THE PROSODY OF SINTATICALLY AMBIGUOUS SENTENCES IN BRAZILIAN PORTUGUESE: LENGTHENING CUES[1]

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- ABSTRACT: Using syntactically ambiguous sentences involving local and non-local readings, this paper investigates the role of duration effects as cues to prosodic mapping in Brazilian Portuguese (henceforth BP). Based on Nespor and Vogel's (1986) prosodic theory, we aim to discuss whether BP speakers differentiate the readings by making a syllable longer according to the prosodic domain of the intended meaning. We carried out a comparative experiment on the production of 9 NP1-V-NP2-Attribute sentences by 30 BP speakers, in which one interpretation leads to a phonological phrase boundary between NP2 and the Attribute, while the other interpretation does not. The results have not shown a relevant statistical difference in lengthening when only the readings were considered, but have indicated a strong correlation between each interpretation and individual speakers. In addition, in all significant cases, the duration was longer when the attribute was related to NP1, that is, when there was a phonological phrase boundary inserted between NP2 and the Attribute.

- KEYWORDS: Prosodic boundaries. Phonological phrase. Attribute. Local and non-local readings. Lengthening.

Introduction

As Albano et al. (1997) point out, the discussion on the relation between grammatical structure and its specific production is not new "[...] é preciso rediscutir a Fonologia buscando uma metalinguagem que permita constituir uma interface ótima entre os números da Fonética e os símbolos da Gramática." (ALBANO et al., 1997, p.8). The segment, syllable, or pause lengthening effect

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1 A preliminary version of this paper based on fewer sentences and fewer speakers was published in Angelo and Santos (2012). We thank the participants at the Phonetics and Phonology in Iberia 2011 (Tarragona, Spain) and IV Seminário Internacional de Fonologia 2012 (Porto Alegre, Brazil), as well as two anonymous reviewers for their helpful comments. All remaining mistakes are our entire responsibility. The first author would also like to thank the Pró-Reitoria de Graduação of USP (Ensinar com Pesquisa 2010 project and PIBIC 2011). The second author is thankful for the CNPq (Bolsa Produtividade – grant: 311041/2006-0) and FAPESP (2012/23900-4).

that results from prosodic motivations, not only illustrates this, but is also an example of interface with other grammatical components. Many studies have in fact used phonological/phonetic phenomena to shed light on the syntactic structure of sentences (LIGHTFOOT, 1976; CHOMSKY; LASNIK, 1978; JAEGGLI, 1980; MAGALHÃES; MAIA, 2006, 2007; SANTOS, 2003; NUNES; SANTOS, 2009). In this paper we discuss the interface between Phonology and Syntax by investigating the use of duration in the prosodic mapping of ambiguous sentences. The focus of our study is whether speakers make use of duration in segments, syllables or pauses in order to disambiguate sentences. This topic has already been explored by Magalhães and Maia (2006) and Fonseca and Magalhães (2007), but their results were not related to prosodic mapping. Based on Nespor and Vogel's (1986) proposal for Prosodic Theory, our goal is to discuss lenghtening in the duration of syllables and/or pauses when ambiguous sentences are involved.

The organization of the paper is as follows: In section 1, we present a brief overview of Nespor and Vogel (1986) theory for the Phonology-Syntax interface. In section 2, we present the findings on phonetics realization by prosodic studies. In section 3, we review a number of papers on syntactic ambiguity which consider local and non-local readings and prosodic domains in BP. In section 4 we put forth the hypotheses and the methodology of this study. In section 5 we describe the results followed by a discussion in section 6. Finally, in section 7 we present our final considerations.

Prosodic theory and interfaces: the interface with syntax

That the phonological and syntactic components interact is a point of consensus in the literature. The question that remains is how direct or indirect this interaction is. Can phonological rules refer to syntactical information such as the kind of phrase (DP, VP, NP, …) or phrases boundaries, for instance, or is the interaction more indirect and mediated by other constructs? Here we will take the second approach (SELKIRK, 1984; NESPOR; VOGEL, 1986) and assume that there is an interpretative component which maps information from other components to the Phonological domain. From this perspective, the domains created by the interpretative component are the loci for the application of phonological processes that refer to other grammatical components. Concretely, we will assume Nespor and Vogel's (1986) theory, according to which 7 levels can be identified in the prosodic structure: syllable, foot, phonological word, clitic group, phonological phrase, sentence, and intonational phrase. According to the authors, syntactic information is mapped at the phonological phrase level (f), through mapping rules, as can be seen in (1) - (NESPOR; VOGEL, 1986):

(1) Phonological Phrase formation:

I. domain:

The domain of Φ consists of a clitic group (C) which contains a lexical head (X) and all Cs on its nonrecursive side up to the C that contains another head outside of the maximal projection of X.

II. construction:

Join into an n-ary branching Φ all Cs included in a string delimited by the definition of the domain of Φ.

Φ Restructuring (optional):

A nonbranching Φ which is the first complement of X on its recursive side is joined into the Φ that contains X.

Some studies on BP assume that this restructuring is possible in the language (ABOUSALH, 1997; SANTOS, 2003; SANDALO; TRUCKENBRODT, 2002). Assuming this to be so, a sentence like (2) is prosodically mapped as in (2a) and restructured as in (2b), since *o bolo* (the cake) is the complement of *comeu* (ate) and forms one phonological phrase with it. Accordingly, once *ontem* (yesterday) is not the complement of *bolo* (cake), it is not possible to restructure them (cf. (2c)).

(2) *A Maria comeu o bolo ontem.*
Mary ate the cake yesterday.
a) [a Maria Φ] [comeu Φ] [o bolo Φ] [ontem Φ]
[Mary Φ] [ate Φ] [the cake Φ] [yesterday Φ]
b) [a Maria Φ] [comeu o bolo Φ] [ontem Φ]
[Mary Φ] [ate the cake Φ] [yesterday Φ]
c) * [a Maria Φ] [comeu Φ] [o bolo ontem Φ]
* [Mary Φ] [ate Φ] [the cake yesterday Φ]

This mapping generates structural differences in ambiguous sentences in BP as in (3) below. If the meaning is that the son is happy, *feliz* (happy) is associated with *filho* (son) and, then, both phonological phrases can be restructured (cf. (3a)); if the meaning is that the father is happy, there is no relation between *filho* (son) and *feliz* (happy), so the restructuring is not allowed (cf. (3b)):

(4) *O pai visitou o filho feliz.*
The father visited the son happy
a) meaning: The son is happy
[o pai $_{\Phi}$] [visitou $_{\Phi}$] [o filho $_{\Phi}$] [feliz $_{\Phi}$] >> [o pai $_{\Phi}$] [visitou $_{\Phi}$] [o filho feliz $_{\Phi}$]
[the father $_{\Phi}$] [visited $_{\Phi}$] [the son $_{\Phi}$] [happy $_{\Phi}$] >> [the father $_{\Phi}$] [visited $_{\Phi}$] [the son happy $_{\Phi}$]
b) meaning: The father is happy.
[o pai $_{\Phi}$] [visitou $_{\Phi}$] [o filho $_{\Phi}$] [feliz $_{\Phi}$] >> *[o pai $_{\Phi}$] [visitou $_{\Phi}$] [o filho feliz $_{\Phi}$]
[the father $_{\Phi}$] [visited $_{\Phi}$] [the son $_{\Phi}$] [happy $_{\Phi}$] >> *[the father $_{\Phi}$] [visited $_{\Phi}$] [the son happy $_{\Phi}$]

Phonetic implementation in prosodic studies

In recent years, the phonetic implementation of segments in prosodic boundaries has been investigated in many languages. It is known that phonemic contrasts are maximized or better implemented in the beginning of prosodic limits (CHO; KEATING, 2001; KEATING et al., 2003) and that there is lengthening in the production of the segments in initial boundaries (OLLER, 1973) or final ones (OLLER, 1973; KLATT, 1976; WIGHTMAN et al., 1992; FOUGERON; KEATING, 1997).

One interesting finding that has consequences for the discussion of the relation among many grammatical components is that these effects vary according to the prosodic levels in which they appear. Specifically, these studies have shown that the production of phonemic contrasts were maximized and the lengthening was increased depending on how high the relevant prosodic domains were. This means that lengthening in a phonological phrase boundary is shorter than in a sentence boundary, but longer than in the boundary of a clitic group. This lengthening effect was found in the intitial boundary of prosodic domains (BYRD; SALTZMAN, 1998; CHO; KEATING, 2001; FOUGERON, 2001; CHO, 2006; TABAIN, 2003; KEATING et al., 2004), as well as in the final one (BYRD; SALTZMAN, 1998; BYRD, 2000; CHO, 2006; TABAIN, 2003; TABAIN; PERRIER, 2005).

Other relevant results for our paper are the ones from Fougeron and Keating (1997) and Byrd, Krivokapic and Lee (2006), who discuss what the lengthened syllables in the prosodic domain boundaries are. According to Fougeron & Keating, in the final boundary of the utterance not only is the last syllable lengthened but also the stressed one – because it bears the intonational accent. However, to Byrd, Krivokapic & Lee, the lengthening in the final boundary occurs not only in these contexts, but also in the three last syllables before the prosodic boundary, and the lengthening effect decreases as the distance with respect to the boundary gets larger.

Santos and Leal (2008) investigated whether the same effects are found in BP by designing an experiment with words inserted in boundaries of different prosodic domains (phonological word, clitic group, intonational phrase) in non-ambiguous sentences. Their results have shown that in the left boundary of the prosodic domains (filled by the first syllables of the words), there was a significant difference in the duration of syllables only between the intonational and phonological phrase.[2] With regards to the boundaries on the right (filled by the last syllables of the words), syllable duration was longer only in the intonational phrase boundary. In all other levels, including the phonological phrase, there was no statistically significant difference in the durations (cf. Tab. 1). This suggests that once there is no difference in the duration of syllables between the phonological phrase and clitic group boundaries, it should not be possible to find differences that indicate a phonological phrase boundary between *filho* (son) and *feliz* (happy) in (3). However, Santos & Leal conjecture that this lengthening effect may happen when the speaker intends to disambiguate a sentence, leaving the issue open for future investigation.

Table 1 – Pre and Post-tonic syllables in prosodic domains boundaries in BP.

		Post-tonic			
	Prosodic level	Intonational Phrase	Phonological Phrase	Clitic group	Phonological word (clitic group)
Pre-tonic	Intonational phrase	-	**<0.001**	**<0.001**	**<0.001**
	Phonological phrase	**0.016**	-	0.34	0.11
	Clitic group	0.60	0.06	-	0.54
	Phonological word	0.09	0.48	0,25	-

Source: Santos and Leal (2008, p.153).

Ambiguity between Local and non-local readings and prosodic domains in BP

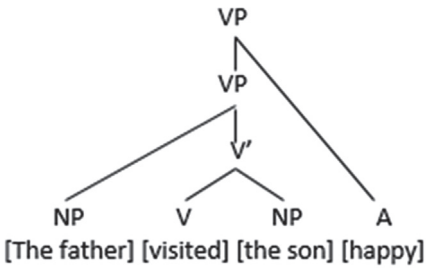
There have been a number of papers on the interpretation of sentences in BP and its phonetic correlates in recent years (for example, LOURENÇO-GOMES, 2003; FINGER; ZIMMER, 2005; LOURENÇO-GOMES; MAIA; MORAIS, 2005; MAGALHÃES; MAIA, 2006; PRESTES, 2006; FONSECA; MAGALHÃES, 2007). In this paper, we concentrate specifically on duration by measuring the final and initial syllables in NP2 and atribute, respectively, in ambiguous sentences with local and non-local readings, as in (3) above. Magalhães and Maia (2006)

[2] Interestingly, there was no difference between the intonational phrase and the levels below in the prosodic hierarchy.

and Fonseca and Magalhães (2007) have investigated this kind of structure by performing a series of experiments to determine whether there was a preference of interpretation for one of the meanings in the sentences. These authors base their analysis on the Implicit Prosody Hypothesis – IPH – (FODOR, 2002) in which there is a default prosodic phrasing pattern. The basis for the study were adjectival predicate constructions from BP, as in (4), in which the adjective (attribute) may modify the first NP, *o pai* (the father), or the second one, *o filho* (the son). In the first case, there is a non-local reading (Fig. 1), and in the second case, there is a local reading (Fig. 2):

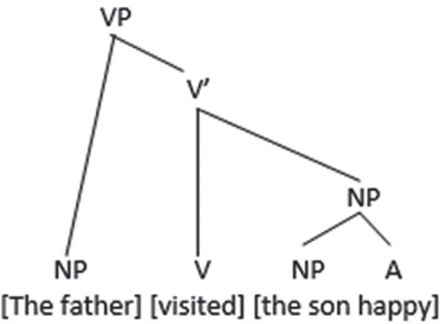
(4) *O pai visitou o filho feliz.*
The father visited the son happy.

Figure 1 – The father was happy (non-local reading)



Source: Authors' elaboration.

Figure 2 – The son was happy (local reading)



Source: Authors'elaboration.

As seen in the first section, these two structures are mapped differently by the phonological component. For local readings there is a restructuring of the phonological phrase domain (cf. (5)) which does not occur in non-local readings (cf. (6)):

(5) *O pai visitou [o filho feliz* ϕ]
The father visited [the son happy ϕ]
✓ The son was happy (*feliz* (happy) is associated with *filho* (son))

(6) *O pai visitou [o filho* ϕ] [*feliz* ϕ]
The father visites [the son ϕ] [happy ϕ]
✓ The father was happy (*feliz* (happy) is not associated with *filho* (son), then it cannot be restructured in the same phonological phrase).

Using 24 sentences with the structures seen above, Magalhães and Maia (2006) designed a production and comprehension experiment to investigate the preference of interpretation and its correlation with prosodic cues – subjects were shown sentences and asked about their interpretation. The presented sentences were manipulated in 4 ways: with a bar segmentation between the verb and NP2 (for silent reading), with a bar segmentation between NP2 and the attribute (for silent reading), without segmentation for silent reading, and without segmentation for oral reading. The sentences were recorded for a prosodic cue analysis. The perception results pointed to a preference for the local reading when there was no segmentation in the presented sentences or when there was segmentation between the verb and NP2. However, whenever there was segmentation between NP2 and the attribute, there was a greater preference for the non-local reading. With regard to oral production, Fonseca and Magalhães (2007) showed that the chosen interpretation varied according to some prosodic cues observed (specifically, F0 rise in NP1, silent pause between NP2 and the attribute, or lengthening of the stressed syllable of the attribute). Relevant to our study is the fact that in cases of non-local readings, some speakers lengthened the stressed syllable of the attribute (*feLIZ* – happy).

However, one problem in the experiment acknowledged by the authors is that only thirteen out of twenty-four sentences were interpreted by the informants as being ambiguous, while the other sentences were considered pragmatically unacceptable. Besides, another problem we can point out involves the measuring of the duration of the syllables: some of the relevant contexts where string restructuring can occur may allow external sandhi – more specifically, elision – or have occlusive consonants, both of which making measurements less reliable. In the first case, measuring gets unclear due to the elision of the non-stressed syllable. For example, in "*O pai visitou o filho embriagado* (The father visited the

son drunk)", the speaker can produce [ʎẽj̃] instead of *lho em*, making it difficult to distinguish if the produced syllable was elongated because of the prosodic boundary or because of two fused syllables. In the second case, the occlusive consonant generates silent pause (the voice onset time (VOT) from the second syllable consonant), which can also alter the duration of the syllables and hinder measuring. To illustrate this, in "*O assessor auxiliou o presidente preocupado* (The aide helped the president concerned)", it is difficult to measure the duration of the syllable *pre* in *preocupado*, since it can be preceded by silence. If this is the case, how is it possible to distinguish the silence between words from the one of the occlusive VOT? As we show in the methodology below, these cases as well as the sentences that were not recognized as ambiguous were excluded or modified in our experiment.

Moreover, Santos and Leal (2008) call attention to the fact that the lengthening result found in Magalhães & Maia's experiment cannot be explained by current prosodic theories. For Nespor and Vogel (1986), phonological processes take into account the prosodic domains that are constructed in the interface with other grammatical components. Specifically for phenomena that take into account syntactic information, the relevant domain is the phonological phrase. Thus, if the relevant syllable for the analysis is not mapped differently depending on the prosodic (phonological phrase) domains for both interpretations, there should not be any preference for a given interpretation. In the case of the adjective *feliz* (happy), for example, the fact that [lis] is elongated should not point to any interpretation, because in both of them this syllable is the final stressed one in the phonological phrase domain. Indeed, what would be expected is lengthening of the final syllable from the preceding phonological phrase, namely, from *filho* (son). This indicates that the phonological phrase in which this word is inserted is not the same as the one in which the attribute is (cf. (7)):

(7) *O pai visitou [o filho] [feliz].*
The father visited [the son] [happy].

Yet, these strings were not measured in Magalhães and Maia's (2006) study.

Hypotheses and Methodology

Although Santos and Leal (2008) have not found syllable lengthening effects in BP similar to what was found in other languages (OLLER, 1973; KLATT, 1976; WIGHTMAN et al., 1992; FOUGERON; KEATING, 1997), here we will rely on Magalhães and Maia's (2006) results to further explore Santos and Leal's suggestion that when sentences are syntactically ambiguous, speakers use

phonetic cues to single out each of the relevant meanings. Our speficic hypotheses for this study are the following:

a) Speakers will display differences in duration depending on the local or non-local interpretation.
b) The relevant strings will be longer under non-local readings (type A) than under local ones (type B), due to the presence of a phonological phrase boundary.

To test these hypotheses, we designed an experiment based on Magalhães and Maia (2006), so that we could compare our results with theirs. We used the sentences tested in Magalhães and Maia (2006), excluding or modifying the ones speakers did not identify as ambiguous, the ones with occlusive consonants in the first syllable of the attribute, and the ones that began with vowels. As discussed above, the silent pause and the possible elision in these cases could interfere in the measuring results.

Thus, our experiments comprises the following sentences:

1. *O pai visitou o filho feliz.*
   The father visited the son happy.
2. *A babá ninou a menina chorando.*
   The nanny rocked the girl crying.
3. *A mãe encontrou a filha suada.*
   the mother met the daughter sweaty
4. *O réu encontrou o advogado nervoso.*
   The defendant met the lawyer nervous.
5. *O aluno consultou o monitor cismado.*[3]
   The student consulted the monitor worried.
6. *O sobrinho cumprimentou o tio sonolento.*
   The nephew greeted the uncle sleepy.
7. *O assessor auxiliou o presidente furioso.*
   The aide helped the president furious
8. *O repórter entrevistou o político sozinho.*
   The reporter interviewed the politician alone.
9. *A mãe procurou a filha magoada.*
   The mother looked for the daughter hurt.

[3] A reviewer asked whether this sentence is indeed recognized as ambiguous, and not exclusively with a non-local interpretation. Despite being considered unambiguous by Magalhães & Maia's (2006) subjects in its previous format, it was taken as ambiguous by the subjects in our experiment. In order to confirm this analysis, 5 other subjects were asked to find ambiguity in this sentence, and not only all of them considered it ambiguous, but also two of them said that the local interpretation was their first interpretive option.

These 9 sentences were inserted in 18 narratives that prompted only one of the interpretations. These narratives were divided into 2 lists, each of which containing only one of the versions for each sentence, so it was never the case that one speaker was tested on both readings for the same sentence. We also added 6 distractor sentences in each list. In (8) we show the two narrative versions for the following sentence: '*O réu encontrou o advogado nervoso* (The defendant met the lawyer nervous)':

(8)

a) *Bruno estava sendo acusado de matar o próprio tio devido a uma possível herança que receberia. Seu advogado o defendia acreditando realmente que o réu era inocente, pois Bruno sempre jurou estar em outro lugar no dia da morte do tio. Faltavam dois dias para o julgamento final quando o réu decidiu ir atrás de seu advogado com o intuito de contar que era culpado, e estava com muito medo do advogado desistir da defesa. Marcaram um encontro no escritório do advogado, que estava tranquilo, crente que Bruno queria apenas umas últimas informações antes do julgamento.* ***O réu encontrou o advogado nervoso****. Tremendo muito, Bruno confessou sua culpa e o advogado decidiu mesmo abandonar o caso.*
Bruno was being charged with killing his own uncle because of an inheritance he would come into. His lawyer defended him because he believed the defendant was innocent. Bruno had always claimed he was somewhere else on the day of his uncle's death. Two days before the final judgment the defendant decided to look for his lawyer and tell him he was guilty, but he was afraid the lawyer would give up defending him in court. They met at the lawyer's office. The lawyer was calm, believing Bruno just wanted some additional information before the trial. **The defendant met the lawyer nervous**. Shaking a lot, Bruno confessed he was guilty and the lawyer decided to abandon the case.

b) *Pedro era um ótimo advogado e exercia sua função há mais de 10 anos. Ele não aceitava perder nenhuma causa e, de fato, raramente perdia. Quando acontecia, ele não se perdoava e ficava irritado com tudo e com todos. Hoje, era dia de mais um processo. O réu estava muito ansioso. Porém, antes do réu chegar ao fórum, o advogado ficou sabendo da existência de uma testemunha do lado oposto que poderia atrapalhar toda a sua defesa. Chegando no fórum,* ***o réu encontrou o advogado nervoso****. O advogado não sabia como contar a novidade ao rapaz.*

Pedro was an incredible lawyer, who had been working for more than 10 years. He did not like losing any lawsuit and, in fact, he had almost never lost. When this happened, he did not forgive himself, getting angry at everyone and becoming nervous for anything. Today he was defending a client against a lawsuit. The defendant was anxious. However, before the defendant arrived at the court, the lawyer had discovered a new witness from the prosectution side who could destroy all his defense arguments. At the court, **the defendant met the lawyer angry**. The lawyer didn't know how to tell his client the bad news.

Even though the target sentences are highlighted in the text above, in the experiment, there were not any marks to show which the analyzed sentences were or how they should be read.

The experiment was conducted with 30 subjects (men and women, all adults and undergraduate students who were born in São Paulo). They were divided into 2 groups with 15 people each. Each group read one of the lists with the 9 target sentences. They were asked to read the narratives in silence at first (to make sure they knew the intended interpretation) and later, aloud, in the most natural way.

The readings of the narratives were recorded using the software *Audacity 1.3 Beta Unicode* and the duration from the final syllable of the object to the first syllable of the attribute of the relevant ambiguous sentence was later analyzed with the software *Praat*. The idea was that this string span should allow us to register any differences of duration around the potential phonological phrase boundary between NP2 and the Attribute (in the last syllable of the object, in the first syllable of the attribute, in the pause between them, or even in all of them together). Thus, in the sentence above *O réu encontrou o advogado nervoso* ('The defendant met the lawyer angry'), the string [dʊ.neɾ] was measured.

Results

In Table 2 below, we present the overall results for type of sentence, that is, all sentences A (non-local readings) *versus* all sentences B (local readings). Graphic 1 shows the distribution of the measures for each sentence read by all 30 subjects.[4] The numbers identifying the sentences should be read in the following way: the first digit indicates which presentation list the sentence belongs to and the second digit, the sentence itself. Thus, "11" corresponds to list 1 and sentence 1 (in this

[4] The dashed line refers to the overall mean and the continuous line refers to the mean per sentence. The grey diamonds indicate the specific mean of each sentence; its top and bottom edges are the 95% confidence interval (CI) for the mean.

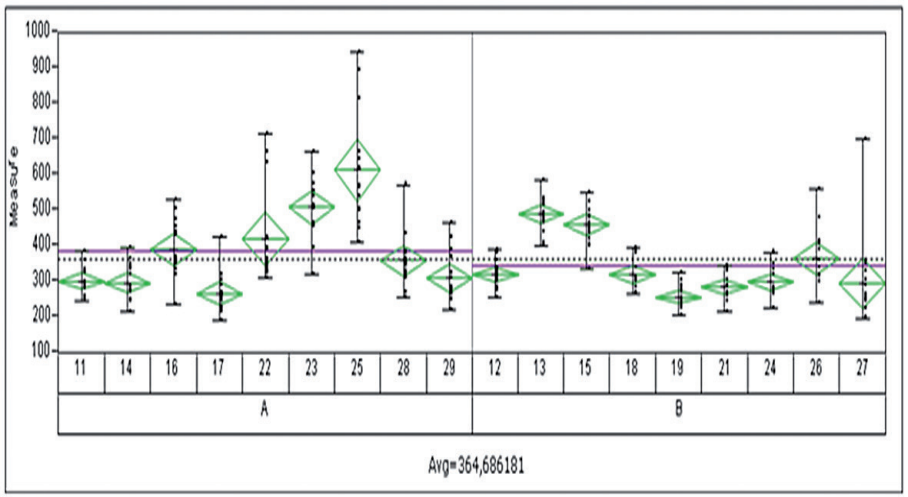
case, interpretation A), which is to be compared to "21", which correspond to list 2, sentence 1 (interpretation B).

Table 2 – Duration difference between sentences A *vs.* B

	Mean	Standard deviation	Average standard error	95% CI		Maximum	Minimum
				lower	upper		
Measure (ms.)	364,7	121,8	7,4	350,1	379,3	190,1	946,0
Sentence A	385,2	139,7	12,0	361,5	409,0	190,1	946,0
Sentence B	344,1	96,9	8,3	327,6	360,6	196,7	700,1

Source: Authors' elaboration.

Graphic 1 – Sentences A vs. Sentences B durations (all subjects)

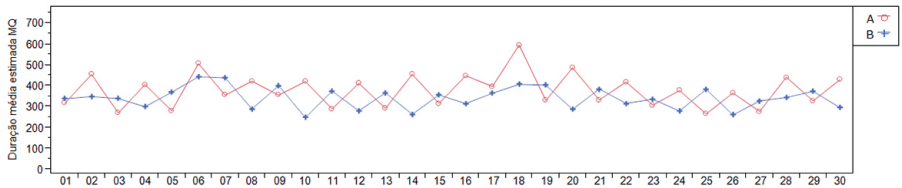


Source: Survey's data.

As can be observed, there is a great variation in the duration of the relevant context for each sentence. This is particularly noticeable with respect to sentence 25. This variation hampers our evaluation of the significance of the difference between the average duration of sentences A and B. What can be seen is that sentences with interpretation A show more dispersion - 139,9 miliseconds of standard deviation, with mean of 385,7 miliseconds (CI 95% [361,5; 409,0]), against a standard deviation of 96,9 miliseconds from sentence B, with mean of 344,1 miliseconds (CI 95%; [327,6; 360,6]).

In a follow-up analysis, an analysis of the variance (ANOVA) was conducted by considering the sentence, the speaker, and the interaction sentence-speaker. This second analysis of variance shows that the interaction of the sentence and the subject is highly significant, 1% (prob > F = 0,0101), which means that we cannot analyze the sentences without taking into consideration the subjects. Graphic 2 below shows the estimates for the least-squares (LS) of the mean of each sentence A and B for each subject.

Graphic 2 – LS of the sentences for each subject

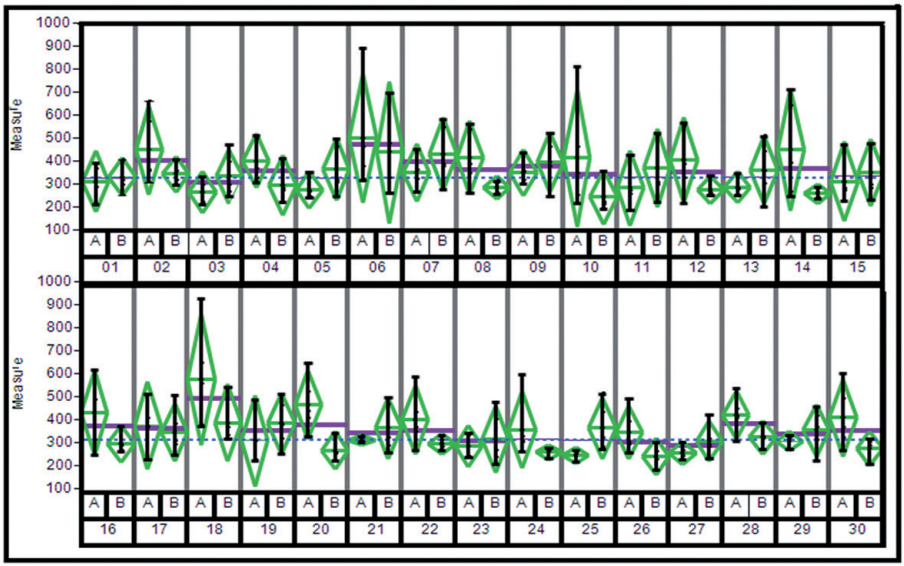


Source: Survey's data.

In the graphic above, it becomes evident that the duration estimates from each sentence vary from subject to subject, as well as the relation between sentences A and B. These results also show that speakers 2, 4, 6, 8, 10, 12, 14, 16, 17, 18, 20, 22, 24, 26, 28 and 30 produce longer durations in the interpretation of A, while speakers 3, 5, 7, 9, 11, 13, 19, 21, 25, 27 and 29 produced longer durations in the interpretation of B, and speakers 1, 15 and 23 produce practically the same duration in both interpretations.

In a subsequent investigation, we examined whether there is a statistically significant difference in the subjects' productions showing that sentences A are longer than sentences B for each subject. The results of this investigation are shown in Graphic 3 below:

Graphic 3 – Duration differences between sentences A *vs.* B for each subject



Source: Survey's data.

The results above show (i) a tendency for sentences A to have longer duration than sentences B – despite an inversion of this result for some subjects – and (ii) a considerable variability in the observed contexts. In our next analysis, we investigated whether there is a significant difference between the two readings. Table 3 below shows the p-values for each subject. The p-values highlighted in dark grey (for subjects 10, 14, 18 and 20) show a statistically significant durational difference ($p < 0.05$); the ones highlighted in light gray (for subjects 8, 12, 16 and 30) also show a significant difference ($p < 0.1$), but not as high as the previous ones; the p-values not highlighted are not significant. If we cross-tabulate these results with those from Graphic 3, we can see that in all the cases in which there is a significant difference, interpretation A is longer than B.

Table 3 – Prob> |t| for the duration between sentences A *vs.* sentences B for each subject

Subject	**1**	**2**	**3**	**4**	**5**
Prob> | t |	0,785	0,164	0,363	0,163	0,242
Subject	**6**	**7**	**8**	**9**	**10**
Prob> | t |	0,409	0,278	0,082	0,554	0,024
Subject	**11**	**12**	**13**	**14**	**15**
Prob> | t |	0,264	0,086	0,333	0,013	0,599
Subject	**16**	**17**	**18**	**19**	**20**
Prob> | t |	0,08	0,673	0,014	0,337	0,009
Subject	**21**	**22**	**23**	**24**	**25**
Prob> | t |	0,492	0,178	0,712	0,199	0,124
Subject	**26**	**27**	**28**	**29**	**30**
Prob> | t |	0,169	0,508	0,204	0,547	0,082

Source: Authors' elaboration.

Discussion

We have worked with two hypotheses in this paper. The first one predicted that there would be a significant difference of duration in the relevant contexts depending on the local or non-local interpretation of the sentences. As reported in Table. 3, it is not possible to analyze this durational difference without taking into consideration the subjects. When considering this correlation, we see that 27 subjects show a difference in the duration of the context depending on the interpretation, revealing a strong interaction between the subject and the sentence. However, only 8 of them show a statistically significant difference and for all of them, the relevant context for the non-local reading (A) is longer than the local one (B).

Our second hypothesis predicted that context A would be lenghtened due to the presence of the phonological phrase boundary. Based on the results which did not consider the subject, we observe that there is no difference in duration. This means that there is no difference between the duration of the segment in phonological phrase boundaries (non-local readings) and clitic groups (the domain immediately below in which there is no phonological phrase boundary), corroborating Santos and Leal's (2008) results. However, it is interesting to note that the contexts in sentences A were always slightly longer (but not statistically significant) than B, indicating that there is a tendency for the speakers to resort to lengthening where there is a phonological phrase prosodic boundary, which is in accordance with Santos & Leal's suggestion.

Finally, with regards to the analysis of each subject (without considering the kind of sentence), it must be pointed out that almost 1/3 of the 30 speakers did show a significant difference between the readings of sentences A in comparison with sentences B. Interestingly, the longer duration is always in non-local readings (A), as our hypothesis predicted, following Santos and Leal (2008).

Given these results, we would like to make some remarks regarding the experiment conducted in this study. First, the results were not biased by sentences that were later questioned (as happened with Magalhães & Maia 2006). In fact, none of the subjects has made any comments about the unambiguous sentences as being pragmatically poor. Secondly, as mentioned above, the sentences to be analyzed were inserted in narratives which prompted the intended interpretation. This may have induced speakers to believe it was not necessary to disambiguate the sentence in speech.

Finally, another aspect that must be considered is that speakers have read just one version of the sentences. This means that it was not possible to compare the readings of the same speaker for the same sentence in order to check differences in production that could be accounted for by the segmental aspects of each context (which is different according to the sentence). Thus, these observations indicate that further investigations should be conducted.

Final Considerations

In this paper, we have investigated whether speakers use duration as a lengthening process in order to disambiguate syntactically ambiguous sentences in a situation where the phonological phrases can be restructured and form a unique domain or be kept in two different domains, according to the interpretation. This lengthening in the relevant context would be accounted for by (i) the tendency of lengthening the syllable in the higher prosodic domain (OLLER 1973; KLATT, 1976; WIGHTMAN et al., 1992; FOUGERON; KEATING 1997, but not in BP (SANTOS; LEAL, 2008)) or (ii) a longer pause inserted between the relevant prosodic boundaries.

In our experiment, we have tested sentences of the same kind as the ones used in Magalhães and Maia (2006). They are formed by Noun Phrase 1 – Verb – Noun Phrase 2 – Attribute, in which the attribute can modify either the first or the second NP, and we measured the context that included the last syllable from NP2 and the first syllable from the attribute. This context allowed us to observe any possible differences in the production of what is around the phonological phrase when it is restructured (the syllables before and after the boundary as well as the pause in it). Our results did not show any statistically significant difference in duration in the measured context. What we have found is that the production

of differences in duration is highly correlated to the speaker. This means that some informants make this difference, while others do not. Importantly, in all cases where this difference in duration was correlated to the speaker, it was statistically significant: the reading where the Attribute modified the first NP (non-local reading) was the longest one.

We call attention to some issues that may have influenced the results: The sentences being part of the narratives that disambiguated them may have guided the speaker not to produce the durational differences we expected. In addition, the non-production of the two versions of the sentences by the same speaker may have biased the use of duration as a cue to the interpretation, as we could not compare the production of the two readings for each speaker.

ANGELO, M. C.; SANTOS, R. S. A prosódia em sentenças sintaticamente ambíguas do Português Brasileiro: pistas de duração. **Alfa**, São Paulo, v.59, n.2, p.375-394, 2015.

- *RESUMO: Utilizando sentenças sintaticamente ambíguas pelas posições local e não-local do atributo, este artigo discute o uso da duração como pista do mapeamento prosódico de sentenças no português brasileiro. O que se questiona é se os falantes diferenciam as leituras via alongamento conforme o domínio prosódico do significado pretendido. Para isso, o presente trabalho é baseado em um estudo comparativo da produção por 30 falantes do PB de 9 sentenças do tipo SN1-V-SN2-Atributo onde, conforme a interpretação, pode haver uma fronteira de frase fonológica entre SN2 e o Atributo. Para efeitos de discussão acerca do tema, a teoria prosódica de Nespor e Vogel (1986) foi adotada. Os resultados encontrados não mostraram uma diferença estatística significativa na duração do contexto analisado (da última sílaba de SN2 até a primeira sílaba do atributo) quando apenas as leituras são consideradas, mas apontaram para uma forte correlação entre interpretação e informante, e em todos os casos significativos havia uma duração maior dos contextos analisados quando o atributo se referia a SN1, isto é, quando havia uma fronteira de frase fonológica entre SN2 e o Atributo.*

- *PALAVRAS-CHAVE: Fronteiras prosódicas; Frase fonológica; Atributo; Aposição local e não-local; Alongamento*

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Received in January, 2014

Approved in June, 2014