Speech Prosody 2016
31 May - 3 Jun 2106, Boston, USA

# Interplay of sociolinguistic factors in rhythmic variation in a minority French dialect

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## Abstract

A contact setting often limits speakers' possibilities to practice the minority language in an array of contexts and thus affects its stylistic and sociolinguistic variation. This paper examines rhythmic variation in read and spontaneous speech samples from speakers of minority Ontario French (Canada). Rate, nPVI-V, VarcoV, %V and the CC model are used to examine the extent of sociolinguistic variation in the dataset and test the hypotheses of convergence to English and of sociolinguistic discontinuity. Age, gender and speaking style each appear to be significant factors, without showing interaction. Females and older speakers showed a more syllable-timed pattern than males and younger participants. In spontaneous speech, all speakers had a less syllable-timed rhythmicity, despite a faster rate. Overall, speakers did not converge to English.

**Index Terms**: rhythm, metrics, French in a minority setting, social and stylistic variation

## 1. Introduction

Sociolinguistic variation in a language spoken in a situation of intense contact with a dominant language often becomes reduced due to limited possibilities for the minority language to be employed. This may lead to the same forms being used, i.e. decreased variation across an array of contexts and by various populations, or to a situation where spontaneous interactions will be marked by a transfer from the dominant language. For example, [1] observed that fluent, or unrestricted, native speakers of French use vernacular forms and pronunciation, whereas more restricted speakers adhere to standard forms maintained at school. As a consequence, syntactic, lexical and prosodic structures are regularly transferred from English into French in this group [2, 3, 4]. In Ontario, linguistic restriction is often correlated with age [5] because younger generations, being more socially and geographically mobile, are more in contact with Anglophone speakers, media, and culture. Also, women, being on the one hand leaders of sociolinguistic changes [6], and on the other, tending towards a supralocal norm [7], may either join younger generation, or adhere to more standard variants.

This study focuses on prosodic rhythm in French spoken in Ontario through examining the extent of sociolinguistic variation in a minority setting. The question addressed here is: will we observe variation where groups of speakers, depending on the type of production (spontaneous speech or reading task), converge to an English stress-timed pattern, or will variation observed be within the range of a syllable-timed French? Older participants, are expected to demonstrate French timing. Younger participants, however, are predicted to show a less syllable-timed pattern overall, and even more so in spontaneous speech. Women are expected to show a very syllable-timed pattern in the reading task, and to stay within the range of French rhythmicity in a less controlled interaction. As for men, they will probably converge to English: the younger generation because of the reasons specified above, and the older one, because of a greater contact with the dominant language at work (vs. women of the older generation staying at home, and thus having less interaction with English speaking environments).

This is the first analysis of this kind conducted on Canadian French data in general, and on a minority French spoken in an intense contact with English in particular. Using popular methods of rhythmic analysis (nPVI-V, VarcoV, %V, and the CC model), this work allows us to compare current results with studies of other languages and dialects, and thus contributes to the general discussion about the performance of rhythm metrics.

## 2. Rhythm metrics

French is described as a syllable-timed language [8, 9], or, in terms of [10], as a "controlling" language, where all elements in a syllable receive similar articulatory efforts. Such languages (cf. Spanish) show no vocalic reduction and prefer CV type syllables. Stress-timed, or "compensating" languages, such as English, demonstrate a more diverse syllabic typology accompanied by variably distributed articulatory efforts across syllables; these lead to co-articulations, overlaps and reductions. Such phonological properties of languages impact the relationships between vocalic and consonantal intervals. The variability of the intervals has thus been traditionally measured to assess the rhythmic pattern of a speech sample as leaning toward the stress-timed or the syllable-timed end of the rhythmic continuum. Preferred syllable structure and relative durational equality of the intervals in syllable-timed languages lead to a higher proportion of vocalic intervals (%V [11]) but to lower values of raw or rate-normalized standard deviations ($\Delta$V, $\Delta$C [11], VarcoV [12], VarcoC [13]) or other metrics, such as nPVI-V [14], in comparison with stress-timed languages. Studies of first and second languages, of various dialects and of languages in contact have applied rhythm metrics to test their discriminatory power. While duration-based metrics remain most exploited, other correlates of prominence and their combinations become utilized ([15, 16, 17], among others).

Some analyses demonstrated unstable or contradictory results, and the metrics have been criticized for their dependence on the phonotactic composition of the material uttered, as well as for not being able to reflect the origins of the variation observed (see [18, 19] among others). Moreover, rate has proven to be an important contributor to social and dialectal variation ([20, 21, 22, 23]), whereas the best performing metrics neutralize its effect. The CC ("Control/Compensation") model claims to solve these issues by offering a method that takes into

 doi: 10.21437/SpeechProsody.2016-245

consideration both vocalic and consonantal intervals, and integrates rate [10]. This continuous model also has a predictive power that helps the interpretation of the results by plotting them on a chart separating compensating and controlling patterns.

### 2.1. Rhythm metrics applied to French

The rhythm of different varieties of French has been regularly examined with the help of rhythm metrics. Among studies that showed no significant differences in rhythmic patterns between groups are:

- [16]: with nPVI-V based on a combination of syllable durations and F0, studied Standard and Swiss French, among other languages/varieties;
- [24]: applied ΔC, ΔV, and %V to study speech samples from monolingual Francophones and French-Arabic bilinguals;
- [25]: compared the speech of Ontario Francophones in both minority and majority settings, and with L2 speakers, using nPVI-V.

Among studies that revealed significant differences between groups are:

- [21]: examined varieties of European French to show that ΔC and rate best capture regional variation;
- [22]: used rate in combination with PVIs calculated from stress-group durations in order to discriminate between datasets representing varieties of European and African French, including varieties in contact;
- [26]: applied rate and an array of metrics to spontaneous samples from Ontario French speakers in a minority setting and from Quebec French speakers, concluding that only rate successfully discriminated between the dialects;
- [27]: found differences between age and gender groups in minority and majority settings in Ontario, but not between the settings.

All these studies focused on differences between languages, dialects, and sometimes styles [28], but rarely between social groups. Rate, however, was examined from different sociolinguistic perspectives in a recent study by [29]. Here, the authors found that regional varieties showed slower tempo than standard varieties of French [see also 21, 22]. They also observed that rate decreased with increased age, even more so in a reading style, and that age had a different effect on men and women across dialects.

To examine variation in the speech of Franco-Ontarians in a minority setting, I use the CC model, because it relies on non-rate-normalized intervals from both consonants and vowels. This allows us to consider three types of measurements together. However, for the purposes of the comparability of the results with other studies, I will also calculate the best performing rhythm metrics (VarcoV, nPVI-V and %V) and articulation rate.

## 3. Data and methods

### 3.1. Subjects and material

The analysis is based on recordings from 12 native speakers of French residing in the Windsor area (six males and six females; six above age 45 and six below) who read a text and participated in a spontaneous conversation with a family member (Windsor corpus, database of the project *Phonologie du français contemporain* [30], see the *PFC* protocol for details). Spontaneous samples that were analyzed vary in duration to satisfy the methodological constraint of getting at least 200 nPVI-V quotients from each speaker [31]. As for the read samples, only the first half of the recorded text was used, because it provided the necessary minimum of intervals, and had a better quality of production (e.g., no fatigue effects).

### 3.2. Analyses

The recordings were first semi-automatically segmented in Praat [32] using EasyAlign [33], then manually verified and corrected. Vocalic and consonantal intervals were identified and coded. Glottal stops, glides, occasional aspiration of voiceless stops, and voiceless vowels were considered non-vocalic elements. All phonetic variants of /R/ were considered consonantal, and assibilated dental stops ([ts] and [dz] resulting from /t/ and /d/ occurring before high front vowels and glides) were treated as one segment.

The metrics underlying the analysis were calculated as follows:

- Rate of articulation (syll/sec): number of syllables divided by their total duration
- CC indices were obtained from both vocalic and consonantal intervals following the formula in (2) and using Correlatore software [34]. First, the formula divides the duration of each interval by the number of segments that compose it. Then, the absolute value of the difference between the values for two adjacent intervals is found. The average of all measurements is multiplied by 100:

$$\sum_{n=1}^{m-1} \left[ \left| \frac{d_n}{N_n} - \frac{d_{n+1}}{N_{n+1}} \right| / (m-1) \right] \times 100 \quad (2)$$

- nPVI-V: first, the absolute value of the durational difference between two consecutive vocalic intervals is divided by the average duration of these intervals; then the average of all measurements is multiplied by 100:

$$\sum_{n=1}^{m-1} \left[ \left| \frac{d_n - d_{n+1}}{(d_n + d_{n+1})/2} \right| / (m-1) \right] \times 100 \quad (1)$$

where *d* is the duration of the $n_{th}$ vocalic interval and *m* is the number of intervals in a between-pause sequence. Median values were calculated for spontaneous speech [31].

- VarcoV: standard deviation of vocalic intervals divided by their average duration and multiplied by 100
- %V: proportion of vocalic intervals

To evaluate statistical significance of the differences observed between styles, I applied 2x2x2 ANOVAs to test the effect of style (spontaneous vs. text reading), age (older vs. younger), and gender (males vs. females). The values within all but rate measurements were normally distributed. Rate in reading style had a substantial positive skewness, while spontaneous data had a moderate negative skewness. Such a distribution problem needed to be remedied before ANOVA tests could be applied. Rate for text readings was log10 transformed, while values for spontaneous production were modified using the sqrt(1+$Rate^{max}$-Rate) formula, following [35]. Finally, in ANOVAs run for CCIs, the original values of articulation rate were included as covariates, since these indices are not rate-normalized.

# 4. Results

The ANOVA tests revealed no interactions between the main effects. Tables 1 through 3 present the results for all calculated variables sorted by main effects of age, gender, and style for all speakers. Note that the average rate values are reported in actual (syll/sec) values, but the ANOVA results are based on the transformed ones. Shading of the values corresponds to significant differences, while shading of the metric in the first column, to the metric with the greatest power.

## 4.1. Effect of age

Looking at age groups, one notices that younger participants articulated faster (4.9 syll/sec) than the over 45 speakers (4.4 syll/sec). This difference was not significant, however ($F(1, 16) = .153$; $p = .7$). The faster rate of the younger group translated into smaller CCIV intervals when compared to the over 45 group (55.7 vs. 61.8), but not the CCICs (36.3 vs. 34.6). This suggests a possible different treatment of consonantal clusters by the age groups, which needs to be explored further.

Table 1. *Average values by age.*

| Metric | Over 45 | | Under 45 | |
|---|---|---|---|---|
| | Average | STD | Average | STD |
| Rate | 4.4 | .5 | 4.9 | .5 |
| CCIV | 61.8 | 11.9 | 55.7 | 8.8 |
| CCIC | 34.6 | 4.1 | 36.3 | 5.8 |
| Med nPVI-V | 40.1 | 4.1 | 41.5 | 4.6 |
| VarcoV | 44.9 | 4.2 | 51.8 | 4.5 |
| %V | 54.2 | 2.0 | 51.9 | 2.9 |

On the other hand, rate normalized nPVI-V and VarcoV values were greater in the under 45 group (41.5 and 51.8) than in the over 45 group (40.1 and 44.9), thus suggesting a less syllable-timed pattern for the former. This is also confirmed by a lesser %V value in the younger speakers (51.9) than in the other age group (54.2). Differences between age groups for VarcoV, %V and CCIC values were significant ($F(1, 16) \geq 6.094$, $p \leq .026$), which confirms the tendency of the younger group to have a less syllable-timed pattern.

## 4.2. Effect of gender

Comparing males and females in Table 2, we note a faster rate in the second group (4.8 syll/sec) than in the first one (4.6 syll/sec), but this was not a significant difference. This translates into lesser values of all but %V and CCIC measurements in females. The significance of the difference between genders was confirmed for nPVI-V and CCIV values ($F(1, 16) \geq 6.450$, $p \leq .023$).

Table 2. *Average values by gender.*

| Metric | Males | | Females | |
|---|---|---|---|---|
| | Average | STD | Average | STD |
| Rate | 4.6 | .7 | 4.8 | .4 |
| CCIV | 64.0 | 11.1 | 53.5 | 7.4 |
| CCIC | 35.3 | 5.9 | 35.5 | 4.1 |
| Med nPVI-V | 43.6 | 3.1 | 38.0 | 3.5 |
| VarcoV | 49.3 | 5.5 | 47.4 | 5.5 |
| %V | 53.9 | 2.4 | 52.2 | 2.9 |

These results suggest a trend towards a more syllable-timed rhythm in women. The opposite appears suggested by %V values, but the difference between male and female values is very small (53.9 vs. 52.2), and only marginally significant ($F(1, 16) = 4.667$, $p = .046$).

## 4.3. Effect of style

Curiously, a faster rate in spontaneous speech (5 syll/sec vs. 4.4 syll/sec in the reading task) comes along with greater values of all metrics in this style, in comparison with text readings. This suggests a trend away from syllable-timed rhythmicity in a less controlled type of production, as we had hypothesized. However, %V seems to contradict this because of its greater value in spontaneous speech.

Style was a significant factor for rate, nPVI-V, %V, and CCIC ($F(1, 16) \geq 6.689$, $p \leq .02$).

Table 3. *Average values by style.*

| Metric | Spontaneous | | Text readings | |
|---|---|---|---|---|
| | Average | STD | Average | STD |
| Rate | 5.0 | .4 | 4.4 | .6 |
| CCIV | 60.2 | 12.9 | 57.4 | 8.2 |
| CCIC | 37.3 | 4.8 | 33.6 | 4.5 |
| Med nPVI-V | 42.3 | 4.5 | 39.3 | 3.8 |
| VarcoV | 49.4 | 6.9 | 47.4 | 3.6 |
| %V | 54.4 | 2.0 | 51.8 | 2.9 |

Considering CCIV and CCIC values taken together, we notice that between both these indices, all main effects were significant. This suggests that this model may be the right tool to account for the trends between speakers of both genders, different age groups, and participating in two stylistically different productions.

## 4.4. The CC model

Figures 1-3 visualize the CCIs according to each of the main effects, starting with age in Figure 1.

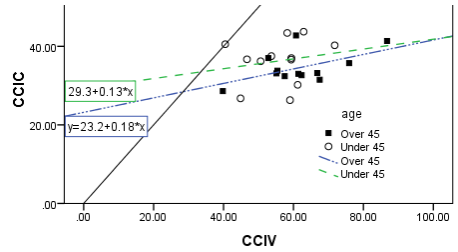


Figure 1: *CC model results: age groups emphasized.*

Here, values for both age groups overlap considerably, and the trend of the over 45 group to have lower CCIC values is not obvious.

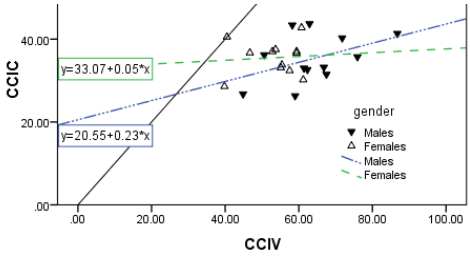


Figure 2: *CC model results: gender groups emphasized.*

Similarly, in Figures 2 and 3, overlaps between groups do not allow us to clearly distinguish between genders and styles. So, even though each of the indices – CCIV and CCIC – were found to be significantly affected by main effects, the CC model still does not capture the variation observed.

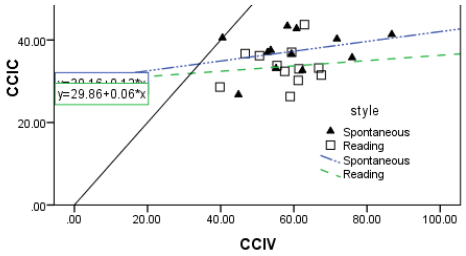


Figure 3: *CC model results: style emphasized.*

To find a way to account for the differences caused by the factors of age, gender and style, the power of ANOVA tests was considered for each effect and for each metric. Figures 4-6 show pairs of metrics that discriminate best between the groups.

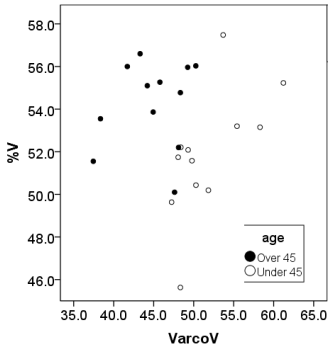


Figure 4: *Metrics discriminating between age groups.*

Metrics that appeared sensitive to age were VarcoV (pwr .970) and %V (pwr .803) (Figure 4).

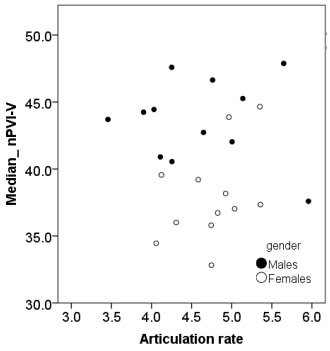


Figure 5: *Metrics discriminating between genders*.

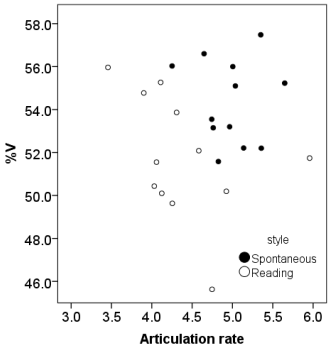


Figure 6: *Metrics discriminating between styles.*

Metrics discriminating between genders are nPVI-V (pwr .996) and CCIV (pwr .661), but to avoid circularity – both are closely related (see (1) and (2)) – rate was used instead of CCIV (Figure 5). Rate (pwr 1.0) and CCIC (pwr .935) contributed to the distinction between styles. However, since rate is already incorporated into the CC model, it is the next significant metric that is used in Figure 6 - %V (pwr .868).

## 5. Conclusions and Discussion

This paper examined the extent of rhythmic variation in the French spoken in a minority setting in Ontario (Canada). Overall, nPVI-V, %V, and VarcoV suggested a typically French rhythmicity in our data (cf. with previously reported results for French and English, Table 4):

Table 4. *Windsor and previous findings compared.*

| French; data from [11,12,14,21,24,34,36] | | English; data from [11,12,14,34,36,37,38] | | Windsor | |
|---|---|---|---|---|---|
| | | | | spont | read |
| nPVI-V | 43.5-50 | nPVI-V | 55-73 | 42.3 | 39.3 |
| %V | 43.6-51 | %V | 38-42.2 | 54.4 | 51.8 |
| VarcoV | 45.5-50 | VarcoV | 53-64 | 49.4 | 47.4 |
| CCIV | 41 | CCIV | 42 | 57.4 | 60.2 |
| CCIC | 39 | CCIC | 36 | 33.6 | 37.3 |

CCIs, on the other hand, pattern the data as tending away from syllable-timed rhythm, because both CCIC, and especially CCIV, values in Windsor are considerably greater than in previous studies on French and English (Table 4). This difference may be due to a slow rate in our corpus; however, the difference between vocalic and consonantal intervals is also greater than in previous studies, suggesting thus a convergence to English. To further explore this, a comparison with the same participants speaking English will be needed.

Age, gender, and style were identified as significant factors. The comparison of the results between factor groups shows that according to nPVI-V, %V, and CCIV, women have a more syllable-timed pattern than men; older participants, compared to the younger ones, also showed a more syllable-timed pattern, according to VarcoV, %V, and CCIC. These observations support our initial hypotheses. Also, traditional metrics suggested no convergence to English across both age groups and both genders, or in spontaneous speech.

As in [21, 22, 29], rate decreased with age. However, it was not possible to make judgments about the behavior of different age and gender groups across styles because of the absence of an interaction between main effects. As for style, a faster articulated spontaneous speech, contrary to expectations, showed a less syllable-timed pattern, judging by nPVI-V, VarcoV, and CCIs. %V, however, suggested the opposite.

Another contradiction: a greater %V in males goes against the tendency suggested by nPVI-V, VarcoV and CCIV values to a less syllable-timed pattern. The greater proportion of vocalic intervals in spontaneous speech, and for males, may be due to an incomplete mastery of the rules of schwa omission and liaison; this was confirmed for the younger speakers of the same dataset by [39]. Finally, traditional metrics and rate allowed for a better discrimination between the three factors considered here. For each factor a different combination of measurements was used, suggesting that different groups and styles have different and independent specifics.

## 6. Acknowledgements

This study was supported by the Social Sciences and Humanities Research Council of Canada and the University of Waterloo.

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