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# Production of Brazilian Portuguese intonational patterns by russophone immigrants

## Produção de padrões entoacionais em Português Brasileiro por migrantes russófonos

LUCIANA LUCENTE* | ANNA SMIRNOVA HENRIQUES** | PAVEL SKRELIN*** | TATIANA KACHKOVSKAIA*** | DARIA GUSEVA*** | SANDRA MADUREIRA**

**Abstract:** This work compares intonation curves of native Brazilian Portuguese (BP) speakers and Russophone BP speakers. Speech data from 6 native BP speakers and 6 speakers of Russian in five speech contexts were used. The intonational annotation of the data was performed using the DaTo system. For comparison of intonation curves regarding alignment, tonal variation and intonation pattern, its temporal normalization was done. The results showed that speakers of Russian produce intonation patterns in BP similar to those of native BP speakers, with differences in tonal variation values, greater in Russophones, and the general slope of the melodic curve, which is more prominent in natives.

**Keywords:** intonation; intonational patterns; L1-L2 influence; DaTo system; Brazilian Portuguese.

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**Resumo:** Este trabalho compara curvas entoacionais de falantes do português brasileiros (PB) nativos e russos falantes de PB. Foram utilizados dados de fala de 6 falantes nativos e 6 russófonos em cinco contextos de fala. Foi feita a notação entoacional dos dados utilizando o sistema DaTo e posteriormente sua normalização temporal para comparação das curvas entoacionais quanto ao alinhamento, variação tonal e padrão entoacional. Os resultados mostraram que os falantes russos produzem padrões entoacionais próximos aos dos nativos, com diferenças maiores quanto aos valores de variação tonal, maior nos russófonos e à inclinação geral da curva melódica, mais proeminente nos nativos.

**Palavras-chave:** entoação; padrões entoacionais; influência L1-L2; sistema DaTo; português brasileiro.

## Introduction

This work is part of a comprehensive research on the speech productions of Russophone immigrants who speak Brazilian Portuguese (henceforth BP) as L2 (Smirnova Henriques et al, 2019; 2020). With the objective of analyzing the differences between the intonational patterns of Russian (L1) and BP (L2), speech production in BP by first-generation Russian-speaking immigrants was observed. These data were compared with the production of native BP speakers in different contexts.

The intonational aspects of Russophone and Brazilian speakers´ productions were analyzed using a system originally developed for BP intonational annotation.

This work presents the first observations on the intonation patterns produced by Russian speakers in relation to those of Brazilians.

## 1. L1 - L2 influence

In discussing L1-L2 influence, two main questions are often the focus of attention. Firstly, what is the direction of this influence? That is, does L1 influence L2, or can the opposite be observed as well? Is it possible that the resulting L2 speech may have its unique features, not present in either of the languages? Secondly, what features are affected by cross-language influence? Can we predict the particular features of L2 accent by comparing the phonology and phonetics of the two languages involved?

There seems to be quite a lot of publications on how segmental features are affected by cross-language influence (Jun & Oh, 2000). And only recently much attention has been drawn to prosody (Delais-Roussarie et al., 2015). Still, the field is under-investigated, as most publications only cover certain aspects of L1-L2 influence in prosody, while no single language contact situation seems to be fully described in terms of all possible prosodic features involved.

When we speak about cross-language influence, we have to bear in mind that L2 situations may significantly differ from each other. In multi or bilingual countries (like many African countries, or e.g. Canada) or bilingual families (where both parents' language is used in everyday situations), two languages are often acquired at quite an early age, and it is sometimes even hard to tell which of them is actually L1. Learning L2 "on purpose" – e.g., as part of standard education – usually comes later, after fully acquiring L1. In the latter case, we can further classify L2 situations in terms of learners' age (e.g., young children vs. adults, as learning mechanisms may differ). Next, we might ask ourselves about the purpose of L2 learning, namely – how crucial it is for the person to learn the new language? What is their learning environment? Is the person permanently staying in the L2 country, and how often do they use L2 (and how often do they come back to using L1)?

Learning a new language includes mastering the rules of this language: grammatical, syntactic and others, such as the prosodic ones. Of course, the result is highly dependent on how the language is taught (for more detail, see Ugarte Olea, 2018). In general, a lot of L2 textbooks do not cover the intonation or rhythm at all. Modern English textbooks do cover these prosodic aspects, but usually in very general terms: e.g., paying attention to producing a rise in yes/no questions, but not its phonetic features – intervals, ranges, or timing. Furthermore, a great number of textbooks with accompanying audiovisual materials are available. Authentic listening materials can help learners to acquire prosodic features by imitating L2 speech patterns. In immersive learning situations, interacting with native speakers tends to exert a positive impact on acquiring L2 prosodic patterns.

Thus, revisiting the points raised - 1) direction of L1-L2 influence, and (2) features involved – we consider that factors relating to the quality and quantity of input (Flege, 1995) matter.

When someone starts learning a L2, his/her first attempts to produce L2 utterances will probably contain a lot of features that are typical of his/her L1. This is probably why L1->L2 influence (also called negative transfer) is widely debated in the Linguistics literature. But at the same time, even at the beginning

stages of learning, the influential degree of the features involved in the process will depend on the teaching methods.

More rarely, one may find examples of L2->L1 influence in scientific literature, e.g., in Occitània, tonal features of questions produced in Occitan (L1) have been shown to be influenced by the dominant language (that is, French or Italian) (Delais-Roussaire et al., 2015, Chapter 5). But there are also cases when the result of cross-language influence is neither L1->L2 nor L2->L1, e.g., a study of Mexican Spanish learners of French has shown that specific tonal features of wh-questions in their L2 cannot be explained by L1 influence (Delais-Roussaire et al., 2015, Chapter 12).

Among the prosodic features addressed in various publications are intonation of various sentence types (often, yes/no questions and wh-questions), tonal patterns of accentual phrases, tones (for tone languages), and speech rhythm. A full list of potentially relevant prosodic features may be formulated by looking into prosodic typology. If we assume that L1-L2 influence is a result of differences between languages, then all of them could possibly lead to changes in L1 or L2 (or both). Prosodically, languages may differ in the following features (Ladd, 2001):

- mapping between melodic tunes and functions (two languages may use the same tune for different functions, or use different tunes for the same function),
- the total amount of melodic tunes (e.g., some languages may not use complex tunes such as fall-rise),
- sentence stress placement (especially in yes/no questions and wh-questions),
- phrasing (including syntax-prosody mapping),
- resolving tonal crowding, i.e. treating complex tunes produced on very short segmental strings (compression vs. truncation),
- intonational phonetics (declination, pitch range etc.).

This is quite in line with Mennen's L2 Intonation Learning theory (LILt) (Delais-Roussaire et al., 2015, Chapter 9) designed to compare contact languages in order to predict possible difficulties in L2 learning. In this framework, languages are compared in terms of 4 dimensions: (1) the inventory and distribution of categorical phonological elements ('systemic dimension'), (2) the phonetic implementation of these categorical elements ('realizational dimension'), (3) the functionality of the categorical elements or tunes ('semantic' dimension), (4) the frequency of use of the categorical elements ('frequency' dimension'). The latter

dimension is obviously new to what we can infer from Ladd's features; however, languages do differ in the frequency of melodic tunes and other categorical elements, which can have an impact on L2 learning.

On contrasting intonational patterns produced by native and non-native speakers of a language, it is helpful to resort to a prosodic annotation tool, such as DaTo (Lucente, 2012; 2017; 2022), which provides information on the height, movement, and alignment of the intonational contours.

In the following section the DaTo system of intonation annotation, which is used in this chapter to compare intonation contours of utterances in Brazilian Portuguese as produced by Russophones and Brazilians, is described and illustrated with examples.

## 2. The DaTo System

The DaTo (Dynamic Tones System) (Lucente, 2012; 2017; 2022; Lucente and Barbosa, 2009) is an annotation tool for phonetic and phonological aspects of intonation and prosody. It was especially developed for BP intonation, but some unpublished tests applied to Spanish and Russian intonation yielded satisfactory results.

As an annotation and a descriptive dynamic system, DaTo is made up of a set of labels which allow the researchers to describe the height, the movement, and the alignment of the intonational contours. As the system includes phonetic segmentation of phonetic syllables as v-to-v units which start in a vowel onset and end in the following vowel onset, including all consonants between them, it enables the detection of rhythmic components, such as the phrase accents, and the stress groups (Barbosa, 2006).

The DaTo system proposes a dynamical and nonlinear approach to intonational annotation. The dynamic contours described by the DaTo system are related to one another by the height at the end of the preceding contour or boundary. In this way, tonal prominences are not considered local events. Despite the use of phonological labels for annotation which represent the opposite characteristics in terms of high (H) and low (L) pitch, each annotation label describes a specific movement at the melodic curve considering the target to be reached.

The target can be reached by considering the effort implemented to raise the pitch and control the pitch fall at a specific point of alignment, taking as reference the stressed syllables. As a result of this mechanism, it is possible to

obtain phonetic measures relating to pitch range and the maximum speed of pitch change, and a precise alignment with the segmental components of speech (Lucente, 2012; 2022).

DaTo system annotation was conceived to be run in the Praat software (Boersma & Weenink, 2022) as it makes it possible to organize the annotation layers, which comprise the system labels, the segmentation into smaller units and the use of scripts for automatic extraction of acoustic features from the data. The general configuration of DaTo annotation can be seen in Figure 1.

The set of labels representing the dynamical contours of the DaTo system consist of rising and falling patterns, which are represented by the combination of the letters "L" and "H" and some diacritics. The reference for the alignment between contours and the segments of speech is the letter that is on the right of the labels, e.g., HLH represents a contour characterized by the fall and subsequent rise of the curve, with the stressed vowel aligned with the highest position in the curve. The notation of the height of f0 at the boundaries, called "boundary levels" in the system, uses only L and H, without combinations. The diacritic ">" represents a late movement of the curve, e.g., in >LH the reference point for the alignment occurs after the stressed vowel, and the diacritic "v" (letter V in lower case), represents a compression of the curve between two peaks.

In Figure 2, the labels of the DaTo system are described.

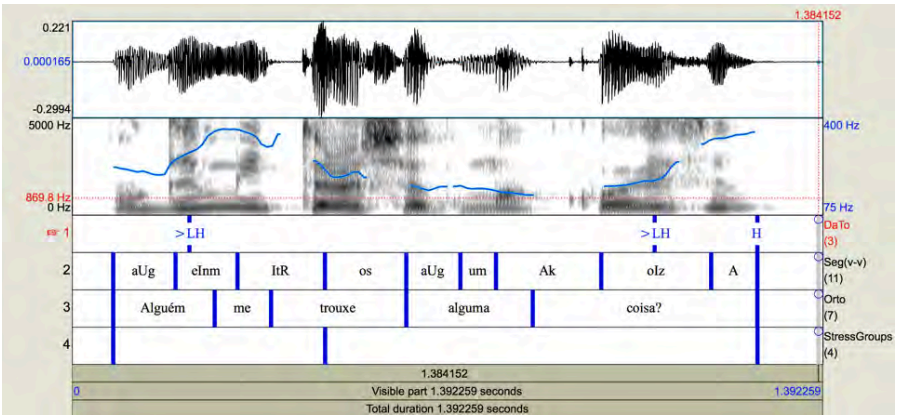


**Figure 1.** The general configuration of DaTo system annotation.

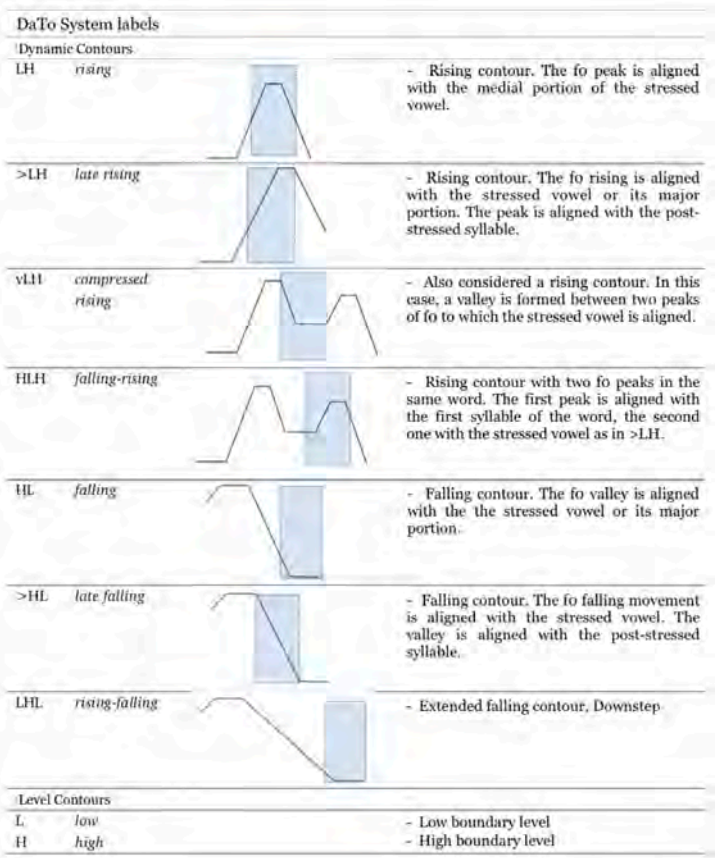


**Figure 2.** Set of labels of DaTo system. The blue rectangle represents the stressed vowel aligned with the specific dynamic contour.

## 3. Method

The data used for this analysis were extracted from the RusIm-Bra1 (First-generation Russophone Immigrants in Brazil) corpus that contains recordings of 40 Russophone participants and 17 native BP speakers (Smirnova Henriques et al., 2020, 2022). The intonation tasks proposed to the speakers were composed by the reading of 17 sentences/small dialogs elaborated by the research group of Dr. Skrelin from Saint Petersburg State University and translated into BP (Smirnova Henriques et al., 2022). The recordings were obtained in a sound-isolated cabin and analyzed using the Praat software.

For the present work, six sentences of five different contexts, extracted from the RusIm-Bra1, are analyzed. They are described in Table 1.

| | | |
|---|---|---|
| Context 1 | Listing | *Se você for no supermercado, compra leite, queijo, tomate e cebola.*<br>(If you go to the supermarket, buy milk, cheese, tomato and onion) |
| Context 2 | Advicing/ Requesting | *Saindo de casa, apague a luz.*<br>(When you leave the house, turn off the lights) |
| Context 3 | Requesting | *Quando chegar em casa, me liga.*<br>(When you get home, call me up) |
| Context 4 | Warning | *Cuidado, tem um degrau embaixo.*<br>(Watch your step when you go downstairs.) |
| Context 5 | Asking for information. | *Vai pegar o bonde?*<br>(Are you going to catch the train?) |

**Table 1.** The five contexts analyzed in the present work.

The selected sentences were produced by six Russophones, three men and three women who came to Brazil as adults and resided in São Paulo city for 6-8 years. Their mean age was 47 years. The control subjects were six Brazilians, also three men and three women residing in São Paulo city and recorded in the same conditions. Their mean age was 31 years.

The 60 sentences were analyzed using Praat. All files were segmented into vowel-to-vowel units (Barbosa, 2006) and orthographically labeled, and then their intonational annotation was made according to DaTo system protocol, as can be seen in Figures 3a and 3b.

To enable a comparison between the alignments and pitch range of the intonation curves of BP speakers as L1 and L2, a temporal normalization of the segments (v-v units) of each sentence was carried out.

The temporal normalization of the data was performed using a Praat script (Arantes, 2015) that preserves the f0 values (in Hertz) associated with each speech segment. In this way, it was possible to generate in R software (Appelhans, Detsch & Nauss, 2015) overlapping images of the intonation curves of each speaker according to each utterance context, as can be seen in the Figure 4.

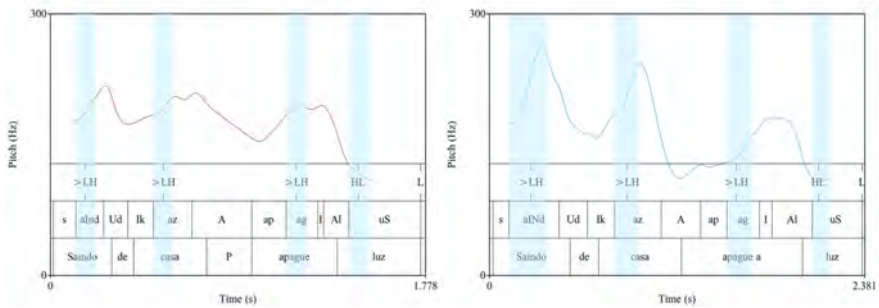


**Figure 3.** Figure 3a (left) shows the DaTo annotation and interpolated and smoothed f0 curve for a native speaker of BP; figure 3b (righ) shows the DaTo annotation and interpolated and smoothed f0 curve for a Russian speaker of BP as L2.

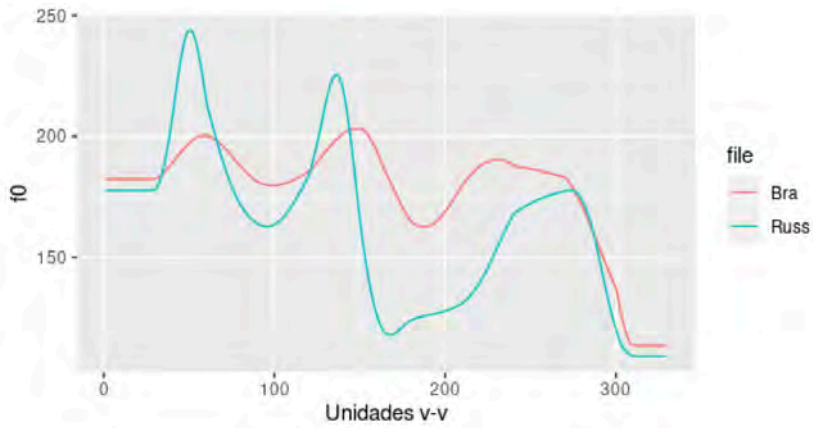


**Figure 4.** Overlapping of two speakers time-normalized intonational curves of the sentence "*Saindo de casa, apague a luz*".

## 4. Analysis

When looking at Figures 3a and 3b and the time-normalized overlapping of these in Figure 4, it is possible to notice that the intonational curves produced by Brazilian and Russian speakers have a very similar pattern, diverging slightly in relation to the peak alignment and more pronounced in the pitch range. Despite these differences, from the phonological point of view, the two speakers produce the same intonational contours.

It is based on this type of observation that this work intends to compare the curves of BP speakers as L1 and L2 in a preliminary quantitative analysis.

The analysis that follows considers similarities and differences between the normalized intonation contour patterns produced by Brazilian and Russian speakers. The intonation patterns are considered in the 5 speech contexts under analysis.

## Context 1

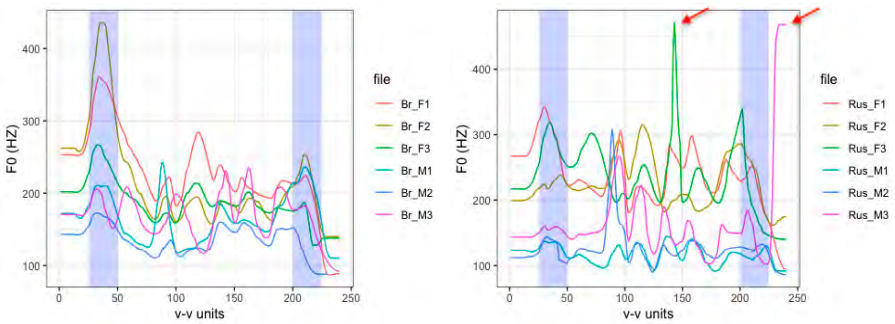


**Figure 5.** Figure 5a (left) shows the intonational contours of the sentence "*Se você for no supermercado, compra leite, queijo, tomate e cebola"* produced by male (M) and female (F) Brazilian speakers; figure 5b (right) shows the same intonational contours produced by Russian speakers. Both graphs show at *x* axis the number of segments multiplied per 10. The red arrows in the right graph indicate errors of f0 interpolation on Praat[1].

In context 1 (Figures 5a and 5b), which is characterized by the speech production of a list of items, excerpts with similar alignments are highlighted in blue, from the sentence where the alignment is quite similar between the two groups. At the beginning of the sentence the Brazilian (Br) speakers produce a late rising contour (>LH), which is expected for assertive sentences in BP. At the final boundary, Br speakers were consistent with a late falling contour (>HL) and a low boundary level (L). The Russian (Rus) speakers also produced the late alignment at the beginning of the sentence. However, at the final

1 Praat uses as linear interpolation in all tiers and grids with values at time points, so at all times between two adjacent points, the pitch values follow the straight line that connects the two points. In Figure 5b, for example, the so called "errors" of interpolation are caused by short high pitch values captured by the microphone.

boundary, they produce a downstepping, labeled by the rising-falling contour (LHL) and L boundary level.

In terms of pitch range, Br speakers show a global decrease of f0 during sentence production, characterized by a large increase in f0 at the beginning, more prominent in female speakers.

## Context 2

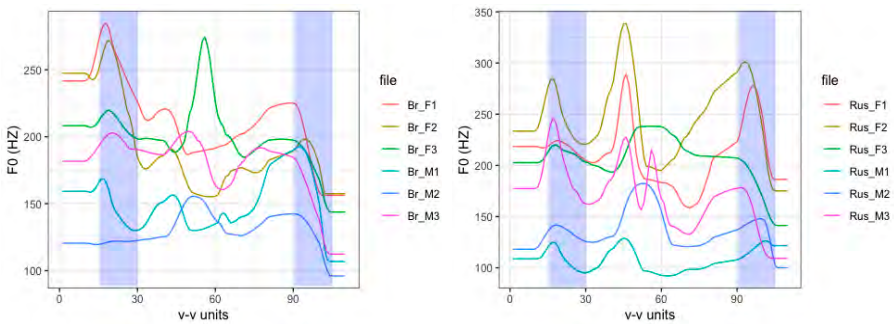


**Figure 6.** Figure 6a (left) shows the intonational contours of the sentence "*Saindo de casa, apague a luz"* produced by Brazilian speakers; figure 6b (right) shows the same structure produced by Russian speakers. Both graphs show at *x* axis the number of segments multiplied per 10.

Context 2 can be pragmatically understood as an advice or a request, but despite this fact, the two groups of speakers produced similar intonational and alignment patterns in the beginning and final boundary of the sentences. As can be seen in the Figures 6a and 6b, Br and Rus speakers produce a rising contour at the beginning, in most cases labeled as >LH, and the >HL contour followed by a L level at the final boundary. In general, it is possible to say that Rus speakers produce an intonational pattern similar to that of Br speakers, but with a wider pitch range. On the other hand, Br intonation contour patterns exhibit a steeper F0 inclination, starting with higher values of frequency, which decreased throughout the utterance.

It is interesting to note that all speakers, Brazilian and Russian, perform a focal prominence at some point in the medial portion of the sentence. The placement of this prominence aligned with a specific word may be associated with the type of pragmatic information that speakers intend to indicate, whether a request or advice.

## Context 3

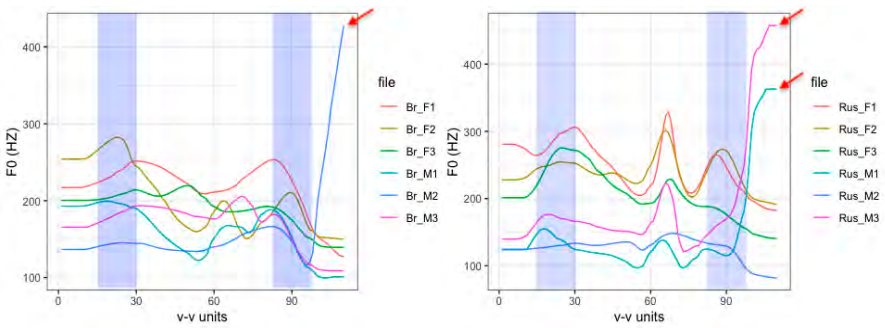


**Figure 7.** Figure 7a (left) shows the intonational contours of the sentence "*Quando chegar em casa, me liga*" produced by Brazilian speakers; figure 7b (righ) shows the same intonational contours produced by Russian speakers. The red arrows in both graphs indicate errors of f0 interpolation on Praat.

Context 3 refers to a simple request in BP, and in comparison with context 2, speakers in both groups exhibit quite a similar intonation contour. Br speakers produce >LH at the beginning of the sentence and HL and L at final. As can be seen in Figure 7, speaker Br_M2 produces a final rising contour, indicated by the red arrow. This is one of the cases in which there's an error of interpolation, as explained earlier.

For this specific context, Rus speakers were more consistent in terms of intonational curve if compared with Br speakers. The Rus speakers produced two fairly consistent patterns that only diverged in the final falling contour: all Rus speakers start the sentence with a >LH contour, and all speakers produce a prominence in the middle of the sentence, aligned with the word "casa" (house), described by the >LH contour. This is very likely the influence from Russian, where such rise-fall is typical in such contexts. The utterance "*Quando chegar em casa, me liga*" is divided into two intonational phrases, and "casa" bears the typical utterance-medial nuclear accent. However, at the final boundary, speakers Rus_F1 and Rus_F2 produced the same contour HL as the Brazilians, and Rus_F3 and Rus_M2 produced a LHL contour.

As indicated with the red arrows in Figure 7b, the intonational curves of speakers Rus_M1 and Rus M3 presented errors of interpolation in final boundaries. With the aim of showing the f0 curves without such errors, Figures 8a and 8b show the speaker's curves only smoothed, but not interpolated.

When the curves are observed without interpolation one can see that speaker Rus_M3 (Figure 8a) produces a pattern similar to that produced by speakers Rus_F1 and Rus F2, and the speaker Rus_M1 (Figure 8b) produces a similar pattern to that produced by speakers Rus_F3 and Rus_M2. Such a finding supports the fact that there are two patterns for Rus speakers in this context.

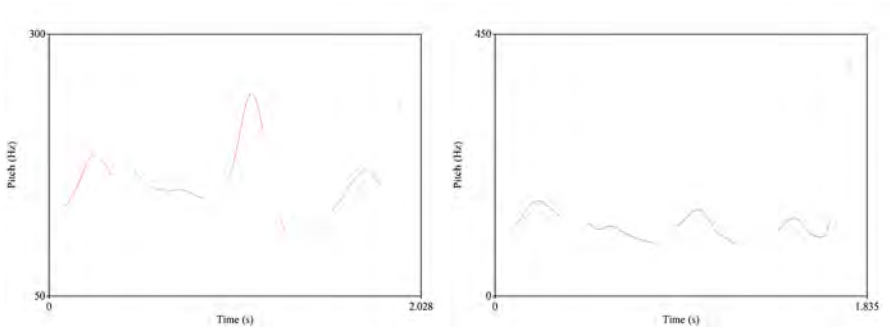


**Figure 8.** Figure (8a) shows the f0 curve without interpolation of the sentence "*Quando chegar em casa, me liga*" produced by Rus_M3, and figure (8b) shows the f0 curve without interpolation produced by Rus_M1.

## Context 4

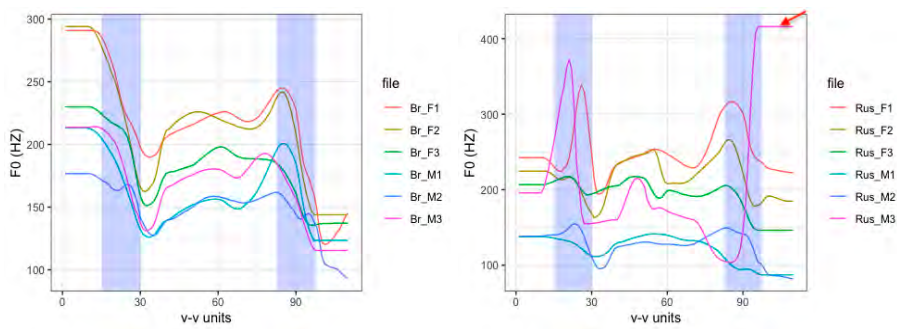


**Figure 9.** Figure 9a (left) shows the intonational contours of the sentence "*Cuidado, tem um degrau embaixo!*" produced by Brazilian speakers; figure 7b (righ) shows the intonational contours of the sentence produced by Russian speakers. The red arrow in the right graph indicates errors of f0 interpolation on Praat.

Context 4 refers to a warning speech act. A very consistent intonation pattern is found in Br speech productions as can be seen in Figure 9a. The contours mostly found for Br speakers were >HL right at the beginning of the utterance and again >HL at the final boundary, followed by the L level contour.

The most divergent factor between Rus speakers' intonation curves in relation to Br speakers in this context is the difference in pitch range at the beginning of the sentence. Br speakers produce a falling pitch range of 100 Hz approximately, even for male speakers. This falling contour is a characteristic of the warning speech act in BP. Rus speakers produced very varied initial contours among themselves, but the final contours were more consistent in terms of alignment, varying between HL (falling) and LHL (rising-falling) followed by L. One of the Russophones, F1, uses a wide rise-fall within the word "Cuidado". This is the same IP-final rise-fall in Russian that we have already seen in contexts 2 and 3. In this context, however, it is only produced by one speaker, as one-word IPs are less likely than longer ones.

## Context 5

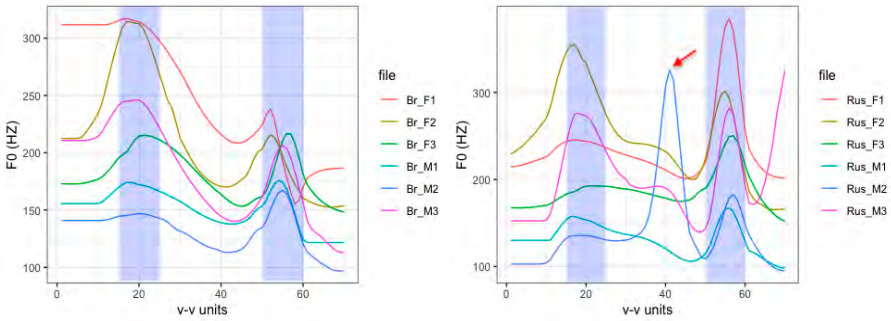


**Figure 10.** Figure 10a (left) shows the intonational contour of the sentence "*Vai pegar o bonde?*" produced by Brazilian speakers; figure 10b (right) shows the intonational contour of the sentence produced by Russian speakers. The red arrow in the right graph indicates errors of f0 interpolation on Praat.

This context (Figura 10) has been classified pragmatically as a request for information, but grammatically it is classified as a question. In BP the general intonational patterns for yes/no question, *Qu* question and *Qu* question *in-situ* are illustrated in the Figures 11, 12 and 13. For yes/no questions, the intonational

pattern is a late rising contour at the beginning, labeled as >LH, and again a late rising contour at the final boundary, also labeled as >LH. *Qu* question (corresponding to *Wh* question in English) starts with high f0, providing a late falling contour, labeled as >HL, aligned with the *Qu* particle, followed by a downstep until the final boundary, labeled as LHL. The *Qu* question *in-situ* presents a pattern with a late rising contour preceding the *Qu* particle, which, in turn, is aligned with a falling contour. All these cases correspond to neutral interrogatives, that is, without focus on any word.

The type of question relating to the request for information is the yes/no question. Therefore, the intonational pattern present in Figures 10a and 10b shows the same pattern of yes/no question in Figure 11: a sequence of two late rising (>LH) contours, the first aligned with the auxiliary verb (*vai*) and the second with the last noun in the sentence. In terms of alignment, Rus speakers show an alignment similar to that of Br speakers. It is interesting to observe that Rus speakers make a higher prominence in the word "bonde", or to the end of the sentence, while Br speakers put higher prominence in the auxiliary verb, or to the first word of the sentence.

The stronger accent on the final word in Russophones' recording can be the result of L1 influence. In Russian, neutral yes/no questions are produced with the main accent on the finite verb, However, this utterance was produced in the following context:

– *Vai pegar o bonde?* (Are you going to take the tram?)

- *Sim, e você?* (Yes, what about you?)

- *E eu o ônibus.* (I'll take the bus)

That is, the word "bonde" is in contrast with "ônibus" – thus it bears contrastive stress. In such cases in Russian speech the main accent is indeed on the contrasted word, i.e. "bonde".

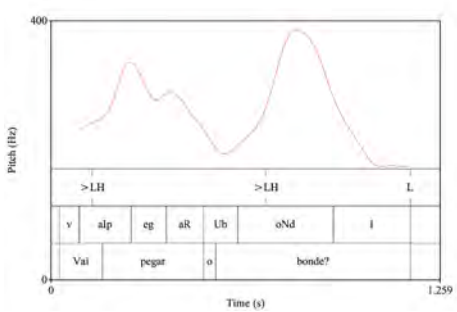


**Figure 11.** Yes/No question intonation pattern in BP.

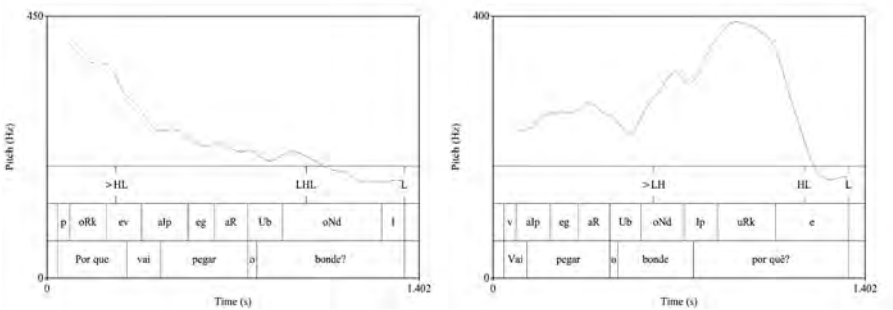


**Figure 12** (left): *Qu* question intonation pattern in BP. Figure 13 (righ): *Qu* question *in-situ* intonation pattern in BP.

## 5. Conclusion

The comparative analysis of the BP intonation patterns produced by Russophones speaking Brazilian Portuguese and Brazilians showed that: i) the Rus speakers have succeeded in acquiring/learning the intonation system of L2, but some Russophones' recordings still contain melodic features typical of their L1 intonation; ii) pronounced differences in pitch range were found, with the range of rises and falls higher for Rus speakers; iii) besides the wider pitch range in Rus speakers, the general melodic pattern shows that Br speakers often start the utterance in higher f0 than Russophones; iv) subtle differences in pitch alignment were found. These differences can be attributed in part to a larger variation in pitch range found in Russophone speech productions. As argued by Lucente (2015), the range of pitch variation can result in changes of F0 alignment in stressed vowels. These findings may indicate a process of L2 adjustment by the speakers of Russian as L1.

It should be considered that some of the observed differences are similar to those typical for "neutral vs. expressive (emotional, ironic etc.) speech". However, languages differ in the way these features are used and interpreted. Thus, we may assume that for native speakers of BP the Russophones' recordings may sound unusual and contain additional connotations.

A possible limitation of this research is the use of time normalization. On the one hand, it is a great tool that enables the researcher to compare phrases of different lengths. On the other hand, by using this approach we lose a great tool that enables the researcher to compare phrases of different lengths, but it is indeed true that we lose information about the steepness of melodic change, which is crucial for perception.

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