Parser Immaturity and the Processing of Ambiguous Relative Clauses in Brazilian Portuguese

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1. Introduction

Studies in several languages have observed that object relative clauses (1b) seem harder to process than subject relative clauses (1a) (Brown, 1971; Tavakolian, 1981; de Villiers, de Villiers & Hoban, 1994; Corrêa, 1995; McKee, McDaniel & Snedeker, 1998; Friedmann & Novogrodsky, 2004; Gordon, Hendrick & Johnson, 2004; Novogrodsky & Friedmann, 2006, Friedmann, Belletti & Rizzi, 2009):

(1) a.   The girl that __ washed the clothes   (Subject relative)
     b.   The clothes that the girl washed __   (Object relative)

These structures involve fillers (*girl* in (1a), *clothes* in (1b)) that need to be related to gaps inside the relative clauses (marked with '__'). The distance between filler and gap is shorter in the subject relative in (1a) than in the object relative in (1b).

It has been observed that the parser prefers shorter dependencies (Phillips, Kazanina & Abada, 2005). Therefore, when it identifies a filler, it will try to assign a gap in the first available position (*Minimal Chain Principle* from de Vincenzi, 1991). This is one of the reasons why subject relatives are easier to process; in order to assign a gap in object position, the parser would have to store information for a longer period of time in working memory, which would be more costly (Warren & Gibson, 2002).

In order to avoid these processing costs, in production tasks, adult speakers produce shorter dependencies (such as subject relatives or passive relatives) (Belletti & Contemori, 2010). In comprehension tasks, adults tend to take longer to process object relatives than subject relatives and to make more interpretation mistakes in object relatives (Cook, 1975; Hakes, Evans & Brannon, 1976;

Frauenfelder, Segui & Mehler, 1980; Ford, 1983). This behavior is also found in children, as discussed below.

In the language acquisition literature, children's difficulty with object relatives has been analyzed as being related to intervention effects. Friedmann, Belletti & Rizzi (2009) observe that object relatives involve movement of the NP object (in (1b), *clothes*) over the subject of the relative clause (in (1b), *girl*) on its path to become the head of the relative clause. Children show difficulty when both the subject and the object are NPs, because, in this case, movement of the NP object crosses over an element with the same feature make-up. The [NP] feature present in the subject is a subset of the set of features on the object ([R] and [NP]). According to the authors, children have difficulties with this array, which can be explained in terms of Relativized Minimality (Rizzi, 1990). Therefore, children acquiring different languages avoid the problematic structure producing different ones that do not involve intervention.

Belletti & Contemori (2010, p. 5) observed that in Italian the general preference (by adults and children) is to produce a subject relative in which the direct object is passivized (2b), avoiding the intervention effect present in the object relative (2a).[1] Utzeri (2007, p. 299) also observed the use of the *si-fa* construction (2c):

(2) a. Vorrei essere il bambino che l'elefante   bagna
        I would rather be the child that the elephant wets
        'I would rather be the child that the elephant wets.'
    b. Voglio essere la bambina che si bagna
        I would rather be the child that is getting wet
        'I would rather be the child that is getting wet.'
    c. Il bambino che si fa pettinare dal re
        The child that himself makes comb by the king
        'The child that makes himself comb by the king'

In English, children tend to avoid intervention using relatives with resumptive pronouns (3a), subject relatives with a change in the meaning (3b) or using a different verb, as in (3c) (Zukowski, 2008). They also use passive relatives as in (3d):

(3) a. The car that the boy washed it
    b. The boy that __ washed the car
    c. The car that __ got clean
    d. The car that __ was washed

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[1] Considering the *smuggling* analysis proposed by Collins (2005), the passive relative involves an operation which moves VP (containing the verb and the direct object) to a position higher in the structure, above the external argument within the [Spec vP]. From there, the object DP moves to [Spec IP], becoming the subject of the sentence. This movement does not cross an intervening element, avoiding the intervention effect.

In German, Adani, Sehm & Zukowski (2012, p. 3) observed that children also produce passive relatives, but this is less common than in Italian and English. They produce relatives with uninflected complementizers (*wo* in (4a) and *was* in (4b)) instead of the standard relative pronouns (*der/den*, *dies*, *das*) that are inflected for Case.

(4) a. Und Max grotografiert das Pferd, was der Junge streichelt
       And Max photographs the horse, what the boy   strokes
       'Max photographs the horse that the boy is stroking.'
    b. Das Pferd, wo   der Junge reitet, is rot
       The horse where the boy rides   is red
       'The horse the boy is riding is red.'

In Brazilian Portuguese (BrP), studies have observed that children also tend to avoid the object relative by producing structures without intervention. Besides producing subject and passive relatives, children resort to what has been dubbed the absolutive relative (5a), which is derived from an absolutive sentence (5b) (Vivanco & Pires, 2012; Grolla & Augusto, 2016; Rangel, 2016; Augusto, Grolla & Rodrigues, 2019; Augusto, Rodrigues & Grolla in press):

(5) a. A   roupa que lavou
       The clothes that washed
       'The clothes that got washed'
    b. A   roupa   lavou.
       The clothes   washed
       'The clothes got washed'.

Sentences (6a) and (6b) below bring more examples of the absolutive construction, which is analyzed as a structure with a verb valence alternation: it displays a transitive verb with only its theme argument, which moves to a preverbal position and agrees in person and number with the verb.

(6) a. A   casa   vendeu.
       The house sold
       'The house was sold.'
    b. O   jardim   destruiu.
   The garden destroyed
       'The garden was destroyed.'

The studies on BrP mentioned above have all explored children's production of relative clauses having identified children's preference for the absolutive relative when an object relative is elicited. In this study, we turn to children's comprehension instead. We investigate children's preferences when faced with an ambiguous relative, which can be interpreted either as a subject relative or an absolutive relative. Both subject and absolutive relatives lack an intervener, a fact

which renders both options easier to process than object relatives. However, based on processing considerations, we hypothesize that children will tend to interpret these ambiguous sentences as subject relatives.

The paper is structured as follows: the next section presents the absolutive construction in BrP. Section 3 discusses the studies on child BrP mentioned above. In section 4, we present the ambiguous relative clauses we investigated, discussing the processing of these structures. In section 5, we present the experimental study we conducted. Section 6 concludes the paper.

2. The absolutive construction in Brazilian Portuguese

As we saw in (6) above, the absolutive construction is formed by a transitive verb that lacks its agent argument, having only the theme argument present. According to Negrão & Viotti (2010), the agent is absent not only superficially; it is not present at all. They propose that, in the absolutive structure, the agent of the transitive verb is not projected, so there is no vP. The object DP moves to a projection above VP, but below IP, where it agrees with the verb. Negrão & Viotti (2010, p. 57) provide the following structure for the absolutive sentence:

(7)
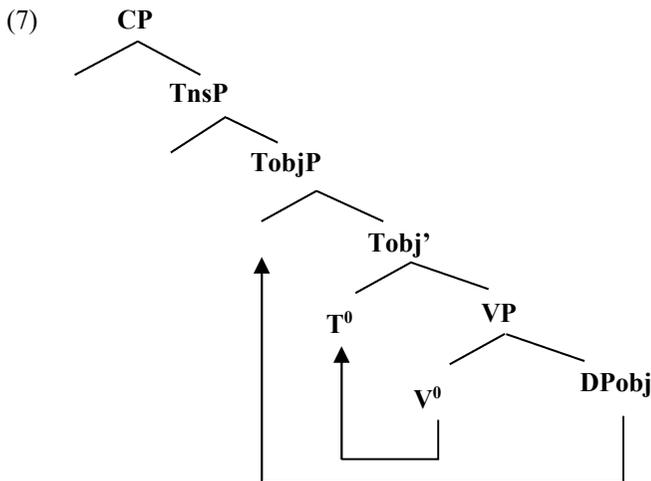
The relative clause derived from the absolutive is shown in the structure below, which brings the derivation for sentence (5a) above ('*the clothes that washed*'):

(8) $[_{CP} [_{DP} \text{clothes}_i [_{DP} \text{that } t_i]]_k [_{C'} [_{TnsP} [_{TobjP} t_k [_{Tobj} \text{washed}_v] [_{VP} t_v t_k]]]]$

Góes (2019) proposed this structure for the absolutive, based on Kayne's (1994) raising analysis, on Kato & Nunes' (2009) proposal for relative clauses in BrP and on Negrão & Viotti's analysis for the absolutive. In this structure, the NP *clothes* is generated in its argument position within the relative clause (in a

'relative DP' [$_{DP}$ that clothes]). Then, the whole DP moves to [Spec TobjP], where it receives nominative Case and agrees with the verb. From [Spec TobjP], it moves to [Spec CP]. In this position, *clothes* is adjoined to DP, giving rise to [$_{DP}$ clothes$_i$ [$_{DP}$ that t$_i$]]. The resulting structure is *clothes that washed*, an absolutive relative.

Observe that in (8) movement of the direct object to the preverbal position does not cross another DP on its way, not displaying the intervening element present in object relatives. This is so, because the agent of the action denoted by the verb is not present in the structure. As such, the absolutive relative is simpler than an object relative. The absolutive relative is also simpler than a passive relative in several aspects, such as: its morphology (lacking the auxiliary verb and the main verb in the participle form), its structure (with fewer projections) and its derivation (with fewer movements involved).

However, the absolutive relative is not simpler than a subject relative. Consider the structure for the relative in (1a) above '*the girl that washed the clothes*':[2]

(9) [$_{CP}$ [$_{DP}$ girl$_i$ [$_{DP}$ that t$_i$]]$_k$ [$_{IP}$ t$_k$ [$_{vP}$ t$_k$ [$_{vP}$ washed the clothes]]]]

In this structure, the 'relative DP' [$_{DP}$ that girl] is generated in its argument position in [Spec vP]. From there, it moves to [Spec IP] where it receives nominative Case and agrees with the verb. It moves a second time to [Spec CP]. In this position, *girl* is adjoined to DP, giving rise to [$_{DP}$ girl$_i$ [$_{DP}$ that t$_i$]]. The resulting structure is *girl that washed the clothes*, a subject relative.

The structures in (8) and (9) indicate that both the subject and the absolutive relative are simpler than an object relative, without intervening elements. When children are faced with the task of producing an object relative, they can respond with an absolutive relative, which will promote the required theme argument, just like the object relative does, but without displaying an intervening element. As such, it should be the preferred alternative to young children faced with the task of producing object relatives. This is indeed what was found in a series of studies carried out in BrP, as reported in the next section.

3. Production of relative clauses in child Brazilian Portuguese

Previous studies investigating children's production of object relative clauses in child BrP have used Labelle's (1990) elicited-production method, where children are presented with pairs of pictures depicting identical characters involved in different actions, and the participant's task is to choose one of the pictures and tell the experimenter (who cannot see the pictures) which one (s)he chooses (Vivanco & Pires, 2012; Grolla & Augusto, 2016; Rangel, 2016). A trial example is shown below:

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[2] We are ignoring verb's movement, which is claimed to move as high as I in BrP.

(10) Experimenter: *Look at these pictures: there are two watermelons. Here Magali is eating a watermelon and here Magali is cutting a watermelon. Tell the puppet which watermelon you choose.*
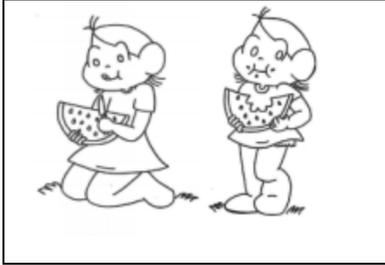Target response: *I choose the watermelon <u>that Magali is eating/cutting</u>.*

Figure 1. Images of the elicited production task (Grolla & Augusto, 2016, p. 43)

In general, the findings of these studies are that children acquiring BrP can produce object relatives, but they tend to avoid them, similarly to what is found in child Italian, English, German, and others.

Vivanco & Pires (2012) tested 5- and 6-year-old children, who produced 58% of object relatives and 38% of other constructions. 31% of children's productions were absolutives. Subject relatives occurred only in 5,5% of trials eliciting object relatives and passive relatives occurred only 1,5%. The study does not report adults' data.

Grolla & Augusto (2016) tested 4- and 5-year-olds and adults. Object relatives were produced 36,25% of the time by 4-year-olds, 28,75% of the time by 5-year-olds and 42,5% of the time by adults. The absolutive relative was productive in children's groups: 26,25% in the 4-year-olds' group and 28,75% in the 5-year-olds' group, whereas adults produced this relative only 1,25% of the time. Passive relatives were the preferred strategy by adults (40%). In children's groups, only 5-year-olds produced them 11,25% of the time.

Rangel (2016) is another study where the production of object relatives is investigated. In particular, Rangel manipulated the animacy features present in the relative head and in the subject inside the relative. Considering all the trials eliciting direct object relatives in the experiment, regardless of the animacy configurations, Rangel's results match those of Grolla & Augusto's: all of the groups tended to avoid the target direct object relative. The production of absolutive relatives decreases with age (4-year-olds: 24,2%; 5-year-olds: 22,9%; 6-year-olds: 15,3%; adults: no occurrence), while the production of passive relatives becomes more frequent with age (from 4-year-olds to adults: 2,6%, 7,1%, 21,4% and 85,6%).[3]

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[3] Irrespective of the animacy configurations, the author identified the same tendency to avoid object relatives. However, this behavior was more expressive when the object was animated and the subject was inanimate, as in "<u>The owl</u> that the hurricane brought down __". We refer the reader to Rangel (2016) for a detailed analysis of these data.

The studies on object relatives presented in this section have all come to the same results: younger children acquiring BrP produce the absolutive relative more frequently than older children and adults, who rarely produce it. Given that passives are usually analyzed as not being available to young children (Maratsos, Fox, Becker & Chalkley (1985), Borer & Wesler (1987) e Fox & Grodzinsky (1998)), the use of absolutives in BrP becomes a natural alternative for them. At around age 6, when passives have already been mastered, children's behavior starts to resemble that of adults, with a higher percentage of passive relatives and fewer cases of absolutives.

Given children's difficulties with the direct object relative and with the passivized relative, it is not surprising that young children resort to the absolutive relative in production tasks. However, it remains to be seen what happens in comprehension tasks. Would children's preference for the absolutive relative remain in a comprehension study? This is what this paper explores in the next sections.

4. The processing of ambiguous relative clauses in Brazilian Portuguese

Consider the sentence below, which is ambiguous between an absolutive relative and a subject relative:

(11)   A menina que lavou
         The girl   that washed
         'The girl that washed <something>'   (agent interpretation)
         'The girl that got washed'   (theme interpretation)

In the subject relative interpretation, *the girl* is the subject of the verb *wash* and this verb is interpreted as having a null direct object, with an arbitrary interpretation, as shown in the structure in (12) below. In (13), the structure for the absolutive is depicted, with *the girl* generated as the direct object of the verb *wash* and moved to [Spec CP]:[4]

(12) [$_{CP}$ [$_{DP}$ girl$_i$ [$_{DP}$ that t$_i$]]$_k$ [$_{IP}$ t$_k$ [$_{vP}$ t$_k$ [$_{VP}$ washed <ec>]]]]

(13) [$_{CP}$ [$_{DP}$ girl$_i$ [$_{DP}$ that t$_i$]]$_k$ [$_{TnsP}$ [$_{TobjP}$ t$_k$ [$_{Tobj}$ washed$_v$] [$_{VP}$ t$_v$ t$_k$]]]]

Structurally, (12) and (13) seem to be of comparable complexity. So, upon hearing a sentence like (11) in a context that makes both interpretations possible, which one would the child prefer? Here, we would like to suggest that processing

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[4] A third, logically possible analysis, in which the subject of the relative clause is a null subject (as shown below), cannot be supported in this case, since BrP does not license null subjects in embedded sentences (Ferreira, 2000).

(i)   # A menina que pro lavou
        'The girl   that pro washed'
        [the girl$_i$ that *pro* washed t$_i$]

considerations would lead the child to prefer the subject interpretation, where *the girl* is paired with the agent theta-role.

There are two reasons for this prediction. First, as discussed before, the parser prefers shorter dependencies. So, when it identifies a filler, it will try to assign a gap in the first available position in order to parse the sentence more quickly (de Vincenzi, 1991; Phillips, Kazanina & Abada, 2005). For the relative in (11) above, assigning a gap in object position (as in (13)) would lead the parser to store information for a longer period of time in working memory, which would be more costly than assigning a gap in subject position. Second, the [+animated] feature of the relative head is usually associated with the agent theta-role (and the subject's syntactic position). Inanimate elements, on the contrary, are associated with the theme or patient theta-roles (Becker, 2014). Thus, the animated NP present in the ambiguous relative also favors the parser's preference for the agent interpretation, paired with the subject relative.

Previous studies have shown that children are sensitive to these aspects: they prefer shorter dependencies more frequently than adults, as we see in the children's preference for the subject relative than the object relative in the studies mentioned above, and also associate the agent theta-role with the subject's syntactic position (Hogeweg & de Hoop, 2010). It remains to be investigated if these aspects are sufficient for children to prefer the apparently more accessible interpretation in contexts with ambiguous relatives such as (11).

Some studies have highlighted that children's parser is immature, compared to the adults' parser (Trueswell, Sekerina, Hill & Logrip, 1999; Snedeker; Trueswell, 2004). When confronted with an ambiguous sentence, once children assign it an interpretation, they seem unable to reanalyze it and assign it another interpretation. They also seem unable to consider contextual information in order to arrive at the right interpretation, contrary to adults, who use contextual information to arrive at the right interpretation. Children's immature parser might therefore lead children to behave in unexpected ways. The next section discusses our experiment and its results.

5. Experimental study on the interpretation of ambiguous relative clauses in BrP

As discussed above, we assume that: (i) in filler-gap dependencies, the parser tends to assign a gap in the first available position, i.e., the subject position; (ii) a [+animated] NP is usually associated with the agent theta-role. These assumptions lead us to predict that, on our comprehension task with ambiguous relatives, children should prefer the agent interpretation, a different behavior from what was observed in the production studies reported in section 3.

Participants. We interviewed 46 children between the ages 3;6 and 5;11 and 26 adults as a control group. All the participants were native speakers of BrP.

Method. The experiment was a truth-value judgment task (Crain & Thornton, 1998). After hearing stories presented through images on a computer screen, the participants judged some sentences about the stories as true or false. The sentences were uttered by a puppet, who was presented to children as being

very distracted. Children had to hear the puppet's sentences and tell the experimenter if what he said was true or false. This judgment allowed us to infer how the participants interpreted the sentences: either as a subject relative or an absolutive relative.

Materials. The experiment design consisted of 3 variables: ambiguous relatives, passive relatives and direct object relatives. There were 6 trials of ambiguous relatives, 3 trials of passive relatives and 3 trials of direct object relatives, giving rise to a total of 12 test-sentences. We also included 9 distractors mixed with the test-sentences: 3 simple transitive sentences, 3 sentences with an embedded clause (which was not a relative clause) and 3 simple, stative sentences. These sentences were randomized in order to avoid repetition and priming effects.

The verbs used were prototypically transitive verbs that can occur in absolutive sentences: *molhar*, 'to wet'; *pintar*, 'to paint'; *enxugar*, 'to dry'.

6 stories were presented to children, each one related to one ambiguous relative. The stories were organized in order to guarantee the ambiguity of the relative. We presented three characters from the same category (fairies, mermaids, heroes etc.), with one of them being responsible for carrying out an action (the agent of the verb) and the other two as themes (receiving the action).

For example, in one of the stories, we have 3 fairies: the Green one, the Blue one and the Pink one. The fairies are going to their swimming class and the Green fairy is responsible for wetting all the fairies, so they can go into the pool already wet. Only the Green fairy can wet the other fairies using her bucket. The plot unfolds in the following way:

- Green fairy wet Blue fairy.
- Green fairy almost fell into the pool, as her bucket was too heavy.
- Peter Pan helped her: he got the bucket and wet Pink fairy.
- Pink fairy fell into the pool by accident.

By the end of the story, we have one fairy depicted as the agent responsible for all the wetting action (Green fairy) and fairies that were the theme of the wetting action (Blue and Pink fairies). The test sentences in this story were:

(14) a. A fada que molhou caiu na piscina.(Ambiguous relative)
       the fairy that wet   fell   into-the pool

   b. A   fada que o Peter Pan molhou é rosa.   (Object relative)
       The fairy that the Peter Pan wet   is pink
       'The fairy that Peter Pan wet is pink.'

   c. A fada que   foi molhada pelo Peter Pan é rosa. (Passive relative)
       the fairy that was wet   by Peter Pan is pink
       'The fairy that was wet by Peter Pan is pink.'

The context provided above makes (14b) and (14c) true. Children who heard (14b) did not hear (14c) and vice-versa, making this a between-subjects study. All of

them heard (14a). On ambiguous trials, the truth-value depended on the interpretation assigned to the sentence:

(15)   A fada   que molhou caiu na   piscina.
         The fairy that wet   fell into-the pool.

(16)   Absolutive relative (theme interpretation):
Interpretation: The fairy that got wet fell into the pool.
Truth-value: True → Pink fairy got wet and fell into the pool.
Structure: [$_{CP}$ [$_{DP}$ fairy$_i$ [$_{DP}$ that t$_i$]]$_k$ [$_{TnsP}$ [$_{TobjP}$ t$_k$ [$_{Tobj}$ wet$_v$] [$_{VP}$ t$_v$ t$_k$]]]]

(17)   Subject relative (agent interpretation):
Interpretation: The fairy that wet <ec> fell into the pool.
Truth-value: False → Green fairy wet other fairies, but did not fall into the pool.
Structure: [$_{CP}$ [$_{DP}$ fairy$_i$ [$_{DP}$ that t$_i$]]$_k$ [$_{IP}$ t$_k$ [$_{vP}$ t$_k$ [$_{VP}$ wet <ec>]]]]

Observe that in the theme interpretation, associated with the absolutive relative, the sentence is true, as there is a fairy that got wet and fell into the pool, which is the Pink fairy. In the agent interpretation, associated with the subject relative, the sentence is false, as the fairy that wet (the other fairies) did not fall into the pool. She almost did, but was able to avoid it.[5]

Results. Graph 1 shows the rate of correct responses for the object relatives and passive relatives and the rate of theme interpretation assigned on ambiguous trials by adults and children.
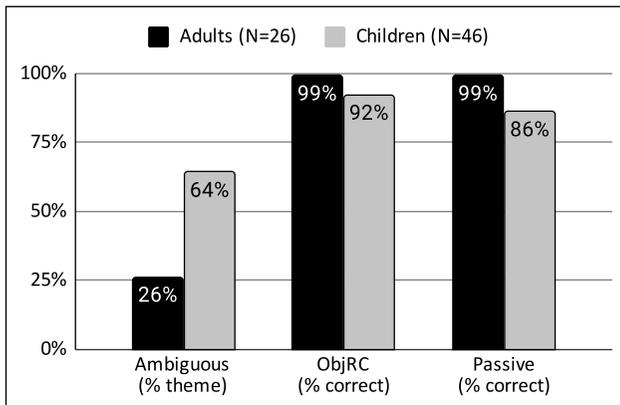
Graph 1. Percentage of correct responses and of theme interpretation

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[5] Our stories were formulated in such a way as to include the *Condition of Plausible Dissent* (Crain & Thornton 1998), in which the event associated with the false interpretation is entertained and 'almost' happens.

A statistical analysis was performed using a generalized linear model with binomial distribution and identity link function, considering a significance level of 5%.

The graph shows that children performed similarly to adults in object relatives and passive relatives, displaying high rates of correct responses on both: 92% in object relatives and 86% on passive relatives. There was no statistically significant difference to adults' responses on these variables ($p = 0.35$ for object relatives and $p = 0.64$ for passives). On ambiguous trials, children preferred the theme interpretation 64% of the time. Adults, on the other hand, preferred this interpretation only 26% of the time, resulting in a statistically significant difference between the groups ($p < 0.01$).

Discussion. Children's high rates of correct responses on direct object relatives and on passive relatives indicate that children had no difficulty with these structures, contrary to what has been found in production tasks, where children tend to avoid producing them. Children produce simpler structures in production tasks, but this behavior is not due to children's lack of mastery of these structures, as the low rates of incorrect responses in our comprehension study indicates.

Turning now to the ambiguous trials, we see that children prefer the absolutive interpretation, similarly to what is observed in production studies, but contrary to our predictions.

In what follows, we discuss some issues that might explain children's preference for the absolutive interpretation. The first one to consider is methodological. In all of the stories of this study, it was necessary to present three characters of the same type, two of whom were assigned theme theta-roles. Despite careful control, it is possible that these characters became more prominent in children's working memory, as they appear more often than the character bearing the agent-role throughout the experiment. This may have caused an effect of preference for the theme arguments.

However, this possibility does not seem very plausible, given that the contexts presented to children somehow favored the agent interpretation, in that the agent characters (i) were the protagonists of the stories and (ii) were also animated, which we know favors the agent interpretation. These aspects should have played a role in helping participants process the DP they heard in the beginning of the sentence as the agent. Adults behaved as we expected: they were sensitive to these cues and interpreted the relatives mostly as subject relatives.

A more promising explanation for our results seems to be related to both grammatical and processing issues. Since the verbs used in the experiment were prototypically transitive, it was necessary to assign an arbitrary interpretation for the null direct object when interpreting the ambiguous relative as a subject relative (*the fairy that wet <someone/ something>*). With some verbs, this interpretation is quite common in BrP, as, for example, the verb *eat*, as in *Mary already ate (something)*. It is possible that children have not mastered this verb alternation yet, preferring a structure that is more common and already learned (that is, the absolutive).

This interpretation of our results is consistent with what has already been found in the literature. Trueswell et al. (1999) observe that there are several

reasons why children might favor one interpretation over another in experiments with ambiguous trials. One of them is related to the lexical properties of the input, as children may base their parsing commitments on their syntactic and/or semantic knowledge of verbs and possible arguments.

Children's preferences might be related to their limited processing capacity, which will prevent them from entertaining uncommon and/or complex syntactic alternatives. In our study, we could hypothesize that children did not favor the agent interpretation, since it involves a null object with arbitrary interpretation. Being a construction with low probability of occurrence, children will have more difficulty to process it. The absolute relative, on the other hand, constitutes a more ordinary construction, being more accessible to children.

6. Concluding remarks

Previous studies on absolutives in BrP have focused on children's productions, having discovered that they seem to produce absolutives as a strategy to avoid direct object relatives. Adults, on the other hand, preferred other alternative constructions, such as the passive relative. This difference between children and adults can be attributed to processing issues: the absolutive relative constitutes an escape hatch that children resort to in order to avoid the complexity imposed by object relatives.

In this study, we bring new data on children's comprehension of absolutive relatives. Our results from a comprehension task corroborate the processing analysis put forth in production studies: when processing ambiguous relatives, children preferred the theme interpretation, which involves a more common structure for them. The subject relative (with agent interpretation) of our study involves a structure with a null object with arbitrary interpretation. We conjecture that children might not be familiar with it and will not commit to this analysis, due to their limited processing capacity, associated with their immature parser.

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