

# Re-thinking the Acquisition of Relatives: A New Comprehension Study with Italian Children

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## 1 Introduction

Going back to Quine (1960: quoted in (Heim & Kratzer, 1998), restrictive relative clauses (RCs) are traditionally analyzed as predicates, i.e. they are noun modifiers in the same way as APs and PPs usually are. For instance, interpreting the RC in (1):

- (1) The cow bumped the horse that tickled the cat.

requires the ability to understand that the embedded clause is a noun modifier and that the noun that is being modified is the NP, *horse*. The NP *horse* is the head of the RC. Following Quine (1960), the correct interpretation is derived by predicate modification of “that tickled the cat” combined with the RC head “horse”. This operation restricts the referent set given in the context. Hence, in order for the RC in (1) to be pragmatically felicitous it is presupposed that at least two or more horses are presented in the context. Furthermore, when “horse that tickled the cat” becomes the argument of the definite determiner “the”, it denotes that exactly one horse is chasing the lions in the given context.

The acquisition of restrictive RCs has been at the center of a lively debate among researchers at least for the past two decades. Contrasting findings in production and comprehension (and, very often, also within the same modality) have given rise to a number of questions about acquisition time course, underlying processing mechanisms and how linguistic theory that can account for the experimental findings. In particular, elicited production experiments (Crain *et al.*, 1990; Diessel & Tomasello, 2005; Guasti & Cardinaletti, 2003; McKee *et al.*, 1998) show that children start to use RCs around age 3/4. Moreover, Diessel & Tomasello (2000) describe the earliest naturally occurring relative attempts as semantically simple and find examples of their occurrence from 2 years onwards.

In early RC comprehension studies (see (Guasti, 2002) for a review) manipulation of toys was used (*acting out* task) and children performed at chance level until age of 5. This delay was explained by saying that children’s grammar was different from that of adults and revealing different processing/surface heuristics which were claimed to be at play in the immature grammar system.

However, methodological flaws in these early tasks were soon pointed out (Corrêa, 1995; Goodluck & Tavakolian, 1982; Hamburger & Crain, 1982). Hamburger & Crain (1982) showed that when the experimental setting was pragmatically appropriate, 4-year-old American children comprehension and production were above chance. In a later study, (Crain *et al.*, 1990), 2- and 3-year-old children were also able to produce such sentences.

Lately, pictures (instead of toys) have been widely used in experimental investigations, in that they allow to test more items per condition, less between-subjects variability and are more suitable for language disorders assessment. But in a number of recent studies (Arnon, 2005; Arosio *et al.*, 2005; Friedmann & Novogrodsky, 2004), some of the ‘old’ methodological flaws are at play again.

We present data from 3 to 7-year-old Italian monolingual children who have been tested on right-branching subject and object RCs. Three sentence types were tested, subject relatives (OS, henceforth) and two types of object relatives (OO and OOp). As for object relatives, OO differ from OOp in the superficial word order of the subject DP: it is in pre-verbal position in the former but in post-verbal position in the latter. An example is provided in (2):

- (2) a . Indica il cavallo [che sta inseguendo i leoni].  
‘Point to the horse that is chasing the lions’.  
b. Indica il cavallo [che i leoni stanno inseguendo].  
‘Point to the horse that the lions are chasing’

- c. Indica il cavallo [che stanno inseguendo i leoni].  
 Point to the horse that are chasing the lions  
 'Point to the horse that the lions are chasing'

The RC is indicated in squared brackets. It is worthwhile mentioning that in Italian, the sentence in (3) is ambiguous, between the subject and object reading:

- (3) Indica il cavallo [che sta inseguendo il leone].  
 Point to the horse that is chasing the lion  
 'Point to the horse that is chasing the lion' or 'Point to the horse that the lion is chasing'

The aim of this paper is two-fold: first, we present a task for the assessment of RC comprehension which offers the advantages of using pictures (instead of toys) and it also overcomes (some) of the methodological problems. Second, we will claim that children's data support the idea of continuity between early and adult's grammars. In particular, we suggest that children access the operation of relativization from early on and that the early difficulty with object RCs finds an explanation using a locality principle such as Relativized Minimality (RM) (Rizzi, 1990, 2004) as a metric of syntactic complexity.

The paper is structured as follows: first, some criticisms of previous experimental designs are outlined, and a solution is proposed. Second, we introduce a new experimental setting and procedure for testing restrictive RC comprehension with children. Third, our participants and results are presented and then theoretical implications of our results are discussed. We will conclude the paper by outlining some remaining open questions that will require further investigation.

## 2 Some methodological observations

As Hamburger & Crain's (1982) influential work pointed out, the matrix and embedded clauses in RCs are in an assertion-presupposition relation. Let us look at (4):

- (4) a. The cow bumped the horse [that tickled the cat].  
 b. The cow bumped the horse [that the cat tickled].

The meaning conveyed by (4) is expressed by the matrix "*The cow bumped the horse*" but it presupposes that the same horse tickled the cat. Furthermore, the use of (4) is pragmatically felicitous when at least two horses are presented in the referent context. In fact, the restrictive RC function is that of restricting the set of potential referents for the definite expression *the horse*. Hamburger & Crain (1982) show that once the experimental setting was modified (by adding an extra horse toy, in the example above), 3, 4 and 5 year-old children performed at 69%, 74% and 95% correct, respectively.

More recently, research on atypically-developing populations have also focused on the acquisition of RCs. A common finding across these studies is that children with SLI show a significantly poorer performance on RC comprehension than their language and age peers. This is taken as an evidence that the underlying deficit in SLI affects the representation of A'-dependencies. From a methodological perspective, we would like to discuss Friedmann & Novogodsky's experimental design, noting that the same observations are also applicable to Arosio et al.'s (2005) study.

Friedmann & Novogodsky (2004) tested a group of 10 Hebrew-speaking children with (syntactic-)SLI (age 7;3-11;2) and two groups of typically-developing children aged 4;7 and 6;2, using a binary picture-sentence matching task. They were testing both subject and object right-branching relatives such as (5) and (6) with two pictures as in Figure 1 (from Friedmann & Novogodsky (2004: 670-671):

- (5) *Zot ha-safta she-menasheket et ha-yalda.*  
 OS: This is the-grandmother that-kisses ACC the-girl
- (6) *Zot ha-safta she-ha-yalda menasheket.*  
 OO: This is the grandmother that the girl is kissing



Figure 1(a) and (b): A sample of Friedmann & Novrotsky's (2004) experimental pictures

Children were asked to choose one of two pictures. They found that the comprehension of subject relatives was poorer in 4 year-olds (85%) rather than 6 year-olds or children with SLI (95% and 98.5%, respectively). Furthermore, they found that 6 year-olds have an 86% level of accuracy on object relatives, compared to 4 year-olds and children with SLI who were at chance (58% and 62%). We observe that chance level performance at 4 is an unexpected low result and there are reasons to believe that it may be related to some confounding factors in the experimental design. In particular, as we have seen, RCs are noun modifiers and, therefore, being able to interpret a RC correctly means to be able to understand (among other things) which NP it refers to. Hence, given (5) or (6), the child has to individuate which one is the correct grandmother. This is pragmatically different from choosing between pictures where the grandmother is kissing the girl or the one where the grandmother is being kissed by the girl. In other words, the choice between two pictures such as Figure (1a) and (1b) is not the correct task requirement to individuate the referent of a RC head. Moreover, although the authors explicitly state (p.672) that their experimental setting satisfies Hamburger & Crain's felicity requirements, we suggest that this is not the case given that within one picture no other possible referent to restrict the set is presented (e.g. an extra-grandmother). If both pictures have to be taken into account at the same time, a different problem arises: namely, the infelicitous use of the definite determiner "the" to specify "girl", in a context where in fact two girls are present.

The observation about picture-selection as an inappropriate task demand was also put forward by Arnon (2005), who replicates F&N's study, asking children to point to the correct character in one of the two pictures. However, we suggest that an unnecessary complication (or a potential confound) is still present in her study. Namely, there is no need to use two separate pictures if the task demands selection of one referent out of the others. Moreover, the infelicitous use of a definite determiner also applies to Arnon's study. Stemming from these observations, we propose a new methodology as described in the subsequent sections.

### 3 Method

#### 3.1 Participants

One hundred and sixteen Italian monolingual children participated in this study. Parent consent forms were collected. See the Table 1 for more details about participants:

	Age Groups				
	3	4	5	6	7
N	12	17	27	37	23
Mean Age	3;6	4;5	5;6	6;6	7;3
Age Range	3;4-3;11	4;0-4;11	5;0-5;11	6;0-6;11	7;0-7;9

Table1: Participants details

#### 3.2 Materials

The sentences under investigation are those reported in (1) and repeated in (7) for clarity:

- (7) a . Indica il cavallo [che sta inseguendo i leoni].  
 'Point to the horse that is chasing the lions'  
 b. Indica il cavallo [che i leoni stanno inseguendo].  
 'Point to the horse that the lions are chasing'  
 d. Indica il cavallo [che stanno inseguendo i leoni].

Point to the horse that are chasing the lions

'Point to the horse that the lions are chasing'

Animate and inanimate referents seem to play a different role in adult processing studies. Hence, unless animacy is taken as experimental factor, it is necessary to control for these effects. In our experiment we decided to neutralize animacy effects by using exclusively animate referents. For each trial, only transitive verbs are used. We used the following verbs: rincorrere (*to run after*), tirare (*to pull*), inseguire (*to chase*), beccare (*to peck*), seguire (*to follow*), lavare (*to wash*), guardare (*to look at*), mordere (*to bite*), spingere (*to push*).

Each experimental trial is disambiguated through number agreement between the subject and auxiliary verb. In particular, the relative head is always singular whereas the embedded noun is always plural. The verb can either refer to the relative head (OS) or to the embedded noun (OO and OOp). The test is composed of picture/sentence pairs. The pictures were selected from those used by (De Vincenzi, 1996) for testing subject/object wh-questions in Italian. The pictures always have the same structure: animal X on the left, a pair of animals Y in the middle and animal X on the right. For example, a horse that is chasing two lions and these two lions are chasing another horse (Figure 2). So, Figure 1 is paired with one of the structures in (7):

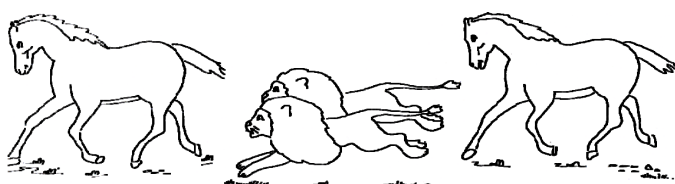


Figure 2: A sample of the experimental pictures

Hence, the correct answers are always on one of the peripheries of the picture. All sentences were recorded by a female voice and were administered using speakers connected to a laptop. It is important to emphasize how these pictures are more appropriate for RC assessment than other methodologies previously used: first, the use of pictures and pre-recorded sentences rather than toys makes the assessment of this constructions more homogeneous across subjects; second, the structure of the pictures as illustrated above satisfies the pragmatic felicity conditions for using a RC (i.e. two horses occur in the same picture); third, given that a RC is by definition a noun modifier, the Agent selection task is a more appropriate task demand than picture-selection. For instance, in (7) the child is asked to "Point to the horse...". An additional change with respect to previous methodologies is naming aloud all the characters, before the sentence started. In doing so, we allow children to scan the experimental setting and, furthermore, we minimize lexical access load.

Twelve filler sentences were used in order to introduce some correct responses corresponding to the character in the central position.

Children's responses were scored into one of three categories, one of which is the target response and the other two are non-target responses. Non-target responses are conventionally labeled as "reversed error" and "middle error". The reversed error occurs when the other character corresponding to the head NP is chosen. For instance, given (8) and Picture 1 above,

- (8) Indica il cavallo che i leoni stanno inseguendo  
'Point to the horse that the lions are chasing'

the reversed error consists of choosing the horse on the left (rather the one on the right hand side). The lion on the left is the one that is chasing the lions, rather than being chased by the lions. For instance, given (8) above, the child points to the lions in the middle. The introduction of this response option is particularly relevant given that there is a claim in the literature (Arnon, 2005) according to which 4- to 5-year-old Hebrew-speaking children make the two errors at virtually the same rate in OR (22% Agent, 27% Reversed).

### 3.3 Procedure

We began with a verb comprehension test, in order to make sure that all children (especially the 3-year-olds) were familiar with the lexical verbs that were used in the test. In order to make sure that participants knew all the characters each trial was introduced by an intro. For example, for one of the conditions in (7), the delivery would be: *Look, here there's a horse, here there are two lions and here there's another horse. Now, we will listen to a voice saying something and you will show Camilla, which is the right character*". Camilla is the puppet that we used as mediator between children and us. We began with three practice sentences and then moved to the experimental trials. See (F. Adani, forthcoming), for more details about our experimental procedure.

## 4 Results

Response type percentages for each group are summarised in the Table 2 (percentages are indicated because group sizes differ. However, for the statistical analysis raw scores were used):

Age Group	OS			OO			OOp		
	Target %	Reversed %	Middle %	Target %	Reversed %	Middle %	Target %	Reversed %	Middle %
3	91	9	0	53	34	13	36	60	3
4	93	7	0	83	10	7	59	41	0
5	90	9	1	74	15	11	54	44	2
6	96	4	0	85	14	1	55	45	0
7	93	7	0	89	11	0	70	30	0

Table 2: Response type percentages for each age group

Two statistical analyses were performed in order to determine which differences are statistically significant using a repeated-measure Logistic Regression. Logistic models calculate the experimental factor effects on the odds of an event over the non-event. The odds are the ratio between the event probability and the non-event probability. We take this ratio as the dependent variable of the logistic models. As for the first analysis, the ratio under investigation is Non-target responses (event) rather than Target responses (non-event). We want to see how children's non-target responses vary, with respect to Sentence type (within-subject factor) and Age group (between-subject factor).

### 4.1 Target Response Analysis

The main results of the target response analysis reveals that subject relatives are more accurate than object relatives, as found in adult sentence processing. Therefore, the so called Subject/Object asymmetry is confirmed. As for the two object relatives, OO is more accurate than OOp, as also found in Arosio et al. (2005). A detailed statistical analysis is provided in Adani (forthcoming). Nevertheless, it is important to draw the reader's attention to the fact that, overall target response rates are consistently extremely very accurate and, furthermore, substantially higher than in previous studies (Arnon, 2005; Arosio et al., 2005; Friedmann & Novogrodsky, 2004).

Once we have established how accurate children are in the task, we can now explore how they perform when a non-target response is provided. In other words, what do they do when they do not get it right? Do children behave differently at different ages? These questions will be addressed in the non-target response analysis, where Reversed and Middle responses are compared. We address this issue in the following section.

### 4.2 Non-target response analysis

The analysis of non-target responses revealed that when children do not get the target response, they show two distinct response patterns: as for OOp, they tend to choose the interpretation where arguments are reversed. In particular, this response type ranges from 60% in 3 year-olds to 30% in 7 year-olds. On the other hand, two different responses are attested in OO: 3 year-olds show a 34% of reversed interpretations but this error drastically drops to 10-15% from 4 year-olds onwards. Furthermore, we have shown that another non-target response appears in OO, namely, 3 to 5 y.o.

children choose the embedded NP rather the head NP between 7 to 13% of the times. After 5, this error virtually disappears. In particular, as the individual data show that error Middle is chosen by 6 out of 12 children at age 3, by 4 out of 14 at age 4 and 4 out of 27 children at age 5 choose it at least 2 times. A detailed statistical analysis is provided in Adani (forthcoming).

Our response pattern correlates with Arnon's finding. However, 4 to 5 year-old Hebrew children were observed to choose one error over the other nearly with the same frequency (22% Middle, 27% Reversed). Conversely, the group of Italian children tested in our study show an asymmetry in their non-target responses: in average, 20% Reversed and 10% Middle from 3 to 5 (i.e. for those ages where both error are consistently reported). Interestingly, in Italian there are fewer errors overall, but especially fewer Middle type errors. The different behaviour between Italian and Hebrew children could be influenced by the different methodology, namely one big picture (Italian) versus two pictures (Hebrew).

## 5 General discussions

We will divide the discussion of our results in two parts. First, we will explain why the gradient of difficulty in the sentence types under investigation. Second, we will provide an explanation processes underlying children's non-target responses.

### 5.1 Gradient of difficulty OS>OO>OOp

Our results show that a gradient of difficulty (OS>OO>OOp)<sup>1</sup> is attested in children's comprehension of RCs and this finding correlates with most of the previous results in the literature (both in production and comprehension). Following Arosio et al. (2005), we suggest that the OS>OO asymmetry can be explained by the Minimal Chain Principle (De Vincenzi, 1990). Namely, shorter dependencies are less demanding to process than longer ones and therefore, the human parser is predicted to start with a short dependency analysis. Thus, the parser should always start with a subject RC analysis, (9), which is then abandoned when an object RC analysis is required, (10):

- (9) Indica il cavallo<sub>i</sub> [che <e><sub>i</sub> sta inseguendo i leoni]. one (short) chain: <head NP, e>  
 (10) Indica il cavallo<sub>i</sub> [che i leoni stanno inseguendo <e><sub>i</sub>]. one (long) chain: <head NP, e>

Following the same line of reasoning, the asymmetry OO>OOp is also captured. In addition to the first chain instantiated between the head NP and the gap in embedded object position required for OO (cf. 13), OOp also require a second chain between the expletive *pro* in pre-verbal position and the post-verbal NP (L. Rizzi, 1986), as in (11):

- (11) Indica il cavallo<sub>i</sub> [ che *pro*<sub>j</sub> stanno inseguendo <e><sub>i</sub> i leoni<sub>j</sub>].  
 I chain: <head NP, e>  
 II chain: <pro, subject NP>

No age effect was attested on subject relatives, given that all groups perform at ceiling (90-96%). However, it could be argued that, not real knowledge of RC function is necessary to interpret an OS, given that the linear order of constituents would trigger the target response. However, 53% accuracy on OO at 3 is certainly a hint that also 3 year-olds understand these structures, although not in a consistent way. This observation is confirmed looking at 3-year-old's individual performances: two children scored 100% correct, whereas one child scored 75% correct. We take these results as showing that the operation of Relativization is available in child grammar from at least age 3. Children begin with relativizing subjects (this means that they are able to represent an empty category in Spec,TP that is bound by the DP to which the CP is adjoined, cf. (15a)). From age 4, child grammars are also able to represent a bound category in object position, cf. (15b). We suggest that from 4 years onwards, the two representation in (12) are both available, but (12b) tends to be preferred by the parser as the Minimal Chain Principle predicts:

<sup>1</sup> Conventionally, we use ">" for more accurate and "<" for less accurate

- (12) a. DP [<sub>CP</sub> che [<sub>TP</sub> <e> [<sub>VP</sub> ....]]]  
 b. DP [<sub>CP</sub> che [<sub>TP</sub> DP [<sub>VP</sub> .... <e> ]]]

Interestingly, unexpected low performances in 5 year-olds have also been found by Guasti, Stravakaki and Arosio (2007) in a Greek/Italian comparative study using the same methodology, but we do not have an explanation for this.

What seems to be more challenging for Italian children is the interpretation of OOp (i.e. object relatives with post-verbal subject) which require the simultaneous computation of RC and inverted subjects. In fact, whereas 3 year-olds perform at below chance (36%), from 4 to 6 year-old, the accuracy rate is around 50%. However, at age 7, accuracy rates rise up to 70%. Hence, the addition of the second chain <*pro*, *i leoni*> is even more taxing for the child system and it determines a predominant application of the Minimal Chain Principle. As a consequence of processing load, the interpretation of a null *pro* instead of a full DP does not seem to be fully represented until age 7 (but see our concluding remarks for a potential experimental confound on this point).

## 5.2 Children's non-target responses as a grammatically-based phenomenon

In the remaining part of the discussion we elaborate in depth the idea that 3-year-olds' difficulty in object RCs can be explained as a consequence of a temporary computation overload due the intervention of the embedded DP and we will adopt Relativized Minimality (Luigi Rizzi, 1990; L. Rizzi, 2004) as a metric of syntactic complexity. Relativized Minimality (RM) is a principle of economy of syntactic representation and it states that the formation of a chain over an intervening element is blocked when the two elements belong to the 'same structural type', but is possible otherwise. Within a cartographic approach to left periphery of CP (L. Rizzi, 2004), what was traditionally called Spec, CP is divided in a hierarchy of functional positions, each of which is associated to a specific set of morpho-syntactic features (cf. (61) in Rizzi (2004) reported below):

- (13) a. Argumental: person, number, gender, case  
 b. Quantificational: Wh, Neg, measure, focus  
 c. Modifier: evaluative, epistemic, Neg, frequentative, ...  
 d. Topic

Specifically, RM effects are predicted among features that belong to the same class. As for the present discussion, only Argumental (a) and Quantificational (b) classes are considered.

RM has inspired a recent account of comprehension errors by agrammatic patients (Garraffa & Grillo; Grillo, 2005). These authors suggest that below chance performances on a number of constructions with dislocated constituents at the surface level (object RCs, wh- object extracted questions, passives) can be explained as RM effects, where the DP feature representation is not fully accessible due to processing overload of an impaired system. As we have seen, in order to interpret a RC, the human parser needs to build up a relation between the first DP encountered in the main clause (RC head) and its gap in the embedded clause. Whereas in OS relatives, such as (9), not other potential candidate intervenes between the RC head and its gap, in OO relatives, such as (10), the intervening DP can, under particular circumstances (i.e. other than in the intact adult parser), make the establishment of this relation more difficult.

As for typical development, it has been already suggested that children's non-target early productions are repercussions of a not fully developed performance system (L. Rizzi, 2005, 2007). In particular, whereas most parameters seem to be successfully fixed by the third year of life, some child inconsistencies in the use of the A'-syntax (mainly wh-extraction) are attested even after 3 year-old. Given that this applies to production, there is no principled reason why similar patterns cannot be found in comprehension.

In particular, RM predicts above chance accuracy on OS, as no DP intervenes between the moved subject (RC head) and its gap, as (14) illustrates (Q indicates the wh-/relative feature)<sup>2</sup>:

<sup>2</sup> At least as far as the final word order is concerned but see Adani (forthcoming) for a more specific manipulation supporting the idea that milder intervention effects occur also during the derivation of subject RCs

As for the child's representation, we suggest that the interpretation of a null *pro* is even more taxing than the interpretation of a full DP, as in (12b). This would determine a deficient representation of *pro* which has repercussion on the correct representation of agreement features on the verb, given that *pro* is the licenser of these agreement features. As a consequence, the final NP *i leoni* fails to be interpreted as the subject of *stanno*. Given this deficient feature representation and guided by general processing strategies of economy (Minimal Chain Principle), our prediction is that children will give a representation of an OOp, which is different from the adult representation but is allowed by child grammar. Our data confirm that 3-year-olds interpret OOp as OS, given that for them only (12a) is available. They do this 60% of the times. From 4 years onwards, both representations in (12) coexist and therefore, processing constraints will make the child to pick one or the other. From 4 to 6 years, children choose the reversed interpretation from 41-45% of the times. At age 7, children provide a more refined representation of features and are able to see the mismatching agreement morphology on the upcoming verb. This allows them to block the representation in (12a), adjust (12b) by interpreting *pro*, and thus the adult interpretation is derived.



However, an additional observation is in order at this point. In the production domain, there is evidence that children produce post-verbal subjects with RCs (Guasti & Cardinaletti, 2003; Utzieri, 2007). In her production task, Utzieri found a significant difference in the use of pre-/post-verbal subjects between the two tasks she had been using. Her Preference Task (as opposed to the Picture Description Task) elicited significantly more post-verbal subjects. This difference was explained by saying that, whereas children had to choose in which situation (out of two options) they preferred to be, the degree of involvement was higher (compared to the other task, where they were talking about other characters). In syntactic terms, we can say that they were more focused on the subject. In our task, this condition was not tested and therefore, it could be argued that poor comprehension of OOp depends on the experimental setting, where information structure requirements fail to be satisfied. This possibility is completely open and a specific experiment to tackle this research question is required. However, our data clearly show that whereas an improvement in dealing with RC is expected between 3 and 4, this is indeed attested also in OOp. However, we have to wait until age 6-7, for children to be able to compute both relations successfully.

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