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THE INFLUENCE OF REFERENTIALITY, DEFINITENESS, AND "PREPOSITION+DETERMINER" CONTRACTION ON RELATIVE CLAUSE PROCESSING

A INFLUÊNCIA DA REFERENCIALIDADE, DA DEFINITUDE E DA CONTRAÇÃO PREPOSIÇÃO+DETERMINANTE NO PROCESSAMENTO DE ORAÇÕES RELATIVAS

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In this paper, we present two experiments (questionnaires) that we conducted to investigate the influence of referentiality, definiteness, and preposition+determiner contraction (P+D contraction) on relative clause processing. The first experiment was conducted in Brazilian Portuguese, and the results revealed an influence of referentiality and definiteness on relative clause interpretation: N2 modification (low attachment) was more probable when N2 was referential and when it was introduced by an indefinite article. The results did not reveal, however, an effect of P+D contraction. The second experiment was conducted in Spanish and it focused on referentiality and P+D contraction. The results revealed a significant effect of both factors: N2 modification was more probable when N2 was referential and when the article preceding it was not contracted with the preposition. Based on these results, we emphasize the influence of the three factors investigated on relative clause interpretation, highlighting the novelty of the P+D contraction effect.

Keywords: Relative clause processing. Referentiality. Preposition+determiner contraction. Definiteness. Brazilian Portuguese. Spanish.

Neste artigo, apresentamos dois experimentos (questionários) que conduzimos para investigar a influência da referencialidade, da definitude e da contração preposição+determinante (contração P+D) no processamento de orações relativas. O primeiro experimento foi conduzido em português brasileiro e os resultados revelaram um efeito significativo da referencialidade e da definitude: a modificação do N2 (aposição local) foi mais observada quando o N2 era referencial e quando ele era introduzido por artigo indefinido. Os resultados não revelaram, porém, efeito da contração P+D. O segundo experimento foi conduzido em espanhol e focalizou a referencialidade e a contração P+D. Os resultados revelaram um efeito significativo dos dois fatores: a modificação do N2 foi mais observada quando o N2 era referencial e quando o artigo que o precedia não envolvia contração com a preposição. Com esses resultados, enfatizamos a influência dos três fatores investigados na interpretação de orações relativas, destacando a originalidade do efeito da contração P+D.

Palavras-chave: Processamento de orações relativas. Referencialidade. Contração preposição+determinante. Definitude. Português brasileiro. Espanhol.

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1. Introduction

In this paper, we present two experiments designed to test the influence of referentiality, definiteness, and "preposition+determiner" contraction (P+D contraction) on the interpretation of relative clauses associated with complex noun phrases (complex NPs) of "substance" reading. We conducted this investigation in two languages: in Brazilian Portuguese (BP) and Spanish. Referentiality and P+D contraction were investigated in both languages, but definiteness was investigated only in BP, and the reason will become clear later in this introduction.

We are working with the following structure in example 1:

(1) The policeman confiscated the shoe$_{(N1)}$ of (the) leather$_{(N2)}$ that was illegally imported.

In this sentence, there is an ambiguity with respect to the interpretation of the relative clause: *that was illegally imported* can be attached either to N1 (*the shoe*) or to N2 ((*the*) *leather*). Considering these two possible analyses, we have the following initial questions:

- which interpretation do perceivers prefer in this type of ambiguity?
- What motivates their preference?

These questions are far from new: the first research to point them out and address them was developed by Cuetos and Mitchell (1988). These authors investigated the processing of sentences in two languages – English and Spanish like this one (which contains the same structural ambiguity as example 1 above):

(2) Someone shot the servant of the actress who was on the balcony

They found a preference for N2 modification in English and for N1 modification in Spanish, and these divergent findings had a huge impact on the Sentence Processing area. More specifically, they called into question one of the principles postulated within the framework of the Garden Path Theory (Frazier 1979; Frazier & Rayner 1982; Frazier 1990).

The Garden Path Theory is a "syntax-first" model of sentence processing: the parser (or human sentence processor) incrementally attributes a syntactic representation to the linguistic input, and, to do so, it only has access to syntactic information, being constrained by working memory limitations. The theory assumes that, when dealing with a structural ambiguity, the parser immediately chooses one specific analysis, which corresponds to the analysis that requires the lower number of syntactic nodes (Minimal Attachment Principle), or, when the two possible analyses have the same structural complexity, to the analysis that implies an attachment to the phrase or clause currently being processed (Late Closure Principle). Cuetos and Mitchell's (1988) results challenged

the answers that the Late Closure Principle would give to the initial questions presented above: this principle would predict, in examples 1 and 2, a systematic preference for low attachment, that is, for N2 modification, but they found a preference for high attachment (or N1 modification) in Spanish.

Experimental studies in several languages have been conducted in order to better understand the processes involved in the resolution of this type of ambiguity, and different hypotheses have been postulated to deal with the absence of a systematic preference for N1 or N2 modification that has been found across languages: Tuning Hypothesis (Mitchell & Cuetos 1991), Recency Preference & Predicate Proximity (Gibson, Pearlmutter, Canseco-Gonzalez & Hickok 1996), Implicit Prosody Hypothesis (Fodor 1998), Attachment-binding dualism (Hemforth, Konieczny, Seelig & Walter 2000), and PR-first Hypothesis (Grillo & Costa 2014).

In this paper, we are going to approach the processing of sentences like example 1 in light of the Construal Hypothesis, which was postulated by Frazier and Clifton (1996) as a reformulation of the Garden Path Theory. This hypothesis argues in favor of the universality of Late Closure but proposes that it is not applied in the processing of sentences like examples 1 and 2, and this would be the reason for an absence of a systematic preference for low attachment in the processing of such type of sentences across languages. The crucial idea behind this proposal is that the parser behaves differently depending on the type of structure that it finds in the linguistic input. The authors emphasize a distinction between two types of structure: primary phrases/relations, which refer to the subject and the main predicate in a finite clause, as well as to its mandatory constituents and complements; and secondary phrases/relations, which refer to the phrases that cannot be analyzed, not even temporarily, as primary phrases (secondary phrases "known as potentially primary" will have their "primary" status accessed first). Roughly speaking, primary phrases refer to arguments, whereas secondary relations refer to adjuncts. Considering this distinction, the proposal is that when the parser finds an ambiguity regarding the analysis of a primary phrase, there is a pressure to determine the lexical description of a given lexical head, and this leads the parser to choose one specific analysis right away: an immediate attachment is made based on syntactic information and structural principles such as Minimal Attachment and Late Closure; however, when the parser finds an ambiguity involving the analysis of a secondary phrase, there is no pressure to specify the properties of lexical heads (adjuncts are optional elements), and the result is that the parser may not determine one specific analysis immediately, that is, the ambiguity may be left temporarily unsolved: the secondary phrase is associated into the current thematic processing domain (the extended maximal projection of the last theta assigner) and then interpreted using structural and nonstructural information/principles. Frazier and Clifton's (1996) conclusion, therefore, with respect to the processing of sentences like examples 1 and 2 is that, considering that restrictive relative clauses correspond to secondary phrases, we cannot apply Late Closure's prediction to their processing, in fact, we would have to assume the influence of non-syntactic information, which opens the door to different preferences of analysis based on different motivations (for example, prosody, semantics, and discourse).

In this paper, we are going to focus on the influence of three linguistic factors on relative clause processing: referentiality, definiteness, and P+D contraction. Considering, first, referentiality, Gilboy, Sopena, Clifton, and Frazier (1995) proposed, within the framework of the Construal Hypothesis, one specific principle to make predictions about the influence of this information on relative clause processing. They proposed the Referentiality Principle, which predicts that restrictive modifiers (such as restrictive relative clauses) preferentially seek hosts which are referential in the sense that they introduce discourse entities into a discourse model or correspond to already existing discourse entities. The authors assume that a head noun of an NP corresponds to a discourse entity when it is introduced by a determiner. According to this principle, when two hosts are available within the current thematic processing domain and one of them in non-referential, the relative clause will preferentially modify the referential one.

Gilboy and others (1995) provided evidence in favor of the Referentiality Principle through questionnaire studies in English and Spanish. They focused on two types of complex NPs: substance NPs (like "the sweater of cotton") and quantity NPs (like "the glass of water"), which contain, more naturally, a referential N1 and a non-referential N2. In a questionnaire conducted with native speakers of English and native speakers of Spanish, they found a preference for N1 interpretation in sentences like:

(3)

a. Yesterday they gave me the sweater of cotton that was illegally imported.
'Ayer me regalaron el jersey de algodón que importaban de contrabando.'

Example 3a contains a referential N1 and a non-referential N2. In another questionnaire, conducted only with native speakers of English, the authors manipulated the N2 referentiality, comparing sentences in which the N2 was introduced or not by a determiner. They found that the percentage of N2 answers increased from 26% in sentences like:

(3)

b. Yesterday they gave me the sweater of the cotton that was illegally imported.

Here the N2 is non-referential, to 55% in sentences such as the one in example 3a, in which the N2 is referential. The results of both questionnaires were taken as positive evidence in favor of the predictions of the Referentiality Principle.

The influence of referentiality information on relative clause processing was first investigated in BP by Maia and Finger (2007) through a questionnaire study. The authors also focused on sentences with complex NPs of substance reading, like:

(4) O rapaz vendeu a mesa de madeira que empena.
'The boy sold the table of wood that warps.'

In this example only the N1 is referential. The results revealed a general preference for N1 interpretation (69.95% of N1 answers), as predicted by the Referentiality Principle

(Gilboy *et al*. 1995). The authors, however, did not investigate the role of N2 referentiality. Bezerra and Leitão (2017) advanced the discussion in BP in this sense. Also using complex NPs of substance reading, they compared the processing of sentences in which the N2 is non-referential, example 5a, and in which the N2 is referential, example 5b:

(5)

a. O policial apreendeu o sapato de couro que foi irregularmente importado pela empresa
'The policeman confiscated the shoe of leather that was illegally imported by the company'

b. O policial apreendeu o sapato do couro que foi irregularmente importado pela empresa.
'The policeman confiscated the shoe of the leather that was illegally imported by the company'

The results revealed a preference for N1 interpretation in sentences like the first one (with a non-referential N2) (only 13.25% of N2 answers) and also in sentences like the second one (with a referential N2) (37.5% of N2 answers), but they also revealed an effect of N2 referentiality: more N2 answers were given to a referential N2 than to a non-referential N1, as predicted by the Referentiality Principle.

We want to emphasize now that a comparison between the results obtained by Bezerra and Leitão (2017) in BP and by Gilboy and others (1995) in English was the motivation for the present investigation, not only regarding referentiality, but also P+D contraction and definiteness, as we will see shortly. If we consider, more specifically, the sentences in which the N2 is referential, in BP the results showed only 37.5% of N2 answers, while in English the results showed 55% of N2 answers. Our question was: why does the preference of N2 interpretation was higher in English than in BP in sentences with a referential N2? An obvious answer could be provided based on the literature about relative clause processing (not focused on substance complex NPs). In English, it has been reported a preference for low attachment since Cuetos & Mitchell's (1988) paper (*cf.*, for example, Carreiras & Clifton 1999). In BP, however, it has been argued that it is a language with a preference for low attachment at the initial stages of sentence processing (on-line preference for N2 modification), but a preference for high attachment at the final stages (off-line preference for N1 modification) (Maia, Fernández, Costa & Lourenço-Gomes 2006).[1] Following these findings reported by previous studies, we could

[1] Although Maia and others (2006) argue with theoretical clarity and experimental evidence in favor of this relative clause processing pattern in BP (on-line low attachment and off-line high attachment), the discussion is not closed, mainly if we consider some divergent results in BP. Ribeiro (1998, 2004, 2005), for example, reported off-line and on-line preferences for high attachment in BP, while Miyamoto (1999) reported an on-line preference for low attachment. Miyamoto (2005) reanalyzed this finding, acknowledging that it could be due to an interference effect related to the use of number agreement as disambiguating material, but the fact is that Maia and others (2006), using on-line measures and number agreement as disambiguating material (without creating interference effects), also found an on-line preference for low attachment in BP. In this sense, we have divergent results in BP considering the on-line findings reported by Maia and others (2006), and Ribeiro (1998, 2004, 2005), but, as we are working with

simply say that the higher preference for N2 interpretation in English than in BP is not surprising, it would be, actually, a predictable result. However, one difference between these two languages with respect to the structure of the complex NP called our attention: in BP, there is a contraction involving the preposition and the article introducing the N2 (*do couro*, 'of-the leather'), whereas in English there is not such a contraction ("of the leather"). We thought that it was worth to investigate if this linguistic difference could be one of the factors underlying the higher preference for N2 interpretation in English than in BP considering Gilboy and others (1995) and Bezerra and Leitão's (2017) results (but also the literature about the topic that we mentioned above). The idea, which is still is elaboration, is that the absence of P+D contraction would favor N2 modification and its presence would favor N1 modification. Why the parser would avoid "breaking" the contraction, favoring N1 attachment, is still an open question, but we consider some hypotheses later in this paper.

The question about a possible influence of P+D contraction on relative clause processing led us to look also at the influence of definiteness. This factor interested us firstly because it would allow an investigation of the influence of P+D contraction in BP: in this language, there is an obligatory contraction of the definite article with the preposition in the structure we are focusing on (*do*, 'of-the'), but the indefinite article can appear contracted with the preposition (*dum*, 'of-a') or not (*de um*, 'of a'). With these two options, therefore, we could test if the preference for N2 interpretation would be higher in sentences with *de um*, 'of a', than in sentences with *dum*, 'of-a'. But definiteness also interested us because it could, by itself, have an influence on relative clause interpretation. The Referential Theory (Crain & Steedman 1985; Altmann & Steedman 1988; Spivey-Knowlton & Sedivy 1995), for example, makes predictions about the role of definiteness on the processing of restrictive modifiers through the Principle of Parsimony. This principle predicts that, in case of ambiguity, the parser favors the analysis that carries fewer unsatisfied but consistent presuppositions. Definite and indefinite NPs differ with respect to the involvement of presupposition: definite NPs involve presupposition (it refers to an entity present in the discourse), but indefinite NPs does not (it introduces an entity into the discourse model). In a null context task investigating restrictive relative clause processing, a definite NP would trigger unsatisfied presuppositions, and a contrast set would have to be built in order to justify the restrictive modification; an indefinite NP, on the other hand, would not trigger such presuppositions, and the relative clause would act in the introduction and identification of a discourse entity. We could expect, therefore, an influence of definiteness on relative clause interpretation.

These thoughts and hypotheses about referentiality, P+D contraction, and definiteness motivated the elaboration of the experiment we conducted in BP. The experiment we conducted in Spanish, on the other hand, was mainly motivated by a critical reflection upon the results of the experiment in BP. The idea, in this case, was to investigate the influence of P+D contraction on the interpretation of relative clauses associated with substance NPs without considering additional factors, such as

off-line measures in this paper, Maia and others (2006), and Ribeiro (1998, 2004, 2005) make the same predictions based on BP data: preference for N1 modification.

definiteness: we wanted to isolate the factor contraction, and Spanish made this possible since it has a contracted form (*del*, 'of-the$_{(MASC)}$') and a non-contracted form (*de la*, 'of the$_{(FEM)}$') for definite articles. Besides that, we had two other reasons: first, we wanted to look at the influence of N2 referentiality in Spanish, since Gilboy and others (1995) did not manipulate this information in their questionnaire with native speakers of Spanish; second, as Spanish is a language with a preference for high attachment and is a language that also presents P+D contraction, we thought it would be interesting to test the influence of P+D contraction also in this language, potentiality contributing, with the experiment in BP, to the huge discussion about relative clause processing in the Sentence Processing area.

We present the experiment in BP in the next section and the experiment in Spanish in Section 3. We conclude our paper with a general discussion about the results we found in each language.

2. Experiment 1

This experiment consisted of a questionnaire study, and its aim was to investigate the influence of referentiality, definiteness, and P+D contraction on the interpretation of relative clauses associated to complex NPs of "substance" reading in BP. We manipulated three variables: N2 referentiality (Non-referential N2 / Referential N2), N2 definiteness (Definite / Indefinite), and P+D contraction (Non-contracted form / Contracted form). These variables produced the following experimental conditions:

a) Non-referential N2 (NRN2):

(6)

O policial	confiscou	o sapato	**de** couro	que	foi importado	irregularmente
the policeman	confiscated	the shoe	**of** leather	that	was imported	illegally
pela empresa.						
by-the company						

b) Referential N2 / Definite N2 (RDN2):

(7)

O policial	confiscou	o sapato	**do** couro	que	foi	irregularmente
the policeman	confiscated	the shoe	**of-the** leather	that	was	illegally
importado	pela empresa.					
imported	by-the company					

c) Referential N2 / Indefinite N2 / Non-Contracted form (RIN2NC):

(8)

O policial	confiscou	o sapato	**de um** couro	que	foi	irregularmente
the policeman	confiscated	the shoe	**of a** leather	that	was	illegally
importado	pela empresa.					
imported	by-the company					

d) Referential N2 / Indefinite N2 / Contracted form (RIN2C):

(9)

O policial	confiscou	o sapato	**dum** couro	que	foi importado	irregularmente
the policeman	confiscated	the shoe	**of-a** leather	that	was imported	illegally
pela empresa.						
by-the company						

After each experimental sentence, participants had to answer a comprehension question focusing on the relative clause interpretation. Considering the examples above, they would read a question like "O que foi importado irregularmente?" ('What was illegally imported?'), and then choose between two response options: ( ) Sapato ( ) Couro (( ) Shoe ( ) Leather), the first corresponding to N1 modification and the second, to N2 modification. Our dependent variable, therefore, was the type of response: N1 or N2.

Our hypotheses and predictions are the following:

Hypothesis 1: Influence of referentiality: we are expecting a preference for N1 interpretation when only the N1 is referential (condition a) and an attenuation of this preference when the N2 is also referential (conditions b, c, and d) (Gilboy *et al*. 1995; Bezerra & Leitão 2017). We predict, therefore, a higher number of N1 answers than N2 answers in condition (a), and a higher number of N2 answers in conditions (b), (c), and (d) than in condition (a).

Hypothesis 2: Influence of definiteness: we are expecting a higher preference for N2 interpretation when the N2 is indefinite than when it is definite (Crain & Steedman 1985; Spivey-Knowlton & Sedivy 1995).
Hence, we predict a higher number of N2 responses in conditions (c) and (d) than in condition (b).

Hypothesis 3: Influence of P+D contraction: we are going to formulate a hypothesis about this factor based on Schwarz's (2009) observations about the existence of two types of articles in German, and based on the Referential Theory (Crain & Steedman 1985; Altmann & Steedman 1988; Spivey-Knowlton & Sedivy 1995). Schwarz (2009) emphasizes a difference between *weak* and *strong* articles. Compare the sentences "Hans ging zum haus" ('Hans went to-the house') and "Hans ging zu dem haus" ('Hans went to the house'). One important difference between these sentences is the presence or absence of P+D contraction: it is present in the first sentence (*zum*, 'to-the') but it is absent in the second one (*zu dem*, 'to the'). This difference is linguistically rich. In the first case we are seeing a weak article, which necessarily appears in contraction with the preposition, involves uniqueness (for example, "the sun"), and cannot appear with restrictive relative clauses. In the second case we are seeing a strong article, which does not involve contraction with the preposition, involves anaphoricity (a linguistic referent in the preceding context), and is the form required for the use of restrictive relative clauses. Considering this difference between weak and strong articles, but without making a strict relation between these two types of article in German and the ones in BP (first, we are focusing on the distinction *definite* versus *indefinite*; second, the indefinite article with contraction is not semantically different from

the indefinite article without contraction), we want to use the logic "weak article = contracted form" and "strong article = non-contracted form" to hypothesize that "breaking" a P+D contraction would mean to turn a weak article into a strong article. Bringing the factor definiteness to our discussion (Altmann & Steedman 1988; Crain & Steedman 1985; Spivey-Knowlton & Sedivy 1995), we can have more specific hypotheses: in the condition (b), with definite N2, breaking the contraction would mean to turn a weak article into a strong article, and this would not be an efficient procedure in a null context task, since the strong article here is definite and would imply unsatisfied presuppositions and the creation of a contrast set (extra processing cost) to allow a restrictive modification; therefore, N2 interpretation would not be favored; in the condition (c), with indefinite N2 + non-contracted form, the strong article is indefinite and introduces an entity into the discourse model, allowing a restrictive relative clause for identification; therefore, N2 interpretation would be highly favored here (in fact, among all conditions, (c) would be the best condition to get an N2 interpretation); in the condition (d), with indefinite N2 + contracted form, the act of breaking the contraction would mean, as we know, to turn a weak article into a strong article, but the article here is indefinite, and, if the factor definiteness is stronger than the factor contraction, the processor would consider that an indefinite article as a strong article would introduce an analysis supported by the context; therefore, N2 interpretation could be favored here (if the factor contraction is, in fact, stronger than the factor definiteness, N1 interpretation would be favored: the processor would avoid breaking the contraction in spite of the expression being indefinite).

Our predictions are the following: a higher number of N2 responses in (c) than in (a), (b), and (d) (both contraction and definiteness favor N2 interpretation); a lower number of N2 responses in (d) than in (c) (contraction effect), but a higher number of N2 responses in (d) than in (b) (definiteness stronger than contraction).

2.1. Method

2.1.1. Participants

Forty undergraduate students at the State University of Paraiba (Campina Grande, Brazil) participated voluntarily in this experiment. All of the participants were native speakers of Brazilian Portuguese and had an average age of 20 years.

2.1.2. Material

The material consisted of four experimental sets, each one containing s16 experimental sentences (four sentences per experimental condition) and 32 fillers, following a Latin Square distribution and a within-subjects design: each subject was exposed to four instances of each of the four experimental conditions, but not to more than one version of an experimental item. All experimental sentences used in this experiment appear in Appendix A.

The experimental sentences had the following structure: NP + VP + complex NP (N1 of N2) + Relative Clause (that + was + participle + adverb + by + agent). Three linguistic factors differentiated the four experimental conditions: N2 referentiality (in the

condition NRN2, the N2 was a bare noun; in the conditions RDN2, RIN2NC, RIN2C, the N2 was introduced by a determiner); N2 definiteness (definite article in the condition RDN2, and indefinite article in the conditions RIN2NC and RIN2C), and P+D contraction (non-contracted form in RIN2NC, and contracted form in RIN2C). The experimental items were ambiguous: both N1 and N2 had the same gender (masculine), which was compatible with the gender of the participle present in the relative clause. As mentioned earlier, for each experimental item, there was a comprehension question followed by two options of response: N1 and N2.

The task was a paper-based questionnaire: experimental items and fillers were printed on A4 size paper sheets, which were then cut into small pieces and put together in the format of a pad of paper in order to isolate the sentences in such a way that participants could see only one sentence at a time. The comprehension questions were printed on the back of the sentences and the two options of response appeared just below them: in the experimental items, the N1 was on the left side and N2 was on the right side; in the fillers, half of the correct responses was on the left side and the other half was on the right side. The lists were pseudo-randomized so that the experimental sentences were always separated from one another by two fillers (one with the correct response to the left, and the other with the correct response to the right).

2.1.3. Procedure

Participants were tested individually or simultaneously in silent rooms at the State University of Paraiba. Before the task, they were given instructions that emphasized the following aspects: they should read the sentences at a natural pace; they should answer the comprehension questions choosing between the two options based on their interpretation of the sentence; they should not return to reread the sentence after reading the comprehension question; and, in the case of simultaneous application of the task, they should not talk to each other during the experiment.

Participants took an average of fifteen minutes to answer the questionnaire.

2.2. Results

In the statistical analyses, we used the program Action to perform qui-squared tests, and the program *R* to perform binomial logistic regression analyses. Considering, first, the results obtained in each condition separately, qui-squared tests revealed a significantly higher number of N1 responses than N2 responses in the conditions NRN2, RDN2, and RIN2NC, with no difference in the condition RIN2C. The statistical results can be seen in Table 1:

Table 1. Qui-squared tests – Experiment 1.

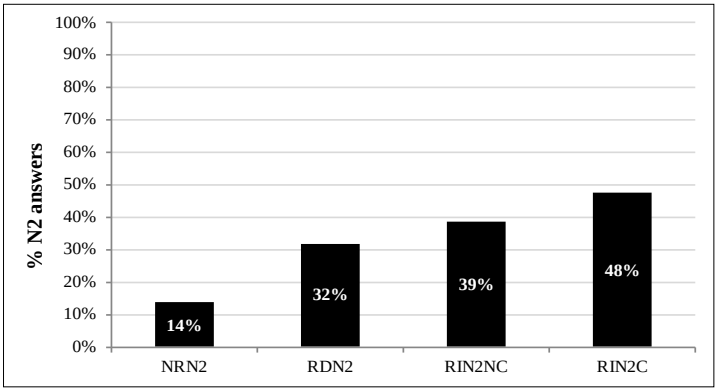
Experimental condition	X^2 results
NRN2	$X^2(1, N = 40) = 84.1, p < .001$
RDN2	$X^2(1, N = 40) = 21.02, p < .001$
RIN2NC	$X^2(1, N = 40) = 8.1, p = .004$
RIN2C	$X^2(1, N = 40) = 0.4, p = .52$

Source: Created by the author.

Comparing, now, the conditions, the logistic regression analysis[2] revealed a significant effect of N2 referentiality: a referential N2 significantly increased the probability of N2 responses (β = 1.4046, *SE* = 0.2478, z = 5.667, $p < .001$). More specifically, logistic regression analyses revealed that, in comparison with a non-referential N2, a definite N2 significantly increased the probability of N2 responses (β = 1.0767, *SE* = 0.2855, z = 3.772, $p < .001$), as well as an indefinite N2 with contraction (β = 1.7361, *SE* = 0.2789, z = 6.226, $p < .001$) and without contraction (β = 1.3784, *SE* = 0.2811, z = 4.903, $p < .001$).

The logistic regression analysis also revealed a significant effect of N2 definiteness: an indefinite N2 significantly increased the probability of N2 responses (β = 0.4828, *SE* = 0.2038, z = 2.369, p = 0.01). More specifically, logistic regression analyses revealed that, in comparison with a definite N2, an indefinite N2 with contraction significantly increased the probability of N2 responses (β = 0.6594, *SE* = 0.2320, z = 2.842, p = 0.004), but not an indefinite N2 without contraction (β = 0.3017, *SE* = 0.2348, z = 1.285, p = 0.19).

Finally, the logistic regression analysis did not reveal a significant effect of P+D contraction: in comparison with an indefinite N2 with contraction, the indefinite N2 without contraction did not increase the probability of N2 responses (β = -0.3577, *SE* = 0.2267, z = -1.578, p = 0.11); in fact, there was a numerical difference between them in the opposite direction, as we can see in Graph 1:



Graph 1. Percentage of N2 responses per experimental condition.

[2] In this experiment and in Experiment 2, we used the following type of logistic regression model, changing, naturally, the predictor (independent variable) and the data to perform the different analyses: glm(formula = Resposta ~ Referencialidade, family = binomial(link = "logit"), data = dados1).

We discuss these results in the following section.

2.3. Discussion

As initially predicted, the results revealed an influence of referentiality and definiteness on relative clause interpretation: (i) there was a preference for N1 interpretation in the condition NRN2, in which only the N1 is referential, but this preference was significantly diminished in the conditions RDN2, RIN2NC, RIN2C, in which the N2 is also referential (Bezerra & Leitão 2017; Gilboy *et al*. 1995); (ii) the chance of achieving an N2 interpretation was significantly higher in sentences with an indefinite N2 (mainly in the condition with contracted form) than in sentences with a definite N2 in this task with null context (Crain & Steedman 1985; Spivey-Knowlton & Sedivy 1995). The results, however, did not support our prediction of an influence of P+D contraction on relative clause interpretation.

It is interesting to see that, despite of the referentiality effect that was found, we still had a preference for N1 interpretation in the conditions with a referential N2 (except in the one with indefinite N2 and contracted form, in which the number of N1 and N2 responses was balanced). If we consider the condition with a definite N2, this would not be a surprising result, since Bezerra and Leitão (2017) found results in the same direction. However, finding a preference for N1 interpretation even in the presence of an indefinite N2 was unexpected. This result probably has to do with a resistance to a referential N2 (definite and indefinite) in complex NPs of substance reading. Bezerra (2017) found evidence for that with an acceptability judgment task using the same sentences that we used in this experiment. The author used a Likert scale (from 1 (very unnatural) to 5 (very natural)) to measure how natural the sentences were to native speakers of Brazilian Portuguese. The results revealed, first, that the condition NRN2 (with non-referential N2) was seen as more natural than the other three conditions (with referential N2) and, second, that the conditions with an indefinite N2 were seen as less natural than the condition with a definite N2. The first result is coherent with the idea that complex NPs of substance reading contain, more naturally, a referential N1 and a non-referential N2 (Gilboy *et al*. 1995). The second result, however, is curious: the conditions with an indefinite N2, which gave us more N2 answers in the present experiment, was judge as less natural than the condition with a definite N2. Our hypotheses are the following: (i) the conditions with an indefinite N2 were judged as less natural precisely because they force more the N2 analysis than the condition with a definite N2: they force a referential analysis of the N2 in a complex NP in which such noun would rather be used as non-referential (as just describing the material of which the 2 is made); (ii) although the indefinite N2 forces more the N2 interpretation, it is still part of a complex NP of substance reading, which means that it indeed favors more the N2 interpretation than the definite N2 but it does not actually fully determines it as the preferred analysis.

The idea that the indefinite N2 may force more a referential interpretation than a definite N2 is based on what Aguilar-Guevara (2014) suggested using a different type of structure:

(10)

a. Lola is reading the newspaper.
b. Lola is reading a newspaper.
c. Lola listened to a radio until she fell asleep. She turned iti off when she woke up in the middle of the night.

Comparing sentences like 10a and 10b, the author proposes, focusing on the contrast *the newspaper* versus *a newspaper*, that while in 10a we would have a weak definite, which does not have the potential to introduce a specific referent into the discourse model, in 10b we would in fact get a referential interpretation, and this could be proven by the use of a pronoun, as in example 10c, considering here *a radio*.

It is important to bring Aguilar-Guevara (2014) to our discussion because we believe that the absence of a previous context in our task cannot fully explain the definiteness effect that we found. The reason for that can be understood through a more carefully examination of our sentences. In the sentence in example 7 (Section 2), the NP *o couro* seems to require a restrictive modification to achieve a referential interpretation: "O policial confiscou o sapato do couro" ('the policeman confiscated the shoe of-the leather') is not a good sentence in BP, and an immediate question after reading it is "qual couro?", 'which leather?'. Interestingly, the same question arises after reading "O policial confiscou o sapato de um couro" ('the policeman confiscated the shoe of a leather'), which means that an indefinite N2 also seems to require a restrictive modification, in this case, to identify the referent. What we can conclude from these observations is that independently of the presence or absence of a previous context, an argument that we used, based on the Referential Theory (Crain & Steedman 1985; Spivey-Knowlton & Sedivy 1995), to hypothesize a difference between a definite and an indefinite N2 with respect to the relative clause interpretation, the N2 (definite or indefinite) by itself asks for an additional modification to receive a referential interpretation in the sense of corresponding to a particular referent in the discourse model. In our view, this need for an additional modification comes from the semantic nature of the N2 – it is a mass noun.

(11) O policial confiscou o sapato da mulher.
'The policeman confiscated the shoe of the woman.'

In a sentence like 11, for example, the NP *a mulher*, 'the woman', does not require an additional modification for the sentence to be considered "good". A noun like *couro*, 'leather', is a prototypical mass noun and does not denote inherently individuable entities (natural units), but substances. In our sentences, in the conditions with a referential N2, we combined a massive noun with a determiner, consequently, we placed the massive noun at the level of a count noun; however, to be countable, the massive noun needs to be individualized, and this can be done by the use of a classifier, like "type of" and "piece of" , for example (Chierchia 1998). Based on this consideration, we want to argue that in *o sapato do couro*, 'the shoe of-the leather', there may be a hidden classifier, which may be the factor responsible for the need of a restrictive modification that we mentioned.

(12)

a. Paulo comprou o couro.
'Paulo bought the leather.'

b. Paulo comprou o tipo de couro.
'Paulo bought the type of leather.'

In a sentence like example 12a considering a classifier like "type of", we would have example 12b which requires a restrictive modification (Schmitt 2000), in this case, to specify the type of leather.

To summarize: in our task with null context, both definite and indefinite N2 are mass nouns and seem to require an additional modification to be referentially interpreted; therefore, the definiteness effect is not only related to the fact that we did not have a previous context, but also to the fact that an indefinite N2 would force more a referential interpretation than a definite N2 (Aguilar-Guevara 2014). Moreover, the fact that we still had a preference for N1 modification in the sentences with a definite N2 and an indefinite N2 (contracted form) in spite of this need for a restrictive modification is a reflection of a resistance to a referential N2 in complex NPs of substance reading.

Considering now the absence of a significant effect of P+D contraction, should we simply assume that it has no influence on relative clause processing? We thought that before answering "yes" to this question we should reflect more on the nature of the contractions *do*, 'of-the', and *dum*, 'of-a', in BP. Hofherr (2012) and Nunes (2008) helped us in this process. The first author focused on P+D contractions in French and German. She raised important questions about it, such as: at which linguistic level (phonological, morphological, syntactic) does the P+D contraction take place? Is it a purely phonological phenomenon (solely conditioned by linear adjacency of P and D)? Answering "no" to the second question, the author answers "morphological" to the first question, assuming a model where morphology applies before and after the syntax. She proposes that P+D contractions in French, like "la maison du père", 'the house of-the father', which involves the contraction "de + le = du", 'of + the = of-the', correspond to inflected prepositions, that is, to single words that combine features of P and D: P and D are contracted in the lexicon (pre-syntactic morphology) and correspond to a single syntactic position, selecting a noun phrase without the D-layer as complement. The author approaches the P+D contraction in German in a different way: in *Peter ist im Haus* ('Peter is in the house'), the contraction *in + dem = im*, 'in + the = in+the', is seen as a result of a post-syntactic morphological process, and D and P correspond to two adjacent syntactic positions (adjacency, however, according to the author, is not sufficient, D has to be the head of the complement of P).

Hofherr's (2012) approach to P+D contraction in French and German reveals how rich the linguistic discussion about the topic can be. Considering the questions this author raised about the nature of P+D contraction, we can ask, for example, if the contractions *do*, 'of-the', and *dum*, 'of-a', have the same linguistic nature, taking place at the same linguistic level. The answer seems to be negative. Nunes (2008), for example, sees the

contraction P+D(definite article) as a morphological phenomenon (morphological merger), emphasizing that the preposition and the determiner must contract when adjacent. P and D, in this case, would correspond to different syntactic positions. As for the contraction involving indefinite article (*dum*, 'of-a'), it is optional and more common in oral and informal speech. Our hypothesis is that *do*, 'of-the', and *dum*, 'of-a', do not have the same linguistic nature: the first one is obligatory in the structure we are focusing on and occurs at the morphological level, whereas the second is optional and seems to involve a more superficial process of reduction. In light of this difference, we concluded that we could not fully reject the hypothesis of an influence of the P+D contraction in the case of *do*, 'of-the', based on the results that we found comparing *dum*, 'of-a', and *de um*, 'of a'. Considering that this comparison was not a good way of testing the contraction hypothesis, we decided to test it again, but this time in Spanish, in which there is contraction when the definite article is masculine (*del*, 'of-the$_{(MASC)}$'), but not when it is feminine (*de la*, 'of the$_{(FEM)}$'). This is a better way of testing our hypothesis because *del* corresponds to an obligatory contraction (as we see in *do*, 'of-the', in BP) and because we could isolate the factor contraction, not bringing definiteness to the discussion. We are going to present this experiment in the next section.

3. Experiment 2

This experiment also consisted of a questionnaire study, and its aim was to investigate the influence of referentiality and P+D contraction on the interpretation of relative clauses associated to complex NPs of "substance" reading in Spanish. We manipulated two variables: N2 referentiality (Non-referential N2 / Referential N2) and N2 gender (Masculine (contracted form) / Feminine (non-contracted form)). These variables produced the following experimental conditions:

a) Non-referential N2 (NRN2):

(13)

El policía	confiscó	el zapato	**de** cuero	que	la empresa	importó
the policeman	confiscated	the shoe	**of** leather	that	the company	imported
ilegalmente.						
illegally						

b) Referential N2 / Contracted form (Masculine N2) (RN2C):

(14)

El policía	confiscó	el zapato	**del** cuero	que	la empresa	importó
the policeman	confiscated	the shoe	**of-the** leather	that	the company	imported
ilegalmente.						
illegally						

c) Referential N2 / Non-Contracted form (Feminine N2) (RN2NC):

(15)

El policía	confiscó	el zapato	**de la** lona	que	la empresa	importó
the policeman	confiscated	the shoe	**of the** canvas	that	the company	imported

ilegalmente.
illegally

After each experimental sentence, participants had to answer a comprehension question focusing on the relative clause interpretation. Considering the examples above, they would read a question like "¿Qué importó la empresa?" ('What did the company import?'), and then choose between two options of response: ( ) Zapato ( ) Cuero (conditions (a) and (b)) / ( ) Zapato ( ) Lona (condition (c)) ("( ) Shoe ( ) Leather) / ( ) Shoe ( ) Canvas"), the first option corresponding to N1 modification and the second, to N2 modification. Our dependent variable was the type of response: N1 or N2.

Our hypotheses and predictions are the following:

> Hypothesis 1: Influence of referentiality: as in the previous experiment, we are expecting a preference for N1 interpretation when only the N1 is referential (condition a) and a reduction of this preference when the N2 is also referential (conditions b and c) (Gilboy *et al*. 1995). We say "reduction" because we may still find a preference for N1 interpretation in the conditions with a referential N2 considering the preference for high attachment that has been associated with this language since Cuetos and Mitchell's (1988) seminal work. Therefore, we predict a higher number of N1 answers than N2 answers in condition (a), a higher number of N2 answers in conditions (b) and (c) than in condition (a), but still a higher number of N1 responses than N2 responses in conditions (b) and (c).
>
> Hypothesis 2: Influence of P+D contraction: we are expecting a higher preference for N2 interpretation in condition (c), with non-contracted form, than in condition (b), with contracted form – the parser would avoid breaking the contraction in (b) perhaps because in doing so it weakens the article and prevents a "strong referential interpretation" of the N2 (here we could mention Schwarz (2009) again, although the weak article in German is quite different from what we find in Spanish: in this language (just like in BP), there is no semantic difference between the contracted and non-contracted forms), which would not be the preferred interpretation in the type of NP we are focusing on, as we previously mentioned.
>
> We predict a higher number of N2 responses in condition (c) than in condition (b).

3.1. Method

3.1.1. Participants

Twenty-four students at the University of the Basque Country (San Sebastián, Spain) participated voluntarily in this experiment. The participants were native speakers of Spanish and had an average age of 24 years.

3.1.2. Material

The material consisted of three experimental sets, each one containing 13 experimental sentences (four sentences per experimental condition) and 24 fillers, following a Latin Square distribution and a within-subjects design: each subject was exposed to four instances of each of the three experimental conditions, but not to more than one version of an experimental item. All experimental sentences used in this experiment appear in Appendix B.

The experimental sentences had the following structure: NP + VP + complex NP (N1 of N2) + Relative Clause (that + NP + VP + adverb). The nature of the N2 determined the different experimental conditions: in the condition (a), NRN2, the N2 was a masculine bare noun; in the condition (b), RN2C, the N2 was a masculine noun introduced by an article, which involves contraction with the preposition; and in the condition (c), RN2NC, the N2 was a feminine noun introduced by a feminine article, which does not involve contraction with the preposition. The N1 was always masculine, whereas the N2, as we have just mentioned, was masculine in the conditions NRN2 and RN2C, and feminine in the condition RN2NC. The experimental items were ambiguous (the relative clause could modify either the N1 or the N2), and the comprehension question was supposed to access the interpretation preferred by the participants (N1 or N2 modification).

The task was a paper-based questionnaire, and it was structured in the same way as the Experiment 1.

3.1.3. Procedure

Participants were tested simultaneously in the library of the University of the Basque Country. As in the previous experiment, before the task, participants were given instructions about the following aspects: they should read the sentences at a natural pace; they should answer the comprehension questions choosing between the two options based on their interpretation of the sentence; they should not return to reread the sentence after reading the comprehension question; and they should not talk to each other during the experiment.

Participants took an average of fifteen minutes to answer the questionnaire.

3.2. Results

Looking, first, at the results obtained in each condition separately, qui-squared tests revealed a significantly higher number of N1 responses than N2 responses in all experimental conditions:

Table 2. Qui-squared tests – Experiment 2.

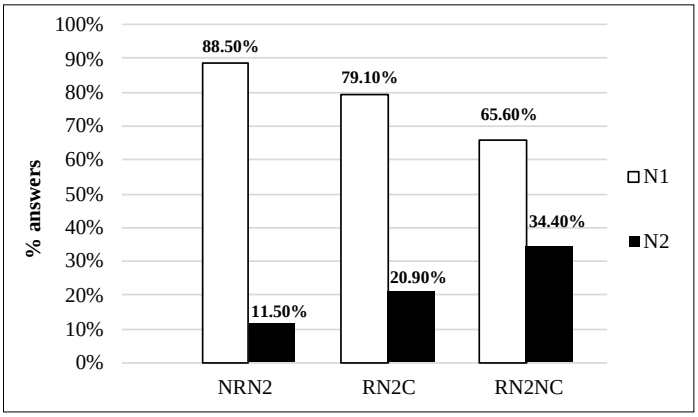
Experimental condition	X^2 results
NRN2	$X^2(1, N = 24) = 57.04, p < .001$
RN2C	$X^2(1, N = 24) = 32.66, p < .001$
RN2NC	$X^2(1, N = 24) = 9.37, p = .002$

Source: Created by the author.

Comparing, now, the conditions, the logistic regression analysis revealed a significant effect of N2 referentiality: a referential N2 significantly increased the probability of N2 responses (β = 1.0806; *SE* = 0.3588; z = 3.012; p = 0.002). More specifically, in comparison with a non-referential N2, a referential N2 without contraction significantly increased the probability of N2 responses (β = 1.3981; *SE* = 0.3858; z = 3.624; $p < .001$), whereas a referential N2 with contraction only marginally increased the chance of N2 responses (β = 0.7098; *SE* = 0.4072; z = 1.743; p = 0.08).

The logistic regression analysis also revealed a significant effect of P+D contraction: in comparison with a referential N2 with contraction, a referential N2 without contraction significantly increased the probability of N2 responses (β = 0.6884; *SE* = 0.3307; z = 2.082; p = 0.03).

The percentage of N1 and N2 responses in each experimental condition can be seen in Graph 2:



Graph 2. Percentage of N1 and N2 responses per experimental condition.

We discuss these results in the following section.

3.3. Discussion

First, the results revealed an influence of referentiality on the interpretation of relative clauses in Spanish: there was a higher preference for N2 modification when the N2 was referential (conditions RN2C and RN2NC) than when it was non-referential (NRN2), as

predicted by the Referentiality Principle (Gilboy *et al*. 1995); however, there was still a general preference for N1 interpretation, since in all conditions the number of N1 answers was higher than the number of N2 answers, and these results are coherent with the literature about relative clause processing in Spanish (Carreiras & Clifton 1999; Cuetos & Mitchell 1988).

Second, the results also revealed an influence of P+D contraction on relative clause interpretation: the probability of N2 interpretation was higher in the condition with non-contracted form than in the condition with contracted form. As far as we know, this finding is original (it was not considered in the literature about relative clause processing yet), and we would like to suggest, based on it, that P+D contraction could be one of the factors underlying the higher preference for N2 interpretation in English (55%) (Gilboy *et al*. 1995) when the N2 is referential than in BP (32%) (Bezerra & Leitão 2017) and now in Spanish (21%), and that it might even be one of the factors underlying the preference for high attachment in Spanish that has been reported since the seminal work developed by Cuetos and Mitchell (1988).

Focusing more on the P+D contraction effect, we need to explain what it means. We could consider a semantic hypothesis: considering that we also used complex NPs of substance reading in this experiment in Spanish and that, as we previously mentioned, a referential N2 is not easily accepted in this type of NP, we could suggest that the parser avoids breaking the P+D contraction in sentences like example 7 (Section 2), as a way of rejecting the strong referentiality intended by the determiner. In this direction, we can also suggest that, when participants prefer N1 interpretation in sentences like the one above (in which the N2 also seems to require an additional modification), and also in the sentences with definite N2 in the previous experiment in BP, they might be interpreting the N2 as weakly referential (Aguilar-Guevara 2014), that is, as a noun referring more to a concept than to a specific referent in the discourse model, and the presence of contraction might be contributing to this weakly referential interpretation in some way. This semantic hypothesis for the contraction effect is good because it is testable: we can investigate if the parser would avoid breaking the contraction when processing relative clauses associated with other types of complex NPs, such as "la masajista del jugador", 'the masseur of-the player$_{(MASC)}$', and "la hija del doctor", 'the daughter of-the doctor'.

An investigation of other types of complex NP is also good because it can help us to clarify another possible explanation for our results. As pointed out to us by a participant during a presentation in a conference, the effect that we found could be an artifact due to an ambiguity in the perception of *del*, 'of-the': it could have been perceived as *de*, 'of', or as *del*, 'of-the'. This is possible, since we are dealing with function words that could pass unnoticed in reading. However, we can argue against it by mentioning that Bezerra, Leitão and Medeiros (2017) found, in an eye-tracking study conducted in BP to investigate the processing of relative clauses associated with complex NP of substance reading, that participants took longer to read *do couro*, 'of-the leather', than to read *de couro*, 'of leather', and this difference was found in the first pass reading times, that is, participants immediately noticed the presence of the determiner contracted with the preposition. In addition to this, we can also use another type of complex NP to see if this idea of an artifact can be sustained: in "la hija del doctor", 'the daughter of-the doctor),

del, 'of-the', could not be misperceived as *de*, 'of', since "la hija de doctor", 'the daughter of doctor', is not a grammatical construction in Spanish. Therefore, if we found a contraction effect comparing "la hija del doctor", 'the daughter of-the doctor$_{(MASC)}$', with "la hija de la doctora", 'the daughter of-the doctor$_{(FEM)}$', it would not be due to an ambiguity in the perception of *del*, 'of-the'. Actually, it would also disconfirm the semantic hypothesis that we considered before. We intend, therefore, to investigate the influence of P+D contraction using other types of complex NP to better understand how contraction can affect relative clause processing.

4. General Discussion

We started this paper by questioning, first, the preferences of analysis in case of ambiguous sentences:

(16) The policeman confiscated the shoe of (the) leather that was illegally imported.

And, secondly, the motivation for one preference or another (N1 or N2 interpretation). We addressed these questions based on the Referentiality Principle (Gilboy *et al*. 1995), postulated within the framework of the Construal Hypothesis (Frazier & Clifton 1996). This principle predicts that restrictive modifiers (such as restrictive relative clauses) preferentially seek hosts which are referential in the sense that they introduce discourse entities into a discourse model or correspond to already existing discourse entities. In this sense, the referential status of the N1 and the N2 would motivate two situations: first, a preference for N1 modification in sentences like in example 16 when only the N1 is referential (*the shoe of leather*), and, second, a higher tendency toward N2 modification in case the N2 is also referential (*the shoe of the leather*). We showed that Gilboy and others (1995), and Bezerra and Leitão (2017) provided experimental evidence in favor of such situations, the first authors using English data and the second authors using BP data. We then mentioned that Gilboy and others (1995) found a higher preference for N2 interpretation than Bezerra and Leitão (2017) in sentences with a referential N2 in the substance complex NP, motivating us to question if this difference could be due to the P+D contraction factor. We decided that we could clarify the differences between the results obtained in English and in BP by investigating, again, the referentiality factor in BP, and also by considering an investigation of the P+D contraction factor, which motivated us to look at the definiteness factor, as we said in the Introduction. In order to do so, we conducted two experiments, one in BP and one in Spanish.

The results obtained in both experiments showed that referentiality has an influence on relative clause processing: in sentences like in 16, when only the N1 was referential, there was a preference for N1 interpretation, but when the N2 was also referential, this preference was attenuated: more N2 answers were given by the participants. These results are coherent with the predictions of the Referentiality Principle (Gilboy *et al*. 1995): in case of ambiguity, referential hosts are favored over non-referential ones by restrictive relative clauses in situations like the one in example 16. They are also coherent with the

literature on relative clause processing: despite of the referentiality effect, we still had a general (off-line) preference for N1 interpretation in BP (excluding the condition with indefinite N2 and contracted form) (Maia *et al*. 2006; Ribeiro 2004, 2005) and in Spanish (Carreiras & Clifton 1999; Cuetos & Mitchell 1988). Following the mechanism of analysis proposed by the Construal Hypothesis (Frazier & Clifton 1996) for the processing of secondary phrases, we understand that, in our experiments, upon encountering the relative clause, participants associated it to the current thematic processing domain and then interpreted it using the referential status of the two hosts available in the complex NP (our off-line task had access to the later stage of interpretation).

The first experiment also showed that definiteness has influence on relative clause processing: an indefinite N2 induced more an N2 interpretation than a definite one, which we explained not only based on the absence of presuppositions in the case of an indefinite N2 (Crain & Steedman 1985; Spivey-Knowlton & Sedivy 1995), but also in terms of the idea that an indefinite N2 would force more the N2 interpretation than a definite one (Aguilar-Guevara 2014), independently of the presence or absence of a previous context in the task. The results of the first experiment also allowed us to think more critically about the structure we focused on. A non-referential N2 in complex NPs of substance reading is more natural than a referential one, and participants showed a resistance to a strong referential reading of the referential N2 in this case: even in a situation in which the referential N2 seems to ask for an additional modification due to its status as a mass noun introduced by a determiner, participants still exhibited a preference for N1 interpretation, which, in our view, suggests that they might have gotten a weakly referential interpretation of the referential N2 (mainly the definite one) most of the time.

The second experiment, in particular, showed an influence of P+D contraction on relative clause processing: there was a higher preference for N2 modification in sentences without contraction than in sentences with contraction. We considered a semantic hypothesis to explain this result: the parser would avoid breaking the contraction *del*, 'of-the', as a way of rejecting the strong referentiality intended by the determiner, reaching a weakly referential interpretation of the N2. The presence of contraction might contribute to this weakly referentiality in some way, for example, by weakening the power of the determiner. We are aware of the fact that the contraction effect that we found needs to be more properly addressed, and, to do so, we need to focus on other types of complex NPs, as we discussed before, but, independently of this, it is an important effect and deserves attention. If we look at the items used by Cuetos and Mitchell (1988) in their second experiment, for example, we see that 19 experimental items, from a total of 24, contained P+D contraction. Even if the effect that we found is just a matter of misperceiving *del*, 'of-the', as *de*, 'of', it is still important, since this could lead to a non-referential interpretation of the N2, favoring N1 modification. Therefore, we suggest that P+D contraction should also receive attention in the literature about relative clause processing. It is worth to see if it could have an effect in other languages, such as French, which requires contraction when the article is masculine but not when it is feminine and is language associated with a preference for high attachment (Zagar, Pynte & Rativeau 1997).

In sum, considering our initial questions, we can say that in sentences like 16, native speakers of BP and native speakers of Spanish exhibit a general preference for N1 interpretation but this preference tends to be diminished when the N2 is referential (definite/indefinite) and when the definite article that introduces the referential N2 is not contracted with the preposition. In our study, these preferences of analysis were motivated by referentiality, definiteness and P+D contraction. Besides that, we would like to suggest that P+D contraction may be one of the factors behind the difference between the results found by Gilboy and others (1995) in English, and by Bezerra and Leitão (2017) in BP. In fact, P+D contraction could also be one of the factors behind the preference for high attachment in Spanish that has been reported since Cuetos and Mitchell's (1988) research. In order to advance the discussion presented here, we are working on two new experiments: one in BP, to investigate the influence of referentiality on relative clause processing using other types of complex NPs, such as "assistente de(do) gerente", 'assistant of(of-the) manager', in which a referential N2 is much more natural than in substance NPs, providing a way of testing the influence of referentiality in a less biased situation toward N1 interpretation; and one in Spanish, to continue the investigation about P+D contraction by using other types of complex NPs, such as "la hija del doctor", 'the daughter of-the doctor', in which the referential N2 is natural, providing a way of testing the semantic hypothesis that we considered in this paper and of clarifying the idea that the contraction effect could be related to an artifact due to an ambiguity in the perception of *del*, 'of-the'.

References

Aguilar-Guevara, A. (2014). *Weak definites: Semantics, lexicon and pragmatics* (Doctoral thesis, Utrecht University, Utrecht, Netherlands).

Bezerra, G. B. (2017). *A influência da referencialidade no processamento de orações relativas associadas a NPs complexos do tipo "substância"* (Doctoral thesis, Federal University of Paraíba, João Pessoa, Brasil).

Bezerra, G. B., Leitão, M. & Medeiros, L. (2017). A influência da referencialidade no processamento de orações relativas em português brasileiro. *Revista de Estudos da Linguagem*, *25* (3), 1397–1431. https://doi.org/10.17851/2237-2083.25.3.1397-1431

Bezerra, G. B. & Leitão, M. M. (2017). The construal hypothesis and relative clause processing: The effect of the referentiality principle in Brazilian Portuguese. In L. Escobar, V. Torrens & T. Parodi (Eds.), *Language processing and disorders* (pp. 54–74). Newcastle upon Tyne: Cambridge Scholars Publishing.

Carreiras, M. & Clifton, C. (1999). Another word on parsing relative clauses: Eyetracking evidence from Spanish and English. *Memory & Cognition*, *27* (5), 826–833.

Chierchia, G. (1998). Reference to kinds across languages. *Natural Language Semantics*, *6* (4), 339–405.

Crain, S. & Steedman, M. (1985). On not being led up the garden path: The use of context by the psychological parser. In D. Dowty, L. Kartunnen & H. Zwicky (Eds.), *Natural language parsing* (pp. 320–358). Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/CBO9780511597855.011

Cuetos, F. & Mitchell, D. C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the late closure strategy in Spanish. *Cognition*, *30*, 73–105. https://doi.org/10.1016/0010-0277(88)90004-2

Fodor, J. D. (1998). Learning to parse?. *Journal of Psycholinguistic Research*, *27* (2), 285–319. https://doi.org/10.1023/A:1023258301588

Frazier, L. (1979). *On comprehending sentences: Syntactic parsing strategies* (Unpublished doctoral thesis, University of Connecticut, Connecticut, USA).

Frazier, L. (1990). Exploring the architecture of the language-processing system. In G. Altmann (Ed.), *Cognitive models of speech processing: Psycholinguistic and computational perspectives* (pp. 409–433). Cambridge, MA: MIT Press.

Frazier, L. & Clifton, C. Jr. (1996). *Construal*. Cambridge, MA: MIT Press Cambridge.

Frazier, L. & Rayner, K. (1982). Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive Psychology*, *14* (2), 178–210. https://doi.org/10.1016/0010-0285(82)90008-1

Gilboy, E., Sopena, J., Clifton, C. Jr. & Frazier, L. (1995). Argument structure and association preferences in Spanish and English complex NPs. *Cognition*, *54* (2), 131–167. https://doi.org/10.1016/0010-0277(94)00636-Y

Gibson, E., Pearlmutter, N., Canseco-Gonzalez, E. & Hickok, G. (1996). Recency preference in the human sentence processing mechanism. *Cognition*, *59*, 23–59. https://doi.org/10.1016/0010-0277(95)00687-7

Grillo, N. & Costa, J. (2014). A novel argument for the universality of parsing principles. *Cognition*, *133*, 156–187. https://doi.org/10.1016/j.cognition.2014.05.019

Hemforth, B., Konieczny, L., Seelig, H. & Walter, M. (2000). Case matching and relative clause attachment. *Journal of Psycholinguistic Research*, *29*, 81–88. https://doi.org/10.1023/A:1005176507878

Hofherr, P. C. (2012). Preposition-determiner portmanteaux in French and German. In P. Ackema, R. Alcorn, C. Heycock, D. Jaspers, J. Van Craenenbroeck & G. Wyngaerd (Eds.), *Comparative germanic syntax: The state of the art* (pp. 99–132). Amsterdam: John Benjamins Publishing Company.

Maia, M. & Finger, I. (2007). Referencialidade e domínio temático na compreensão de orações relativas curtas e longas em português. *Linguística*, *3* (2), 249–278.

Maia, M., Fernández, E. M., Costa, A. & Lourenço-Gomes, M. C. (2006). Early and late preferences in relative clause attachment in Portuguese and Spanish. *Journal of Portuguese Linguistics*, *6*, 227–250. https://doi.org/10.5334/jpl.151

Mitchell, D. C. & Cuetos, F. (1991). The origins of parsing strategies. In C. Smith (Ed.), *Current issues in natural language processin*g (pp. 1–12). Austin: University of Texas,.

Miyamoto, E. T. (1999). *Relative clause processing in Brazilian Portuguese and Japanese* (Doctoral thesis, Massachusetts Institute of Technology – MIT, Cambridge, UK).

Miyamoto, E. (2005). Orações relativas ambíguas e a homogeneidade do processamento de sentenças. In M. Maia & I. Finger (Eds.), *Processamento da linguagem* (pp. 71–90). Pelotas: Educat.

Nunes, J. (2008). Preposition insertion in the mapping from Spell-out to PF. In H. Broekhuis & R. Vogel (Eds.), *Optimality theory and minimalism: Interface theories* [Linguistics in Potsdam 28] (pp. 136–156). Potsdam: Universitätsverlag Potsdam.

Ribeiro. A. J. (1998). *Um caso de não aplicação de Late Closure no português do Brasil*. Rio de Janeiro: UFRJ / FL. Mimeo.

Ribeiro. A. J. (2004). *Late Closure em parsing no português do Brasil* (Doctoral thesis, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil).

Ribeiro. A. J. (2005). Late Closure em parsing no português do Brasil. In M. Maia & I. Finger (Eds.), *Processamento da linguagem* (pp. 51–70). Pelotas: Educat.

Schmitt, C. (2000). Some consequences of the complement analysis for relative clauses, demonstratives and the wrong adjectives. In A. Alexiadou, P. Law, A. Meinunger & C. Wilder (Eds.), *The syntax of relative clauses* (pp. 309–348). Amsterdam: John Benjamins.

Schwarz, F. (2009). *Two types of definites in natural language* (Doctoral thesis, University of Massachusetts, Amherst, USA).

Spivey-Knowlton, M. & Sedivy, J. C. (1995). Resolving attachment ambiguities with multiple constraints. *Cognition*, *55* (3), 227–267. https://doi.org/10.1016/0010-0277(94)00647-4

Zagar, D., Pynte, J. & Rativeau, S. (1997). Evidence for early-closure attachment on first-pass reading times in French. *The Quarterly Journal of Experimental Psychology*, *50* (2), 421–438. https://doi.org/10.1080/713755715

Appendix A. Sentences used in Experiment 1. The four conditions are presented in the following way: "of (NRN2)/ of+the (RDN2)/ of a (RIN2NC)/ of+a (RIN2C) N2"

1. O policial confiscou o sapato de/do/de um/dum couro que foi importado irregularmente pela empresa.
2. O chefe aprovou o muro de/do/de um/ dum concreto que foi produzido estrategicamente pelo operário.
3. O caminhoneiro provou o relógio de/do/de um/dum aço que foi indicado repetidamente pelo revendedor.
4. A modelo comprou o brinco de/do/de um/dum ouro que foi conceituado preciosamente pelo joalheiro.
5. A empregada utilizou o saco de/do/de um/dum plástico que foi elogiado insistentemente pela supervisora.
6. O estilista indicou o vestido de/do/de um/dum cetim que foi fabricado recentemente pela fábrica.
7. O advogado vestiu o terno de/do/de um/dum linho que foi costurado manualmente pelo alfaiate.
8. O pedreiro colocou o portão de/do/ de um/dum alumínio que foi sugerido inicialmente pelo arquiteto.
9. A esposa adorou o anel de/do/de um/dum diamante que foi escolhido cuidadosamente pelo esposo.
10. A gerente elogiou o armário de/do/de um/dum vidro que foi lapidado eficientemente pelo empregado.
11. A decoradora admirou o pedestal de/do/de um/dum mármore que foi esculpido detalhadamente pela artesã.
12. A cantora usou o cachecol de/do/de um/dum veludo que foi comentado internacionalmente pela mídia.
13. A vendedora mostrou o colar de/do/de um/dum rubi que foi adquirido exclusivamente pela loja.
14. A comerciante vendeu o jarro de/do/de um/dum barro que foi modelado delicadamente pelo artesão.
15. O convidado apreciou o copo de/do/de um/dum cristal que foi encomendado antecipadamente pela anfitriã.
16. O padre inaugurou o sino de/do/de um/dum bronze que foi fornecido antecipadamente pela fundição.

Appendix B. Sentences used in Experiment 2. The three conditions are presented in the following way: “of (NRN2)/ of+the (RN2C)/ of the (RN2NC) N2”.

1. El albañil instaló el portón de aluminio/del aluminio/de la madera que el arquitecto sugirió inicialmente.
2. El policía confiscó el zapato de cuero/del cuero/de la lona que la empresa importó ilegalmente.
3. El estilista indicó el vestido de satén/del satén/de la seda que la fábrica produjo recientemente.
4. El novio vistió el traje de lino/del lino/de la lana que el sastre cosió manualmente.
5. El decorador admiró el pedestal de yeso/del yeso/de la cerámica que la artesana pintó detalladamente.
6. La mujer usó el colgante de diamante/del diamante/de la perla que la amiga alabó repetidamente.
7. El cliente prefirió los pantalones de algodón/del algodón/de la gabardina que el vendedor recomendó insistentemente.
8. La modelo compró el pendiente de oro/del oro/de la plata que el joyero elogió enfáticamente.
9. La vendedora mostró el collar de rubí/del rubí/de la esmeralda que la tienda adquirió en exclusiva.
10. El comerciante vendió el frasco de barro/del barro/de la arcilla que el artesano modeló detenidamente.
11. El huésped apreció el vaso de cristal/del cristal/de la porcelana que la anfitriona escogió criteriosamente.
12. Al jefe le gustó el banco de mármol/del mármol/de la piedra que el empleado talló atentamente.

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