Catalan Child Relative Contrasts as a Processing Effect

Anna Gavarró, Arnau Cunill, Míriam Muntané, and Marc Reguant
Universitat Autònoma de Barcelona

1. Introduction

Research in various languages indicates that children interpret subject relatives in an adult-like manner substantially earlier than they interpret object relatives. This asymmetry, while grounded in a grammatical contrast, may be attributed to processing of the corresponding syntactic structures, as in Gibson (1998), Johnson (1998), and Morrill (2000). One question that emerges is: if processing can be argued to be the source of poor performance in the interpretation of object relatives, does this carry over to production? Here we address this issue with data on the acquisition of Catalan; we present original results for relative clause elicitation and compare them with those of a relative clause interpretation experiment.

The paper proceeds as follows: In section 1 we provide the background to the present study. Section 2 gives an analysis for the subject/object relative asymmetry found in comprehension. Section 3 describes an experiment for the elicitation of relative clauses carried out in Catalan. Finally, in section 4, we compare production and comprehension and draw conclusions.

2. Background: relative clause comprehension in Catalan
2.1. An experiment on relative clause comprehension

The acquisition literature reports on work in numerous languages showing a contrast between the interpretation of subject and object relative clauses. This is attested for English (Brown, 1972; Sheldon, 1974; de Villiers et al., 1979), French (Frauenfelder, Seguí, & Mehler, 1980), German (Schriefers, Friederici, & Kühn, 1995), Italian (Arosio, Adani, & Guasti, 2009), Greek (Guasti, Stavrakaki, & Arosio, 2008), and Hebrew (Friedmann et al., 2009), among others. This asymmetry is, however, not universal, since languages with prenominal relative clauses such as Chinese and Basque are known to behave differently: see for example the work of Hsiao and Gibson (2003) on Chinese and that of Carreiras et al. (2010) on Basque. Nonetheless we will centre our attention here on the type of language mentioned first, namely, that of head-initial, postnominal relative clauses, and consider one particular language, Catalan, for which comprehension results are available, and then revisit prenominal relatives at the end of the paper.

Catalan relative clauses are postnominal and headed by the relative pronoun *que,* which, unlike the Spanish relative pronoun, is not identical to a *wh*-word. *Que* introduces both subject and object relatives – only prepositional relatives present the alternative pronoun *qui* (*La nena a qui he enviat el llibre* 'The girl to whom I sent the book').

Gavarró, Adani, Ramon, Rusiñol, and Sànchez (to appear) carried out an experiment on the comprehension of Catalan relative clauses, replicating the experiment of Arosio et al. (2009) and

Adani (2010). The experiment was an agent identification task with picture support. Children had to identify a character in a picture when the experimenter requested it, as illustrated in (1).

(1) a. Assenyala el camell que segueix els elefants!
point to the.SG camel that follows the.PL elephants
'Point to the camel that is following the elephants!'

   b. Assenyala el camell que els elefants segueixen!
point to the.SG camel that the.PL elephants follow
'Point to the camel that the elephants are following!'

   c.   Assenyala el camell que segueixen els elefants!
point to the.SG camel that follow the.PL elephants
'Point to the camel that the elephants are following!'

Example (1a) includes a subject relative, (1b) an object relative with a preverbal subject in the embedded clause, and (1c) an object relative with a postverbal subject in the embedded clause. Object relatives of this last type are potentially ambiguous as Catalan has no overt case-marking and therefore postverbal subjects may be interpreted as subjects or objects, unless subject–verb agreement disambiguates the sentence. This ambiguity is in fact found in all the Romance null subject languages.

All sentences in the experiment were unambiguous and reversible, so that the interpretation rested on the linguistic input only. The task was run with 33 children, 12 of whom were younger than 4;6 (mean age 3;11,26), 11 of ages between 4;6 and 5;6 (mean age 4;11,6), and 10 older than 5;6 (mean age 6;0,12); the age range was 3;5,9–6;2,30 and the mean age 4;11,4. The results appear in Table 1.

Table 1
Results for relative clause comprehension: target comprehension by age

	SR		OR	
<4;6	57/72	79%	47/132	35%
4;6–5;6	64/66	97%	53/121	43%
5;6<	60/60	100%	63/110	57%
Adults	131/132	99%	243/252	96%

Note. SR = subject relative; OR = object relative (from Gavarró et al. to appear).

These results indicate how subject relatives are interpreted in an adult-like manner from early on (79% of the time in the younger group), while object relatives develop at a slower pace; in fact object relatives with postverbal subjects are misinterpreted for the whole period investigated. Very similar results are found in a related language, Italian (see Arosio et al., 2009; Adani, 2010).

2.2. A categorial analysis

In Morrill and Gavarró (2010) we analyze these comprehension contrasts as the result of the relative processing load of the structures involved. We propose to account for the findings by adopting an analysis based on Morrill's (2000, 2010) metric of syntactic complexity, an implementation of Gibson's (1998) and Johnson's (1998) insight that processing difficulties increase as a function of the number of unresolved dependencies that the speaker must keep in memory. Morrill (2000, 2010) proposes a metric of processing cost that can account for the relative difficulty of Catalan object relatives as opposed to subject relatives (notice that both are low in processing cost if compared to center embedding, for example, *the cheese that the rat that the cat saw ate stank*, for which adults are found to have difficulties).

Categorial grammar (Morrill, 2010) classifies words and expressions by means of fractional types built over basic types such as sentence (S) and nominal (which we parameterize here with number singular, N(sg), plural, N(pl), or unspecified, N(_)). An expression of type A\B is one which

concatenates with any expression of type A to the left to form an expression of type B. An expression of type B/A is one which concatenates with any expression of type A to the right to form an expression of type B. Formally:

(2) $A\backslash B = \{s|$ for all $s' \in A$, $s'+s \in B\}$
$B/A = \{s|$ for all $s' \in A$, $s+s' \in B\}$

Morrill (2000, 2010) describes a complexity metric founded on incremental categorial processing in terms of proof nets. In this view of processing, types are marked with input polarity (•), meaning that a resource is given, or output polarity (◦), meaning that a resource is wanted. Polar types are unfolded upwards into polar type trees as follows:

(3)

$$A^{\circ} \qquad B^{\bullet} \qquad\qquad B^{\circ} \qquad A^{\bullet}$$
$$A\backslash B^{\bullet} \qquad\qquad A\backslash B^{\circ}$$
$$B^{\bullet} \qquad A^{\circ} \qquad\qquad A^{\bullet} \qquad B^{\circ}$$
$$B/A^{\bullet} \qquad\qquad B/A^{\circ}$$

We refer the reader to the references above for extensive details but we illustrate the basic idea here with the processing of this sentence:

(4)   John loves Mary.

Initially, a sentence is sought and after hearing the first word its type is given:

(5)

$$S^{\circ} \qquad\qquad N(sg)^{\bullet}$$

John

When the second word is heard, its unfolded type is connected by two dependencies: the subject sought is given by the first word *John* and the sentence projected is matched by the initial expectation of a sentence. We represent this as follows:

(6)

$$N(sg)^{\circ} \qquad\qquad S^{\bullet}$$
$$N(sg)\backslash S^{\bullet}$$
$$S^{\circ} \qquad N(sg)^{\bullet} \qquad\qquad (N(sg)\backslash S)/N(\_)^{\bullet} \qquad N(\_)^{\circ}$$

John   loves

When the final word is heard, the parse is completed thus (the unspecified object number on the verb type becomes instantiated by unification with the type with which it is matched):

(7)

$$N(sg)^{\circ} \quad S^{\bullet}$$

$$N(sg)\backslash S^{\bullet}$$

$$N(\_)^{\circ}$$

$$S^{\circ} \quad N(sg)^{\bullet} \quad (N(sg)\backslash S)/N(\_)^{\bullet} \quad N(sg)^{\bullet}$$

John   loves   Mary

The derivations proposed for a subject relative and an object relative in Catalan appear in (8) and (9) respectively.

(8) Derivation of sentence (1a)

$$S^{\circ} \quad DP\nu^{\bullet} \quad DPsg \quad S^{\bullet}$$

$$CN\nu\backslash CN\nu^{\bullet} \quad \backslash^{\circ} \quad \backslash^{\circ} \quad DP^{\circ} \quad DPpl^{\bullet} \quad CNpl$$

$$/^{\bullet} \quad /^{\bullet} \quad /^{\bullet} \quad CNpl$$

que   segueix   els   elefants

(9) Derivation of sentence (1b)

$$DP^{\bullet} \quad S^{\circ} \quad DPpl^{\circ} \quad S^{\bullet}$$

$$\uparrow^{\circ}$$

$$CN\nu\backslash CN\nu^{\bullet} \quad \wedge^{\circ} \quad DPpl^{\bullet} \quad CNpl^{\circ} \quad \backslash^{\bullet} \quad DP^{\circ}$$

$$/^{\bullet} \quad /^{\bullet} \quad CNpl^{\bullet} \quad /^{\bullet}$$

que   els   elefants   segueixen

The relative pronoun *que* seeks to the right a category in turn seeking a DP, and this is satisfied earlier in the subject relative clause (in subject position) than in the object relative clauses. The processing load at each point in the sentence is mechanically worked out by the metric. The complexity profile of a sentence describes the incremental load at each word boundary by counting the syntactic dependencies that are unresolved at each point (where syntactic dependencies include major categories and feature values, both counting for 1). When the last word of the sentence has been heard, all dependencies are resolved and the profile reaches 0. We can observe the differences in the number of dependencies to be resolved in the subject and object relatives exemplified above. The complexity profiles are read as follows: the Y-axis represents the load on memory at a point; the character *a* represents the load level in the example after you hear one word and before you hear the next. The load level corresponds to the number of lines overarching across in the derivation of the sentence. The complexity profile of (1b) in (11) is higher than that of (1a) in (10), thus predicting lower acceptability,

which by hypothesis results in higher comprehension problems.

(10)   Complexity profile of sentence (1a)

```
3                    a
2                        a
1                    a
0                              a
  Assenyala el camell que    segueix   els   elefants.
  point-to    the camel that    follow-3s   the-pl elephants
```

(11)   Complexity profile of sentence (1b)

```
7                        a
6
5                            a
4
3                    a
2
1
0                              a
  Assenyala el camell que    els    elefants    segueixen.
  point-to    the camel that    the-pl elephants    follow-3pl
```

To summarize, we have shown how a categorial metric of complexity can be put to use to account for differences between subject and object relative comprehension. What we set out to do next is consider the production of relative clauses under the same analysis.

3. An experiment of relative clause production

3.1. Experimental design

In order to test the production of relative clauses in child Catalan, we ran an elicitation experiment, our version for Catalan of the elicitation task designed in the context of COST Action A33, in turn based on Novogrodsky and Friedmann (2006) – results for the sixteen languages tested in the framework of COST Action A33 are in preparation (Friedmann et al., in prep.). The elicitation method is construed as a questionnaire in which we ask children about their preferences. The child is presented with situations such as: 'There are two children. One child is drinking milk, the other child is drinking water' and then is asked 'Which child would you rather be?' The target answer involves a relative clause: 'I'd rather be the child who is drinking milk'. Children were asked to start their answers with 'I'd rather be the child…'; the experimenter could repeat the question at the request of the child, and suggest that the child started with 'I'd rather be the child', but was not to mention the relative pronoun. This elicitation method is exemplified for subject relatives and object relatives for Catalan in (12). The prompts crucially induced the production of relative clauses, and the method proved to be very effective.

(12)   a.   Hi ha dos nens. Un nen beu llet i un altre nen beu aigua. Quin nen t'agradaria ser?
            CL have two children A child drinks milk and another child drinks water Which child CL like to-be
            'There are two children. One child is drinking milk and the other child is drinking water. Which child would you rather be?'

       b.   Hi ha dos nens. Un pare abraça un nen i un pare gronxa un nen. Quin nen t'agradaria ser?
            CL have two children A father hugs a child and a father swings a child Which child CL like to-be
            'There are two children. A father is hugging a child and a father is swinging a child. Which child would you rather be?'

There were a total of twenty items, of which ten corresponded to subject relatives and ten to object relatives. The verbs in the embedded sentence were all transitive. Of each ten subject and ten object relatives, six were reversible (both referents involved could fulfil the Agent and Theme theta role, as in (12b)), while four were irreversible (like (12a) above). Reversibility will not be considered in the analysis.

The children were all native speakers of Catalan (in particular Central Catalan) recruited at the Lloriana Primary School in Sant Vicenç de Torelló and at the Maria Borés Primary School in La Pobla de Claramunt; adult controls also came from the same towns (see Table 2).

Table 2
Age Information about Child and Control Subjects

Groups	N	Age range	Mean age
5-year-olds	20	5;0,11–5;11,24	5;5,15
Adults	10		

Children were tested individually in a quiet room in their schools. The input was not recorded, but rather produced by the experimenters, who also transcribed the answers. Only sentences with a relative pronoun were considered to be relatives, and a relative clause was considered target-like if it was judged grammatical by adult speakers (the authors of the paper made the grammaticality judgments). The responses of all subjects were coded as follows: for subject relatives, target responses included relatives with a gap (termed target relative) and headless relatives, both produced by adults, and fragments without a relative clause and other unexpected answers. For object relatives the types of answers encountered were codified as target relatives with a gap, relatives with a postverbal argument (which are ambiguous between a subject and an object relative), subject relatives instead of object relatives, object relatives with a resumptive pronoun, object relatives with a resumptive full DP or a reflexive resumptive, and fragments.

3.2. Results

For subject relatives, the response types relevant for Catalan were (i) adult-like subject relatives with a gap (13a), headless relatives (13b), and a fragment without a relative clause (13c).

(13)   a.   M'agradaria ser el nen que beu llet.
                    CL would-like to-be the child that drinks milk
                    'I would like to be the child who is drinking milk.'

          b.   M'agradaria ser el que beu llet.
                    CL would-like to-be the that drinks milk
                    'I would like to be the one who is drinking milk.'

          c.   M'agradaria ser el de la llet.
                    CL would-like to-be the of the milk
                    'I would like to be the one of the milk.'

As mentioned above, in the case of object relatives, the strategies that Catalan speakers can adopt are more diverse, and likewise the errors found are also diverse. Answers included: (i) adult-like object relatives with a gap (14a), (ii) relatives with a postverbal argument, possibly the subject (object relative) or the object (subject relative) (14b), (iii) object relatives with a resumptive pronoun (14c), (iv) object relatives with a reflexive resumptive (14d), (v) object relatives with a resumptive full DP (14e), and fragments and inappropriate subject relatives.

(14)   a.   M'agradaria ser el nen que el pare gronxa.
CL would-like to-be the child that the father swings
'I would like to be the child that the father is swinging.'

          b.   M'agradaria ser el nen que gronxa el pare.
CL would-like to-be the boy that swings the father
'I would like to be the boy who is swinging the father' or 'I would like to be the
child who the father is swinging.'

          c.   M'agradaria ser el nen que *el* desperta la música.
CL would-like to-be the boy that him wakes-up the music
'I would like to be the child that the music is waking up.'

          d.   M'agradaria ser el nen que em desperten.
CL would-like to-be the child that REFL wake up-3pl
'I would like to be the child they are waking up.'

          e.   M'agradaria ser el nen que el veí pentina *el nen*.
CL would-like to-be the boy that the neighbour combs the boy
'I would like to be the child that the neighbour is combing.'

While all the options encountered amongst the productions of subject relatives were well-formed, not all the productions of object relatives were so; resumptive pronouns are grammatical in colloquial Catalan, but resumptive full DPs (14e) are not well-formed.

The total number of answers by the children was 400, of which only 13 were not relative clauses. The results for 5-year-olds and adults for subject and object relatives appear in Tables 3 and 4:

Table 3
Results for subject relative production

	5-year-olds		Adults
Target relative	173/200	86.5%	97.5%
Headless	23/200	11.5%	2.5%
Fragment	3/200	1.5%	0%
Other	1/200	0.5%	0%

Table 4
Results for object relative production

	5-year-olds		Adults
Target unambiguous	15/200	7.5%	16%
Ambiguous	76/200	38%	19%
Resumptive pronoun	34/200	17%	53%
Reflexive resumpt	6/200	3%	2%
Null subject	9/200	4.5%	0%
Subject relative	26/200	13%	0%
DP filled gap	25/200	12.5%	0%
Passive		0%	10%
Fragment & other	9/200	4.5%	0%

The first table shows that children produce subject relatives straightforwardly and, although they produce more headless relatives than adults, the pattern of production is very adult-like. While at age 5 children produced 98% of subject relatives, just like adults (including headed and headless relatives), they produced fewer object relatives, as shown in the second table. Only 7.5% of relatives were object relatives with a gap, and 38% corresponded to ambiguous relatives (compared to the 19% ambiguous

responses produced by adults). Although statistical analysis is pending, the difference between subject and object relatives is striking.

Object relatives with resumptive pronouns deserve special mention; they occurred in 17% of cases in the children's production, but constituted 53% of adult production (although these resumptives are considered substandard in Catalan, they are widely used and identified in the literature; see Solà, 2002). Children, unlike adults, produced relatives with a full DP copy of the relativized element, and also unlike adults never produced a subject relative with a passive verb (lack of passives by children is hardly surprising given that passives are a late development, as shown in the literature for many languages).

As we have shown, resumptive pronouns in Catalan relatives are commonly used by children and adults. Child production of resumptives has also been noted for languages that disallow it in the adult grammar, such as English and French (data from Pérez-Leroux, 1995, and Labelle, 1990, respectively):

(15)   the one that he lifted *it*   (Lia 4;5)

(16)   sur la balle qu'il *l'*attrappe.
        over the ball that he it catches   (LE 3;8)

Pérez-Leroux (1995) ran a relative clause elicitation experiment with Spanish- and English-speaking children (26 Spanish-speaking children, aged 3;5 to 6;8, mean age 5;3; 11 English-speaking children aged 3;5 to 5;5; mean age 4;10); based on her results, she argued that resorting to resumptive pronouns should be considered on a par with DP filled gaps in relatives, as in (17)–(18), and was found across languages in a systematic way.

(17)   the one that the cowboy is pulling *the horse*   (Thomas 3;7)

(18)   sur la balle qu'il lance *la balle*   (M 5;0; Labelle, 1990)
        on the ball that he catches the ball

In Catalan we found resumptives with object relatives only, consistent with Pérez-Leroux's findings for English and Spanish, and produced 17% of the time; DP filled gaps were found in 12.5% of cases; taken together, these two sets thus represent 29.5% of answers. Pérez-Leroux found that the percentage of resumptives in a broad sense (including resumptive pronouns and DP filled gaps) was 36.2% in Spanish, 25% in English and 40.9% in French (French data from Labelle's 1990 study); she also found the difference in the production of resumptives in the different languages not to be significant. Our results are clearly in line with those of Pérez-Leroux, and this is particularly relevant given that Catalan adults produce more resumptives than English adults (other than with relatives involving *such that*, English speakers appear not to commonly resort to resumptive pronouns). So we can conclude that our results are consistent with the claim by Pérez-Leroux that, in acquisition, the proportion of resumptives does not differ substantially across languages.[1]

As for the general outcome of the experiment reported, there is a sharp contrast between subject and object relatives in their production by 5-year-olds. It remains to be seen at what age the behaviour of children attains adult levels.

4. Comprehension and production compared

In some domains of language acquisition, the observation has been made that discrepancies emerge between production and comprehension of grammatical constructions. In some of these cases the discrepancy may be just apparent, so that children appear to comprehend a construction, and fail to produce it, yet under closer scrutiny it is found that their comprehension is also delayed. In other cases,

---

[1]   To our knowledge there is no published work in the type logical categorial framework here on the grammar of resumptives or their processing. What our results indicate is that resumption is relatively favoured by children in production.

such as the one of agreement production and comprehension, to which we turn later, the discrepancy still needs to be accounted for. Here we deal with an instance of this general problem. In particular, the research question we address here is: Does the production of relative clauses parallel comprehension in acquisition? As a first step, let us compare the results available involving comprehension to those for production obtained in the present study. It should be noted that the age range of the two groups of children compared does not coincide in its span, since in the comprehension experiment the age groups were children younger than 4;6, children 4;6 to 5;6, and children older than 5;6. Still, given that the pace of development in relative clause comprehension is gradual, it seems legitimate to compare a large group of 5-year-olds with two groups of children spanning 6 months in the older and younger range.

Table 5
Subject and object relative clause comprehension and production

Comprehension				
	SR		OR	
4;6–5;6	64/66	97%	53/121	43%
5;6<	60/60	100%	63/110	57%
Total	124/126	98%	116/231	50.2%
Production				
5-y-o		98%		62.5%

Target object relatives in production here include: object relatives with a gap, relatives with a resumptive pronoun and ambiguous relatives; inclusion of this last type may overestimate the percentage of correct answers (since it may include some or many disguised subject relatives). With this caveat, comprehension and production are graphically represented in Figure 1. Recall that the children taking part in the two experiments were not the same, and in fact the age range of the children in the comprehension experiment was broader; we thus leave for future research testing the same group of children both in comprehension and production.
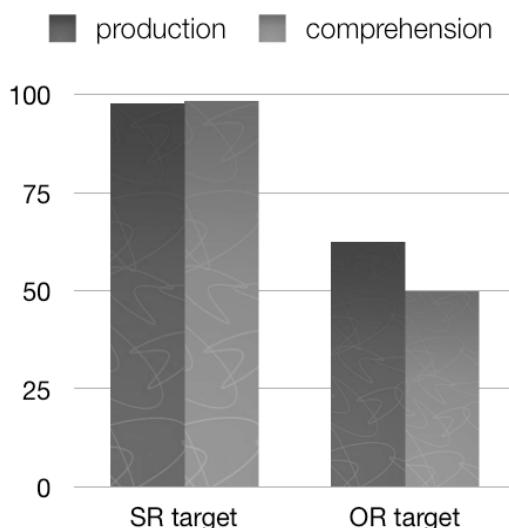
Figure 1. Percentage of correct production and comprehension of relative clauses, Catalan

The similarity between comprehension and production is notable, even more so if we take into account that the production of object relatives may have been overestimated. Here we will argue that, far from being accidental, this parallelism is to be expected under our approach.

There are some differences which the graph does not portray, namely the way in which miscomprehension of object relatives requires that children sometimes ignore the disambiguating morphology in the embedded verb (as found also in Arosio et al., 2009, in Italian), while children never produce errors in agreement in relative production (this contrast actually extends beyond relatives: subject-verb agreement is sometimes disregarded by children in comprehension, but not in production: see Johnson et al., 2005; Pérez-Leroux, 2005, for main clauses).

Gibson's and Morrill's proposals are neutral with respect to whether linguistic knowledge is put to use in production or comprehension: here we claim that, in fact, for the empirical domain considered, production and comprehension are equally taxed. Whether production and comprehension follow the same path is, in our view, an empirical matter, and it is well known that in many domains in language acquisition the parallelism does not hold. Here, however, we have an empirical domain where they operate in parallel fashion. It makes sense to think that if comprehension of a sentence is more taxing to the speaker when there is a higher number of syntactic dependencies that s/he must keep in mind, building such a structure would also be more taxing.

The fact that we are analysing the children's difficulties in comprehending and producing object relatives in Catalan as a processing effect implies that the grammar that we are attributing to them is fully adult-like: we do not claim that children have any problem with relativization per se, with *wh*-movement, or any other basic syntactic operation. Indeed, they do not always fail with object relatives, which is what we would expect if their grammars were immature to handle them.[2] Briefly, we claim that processing resources may be more limited in children than in adults, as shown by the results here, and such limitations have a gradual impact on performance. Equally, in adult populations the same gradual effect of processing load can be found: Catalan-speaking adults also produced more errors with object relatives than with subject relatives, and under pressure we would expect that to become more visible.

Recently, Friedmann, Belletti, and Rizzi (2009) have also taken the stand that comprehension and production run parallel in acquisition in this domain. Friedmann et al. ran a series of comprehension and production experiments involving Hebrew subject and object relative clauses, including headed subject and object relatives with and without resumptive pronouns, free subject relatives, free object relatives, and object relatives with an arbitrary pro subject. The experiments were run with Hebrew-speaking children aged 3;7 to 5;0 and it was found that not all object relatives were poorly understood. The structural similarity between the moved element and the intervening subject was argued to be the source of the interpretation/production problems; when the moved element and the subject of the embedded clause were sufficiently dissimilar, performance improved significantly. Friedmann et al. capitalized in the parallelism in (19) and claimed that the case of problematic object relatives could be subsumed by Relativized Minimality. It is standard to consider (19b), with movement of *how* out of the wh- island, a Relativized Minimality violation; what is proposed by Friedmann et al. is that the movement of the head of the relative in (19a) is subject to the same kind of constraints.

(19)   a.   the boy that the monkey hugs t
       b.   *How do you wonder who behaved t?

Nevertheless, there is a clear contrast between (19a) and (19b): in adult grammar the former is well-formed while the latter is not. In child grammar, object relatives may be produced less often than subject relatives, but they are still produced some of the time, while (19b) is entirely unattested. Unlike the analysis in Friedmann et al. (2009), the approach proposed here does not require that processing of relatives be analyzed as an instance of a Relativized Minimality violation, thereby equating acceptability with well-formedness. Rather, there is a gradation from acceptable to unacceptable which is dependent on the grammatical structure, as opposed to binary well- or ill-formedness. It is for future

---

[2]   If we analyze the individual performance of the children tested, we see that all of them produced adult-like relatives at least some of the time. No child produced less than 7 adult-like subject relatives out of 10, and for object relatives one child produced only one adult-like relative, another child produced 3, and the rest of children produced 5 or more.

research to examine more closely the predictions of our account in relation to those of Friedmann et al. (2009).

As we have argued, the processing load of subject relatives and object relatives is structure dependent, and therefore may vary across languages: as mentioned above, prenominal relatives have been shown to behave quite differently, with subject relatives being more costly than object relatives in terms of processing: Hsiao and Gibson (2003) show in a self-paced reading task that object relatives are processed faster than subject relatives.[3] In Basque, a head-final language with prenominal relative clauses, Carreiras et al. (2010) ran a self-paced reading task and an ERP experiment, and showed that Basque subject relative clauses are not easier to process than object relatives. The analysis here extends to those cases. We will illustrate it with the relatives found in Chinese.

The sentences in (20), taken from Hsiao and Gibson (2003), exemplify subject and object relatives:

(20)   a.   Yaoching fuhao de   guanyuan shinhuaibugui danshi shanyu yintsang.
             invite   tycoon gen official   have   bad intentions but good at hiding
             'The official who invited the tycoon has bad intentions but is good at hiding them.'

         b.   Fuhao yaoching de   guanyuan shinhuaibugui danshi shanyu yintsang.
             tycoon invite   gen official   have   bad intentions but good at hiding
             'The official who the tycoon invited has bad intentions but is good at hiding.'

The derivation of the two sentences appears in (21); the complexity profiles of the two sentences are those in (22) and (23)[4].

---

(21)   Derivations of sentences in (20a) and (20b)

(22)   Complexity profile for (20a)

```
4               a
3                        a     a
2                                      a
1  a
0
        Yaoching   fuhao   de   guanyuan   shinhuaibugui…
```

(23)   Complexity profile for (20b)

```
3                     a    a
2             a                        a
1  a
0
        Fuhao   yaoching   de     guanyuan   shinhuaibugui…
```
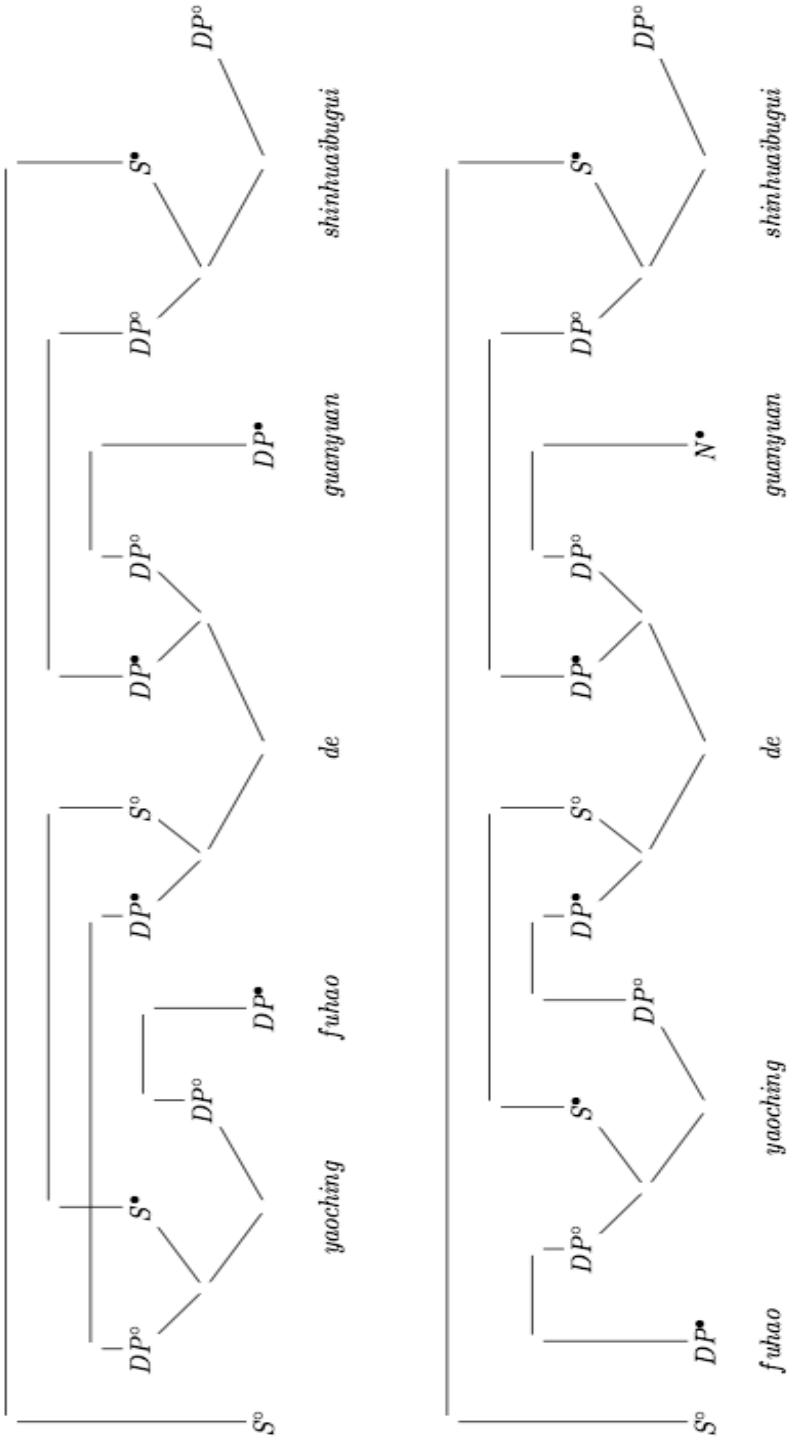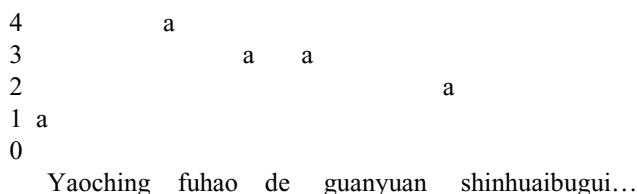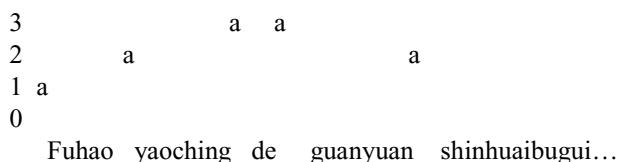
In terms of the complexity metric here, the subject relative in (20a) represents a higher processing load than the object relative in (20b): in (20a) the complexity reaches 4, and 3 at two points; in (20b) it reaches 3 at two points, but never 4. The results of the psycholinguistic experimental work by Hsiao and Gibson can be thus accounted for. So far as we are aware, there are no published results on the acquisition of relatives in Basque, and only those of Lee (1992) for Chinese; testing these languages against our predictions remains for future research.

To summarize, we have presented new results on the production of relative clauses by Catalan-speaking children, and shown that the asymmetry previously found in comprehension between subject and object relatives also holds in production. We have argued that a categorial metric of processing can account for this asymmetry in a precise, non-stipulative way, and that the analysis extends to other typologically different languages.

References

Adani, Flavia. (2010). Rethinking the acquisition of relative clauses in Italian: towards a grammaticality based account. *Journal of Child Language, 38*(1), 141–165.

Arosio, Fabrizio, Adani, Flavia, & Guasti, Maria Teresa. (2009). Grammatical features in the comprehension of Italian relative clauses by children. In José M. Brucart, Anna Gavarró, & Jaume Solà (Eds.), *Merging Features: Computation, Interpretation, and Acquisition* (pp. 138–155). Oxford/New York: Oxford University Press.

Brown, H. Douglas. (1971). Children's comprehension of relativized English sentences. *Child Development*, *42*, 1923–1936.

Carreiras, Manuel, Duñabeitia, Jon Andoni, Vergara, Marta, de la Cruz-Pavía, Irene, & Laka, Itziar. (2010). Subject relative clauses are not universally easier to process: evidence from Basque. *Cognition, 115*, 79–92.

de Villiers, Jill, Tager-Flusberg, Helen B., Hakuta, Kenji, & Cohen, Michael. (1979). Children's comprehension of relative clauses. *Journal of Psycholinguistic Research, 17,* 57–64.

Frauenfelder, Ulrich, Seguí, Juan, & Mehler, Jacques. (1980). Monitoring around the relative clause. *Journal of Verbal Learning and Verbal Behaviour, 19*, 328–337.

Friedmann, Naama, Belletti, Adriana, & Rizzi, Luigi. (2009). Relativized relatives: Types of intervention in the acquisition of A-bar dependencies. *Lingua, 119*, 67–88.

Friedmann, Naama, Belletti, Adriana, Tuller, Laurie, Costa, João, Guasti, Maria Teresa, Lobo, Maria, Hamann, Ewa, Gavarró, Anna, van Hout, Angeliek, Håkansson, Gisela, Ezeizabarrena, M. José, de López, Kristine Jensen, Van der Lely, Heather K. J., Avram, Larisa, Weston, John, Fattal, Iris, Yachini, Maya, Delage, Hélène, Cunill, Arnau, Muntané, Míriam, Reguant, Marc, Yatsushiro, Kazuko, Sauerland, Uli, Kainhofer, Judith, Hummer, Peter, Haider, Hubert, Pych, Agnieszka, Miękisz, Aneta, Contemori, Carla, Grohmann, Kleanthes, & Varlokosta, Spyridoula. (in prep). The child who prefers not to produce object relatives: The acquisition of relative clause production in 16 languages.

Gavarró, Anna, Adani, Flavia, Ramon, Marta, Rusiñol, Sandra, & Sànchez, Raquel. (to appear). La comprensió de

les clàusules de relatiu en català infantil. *Caplletra*. Available as On the comprehension of relative clauses in child Catalan: http://webs2002.uab.es/clt/publicacions/reports/pdf/GGT-09-11, Universitat Autònoma de Barcelona.

Gibson, Edward. (1998). Linguistic complexity: locality of syntactic dependencies. *Cognition, 68*, 1–76.

Guasti, Maria Teresa. (2002). *Language Acquisition. The Growth of Grammar*. Cambridge, Mass.: The MIT Press.

Guasti, Maria Teresa, Stavrakaki, Stavroula, & Arosio, Fabrizio. (2008). Number and case in the comprehension of relative clauses: evidence from Italian and Greek. In Anna Gavarró & Maria João Freitas (Eds.), *Language Acquisition and Development. Proceedings of GALA 2007* (pp. 230–240). Newcastle: Cambridge Scholars Publishing.

Hsiao, Franny, & Gibson, Edward. (2003). Processing relative clauses in Chinese. *Cognition, 90*, 3–27.

Johnson, Mark E. (1998). Proof nets and the complexity of processing center-embedded constructions. *Journal of Logic, Language, and Information, 4*(7), 433–447.

Johnson, Valerie, de Villiers, Jill, & Seymour, Harry. (2005). Agreement without undestanding? The case of third person singular /s/. *First Language, 25*, 317–330.

Labelle, Marie. (1990). Predication, wh-movement and the development of relative clauses. *Language Acquisition, 1*, 95–119.

Lee, Thomas Hun-Tak. (1992). The inadequacy of processing heuristics: Evidence from relative clause acquisition in Mandarin Chinese. In Thomas H.T. Lee (Ed.), *Research on Chinese Linguistics in Hong Kong* (pp. 48–86). Hong Kong: The Linguistic Society of Hong Kong.

Morrill, Glyn. (2000). Incremental processing and acceptability. *Computational Linguistics, 26*(3), 319–338.

Morrill, Glyn. (2010). *Categorial Grammar. Logical Syntax, Semantics, and Processing*. Oxford/New York: Oxford University Press.

Morrill, Glyn, & Gavarró, Anna. (2010). Categorial complexity of relativisation and child Romance performance. In Pedro Guijarro-Fuentes, & Laura Domínguez (Eds.), *New Directions in Language Acquisition: Romance Languages in the Generative Perspective* (pp. 365–387). Newcastle: Cambridge Scholars Publishing.

Novogrodsky, Rama, & Friedmann, Naama. (2006). The production of relative clauses in syntactic SLI: a window to the nature of the impairment. *Advances in Speech-Language Pathology, 8*, 364–375.

Pérez-Leroux, Ana-Teresa. (1995). Resumptives in the acquisition of relative clauses. *Language Acquisition, 4*(1&2), 105–138.

Pérez-Leroux, Ana-Teresa. (2005). Number problems in children. In Claire Gurski (Ed.), *Proceedings of the 2005 Canadian Linguistics Association Annual Conference*, 12 pages. http://ling.uwo.ca/publications/CLA-ACL/CLA-ACL2005.htm

Schriefers, Herbert, Friederici, Angela, & Kühn, Katja. (1995). The processing of locally ambiguous relative clauses in German. *Journal of Memory and Language, 34*, 499–520.

Sheldon, Amy. (1974). The role of parallel functions in the acquisition of relative clauses. *Journal of Verbal Learning and Verbal Behaviour, 13*, 272–281.

Solà, Joan. (2002). Les subordinades de relatiu. In Joan Solà, Maria-Rosa Lloret, Joan Mascaró, & Manuel Pérez-Saldanya (Eds.), *Gramàtica del Català Contemporani* (Vol. 3, pp. 2455–2565). Barcelona: Editorial Empúries.

Selected Proceedings of the 4th Conference on Generative Approaches to Language Acquisition North America (GALANA 2010)

edited by Mihaela Pirvulescu,
María Cristina Cuervo, Ana T. Pérez-Leroux,
Jeffrey Steele, and Nelleke Strik

Cascadilla Proceedings Project   Somerville, MA   2011

Web access and citation information

This entire proceedings can also be viewed on the web at www.lingref.com. Each paper has a unique document # which can be added to citations to facilitate access. The document # should not replace the full citation.

This paper can be cited as:

Gavarró, Anna, Arnau Cunill, Míriam Muntané, and Marc Reguant. 2011. Catalan Child Relative Contrasts as a Processing Effect. In *Selected Proceedings of the 4th Conference on Generative Approaches to Language Acquisition North America (GALANA 2010)*, ed. Mihaela Pirvulescu et al., 37-50. Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #2584.