Rhythmic convergence in Canadian French varieties?

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Abstract

Studies of prosodic rhythm in a minority Ontario French using rhythm metrics did not demonstrate the effect of contact with English; moreover, they demonstrated an even more syllable-timed (French) pattern in this contact variety than in majority Canadian and European ones. To understand these results and further explore regional variation in Canadian French and the effect of linguistic contact, syllabic typology, length and duration of the stress group, syllable duration ratios, and vowel intensity are explored here through a comparison of a minority variety with a majority Canadian French (Quebec). Spontaneous samples show the same syllabic typology and distribution, stress group length and duration, similar syllable ratios, and a regular rhythmic pattern in both Canadian varieties. The analysis of intensity of stressed syllables, however, suggested divergence of the datasets from both traditional description of French and from each other. Thus, intensity accompanies primary stress in Ontario but not in Quebec, and both varieties use intensity to mark secondary stress. These results suggest a convergence to the neighboring English language and need to be confirmed in a controlled setting.

Index Terms: rhythm, stress, French in contact, Canadian French, acoustic cues

1. Introduction

French spoken in a minority setting in Ontario demonstrates effects of an intense contact with English in all aspects of sound production [1]-[3] and in intonation [5]-[7]. Prosodic rhythm, however, does not appear to show such an effect, as a very French-like rhythmicity has been observed in Canadian French varieties [8]. Furthermore, data from French spoken in minority settings demonstrated an even more regular syllabic pattern than majority Canadian and European varieties [9], [10]. However, traditionally, Ontario rhythm has been described as irregular [11], with the stress group penultimate syllable appearing more salient than the final one [12]. These descriptions suggest a divergence from regular rhythmicity and are not coherent with the rhythm metrics results. How to understand such rhythmic (in)variance in Canadian French in general, and in varieties in intense contact in particular? How does Ontario French in a minority setting compare to the historically and genetically related majority dialect spoken in Quebec? More specifically, what are the durational proportions of syllables in a stress group and how do they help us interpret rhythm metrics results? How does syllable structure contribute to this? Are stressed syllables equally marked by duration in both Canadian varieties, and is intensity more present in a minority setting because of the contact with English where stress is manifested by an increase of intensity [13]?

In a preliminary study [14], these questions were explored through a comparison to some earlier results from [11]. Thus, a noticeable shortening of the stress group final syllable was observed in Canadian French varieties in comparison with Standard European French earlier data. Also, differences in vowel intensity across a stress group was observed between two Canadian datasets. Here, I am extending the analysis to include more speakers, looking to confirm the preliminary observations, and exploring the hypothesis of rhythmic convergence in a situation of intense contact in a minority setting.

This is a study of a natural (not laboratory) speech production and has both its benefits and limitations. While it does not allow to control for data composition and quality, which has its effects on sample sizes, it provides us with valuable details on regional varieties of French, especially the minority ones spoken in an intense contact with a typologically different language.

2. Methodology

To answer the research questions and explore the specified aspects of rhythm, spontaneous interviews of 18 speakers (nine from Ontario, and nine from Quebec) were submitted to the analysis. Both datasets come from the database of the PFC project [15]. The Ontario data were collected in the region of the city of Windsor (WIN) [16], a predominantly English-speaking environment where French-speaking population does not reach 3%. The Quebec data (QUE) were recorded in Sainte-Foy, a predominantly French-speaking setting (over 80% of Francophones). The participants were selected to achieve as much balance between the datasets as possible. In the WIN dataset, there are four female and five male speakers, and in the QUE dataset, there are three male and six female participants. The participants' age and varies between 17 and 74 years, and their social characteristics vary. However, this study has the scope of regional variation only. The following phonetic and phonological aspects of rhythm are examined: syllabic typology, length and duration of the accentual phrase, syllable duration ratios within it, and vowel intensity. Length and duration of stress groups in both varieties will help us judge if there is a difference in the size of the stress group, and, therefore, in the frequency of primary stress, which also affects rhythmic pattern.

Recordings were analyzed in Praat [17], with semi-automatic segmentation and syllabification using *EasyAlign* [18], followed by manual corrections based on visual and audio verification that took into consideration sound deletion, liaison and *enchaînement*. The syllable typology was established based on the structures of the phonetic syllables observed; [s] in a group-internal consonant cluster was syllabified in the coda of the preceding syllable; French language syllable structure preferences were favored over the sonority hierarchy: e.g. [ap-

sã] rather than [a-psã]. The frequency of various syllable structures was determined following their occurrences. Based on the number of syllables uttered and the duration of the signal, rate of articulation was calculated (syll/sec). To identify stress groups, perceived stress, visible pitch and morpho-syntactic composition of the content were taken into consideration following [19] among others (this was done by a trained professional and randomly tested by another one for a different previous study). Then, for each group, its duration (sec.) and length (syll.) were recorded.

For the analysis of duration ratios, I focused only on groups of four syllables. Beside being among the most frequent, they appear a 'by default' stress group in French because they allow for a full realization of the underlying tonal pattern [19]. For duration ratios, proportional durations of the syllables were calculated with respect to the stressed syllable, which emphasized differences between the unstressed syllables, and the unstressed and stressed ones at the same time.

To analyze intensity, z-score normalization was applied to the dB values of a subset of four-syllabic stress groups, controlled for the shape of $F0$ contour, and for the presence and place of the secondary stress. For each group, intensity values were extracted, and the difference between each value and the group average was divided by the standard deviation: *(N-Ave)/STD*. Only vocalic z-scores were retained for average calculations, while consonants were excluded due to variability of segmental content of the groups. Z-score normalization allows to offset individual and sound quality differences that are unavoidable in a spontaneous setting.

Differences between two datasets relative to speakers' averages of group length, group duration, and articulation rate were evaluated with One-Way ANOVA tests. To evaluate differences between intensity z-scores, Mixed Effects models were used, with *dialect* and *number of stresses* as fixed factors, *speaker* as random factor, and z-score values for each of four syllables as dependent variables. The follow up Standard Regression tests applied only to the stressed syllables evaluated the strength of the contribution of the fixed factors and the power of the models. Preliminary analyses confirmed no violation of the assumptions allowing to conduct all the tests. Finally, bootstrapping applied to make up for the sample size yield the same results, so, only the original results are reported.

3. Results

3.1. General rhythmic characteristics and syllable typology

The quantity of the material used for the analysis varied among speakers depending on their participation in the conversation and the quality of the signal. After excluding from the analysis silent and filled pauses, overlaps, false departs, truncations, hesitations, English words, etc., the duration of the pure sound material analyzed constituted 762 seconds in the WIN dataset, and 774 seconds in the QUE one. However, Quebec participants uttered faster (5.52 syll/sec) and produced more stress groups (1371) and syllables (4310) than Ontario participants (5.19 syll/sec, 1020 stress groups and 3220 syllables) (Table 1).

The faster rate in QUE ($F(1, 17) = 8.373$, $p = 0.011$) goes together with shorter stress groups (3.12 syll, or 0.57 sec) than in WIN (3.19 syll, or 0.61 sec). The longer duration of the stress groups in WIN was confirmed statistically ($F(1, 17) = 10.715$, $p = 0.005$), but not their length: 3.19 v. 3.12 in QUE ($F(1, 17) = 0.734$, $p = 0.404$). Similar number of syllables per stress group

suggests that the frequency of the occurrence of primary stresses is the same in both varieties.

Table 1: *General characteristics of the samples.*

		WIN	QUE
Total	Duration	762	774
	Nb of stress groups	1020	1371
	Nb of syllables	3220	4310
Average	Group length (syll)	3.19	3.12
	Group duration (sec)	0.61*	0.57*
	Articulation rate	5.19*	5.52*

Another similarity between the datasets concerns the observed syllable structures and their distribution (Table 2), thus providing the same phonological basis for rhythm. The same three types of syllables (CV, CVC, and CC(C)V) make up to 85-88% of all syllables. What is interesting to note is that the CV syllable, while being the most frequent (almost 58% in WIN and 59% in QUE), does not reach 74%-80% of all occurrences, as proposed by [20] for spontaneous Standard European French. The other two most frequent syllables structure (CVC and CC(C)V) constitute all together 27% (WIN) and 28% (QUE) of syllables total. This relatively high proportion of more complex syllables could be the reason of longer proportions of the unstressed syllables in our datasets in comparison [11], but this question cannot be further explored.

Table 2: *Syllable typology and distribution.*

Syllable structure	WIN		QUE	
	#	%	#	%
CV	1853	57.55	2522	58.52
CVC	551	17.11	620	14.39
CC(C)V	334	10.37	568	13.18
V	316	9.81	360	8.35
CC(C)VC	82	2.55	148	3.43
VC	38	1.18	52	1.21
CVCC(C)	46	1.43	37	0.86
CC(C)VCC(C)	3	0.09	2	0.05
VC(C)	2	0.06	1	0.02
Total	3220	100	4310	100

3.2. Proportional durations

For the analysis of duration ratios, 170 and 202 four-syllabic stress groups were selected in WIN and QUE datasets respectively. Proportional durations (%) of the unstressed syllables with respect to the final syllable were calculated. In Fig. 1, we do not observe an irregular pattern in WIN or a lengthening of the penultimate syllable in QUE, as previously reported [11] and [12]. Instead, we find in both datasets regular slightly rising patterns across unstressed syllables, but with higher proportions of unstressed syllables (cf. with [11]). Based on speakers' averages, there is no significant differences between the two datasets for the three unstressed syllables (initial, second and the penultimate ones): $F(1, 17) \leq 1.614$, $p \geq 0.222$ (Levene's tests: $p \geq 0.294$).
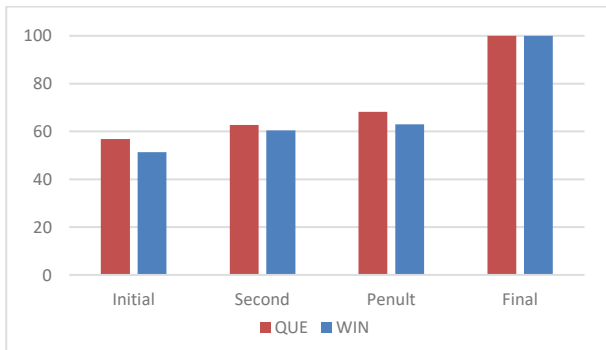
Figure 1: *Ratios of the unstressed syllables relative the stressed (final) one.*

Figure 2: *Normalized vowel intensity across 4-syllabic stress group in WIN and QUE.*

So far, only similarities between QUE and WIN were observed, and it stands out that the final lengthening still marks primary stress in both the majority and the minority variety. In a situation of an intense contact with English, the influence of the dominant language can be happening at the level of other acoustic cues beside duration. In French, primary stress is marked by a group final lengthening, with $F0$ playing an important role as well [21]. In North American English, stress is marked by an increase of intensity and a change of $F0$ [22]. Since $F0$ is the common cue in both contacting languages and because of the importance of intensity in French in contact demonstrated before [23], only intensity is explored here. If WIN dataset shows a higher use of intensity for final stress marking, this would suggest a possible convergence with the dominant language.

3.3. Vowel intensity

For this part of the analysis, further data sorting was applied to neutralize the effect of $F0$ contour, presence or absence of a secondary stress, and its place in the stress group. The identification of the secondary stress followed visual ($F0$) prompts as well as auditory, following [19] and [21], among others. Only non-final groups with a rising contour were considered. Intonation in all groups with one final stress was flat-rising, and in the groups with two stresses, rising-falling-rising. Also, in the groups having a secondary stress, it was realized on the second syllable. I also kept the data maximally balanced across the speakers and retained from each of them similar number of stress groups with one stress and with two stresses. After imposing the above-mentioned constraints on the spontaneous datasets, I analyzed 48 groups from the WIN corpus, and on 46 groups in the QUE dataset. Due to the sample size, the results presented below are preliminary and are to be confirmed in an experimental study.

First, in Fig. 2, appear average values of the normalized vowel intensities for all analyzed four-syllabic groups in each dataset. In QUE, we observe an overall falling pattern, and in WIN, a rising zig-zag pattern. The final syllable bearing the primary stress has a significantly higher intensity in WIN than in QUE (Mixed effects models: $F(1, 15) = 5.556$, $p = 0.032$). Differences between the three preceding syllables were not confirmed (Mixed effects models: $F(1, 90) \leq 2.935$, $p \geq 0.1$).
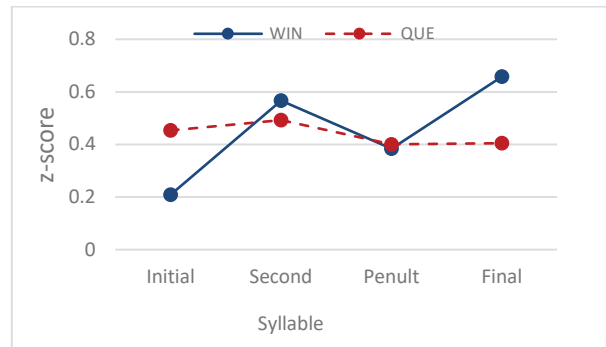
The higher intensity observed on the second syllable in Fig. 2 makes one think about the secondary stress marking. So, to explore the effect of the presence of the group initial rhythmic stress, data were separated accordingly. In WIN corpus, there were 27 groups with one stress and 21 groups with two stresses; in QUE dataset, there were 27 and 19 groups, respectively. The results appear in Figs 3, 4.
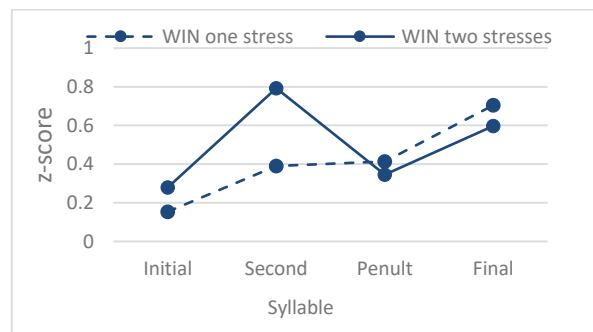

Figure 3: *Normalized vowel intensity in WIN dataset in stress groups with one and with two stresses.*

The intensity pattern observed in WIN (Fig. 2) is indeed a blend of the patterns for groups with one and with two stresses. As we see in Fig 3, the intensity rises on the final syllable (from about 0.2 to about 0.6) regardless of the presence of the initial stress, which is even more intensity-marked than the final syllable (0.8 v. 0.6 respectively). In QUE (Fig 4), the intensity stays about the same throughout the group, varying between 0.3 and 0.4 if there is only one stress; and it goes down from 0.5 to 0.3 if there is an initial stress, which is also intensity-marked (0.6).
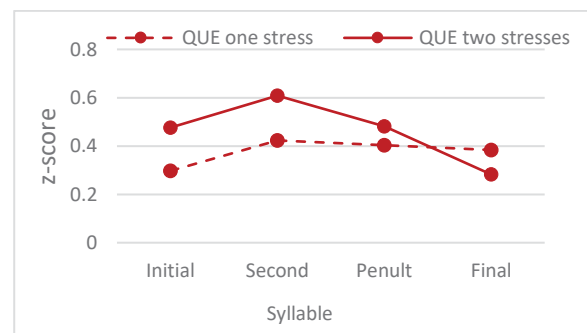

Figure 4: *Normalized vowel intensity in QUE dataset in stress groups with one and with two stresses.*

The presence of the secondary stress has a significant impact on the intensity values in both datasets: $F(1, 90) = 6.233$, $p = 0.014$, since no interaction between *number of syllables* and *dialect* came out in Mixed Effects models.

Standard Regression models evaluated the power of the observations for the syllables bearing primary and secondary stresses. The models confirmed that dialect makes the strongest unique contribution to the primary stress z-score values ($F(2, 93) = 4.215$, $p = 0.018$), and the number of stresses, to the secondary stress ones ($F(2, 93) = 3.405$, $p = 0.038$). The Adjusted R^2 values being low (0.065 and 0.05 respectively), we must take these significant results with a degree of caution.

4. Discussion

Discrepancies between earlier descriptions of Canadian French varieties and the results of the recent rhythmic analyses motivated this study that aimed exploring syllabic typology and distribution, duration and length of stress groups, syllable duration ratios, and vocalic intensity by comparing a contact minority variety to Quebec data. The results revealed series of similarities and differences between the samples. Some of the differences oppose the two varieties to the Standard European French, and some, to each other. Despite a slower articulation rate and longer stress groups in WIN, the number of syllables in the stress groups is the same, which contributes to the same frequency of primary stresses in both WIN and QUE datasets. Together with the same types of syllable structures and their distribution, this gives the same phonological basis for rhythm. Averages of the duration ratios did not demonstrate an irregular pattern or penultimate lengthening, contrary to previous descriptions of Ontario and Quebec varieties. However, an examination of individual patterns may reveal a richer picture.

So, final lengthening is an important marker of the primary stress in our samples. The examination of intensity revealed, however, differences between WIN and QUE. Normalized intensity values show that in WIN corpus, the vowel of the syllable bearing primary stress is realized with significantly more energy than in QUE, which suggests a difference in the nature of primary stress in a minority setting. Also, the intensity patterns in a stress group in WIN mirror the *F0* patterns for stress groups with one and two prominences (flat-rising and rising-descending-rising [19]), the increase of both dB and *F0* values over the syllable/vowel bearing the initial stress suggests that both intensity and pitch are acoustic cues of secondary stress, thus, somewhat contradicting its traditional description as purely melodic ([19] and [21], among others). Their rise over the final syllable, along with its lengthening, suggests that they are also important for the primary stress marking and that the variety in contact appears converging to English with respect to the stress nature. The relative contribution of each correlate to stress-marking remains to be studied.

In the QUE dataset, intensity distribution across the stress group suggests that this parameter does not play a role in the final stress marking but participates in the marking of the initial prominence, as in WIN. QUE results are coherent with the traditional description of French, where acoustic correlates of primary stress are duration and *F0*, however, they also align with the WIN dataset in the realization of the secondary stress. Again, an analysis focusing on relative contribution of various acoustic correlates in stress marking will shed light onto this. Also, a comparison with more recent European French data and with English language productions is necessary for a better understanding of the variation observed. Interaction between durational and loudness variability would also be very interesting to explore [24].

5. Conclusions

The results show series of similarities between WIN and QUE datasets that contextualize previous findings on their prosodic rhythm: identical syllabic typology and distribution of syllabic structures, and similar but higher ratios of syllabic durations. The difference that was identified between the minority variety and the majority one pertains to vowel intensity. It appears an important acoustic correlate of both primary and secondary stress in a minority variety. Results for the Quebec dataset, on the one hand, follow the traditional description of European French where acoustic correlates of the primary stress are duration and melody. On the other hand, they align with the WIN data in showing intensity marking the initial prominence. Our observations suggest a convergence with the neighboring English language in stress marking in both samples.

There are limitations to our investigation because of the spontaneous nature of the data that affected the sample size. Nevertheless, this analysis adds to the description of the rhythmic (in)variance in Canadian French varieties and allows to better understand its origins.

6. Acknowledgements

7. References

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