VOWEL INTRINSIC PITCH IN QUEBEC FRENCH: MEASURING IFO IN CONNECTED SPEECH

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ABSTRACT

As it was established mostly on the basis of carrier sentence corpora built to that effect, the "intrinsic F0" phenomenon exists in all languages, including French. However, the values defined for France French by Di Cristo can hardly be applicable to Quebec French vowels. Being more interested to study IFO effects in connected speech, we decided to investigate a new procedure to calculate these on the basis of the interval between the stressed syllable and a reference line.

INTRODUCTION

In a first task, we have established IFO intervals for vowels in a carrier sentence corpus of Quebec French [1]. To make possible a comparison with France French values [2], our corpus was similar to the Di Cristo's one, that is to say carrier sentences containing a target vowel in a CVC stressed syllable like the following: *Le CVC de (NP) est (copula)*. We analyzed a minimum of 30 tokens of each vowel. An interval of more than 2 semitones was calculated between High and Low vowels (Figure 1). These IFO values are consistent with those calculated for most languages [3].

Meanwhile, our main objective was to find out if these results would be the same in connected speech and, ultimately, in spontaneous speech, that is to say the type of informal language used in a sociolinguistic interview. So we designed a new procedure to calculate IFO in connected speech, which could be considered as intermediate between carrier sentences and spontaneous language. If such a new procedure is functionning correctly, we assume it should work with spontaneous speech.

Some authors [4] [5] [6] [7] analyzed vowel IFO in connected speech. Umeda was the only one, as far as we know, who used a corpus similar to ours. She found there were no significant IFO intervals in connected speech, but her findings were afterwards rejected. Further works calculated IFO variations between High and Low vowels in connected speech. But the authors [6] [5] [4] did not use real connected speech corpora in the sense that most often their works were based on target vowels which commuted in preestablished stressed positions in a text. In such conditions, IFO variations were estimated to be smaller than in carrier sentence corpora.

METHODS

Second task corpus

A 600-syllable text was selected from a reading book; we neither modified the text nor considered its phonetic characteristics. It was recorded in excellent acoustic conditions. Subjects were four Quebec French speaking university students (2 males and 2 females) aged between 20 and 30, and living in Quebec City. They also read the carrier sentence corpora. The data were processed and analyzed with the CSL System (Kay Elemetrics).

Measurements

The main difference between connected speech and carrier sentence corpora for purposes of IFO analysis is that in the latter, it is possible to take direct FO measurements [2] of target vowels which always appear in the same position under controlled phonetic variables. In such conditions, mean IFO intervals can be quite easily calculated for each vowel. A connected speech corpus like the one chosen does not allow such a procedure; there is neither any target vowel, nor any real control of stressed vowels or phonetic environment. Moreover, the intonation variation is important enough to forbid any direct F0 calculations for IFO estimations purposes.

So, we believe it is necessary to consider IF0 values by taking into account, to a certain extent, the prosodic context of the retained vowel. A prominent vowel, most of the time uttered with an increase of F0 over a baseline, is consequently evaluated in comparison with this line [8] [9] [10] [11]. Although there is no consensus on the exact nature of such a baseline, we agree with Ladd's proposal [10]: "We need to acknowledge that the key to normalizing prominence is some sort of abstract reference value in a comprehensive model of pitch range".

Practically, we assume that unstressed vowels constitute points of the said reference line and consequently we decided to retain the interval between the stressed vowel and the preceding unstressed one to evaluate stressed vowel IFO.

Thus, stressed syllables in the four recordings were localized, without a hierarchy being established between primary and secondary stresses. We did not consider final position stress, which was always at the end of a decreasing intonation line in our corpus. We also neglected to appreciate the preceding unstressed vowel nature since IFO in this particular position would not be really conditionned by vowel aperture [12].

Finally, on the basis of the first task which showed us vowels of similar aperture having comparable IFO variations in a carrier-sentence corpus, and because there was not a significant number of occurrences for each vowel in the second task corpus, we grouped them in classes (High tense, High lax, Mid, Low and Nasal) for calculation of IFO intervals. Pitch values were measured at the mid point of vowel duration, where the influence from surrounding segments is seen as minimal.

RESULTS

Task 2 vs Task 1 results

Figure 1 gives a view of the comparison between vowels in both tasks, that is to say carrier sentence and connected speech corpora. A similar IFO classification can be seen in both situations, IFO diminishing regularly from High to Mid to Low and Nasal vowels. However, there is a

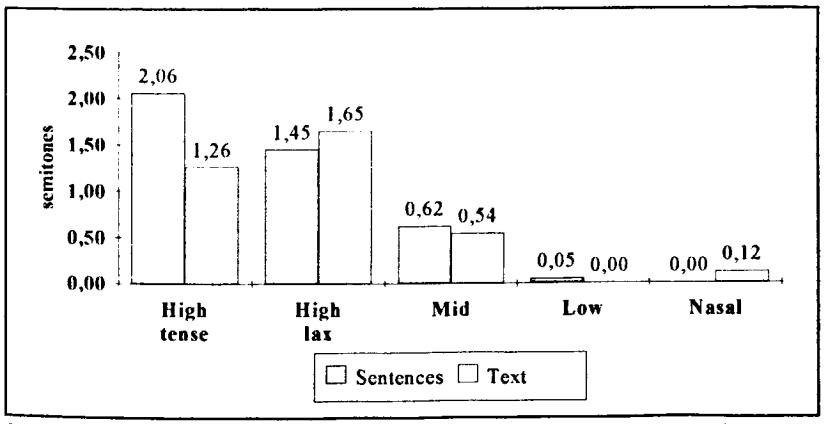

Figure 1. Intrinsic F0 of Quebec French vowels in sentences and in connected speech

noticeable difference: High-tense and High-lax vowel ranks are inversed in connected speech data, High-lax being 0.4 semitone higher than High-tense. This is consistent with some observations for German vowels [13].

At first sight, it seems that IFO intervals are less important in Task 2, High-Low interval being 1.65st compared to 2.06st in Task 1. Such results confirm Ladd & Silverman's [6] findings but they might not be meaningful in our corpus. As a matter of fact, it is important to recall that Task 2 vowels were indifferently under primary or secondary stress conditions, which theoretically should explain a reduction of the High-Low interval.

Detailed IFO calculations for Task 2 are shown in Table 1. High-tense and High-lax classes were grouped into High class. There is evidence for the IFO effects to exist for the four subjects. It seems that female subjects, F1 and F4, are characterized by more important IFO intervals. However, this has to be validated since an inverse tendency, even not significant, was noted by Whalen & Levitt [14].

Table 1. Interval values (in semitones) calculated between the stressed vowel and the preceding unstressed one in Task 2

Class	Interval				Mean
Speaker	*F1*	*M2*	*M3*	*F4*	
High	3.3	4.5	3	2.4	3.3
Mid	2.2	3.4	2.3	1.7	2.4
Nasal	1.5	3.3	2.1	0.9	2
Low	1.7	3	1.8	0.8	1.8
H-L Interval	1.8	1.5	1.2	1.6	1.5

Quebec French vs Di Cristo's French values

As far as we know, there are only two studies on French vowel IFO [2] [14]. As we said earlier, we designed Task 1 expressly to allow the comparison with Di Cristo's findings. Figure 2 illustrates results for both dialects. Two facts are of evidence. On the one hand, the Quebec French High-Low mean interval is twice as important in comparable phonetic contexts, that is in Task 1 and Di Cristo's corpus. On the other hand, more important is the relative position of Nasal vowels which have similar IFO values than High vowels in France French. On the contrary,

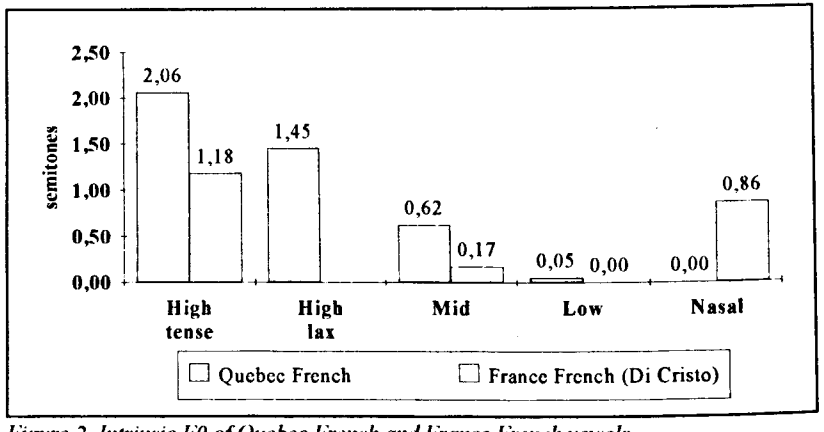

Figure 2. Intrinsic F0 of Quebec French and France French vowels

Nasal stand on Low vowel level in both Quebec French tasks. Di Cristo failed to find an appropriate explanation for the Nasal vowel particular position in his IFO scale; notwithstanding its flaws, the tongue pull theory accounts for Quebec French Nasal vowel classification.

DISCUSSION

For Task 1, standard deviations were calculated at 5% of measured F0 values. This is not the case in the connected speech corpus, for which s.d. go up to 75% of F0 measurements. Such an important variation was observed by Ladd & Silverman [6] in a connected speech corpus. If we also consider the IF0 intervals for each subject in Table 1, it must be admitted that IF0 calculation is characterized by an important variability, increasing with the formal style of the corpora. Such a variability exists between subjects, from a register to the other, from a dialect to the other, and so on. How could it be possible, in these conditions, to propose IF0 correction factors for intonation description purposes?

In future works, we will refine our IFO measurement procedure for connected speech data. In order to do so, we will look for a more satisfactory description of our reference line inspired by Ladd's proposal [10] of a model "whose reference values lie between the valleys and the peaks - which is where both Liberman and Pierrehumbert's reference line and the 'zero line' in the middle of Ladd's 'tonal space' are located". The last part of our research will be an application of this revised procedure to more informal corpora.

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