives omitting the complementizer (SRs: 18.3%; ORs: 36.6%) or they produce declaratives, which account for most of the errors with SRs (64.1%) and with ORs (37.5%). While declaratives are marginally present in the results of the TD-II participants (4.1%), they are not attested in the older control group. Moreover, CP omission, examples of which are given in (31) and (32), is not found in the repetitions of TD children. Examples (33) and (34) are instances of a declarative instead of an SR and an OR, respectively.

Target SR: Questo è il bambino *che* tira il nonno
this one is the child that pulls the grandfather
“This is the child that is pulling the grandfather”

- (31) Questo è il bambino _ tira il nonno
this one is the child _ pulls the grandfather
“This is the child _ is pulling the grandfather” (Group with SLI: S.S., 4;5)

Target OR: Il soldato *che* il dottore dipinge
the soldier that the doctor paints
“The soldier that the doctor is painting”

- (32) Sentence produced: Il soldato _ il dottore dipinge
the soldier_the doctor paints
“The soldier _ the doctor is painting” (Group with SLI:, M.V. 5;0)

Target SR: (Questo è) il bambino *che* tira il nonno
this one is the child that the grandfather pulls
“(This is) the child that is pulling the grandfather”

- (33) Sentence produced: Il bambino tira il nonno
the child pulls the grandfather
“The child is pulling the grandfather” (Group with SLI:, F.V. 5;4)

¹⁰ The p values were calculated with the Fisher Exact test.

Table 7
Individual scores in the repetition task: percentages of correct SRs and ORs.

	SR	OR
SLI		
S.S. (4;5)	0	0
M.V. (5;0)	3.3	6.7
F.T. (5;4)	0	0
F.V. (5;9)	0	0
TD-I		
A.G. (4;5)	93.3	96.7
V.E. (4;11)	76.6	60
L.F. (5;1)	100	96.7
V.L. (5;5)	100	100
TD-II		
G.T. (3;7)	70	66.6
P.C. (3;9)	83.3	93.3
S.G. (3;11)	93.3	96.6
T.V. (3;10)	80	63.3

Table 8
Results of SRs produced in the repetition task.

	SLI	%	TD-I	%	TD-II	%
Correct SR	1/120	0.8	111/120	92.5	98/120	81.6
SR with resumptive DP	–	–	3/120	2.5	–	–
Omission of CP	22/120	18.3	–	–	–	–
CP substitution	11/120	9.1	–	–	–	–
Declarative clause	77/120	64.1	1/120	0.8	5/120	4.1
Fragment	6/120	5	–	–	–	–
No response	2/120	1.6	–	–	6/120	5
OR instead of SR	–	–	1/120	0.8	5/120	4.1
Other utterances	1/120	0.8	4/120	3.3	6/120	5

Table 9
Results of ORs produced in the repetition task.

	SLI	%	TD-I	%	TD-II	%
Correct OR	2/120	1.6	106/120	88.3	96/120	80
Omission of CP	44/120	36.6	–	–	–	–
CP substitution	1/120	0.8	–	–	–	–
OR with reversed theta roles	–	–	7/120	5.8	–	–
Declarative clause	45/120	37.5	–	–	5/120	4.1
Fragment	17/120	14.1	2/120	1.6	4/120	3.3
No response	3/120	2.5	–	–	13/120	10.8
SR instead of OR	–	–	3/120	2.5	1/120	0.8
SR instead of OR with CP substitution	7/120	5.8	–	–	–	–
Other utterances	1/120	0.8	2/120	1.6	1/120	0.8

Target OR: (Questo è) il soldato che il dottore dipinge
 this one is the soldier that the doctor paints
 “(This is) the soldier that the doctor is painting”

- (34) Sentence produced: Il dottore dipinge il soldato
 the doctor paints the soldier
 “The doctor is painting the soldier” (Group with SLI: F.V., 5;4)

5. Discussion

The aim of the present study was to compare the cross-modal performance (comprehension vs. production) of different populations with the same sentence types.

A first general comment regards the difference between children with SLI and the younger, typically developing children. In both groups we observe a discrepancy between comprehension and production. While the children with SLI are weaker in production, with both ORs and SRs equally impaired, the younger, typically developing children show the reverse pattern of behavior, with poorer comprehension of SRs. Thus, by comparing modalities we were able to find a double dissociation in the acquisition of linguistic abilities by children with SLI and younger TD children. Besides the interesting results with respect to the easier subject relatives, qualitative analyses of production strategies showed that the variations can be expressed in grammatical terms and that it is possible to make a distinction between early (TD-II) and impaired (SLI) language development.

5.1. Comprehension

Comprehension of non-canonical sentences by TD-I and children with SLI is comparable. A clear canonicity pattern emerges, with object relatives more difficult to comprehend than subject relatives. Data from the present study are consistent with the literature on comprehension of subject and object relatives and questions (see Arosio et al., 2006 and De Vincenzi et al., 1999 for Italian; Friedmann et al., 2009 for Hebrew). Linguistically impaired and unimpaired children at around five years seem to use the same grammatical strategies to process the two types of relative clauses. The difficulty with non-canonical sentences can be ascribed to a grammatical source, here expressed in terms of intervention effects (as proposed by Grillo, 2008 for acquired aphasia).

In ORs the cognitive system is not yet mature enough to establish the correct syntactic dependency necessary to interpret the discontinuous chain that we defined in terms of DP lexical restriction. Children's performance suggests that they have difficulty in keeping in memory the two "possible" arguments involved in the thematic assignment since the feature distinctions are not yet available. In most cases their performance is at chance level indicating their inability to use the correct syntactic algorithm required to interpret non-local syntactic chains. Interestingly, children with SLI have a lower error rate in the comprehension of SRs compared to ORs, the former being fully mastered before the latter.

A related issue is whether the asymmetry between SRs and ORs is common to both comprehension and production. As far as the younger control group (TD-II) is concerned, the difference between SRs and ORs is not significant. The reason why the canonicity pattern does not emerge in comprehension by TD-II might be due to the complexity of the task for this age group. Their results are in line with De Vincenzi's et al. study (1999) in which a clear difference in comprehension of subject and object relatives had not yet emerged in children aged 3–4 years.

Given that we consider comprehension and production to be closely linked in syntactic computation, we argue that children with SLI, whose production of both subject and object relatives is very poor, adopt a linear strategy (NP1 = Agent) in the comprehension of relative clauses. Crucially, this strategy leads them to the correct answer in comprehending SRs, but causes them to fail in the interpretation of ORs. Moreover, we propose that younger children (TD-II) do not resort to the same simple linear heuristic (NP1 = Agent), but instead construct the relative clause, which they are already able to produce in their speech. Their success in constructing the relative clause in the comprehension task is supported by the TD-II group's good performance in producing SRs. Further support for this hypothesis comes from the TD-II children's good comprehension of simple SVO sentences in the same task.

Therefore, even though the deficit of children with SLI is more salient in production, we suggest that their comprehension might also be impaired.

5.2. Production

While we observed a comparable performance both in children with SLI and in the TD-I control group in the comprehension of canonical and non-canonical sentences, the two groups clearly differ in the production of the two structures. The canonicity effect emerges in the elicited production of both control groups, pointing to a homogeneous trend in TD-I children's comprehension and production. The TD-II group is able to produce subject relatives, even though performance in comprehension is not at ceiling level for all subjects.

On the other hand, children with SLI are unable to produce both correct subject and correct object relatives, even though they appear to have mastered SRs in comprehension. Indeed, the qualitative analyses of productions show that different kinds of sentences are produced by children with SLI and TD groups when a SR or an OR is expected. First of all, children with SLI often give 'no responses' when either subject or object relatives are expected, while control participants of both groups resort to this option less frequently.

Focusing on subject relatives, children with SLI, unlike TD children, produce a low number of SRs in expected contexts and instead produce a high percentage of declarative clauses that may be interpreted as instances of complementizer omission. Therefore, the easier subject relatives, which are known to emerge around age 2–3 in children's speech, are also a challenge for pre-school children with SLI. Their attempts to produce subject relatives result in a lack of modification related to the absence of a CP layer (which hosts the relative pronoun) and a consequent inappropriate answer in the elicitation context.

The studies carried out by Håkansson and Hansson (2000), Schuele and Dykes (2005), Schuele and Tolbert (2001) and Schuele and Nichols (2000) tested relative clauses with pre-school children with SLI and found these structures to be significantly impaired in both elicited production and spontaneous speech, the complementizer being omitted.

Particularly interesting for the present research is Håkansson and Hansson's (2000) study. The authors conducted a longitudinal research on 10 Swedish children with SLI (4;0–6;3) with a main expressive language disorder, in which the comprehension and production of relative clauses were tested. Even though the performance of children with SLI and the control participants was comparable in the comprehension task, production by the two groups differed significantly at both Time I and Time II. Moreover, the authors point out that children with SLI tend to omit the relative complementizer, *som*, more often than the control group (Time I: SLI 77.3% vs. TD 16.7% omissions; Time II: SLI 37% vs. TD 8% omissions).

With respect to ORs, these structures are difficult to produce for both SLI and TD children. In TD children, this is manifested by the lower percentage of target ORs produced compared with SRs. Besides their difficulties with ORs, typically developing children use extensively non-standard ORs: either with a resumptive DP or with a resumptive pronoun, repeated here as (35) and (36). These structures, which may be used to express relative clauses, give us a hint as to the simplification strategies that help the processing load of children's immature systems.

Target OR: "The child that the father/neighbor is combing"

- (35) Che il papà pettina la bambina
that the father combs the-fem child-fem
“(The child) that the father is combing the child” (TD-II: S.G., 3;11)

Target OR: "The child that the father is comb/hugging"

- (36) Che il babbo lo abbraccia
that the father him-cl hugs
“(The child) that the father is hugging him” (TD-II: P.C., 3;9)

Belletti (2005) suggests a “copy + deletion” hypothesis to provide a cross-linguistic explanation of the various kinds of object relative clauses that may be produced. While standard object relatives are derived through an operation of “copy + deletion”, object relatives with a resumptive clitic undergo “copy + partial deletion” and object relatives with resumptive DPs are subject to “DP copy + no deletion”.

Belletti's account, which is supported by TD children's productions, does not predict the performance of children with SLI, whose grammar seems to have a deviant development. It seems that in impaired children's production partial deletion is not an available option in guiding the computation. They instead adopt a strategy that interrupts all non-local chains, treating relative clauses as declaratives.

Finally, another interesting strategy adopted by TD children but not attested in children with SLI is the production of ORs with a post-verbal subject within the relative clause, an example of which is repeated in (37):

Target OR: Il soldato che il dottore dipinge
the soldier that the doctor paints
“The soldier that the doctor is painting”

- (37) Il soldato che dipinge il dottore
the soldier that paints the doctor
“The soldier that is painting the doctor” (TD-I: V.L., 5;5)

In the object relative reading, this type of sentence has a pronominal null subject, as shown in (38); the pre-verbal subject counterpart is shown in (39):

- (38) The soldier that pro_i paints the doctor_i

- (39) The soldier that the doctor paints <the soldier>

Typically developing children may be using an OR with a post-verbal subject, such as (38), to avoid maintaining two similar full DPs and constructing a non-local chain.

The basic assumption is that a configuration with a disjunction of features is possible, as shown by Friedmann et al. (2009) in the comprehension of impersonal *pro* object relatives in Hebrew. In (40),¹¹ if the attractor *the child* is more highly specified in feature terms than the intervening *pro*, blocking does not occur.

- (40) The boy who (someone/they) kiss him
 D NP R *pro* arb pronoun

Let's now consider the chain linking *pro* and the post-verbal subject within the relative clause in (38) (<*pro*, the doctor>). We hypothesize that children treat this dependency as a local one, uncrossed by any similar position. Therefore, they simply solve the task of subject assignment to the clause.

To conclude, children with SLI do not use the same *facilitating* strategies as TD children. They produce few object relatives, and many “no responses” and declarative clauses. These two types of error are common to the production of both subject and object relatives.

6. General conclusions

The results of our research show an asymmetry between comprehension and production in atypical and early typical language acquisition. A detailed analysis of the linguistic strategies adopted to carry out the task with complex sentences (ORs) shows linguistic competence to be at different stages of maturation. The production task promotes syntactic processing and the possibility of generating alternatives by searching for a more suitable strategy to express information.

All the strategies adopted aim at avoiding the more complex syntactic computation involved in discontinuous chains (Grillo, 2008). Furthermore, our data show dissociation in comprehension and production of SRs between children with SLI and younger, typically developing children. With respect to correct SR comprehension in children with SLI, we propose that a linear extra linguistic heuristic (NP1 = Agent) is adopted to carry out the task. Crucially, resorting to this tactic means that syntactic structure is not taken into consideration, thus explaining the difficulty also found in the production of SRs. We argue that the linear strategy is not an option that TD children resort to. Younger control children comprehend SRs and ORs comparably and have mastered the production of SRs. The correct production of SRs suggests that they have acquired the computation involved in relative clauses. Because of that, we postulate that also in the comprehension task younger TD children have acquired the relative clause's structure. However, as the task might be too demanding for their age, their comprehension of SRs and ORs does not differ significantly.

In the present research we would like to support the idea that production plays an active role in language acquisition as it offers the chance to explore different degrees of syntactic complexity in the derivation. Furthermore, we highlight the importance of the strategies observed in the elicited production of TD children, as being a realization of a grammatically driven processing.

Considering all this evidence, the discrepancy between comprehension and production in a parallel testing ground is a fruitful method for evaluating grammatical development. Where linguistic development is grammatically consistent, linear heuristics are not adopted and implementation of a syntactic algorithm is preferred to the use of a “good enough” extralinguistic strategy.

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¹¹ The example in (40) is taken from Friedmann et al. (2009).

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