Perception of tonal contrasts of non-exhaustivity in Brazilian Portuguese: an experimental study

Daise Ribeiro Carpes¹, Juan Manuel Sosa¹,², Izabel Christine Seara¹

¹ Programa de Pós-graduação em Linguística, Universidade Federal de Santa Catarina, Brazil
² Linguistics Department, Simon Fraser University, Vancouver, Canada
daiseriibeiro@gmail.com, sosa@sfu.ca, izabels@linse.ufsc.br

Abstract

In this paper we discuss the perception of tonal contrasts of non-exhaustivity in Brazilian Portuguese in the interface prosody-semantics-pragmatics. In previous work on the production of f0 contours of utterances with non-exhaustive, exhaustive and contrastive foci [1], which was based on the speech of Florianópolis, eight subjects were asked to respond to three different situations designed to elicit the three foci. That production experiment tested whether the comprehension of non-exhaustive, exhaustive and contrastive foci is purely pragmatic in conversation, or if prosody, namely the tonal structure of the sentences, has a crucial role in this process. The results revealed that non-exhaustive focus is expressed by means of specific intonational contours, but also that the pitch curves with either exhaustive or contrastive focus seem to have a very similar intonational shape; for this reason these other foci would need lexical markers like ‘only’ and ‘not’. On the basis of those production results, the current paper addresses the question of whether and how intonation can direct the interpretation by listeners exposed to utterances with non-exhaustive focus, comparing these intonational contours with those of utterances with exhaustive and contrastive foci. With this purpose, two perceptual tests are carried out with twelve listeners. They ratified the proposed prosodic encodings of the types of foci under scrutiny in the tonal aspects of these foci, but not with respect to the relative duration of the syllables that make up the intonational nucleus of the sentences that have been analysed. The first perception test had the aim of verifying whether the tonal patterns identified as the most recurrent for each one of the foci under study would be so interpreted by the listeners; the second one has the aim of verifying timing, duration and pitch range issues. The results of the perception tests has revealed that there is a specific f0 curve that characterizes perceptually the non-exhaustive focus, described as a low prenucleus (L*), and a rising-falling nucleus (ŁH*Ł%). These results have also revealed some effects with respect to the relative duration of the unstressed syllables as compared with the stressed one in the nuclear region of the utterances. Regarding the pitch contour distinction between non-exhaustive and contrastive foci, we identified a significant and systematic increase in the pitch height of the non-exhaustive focus, which suggests that pitch range is at least one of the parameters that characterizes and distinguishes the non-exhaustivity tonal design.

Index Terms: tone, intonation, production, perception, Brazilian Portuguese.

1 Introduction

In this paper we analyse the perception of tonal contrasts of non-exhaustivity in Brazilian Portuguese in the interface prosody-semantics-pragmatics.

Our objective is to verify whether perceptual experiments will ratify the production results we obtained in a previous study [1], on the basis of stimuli consisting of f0 curves produced by the participants of the research. That research on the production of utterances with non-exhaustive focus compared f0 curves of sentences with non-exhaustive, exhaustive and contrastive foci, produced by eight speakers in four different situations. That study showed that there is an f0 curve that is characteristic of non-exhaustive focus.

2 The production experiment and foci

Non-exhaustive focus is a statement that is not the only true proposition of what is being said. That is, the speaker is certain that what he/she is saying is true, but does not exclude that other possibilities may be also true. Thus, non-exhaustive focus could be identified by the features [-exhaustive] and [-contrastive], and for this reason we need to compare it with the exhaustive and contrastive foci [2], [3], [4].

Exhaustive focus discards all other possibilities relating to what is being said, that is, the assertion of a proposition implies the exclusion of all other alternative propositions.

Contrastive focus occurs when a correction to what has been asserted by the interlocutor is intended. This kind of focus is characteristically a proposition that implies a denial of another alternative assertion or some presupposition of the interlocutor.

An example of non-exhaustive focus can be seen in the situation shown in (1), given in [1].

Example (1):

Yesterday there was a soccer game between Uruguay and Brazil. When I arrived at work today, Roberto asked me how many goals were scored in the game. I only watched the first half, and saw Kaká’s goal, but I don’t know whether there were more goals in the second half. Then I told him:

O Kaká marcou um gol.
(Kaká scored a goal)

The response given to the situation presented in (1) shows that it is true that Kaká scored a goal, but cannot assert that no other goals were scored.

On the other hand, exhaustive focus is the one that discards all other possibilities relating to what is being said, that is, the assertion of a proposition implies the exclusion of all other alternative propositions [3]. In the situation presented in (2), we have an example of exhaustive focus.

Example (2):

Yesterday there was a soccer game between Uruguay and Brazil. When I arrived at work today, Roberto asked me how many goals were scored by Kaká. I, who watched the entire game, told him:

O Kaká marcou um gol.
(Kaká scored a goal)
The response presented to situation (2) has to make perfectly clear that Brazil beat Uruguay with only one goal scored during the entire game.

Finally, contrastive focus occurs when a correction to what has been asserted by the interlocutor is intended. This kind of focus is characteristically a proposition that implies a denial of another alternative assertion or some presupposition of the interlocutor. As stated in [4], the prominence of a lexical item identifies the contrastive focus, since it refers to some new information that contrasts with some pragmatic presupposition of the hearer.

Example (3):

Yesterday there was a soccer game between Uruguay and Brazil. When I arrived at work today, Roberto asked me how many goals were scored in the match, believing that Kaká had scored two goals. I, who watched the entire game, know that Kaká scored one goal, not two. So I told him:

O Kaká marcou um gol.
(Kaká scored a goal)

In (3), the response given is actually a correction on the number of goals that were scored in the match, presenting an alternative that is different from that stated by the interlocutor. Normally this type of focus occurs in contexts in which the proposition has already been stated [3].

The objective of the production experiment was to investigate whether the comprehension of the non-exhaustive, exhaustive and contrastive foci is implemented by the tonal structure of the sentences shown in Figure 1 - (a), (b), (c).

The production experiments revealed that non-exhaustive focus is expressed by means of specific intonational contours, but also the pitch curves with either exhaustive or contrastive focus seem to have a very similar intonational shape. For this reason these other foci would additionally need lexical markers like ‘só’ (only) and ‘não’ (no).

Another important observation concerns the relative duration of the syllables that integrate the nucleus of the sentences:

(i) for non-exhaustive focus, the stressed syllable is recurrently longer than the unstressed ones (78%);
(ii) for both exhaustive focus (50%) and contrastive focus (62%), either the stressed syllable exhibits duration that is similar to the unstressed ones, or the pre-stressed syllable is longer than the others.

On the basis of those production results, we address the question of whether and how intonation can direct the interpretation by listeners exposed to utterances with non-exhaustive focus, comparing these intonational contours with those of utterances with exhaustive and contrastive foci.

2. The perception tests

Two perceptual tests were carried out with eleven listeners:

(i) the first perception test had the purpose of verifying whether the tonal patterns identified as the most recurrent for each one of the foci under study would be so interpreted by the listeners;
(ii) the second one had the aim of verifying timing and duration issues.

For both tests, the listeners were requested to decide which utterance was better suited for the situation presented. They had four possibilities of response:

(1) only the first sentence,
(2) only the second,
(3) the two sentences would be adequate,
(4) none of them would be adequate for the situation presented.

The description of the perception tests as well as their outcomes constitute the core of the present study.

2.1 Methodology of the perception tests

The first perception test has the purpose of verifying whether the tonal patterns identified as the most recurrent for each one of the foci under study would be so interpreted by the listeners; the second one has the aim of verifying timing and duration issues.

During the data gathering stage of the sentences that were chosen for the production test, eight subjects\(^1\) heard three situations that contextualized, respectively, a sentence with non-exhaustive focus, another one with exhaustive focus and a third one with contrastive focus. These resulting sentences served as the stimuli for the perception experiment.

2.1.1 Perception test 1

In this first test four subjects heard three situations that contextualized, respectively, sentences with non-exhaustive focus, others with exhaustive focus and a third kind with contrastive focus (as in the examples shown in (1), (2) e (3)). These sentences served as the stimuli for the perception experiment.

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\(^1\) The research we conducted was approved by the Ethics Committee in Research with Human Beings (CEPSH) of the Pró-reitoria de Pesquisa e Extensão of the Universidade Federal de Santa Catarina, n° 2057.
A total of seven pitch curves were used as stimuli – two produced for the non-exhaustive focus (contours A and B), three for exhaustive focus (contours C, D and E) and two for contrastive focus (F and G), as in Figure 2.

Figure 2: Pitch tracks of the sentences used as stimuli for the first perception test.

2.1.2 Perception test 2

The second test investigated duration issues. We restricted the analyses to two types of focus (non-exhaustive and contrastive). The first author recorded tonal curves that are similar to the prototypical curves of non-exhaustivity, as for example, the curves A, C and F; this was in order to control inter-speaker variables.

In this test, we expected that for non-exhaustive focus, the stressed syllable longer duration than the pre-stressed one; and for contrastive focus, the duration of stressed and pre-stressed syllables would be similar.

As stimuli, seven subjects heard three situations that contextualized, respectively, sentences with non-exhaustive focus, another one with exhaustive focus and a third one with contrastive focus.

3. Discussion of the perception tests

3.1 First perception test

For each test carried out as a function of the pairs of presented sentences, we expect as responses that the tonal curves that are similar to the prototypical one of the non-exhaustive focus (A and B) are perceived as such, if the intonational contour is in fact characteristic of this kind of focus.

In this way, when the situation presented to the listeners corresponds to the one with non-exhaustive focus, we expect that sentences A and B are the one singled out by the listeners as the most appropriate. In the case of exhaustive focus, we expect that sentences C, D and E are signaled as the most adequate. And for the situation with contrastive focus, that the most appropriate sentences are F and G. The values shown on Table 1 point out the percentages of responses given by the listeners that actually correspond to those expected responses (in grey) for each pair of sentences presented, as explained above.

Table 1: Types of focus under study and their corresponding pairs of sentences presented as stimuli in the first perception experiment, and its results.

<table>
<thead>
<tr>
<th>Sentence pairs</th>
<th>Expected response</th>
<th>Responses to the focus curves presented (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F x A</td>
<td>F</td>
<td>64%</td>
</tr>
<tr>
<td>F x B</td>
<td>F</td>
<td>50%</td>
</tr>
<tr>
<td>G x B</td>
<td>G</td>
<td>43%</td>
</tr>
<tr>
<td>G x C</td>
<td>G</td>
<td>50%</td>
</tr>
<tr>
<td>G x D</td>
<td>G</td>
<td>29%</td>
</tr>
<tr>
<td>D x A</td>
<td>D</td>
<td>57%</td>
</tr>
<tr>
<td>D x B</td>
<td>D</td>
<td>29%</td>
</tr>
<tr>
<td>D x C</td>
<td>C or D</td>
<td>93%</td>
</tr>
<tr>
<td>D x F</td>
<td>D</td>
<td>29%</td>
</tr>
<tr>
<td>D x G</td>
<td>D</td>
<td>0%</td>
</tr>
<tr>
<td>E x A</td>
<td>E</td>
<td>36%</td>
</tr>
<tr>
<td>E x B</td>
<td>E</td>
<td>43%</td>
</tr>
<tr>
<td>E x C</td>
<td>C or E</td>
<td>100%</td>
</tr>
<tr>
<td>E x F</td>
<td>E</td>
<td>7%</td>
</tr>
<tr>
<td>E x G</td>
<td>E</td>
<td>7%</td>
</tr>
<tr>
<td>A x B</td>
<td>A or B</td>
<td>100%</td>
</tr>
<tr>
<td>C x A</td>
<td>A (or C)</td>
<td>100%</td>
</tr>
<tr>
<td>C x B</td>
<td>B (or C)</td>
<td>100%</td>
</tr>
<tr>
<td>D x A</td>
<td>A (or D)</td>
<td>100%</td>
</tr>
<tr>
<td>D x B</td>
<td>B (or D)</td>
<td>79%</td>
</tr>
<tr>
<td>E x A</td>
<td>A</td>
<td>97%</td>
</tr>
<tr>
<td>E x B</td>
<td>B</td>
<td>86%</td>
</tr>
<tr>
<td>F x A</td>
<td>A (or F)</td>
<td>93%</td>
</tr>
<tr>
<td>F x B</td>
<td>B (or F)</td>
<td>93%</td>
</tr>
<tr>
<td>G x A</td>
<td>A</td>
<td>100%</td>
</tr>
</tbody>
</table>

The results related to the non-exhaustive focus, as can be seen on Table 1, show that there is a high percentage of identifications of the sentences produced with non-exhaustive focus that are considered by the listeners as such given their tonal contours. The lower percentages can also be explained, if we consider that the pitch curves C, D and F have tonal shapes that are similar to the prototypical for non-exhaustive focus.

Thus, when the pair of sentences is composed of one of them and another of non-exhaustive focus (A or B), the listeners have indicated that both the sentences would be adequate. This fact seems to reinforce even more the hypothesis that non-exhaustivity is marked by prosody through a tonal curve that is specific for this kind of focus.

When we analyze the results referring the exhaustive and contrastive foci, they seem to show that there is no really a pattern, since for only two of the combinations the percentage is higher than 50%, not appearing as a pattern. In this way, we start for a second test.
3.2 Second perception test

Regarding relative duration of syllables, the results showed that: (i) for non-exhaustive focus, 57% preferred a similar duration of stressed and pre-stressed syllables; (ii) for contrastive focus, again 57% indicated both similar duration of stressed and pre-stressed syllables, or the stressed syllable longer than the pre-stressed one. This results were not what we expected.

In order to analyse the pitch range difference between non-exhaustive and contrastive sentences, we used a semitone scale; the non-exhaustive and contrastive contours were superimposed for each sentence combination.

Regarding the pitch contour distinction between non-exhaustive and contrastive foci, the results were as follows:

(i) 76% of the responses of the listeners identified the sentences produced with the intonation of the non-exhaustive focus as adequate;

(ii) 80% of the responses indicated the sentences produced with the intonation of the contrastive focus as adequate.

These results suggest that the intonation for the non-exhaustivity and the one for contrastivity are indeed recognized by the listeners as marking the corresponding focus. The F0 contour of the pitch tracks look very similar, but there is a relevant difference in the pitch height of the non-exhaustive focus. This reveals that pitch range is at least one of the parameters that characterized and distinguishes the non-exhaustivity tonal design (Figure 3). These results agree with the findings in [2] for Basque.

The mean difference between sentences with non-exhaustive and contrastive foci in the perception test was around 3.5 semitones, being systematically higher for the curves with non-exhaustive focus. This is the main finding of our research. Previous works [5] for Brazilian Portuguese and [6] for Dutch reported that a difference of three semitones is readily perceived by listeners.

4. Conclusions

The results presented here show that in Brazilian Portuguese:

1) Non-exhaustive focus has a specific pitch pattern that characterizes it, whose nucleus is rising-falling (\textit{\textit{H}^*\textit{L}^\%});

2) The durational relations between the syllables of the intonational nucleus was not a relevant parameter in the interpretation of the foci described here (non-exhaustive and contrastive);

3) The increased value of the F0 for the non-exhaustive focus is remarkably recurrent and regular.

4) This quantitative difference of around 3.5 semitones is, we believe, distinctive, and should be part of the phonological description of these kinds of configurations.

5. References