

# F0 DECLINATION IN BRAZILIAN PORTUGUESE IN READ AND SPONTANEOUS SPEECH

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## ABSTRACT

The presence and magnitude of F0 declination in Brazilian Portuguese is investigated in three different speech styles: spontaneous speech, connected read speech and non-connected read speech. Analysis of F0 curves shows that declination is clearly detectable in non-connected read speech. Stress plays a crucial role in the concrete realization of declination in this style. Three distinct lines are proposed to represent the declination space. The topline, connecting poststressed syllables, and the baseline, connecting prestressed syllables, define the limits of local pitch movements. Stressed syllables occupy an intermediate level. In connected read speech declination is less visible. A possible explanation for this is the higher level of expressiveness and the presence of more complex syntactic patterns in the material analyzed. In spontaneous speech, the massive presence of discourse factors prevents declination to surface in about half the cases.

## 1. INTRODUCTION

Although sentence intonation models that incorporate, at phonetic and/or phonological levels, a F0 declination component are more and more common, we do not have yet a systematic investigation of this phenomenon in Brazilian Portuguese (BP), even if occasionally observed in read sentences [10].<sup>1</sup>

As noticed by Vaissière [17] declination is “easily detected from a visual inspection of relatively long stretches of F0 curve, but calculation of exact rate of declination is a difficult task”. This is due, I believe, to the fact that the declination tendency is sensitive to a large range of factors, including stress, in its various manifestations (lexical, phrasal, secondary) [1, 2, 11, 15, 17], syntactic grouping [6], new/supplementary information strategies [5, 16], emphasis for contrast [13], degree of importance attributed to words [16], degree of speaker’s involvement, utterance length [7, 12, 18], read or spontaneous speech [3, 9, 16], sentence type [8, 13], microprosodic perturbations such as vowel intrinsic pitch or effects of surrounding consonants [4, 14], and the influence of specific attitudinal melodic patterns like irony, doubt, etc.

The weight of these factors is not the same; while the effect of utterance length or of microprosodic factors are not marked to the point of interfering with the visual identification of the phenomenon, the presence of emphasis, emotional speech, read or spontaneous style, may disfigure the expected declination.

The purpose of the present contribution is twofold:

1. to establish some of the basic characteristics of declination in BP, as observed in declarative isolated read sentences;
2. to observe declination in connected \_ read or spontaneous \_ speech, aiming at evaluating the importance of style in the manifestation of declination and the reasons for the differences possibly found.

## 2. METHOD

The speech material analyzed consists of samples of spontaneous and read speech. The spontaneous speech comes from extracts of interviews with three subjects, two females, one male, native speakers of BP (Rio de Janeiro dialect). The samples of read speech were taken from the reading, by the same speakers, of:

- a) the same pieces of spontaneous speech (now connected read speech), allowing thus an easier comparison between the two styles;
- b) five neutral independent sentences (now non-connected read speech), repeated each one twenty times, and composed of five phonological words each, showing a regular distribution of lexical stresses, but presenting different syntactic boundaries.

The sentences were:

1. Marina patina sozinha domingo cedo. (Marina skates alone early on Sunday.)
2. Maria Regina patina domingo cedo. (Maria Regina skates early on Sunday.)
3. A filha da Ana Regina patina cedo. (Ana Regina’s daughter skates early in the morning.)
4. Marina patina sozinha cedo. (Marina skates alone early in the morning.)
5. Marina patina cedo. (Marina skates early in the morning.)

The first sentence has the NP/VP boundary between the first (w1) and the second word (w2). In the second sentence the boundary is between w2 and w3 and in the third, between w3 and w4. The last two sentences are included in order to investigate possible changes in the declination rate in utterances of variable lengths.

Care has been taken to alternate the reading of each sentence with other sentences, to avoid a too mechanical reading. The material was recorded in good acoustic conditions with a digital tape recorder, and subsequently underwent an acoustic analysis. The F0 measurements were taken at the intensity peak of each syllable. The connected read speech material was subjected to a listening test, in order to segment the sound *continuum* according to the incidence of pauses and/or pitch changes.

Thus there were established 230 boundary units to be used as a basis for the comparison of the read/spontaneous material. Short units, that is, those containing only one lexical stress, were not considered.

## 3. RESULTS AND DISCUSSION

a) spontaneous speech

The visual inspection of F0 curve of the sentences considered, displayed in a linear scale, revealed that 47.7 % of the boundary units presented declination (table. 1).

b) connected read speech

In the reading of the spontaneous text the percentage of units

showing a gradual fall in the F0 tracings goes up to 68.9%. (table 1).

speakers \ style	AM	CM	SC	average
spontaneous	54.3%	52.6%	30.2%	47.7%
connected read	77.1%	59.9%	69.8%	68.9%

Table 1. Incidence of declination in spontaneous and in connected read speech.

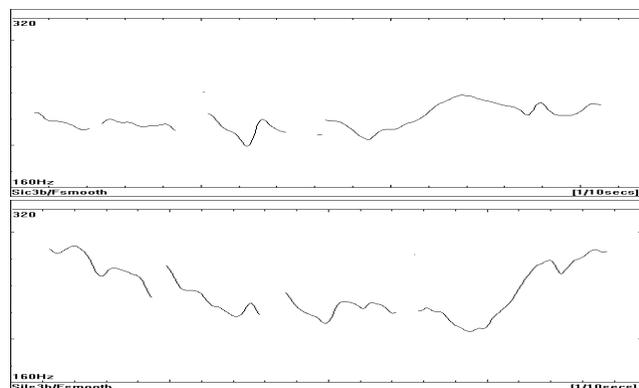


Fig. 1. Sentence *Tinha vontade de fazer outras linguas* uttered spontaneously (parenthetical intonation) with no declination (above) and read by the same speaker, showing declination (below).

The analysis of all the samples of spontaneous and connected read speech (230 boundary units) leads us to consider that the decrease in declination found in spontaneous speech is due to the presence of three factors, namely:

1. the greater involvement of the speaker with what he says, which results not only in a higher pitch register in the spontaneous speech, but also in a lesser incidence of declination owing to a more important rise of the baseline than of the topline.
2. at the word level, a strong presence of emphasis, resulting also in the breaking of the declination line provided that the emphatic pattern is not at the beginning of the boundary unit.
3. the presence of prosodically marked supplementary information (parenthetical clauses) that, if it doesn't necessarily eliminate declination [5], still reduces considerably its range, and consequently its visibility (and audibility).

In connected read speech, the influence of such factors is moderate, which explains the greater incidence of declination in this style.

### c) non-connected read speech

Sentence 1. *Marina patina sozinha domingo cedinho.*

This sentence, read out of context and pronounced in a neutral way, presented in all cases (100%), for all subjects and all repetitions, a clear declination pattern (figure 2 and table 2).

The following points must be emphasized in the description of this pattern:

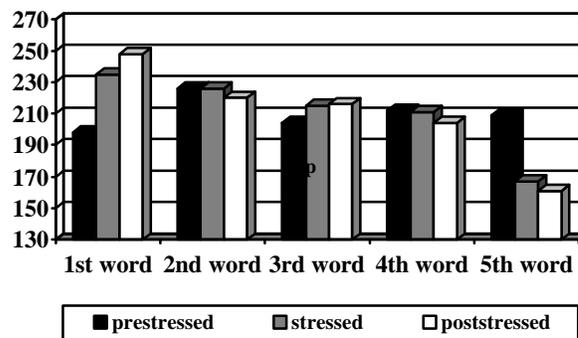


Fig. 2. Mean F0 values (in Hertz) for each syllable of sentence 1. *Marina patina sozinha domingo cedinho.*, as uttered 20 times by speaker CM.

1. As a rule, the average F0 of each word is downstepped in relation to the preceding word.
2. Similarly, considering the stress pattern of the syllables, the stressed and poststressed ones are gradually downstepped.
3. The syntactic boundary between NP and VP, located here between w1 and w2 is characterized by an upward movement on the poststressed syllable of the word that immediately precedes the boundary. Occasionally the stressed and the poststressed syllables stay at the same level, mainly if the boundary in question is low in the syntactic strength scale, as observed within the VP, between w3 (noun modifier) and w4 (verb modifier).
4. Prestressed syllables have a *sui generis* behavior, being more difficult to interpret and show, besides, a greater melodic variability. On the one hand, the first, the third and the last prestressed syllables consistently break the expected declination line. The first and the third syllables, which belong to words in a pre-boundary position, have their F0 lowered (chiefly the first) in relation to the projection of the declination line. The final prestressed syllable, in the word that conveys the sentence type (w5), shows an important melodic rise, increasing the contrast with the final stressed syllable, which will characterize the falling pattern typical of the declarative sentence, resulting from a local rule of level inversion in relation to the F0 behavior expected from the stressing or prestressing of these syllables. On the other hand, the F0 level of the remaining prestressed syllables, which occupy an internal position in the syntactic group, shows a great melodic variation. These syllables are on the average higher than the following stressed syllable in two speakers, and lower in the third. Besides, for each speaker, an appreciable melodic variability for these syllables is also noticed.

Figure 5 represents the declination space in neutral isolated sentences.

Sentence 2. *Maria Regina patina domingo cedinho.*

When the NP/VP boundary is located between w2 and w3, the F0 peak, which characterizes the starting point of declination, moves to w2; w1 suffers a deaccenting at the phrasal level (fig 3). The behavior of prestressed, stressed and poststressed syllables is basically similar to that described for sentence 1.

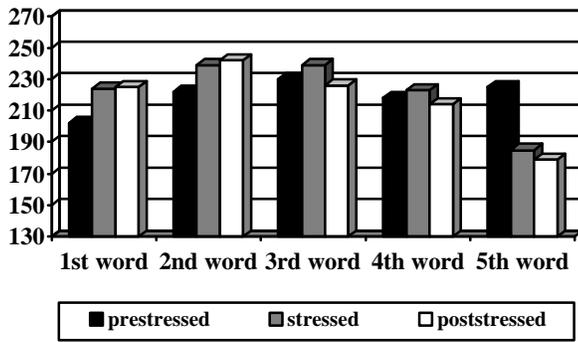


Fig. 3. Mean F0 values (in Hertz) for each syllable of sentence 2. *Maria Regina patina domingo cedinho.*, as uttered 20 times by speaker CM.

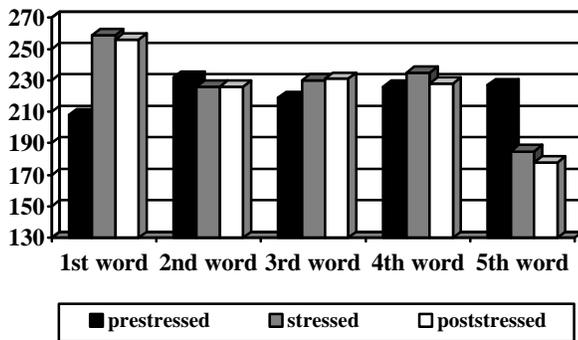


Fig. 4. Mean F0 values (in Hertz) for each syllable of sentence 3. *A filha da Ana Regina patina cedinho.*, as uttered 20 times by speaker CM.

Sentence 3. *A filha da Ana Regina patina cedinho.*  
 In this sentence, which presents an expanded NP composed of three phonological words, declination becomes visually less evident. Although we can't say that it is absent, it suffers perturbations that disfigure it, caused by the NP length. This is more noticeable in the w4 behavior, which frequently breaks the declination line. However, when w4 is confronted with w1 instead of w3, the declination tendency is maintained. In this case, w2 and w3 are interpreted melodically as a sort of parenthetical appendix, prosodically dependent on w1, which doesn't prevent the manifestation of the boundary mark in w3 (poststressed syllable rising).<sup>2</sup>

Establishing the declination rate, even in read isolated sentences of this kind, which clearly show the phenomenon, is not a simple matter, for at least two reasons: the F0 pattern of the sentence's last word is strongly modified by the sentence type and the melodic behavior of the syllables varies, as seen, according to their stress pattern. Taking for this purpose the stressed syllables as reference, since they are the most regular in their downstepping, and discarding the last one, whose pitch is sentence type determined,<sup>3</sup> an average downstep of 6 Hz per

stressed syllable is obtained in sentence 1 (7.7 Hz and 6 Hz, for the female speakers and 4.7 Hz for the male speaker). This corresponds to a declination of 2 Hz per syllable (2.5 Hz, 2 Hz and 1.6 Hz, respectively), if we consider the eight syllables between the first and the last stressed syllables.

Sentences 4 and 5.

Regarding the relation between utterance length and declination slope, the analysis of sentences 4 and 5 in confrontation with sentence 1 didn't show a consistent melodic behavior. While the speakers SC and CM confirm a tendency to a higher beginning and a lower end in longer sentences, speaker AM does not show a correlation between these two variables, suggesting that further research is necessary to clarify this point (table 2).

length speaker	9 syl.		12 syl.		15 syl.	
	first Hz sd	last Hz sd	first Hz sd	last Hz sd	first Hz sd	last Hz sd
SC	247 5,5	225 4,3	249 6,2	222 4,6	253 14	221 5,3
CM	239 9,4	191 4,2	242 11	186 6,5	249 13	184 5,6
AM	127 4,8	88 2,1	123 4,3	88 2,1	125 4,9	86 2,5

Table 2. Mean F0 values (in Hertz) and standard deviations (sd) for the first and the last stressed syllables in sentences of 9, 12 and 15 syllables, for the three speakers (20 repetitions each).

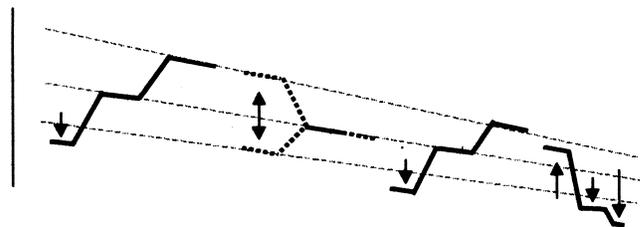


Fig.5. Declination melodic space, with the topline connecting poststressed syllables preceding a syntactic boundary, and the baseline connecting prestressed syllables; the midline connects stressed syllables. The arrows indicate the points where local changes take place, in relation to the expected declination. The double arrow shows the point where the melodic manifestation of a prestressed syllable may have a greater pitch variation.

#### 4. CONCLUSIONS

Declination seems to be highly sensitive to discourse factors like emphasis in its various types, hesitation and parenthetical intonation. The presence of these elements in the spontaneous speech samples analyzed here is responsible, in many cases, for preventing declination from surfacing at the concrete, phonetic level.

The non-connected read speech material, on the other hand, consisting of relatively short sentences and presenting a simpler syntactic structure, is where declination shows itself more evidently. Moreover, it is in such a context that the interplay

sent 1	ma	RI	na	pa	TI	na	so	ZI	nha	do	MIN	go	ce	DI	nho
SC	233 7,0	260 16	280 20	267 9,9	253 9,7	236 8,7	227 9,2	246 4,2	258 11	262 10	242 5,0	249 9,4	253 6,9	217 7,0	203 7,5
CM	198 14	235 16	248 17	226 12	226 11	220 12	204 11	215 13	216 12	212 9,4	211 14	203 8,7	209 12	167 15	159 13
AM	105 6,0	129 7,0	141 9,1	114 8,1	122 8,8	123 9,9	103 6,1	114 7,1	121 9,6	104 6,1	115 9,0	117 8,6	110 8,0	89 4,7	80 4,0

sent 2	ma	RI	a	re	GI	na	pa	TI	na	do	MIN	go	ce	DI	nho
SC	229 4,5	239 7,1	239 9,1	250 9,2	264 15	273 15	275 14	258 6,9	254 9,6	260 6,8	241 3,1	237 6,2	248 5,4	219 4,9	205 3,6
CM	202 5,8	224 7,8	225 12	222 7,1	239 6,6	242 5,6	230 4,1	239 6,7	226 5,4	218 5,4	223 5,9	214 6,4	225 8,2	185 5,2	179 11
AM	103 3,6	116 4,0	117 6,3	106 4,1	122 5,5	131 5,7	109 5,4	117 3,9	118 4,1	107 2,9	114 4,3	115 5,9	112 6,2	87 2,3	79 2,0

sent 3	a	FI	lha	da	A	na	re	GI	na	pa	TI	na	ce	DI	nho
SC	234 3,7	275 13	290 16	274 17	243 12	234 5,8	232 5,5	250 8,2	261 10	265 8,7	253 5,8	248 6,4	260 8,8	223 4,7	206 3,5
CM	208 7,2	259 11	256 8,5	232 6,8	226 7,9	226 7,2	219 10	230 8,9	231 7,3	226 6,0	235 8,6	228 8,1	227 8,7	185 6,2	178 8,3
AM	100 3,9	136 7,4	137 6,2	117 3,3	117 3,4	113 3,4	100 3,5	116 4,8	123 4,9	107 3,7	114 4,5	114 4,7	112 5,3	87 2,5	80 2,2

Table 3. Mean F0 values (in Hertz) and standard deviations for the syllables of three sentences, uttered by three speakers (20 repetitions each).

between stress and syntactic grouping strategies has a crucial role in the concrete realization of declination.

Connected read speech occupies an intermediate position. Actually, the involvement of the speaker is less important here than in spontaneous speech, and the delicate interplay established in the articulation of the main/secondary information in the spontaneous style is not usually conveyed with the same richness in the read text. On the other hand, the presence of words intrinsically emphatic, the syntax often complex certainly contribute to reduce the incidence of declination, as compared with what occurs in non-connected speech.

The relationship between declination and stress is not so clear in connected read speech, and even less in spontaneous speech. Further studies will be necessary to elucidate this specific point.

#### NOTES

1. Declination has been described in European Portuguese by Viana [18].
2. Another possible explanation for this is to consider only de NP, instead of the whole sentence, as the domain of declination.
3. Not taking into account the last word has the advantage of not excluding *a priori* utterances with non-falling final melodic contours (yes/no questions, exclamations) from the material to be analyzed.

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