Describing L2 speech prosody is a challenge, given the great variability observed in the production of bilingual speakers. The use of methods based on discrete labels poses a challenge: what tone inventory is to be used to label the production of bilinguals in the face of phenomena such as L1 to L2 transfer and language attrition (L2 to L1 influence)? [1, 2, 3, 4]. One alternative is to use quantitative methods that describe contour features that are not theory-dependent. In this study, we compare two quantitative techniques to describe the \( f_0 \) contours of wh-questions produced by Brazilian and Spanish monolingual speakers and by Brazilian bilinguals in Spanish L2 and Portuguese L1. The goal is to analyze the relationship between L2 learning and language attrition in L1. The first technique describes a given \( f_0 \) contour by means of its extreme points, i.e., the local \( f_0 \) maxima and minima in the surface \( f_0 \) contour and \( f_0 \) velocity contour [5]. It is a simple procedure that does not rely on any strong underlying assumption. The second technique we tried is the Fujisaki model [6]. The goal of this study was to compare the results reported in [4] with the results obtained with the Fujisaki model to assess the advantages of a more sophisticated method that models the observed \( f_0 \) contour by superimposing global (phrase) and local (accent) components. A further advantage of this model is the possibility to resynthesize utterances with modified \( f_0 \) contour to test our hypotheses perceptually. For that, we explore the position and magnitude of phrase commands; the amplitude, duration, and position of accent commands relative to stressed syllables in final and non-final words. The previous study showed evidence of L2 learning, since most of the \( f_0 \) contours produced by Brazilian bilinguals that are Spanish-like (final rise, nuclear circumflex and double circumflex) are similar to the ones produced by Spanish monolinguals. The study also showed evidence of L1-L2 transfer, since the participants also produced \( f_0 \) contours typical of Portuguese L1 (global falling) in Spanish L2 and evidence of language attrition. The authors identified qualitative attrition, characterized by the production of Spanish-like contours in Portuguese L1 and quantitative attrition, since the bilinguals produced global falling contours in L1 with wider \( f_0 \) range than monolinguals.

Figure 1 (Fujisaki model) shows an example of qualitative attrition identified in the previous study. We analyzed data from 25 speakers. Ten Brazilian and Spanish speakers (6 female and 4 male). The Spanish speakers never studied Portuguese as L2 and the Brazilians never studied Spanish as L2. Fifteen Brazilian speakers (10 female and 5 male) that also speak Spanish as L2. All started learning Spanish after the age of 18 and lived in Madrid at the time the data was collected. The results of the present study with Fujisaki model lead to a similar classification suggested by the accents commands for monolinguals and bilinguals. Furthermore, the results showed that there is a greater \( f_0 \) range in the production of bilinguals in L1 and L2 compared with the Brazilian monolinguals (Figure 2). The phrase commands of global falling contours produced by bilinguals have significantly higher mean magnitude in Portuguese L1 (\( p = 0.002 \)) and a marginally significant higher mean value in Spanish L2 (\( p = 0.072 \)) compared to the same contour type of Brazilian monolinguals. The analysis of the first accent command shows in Brazilian monolinguals a lower mean amplitude compared to bilinguals (both Portuguese L1 and Spanish L2 \( p < 0.001 \)). The present findings suggest that the extended \( f_0 \) range observed in bilingual contours results from a combination of a stronger phrase accent and a stronger initial accent command aligned with the interrogative pronoun. There are also other differences that will be discussed in more detail in the presentation.
Figure 1: One example of analysis in Portuguese L1 of the sentence “Onde estão meus livros?” Where are my books? With global falling contour of a female monolingual Brazilian speaker 2 (left) and of a female bilingual Brazilian speaker (right); Each panel displays from the top to the bottom: The speech waveform, the F0 contour (extracted ++++, modelled ---) the underlying impulse-wise phrase commands and box-shaped accents commands of the Fujisaki model. Syllables boundaries are indicated by dotted vertical lines.

Figure 2: Boxplots of phrase command amplitude Ap (left) and first accent command amplitude Aa (right) for MP (Portuguese L1 monolinguals), BL1 (Portuguese L1 bilinguals) and BL2 (Spanish L2 bilinguals)

References