IT DOESN'T SOUND FRENCH, OR DOES IT?

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Language learners often struggle with L2 prosody, including aspects such as articulation rate, run length, and speech rhythm. We examined these temporal aspects of prosody in text readings by Canadian Anglophone learners of French. We compared their L1 English and L2 French productions, and their L2 French productions with L1 French data from native speakers. We analyzed learners' pre-test and post-test productions. Learners had slower articulation rates in the L2 but showed native-like rhythm and similar (in pre-tests) or longer (in post-tests) runs compared to L1 French speakers. Our study confirms that prosodic acquisition is multilayered and influenced by other aspects of French sound structure.

INTRODUCTION

L2 prosody is challenging for language learners. Consequently, learners transfer prosodic patterns from their first language and often do not reach native speakers' levels of performance. In this paper, we examine readings by Canadian English learners of L2 French and investigate three temporal characteristics of speech: articulation rate (AR), length of phonetic utterances (i.e., runs), and speech rhythm. Using learners' pre-tests and post-tests taken within a pronunciation course, we explore the importance of L2 learning background (previous core French vs. immersion instruction) in the acquisition of these aspects of French prosody. Our objective is to find out whether the participants make prosodic transfers between their L1 and L2 and how closely they achieve native-like patterns.

Prosodic Aspects Under Investigation and Motivation for our Study

Temporal characteristics of speech production include utterance fluency and speech rhythm. These can be measured objectively and compared between languages and speakers, which allows for assessments of transfers and learning progress.

Utterance fluency measures include speaking and articulation rates, the frequency and duration of filled and silent pauses and of corrections, and the length of stretches of speech between silent pauses, also referred to as Inter-Pausal Units (IPUs) or "runs" (Peltonen, 2024). In this paper, our focus is on IPUs and articulation rate (AR) - the number of syllables per second, excluding pause time.

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According to Préfontaine et al.'s (2016) study of perception of L2 French by native speakers, the average number of syllables in IPUs (or the mean length of run, MLR) and AR are the most important factors in the listeners' judgment of fluency; greater MLR and faster AR are perceived by raters as representing more fluent speech, indicating that participants' speech processes are more automatic. This observation motivated our focus on IPUs and AR in our study of L2 French speech production. Interestingly, both L1 French and L1 English show similar average values for AR but differ significantly in the organization of speech into IPUs, with shorter runs in English than in French (Grosjean & Deschamps, 1975). Based on this, one may expect that learners could achieve a native speaker level with respect to AR, but even advanced Anglophone learners of L2 French would produce shorter IPUs than L1 French speakers.

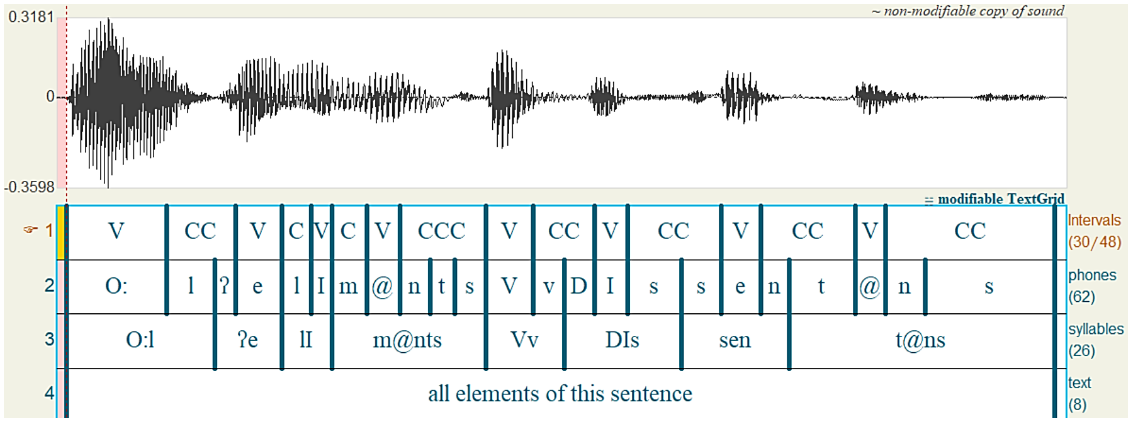
Speech rhythm (or *phonetic rhythm*) refers to the perceived isochrony of speech elements. In French, the elements that have been perceived as having similar durations are the syllables. In English, it is stress intervals. Based on this, French has traditionally been classified as a syllable-timed language and English as a stress-timed one (Abercrombie, 1967; Pike, 1945). Syllable-timed and stress-timed rhythm patterns can be illustrated as in Figure 1.

Figure 1
Representation of syllable-timed (left) and stress-timed (right) languages

Note. Adopted from Avery et al., 1992, p. 73

Over time, this *rhythm-class* approach has evolved towards the view of rhythm as a *continuum* informed by languages' phonological properties, among which syllable structure and vowel reduction are the most important (Dauer, 1983). These properties can be cumulative and affect durations of vocalic (V) and consonantal (C) intervals, contributing to a *more* or *less* syllable- or stress-timed rhythmicity. Figure 2 shows examples of such V and C intervals on the top tier of the annotated waveform.

Figure 2
Annotated waveform with vocalic (V) and consonantal (C) intervals on the top line of the textgrid.



Durational variations of the intervals of the same type can be measured and compared between languages, groups of speakers, etc. These measurements are called rhythm metrics, with those that are most successful at distinguishing languages being %V, VarcoV and Vnpvi (Grabe & Low, 2002; Ramus et al., 1999; White & Mattys, 2007):

- %V: the durational proportion of vocalic intervals relative to consonantal intervals
- VarcoV: standard deviations of the vocalic interval durations normalized for AR (100*ΔV/Ave duration)
- Vnpvi: the average from durational differences between adjacent vocalic intervals divided by their average duration, multiplied by 100.

Rhythm metrics are expressed numerically, which allows languages to be compared on a rhythmic continuum. With French and English tending towards opposite ends of the continuum, one expects that Anglophone learners of French will have difficulty acquiring L2 French rhythmicity and show an English-like pattern in their second language productions.
Next, we provide a context for our study, which shaped our research questions and hypotheses relative speech rhythm, AR and IPU length.

Context and Scope of the Study

Rhythm metrics can be used to detect differences in rhythmic patterns and reveal rhythmic transfers in a new language; they have also been useful in discriminating between learners' proficiency levels (Ordin & Polyanskaya, 2015). Yet only a few studies have used metrics to examine L2 French rhythm. Guilbault (2002) studied Canadian anglophone learners of French in British Columbia and used a series of metrics including %V and found no significant difference between intermediate and advanced learners' rhythm in a recall task, while both groups differed from the native control group. However, in conversation, intermediate participants had a less 'French-like' pattern than advanced learners, who patterned together with native speakers. Using Vnpvi, Tennant (2011) compared phonetic rhythm in text readings by French language learners and in guided interviews by Canadian Francophones residing in Ontario, but did not find any differences between L2 and L1 participants. Drouillet et al. (2024) used a similar metric based on syllable durations and examined Anglophone French learners within a European French prosody course. Two groups of learners were compared: those who received prosodic training and a control group. The study also compared pre- and post-tests based on different tasks. The analysis showed that all participants' speech rhythm improved between pre-tests and post-tests but did not match native speakers' rhythmic measurements. Besides speech rhythm, Drouillet et al. (2024) examined the quantity and duration (in seconds) of IPUs. They found that while the control group remained constant between pre- and post-test, the group that received prosodic training produced shorter IPUs, contrary to expectations. The authors did not, however, examine the articulation rate, nor did they look at the number of syllables in IPUs. So, it was unclear whether the IPU durations shortened because the speed of pronunciation increased, or because the number of syllables in the IPUs decreased.

Some studies of L2 French have looked at the length (in the number of syllables) of IPUs, including Kennedy et al. (2013) and Trofimovich et al. (2017). In both studies, the MLR of the learners did not increase between pre- and post-tests; however, longer MLRs were associated with better fluency and comprehensibility. In another study, based on an online pronunciation course, Inceoglu (2019) observed an improvement in learners' MLRs between pre- and post-tests, but this did not affect listeners' judgments about learners' fluency and comprehensibility. We note that AR was not examined in these studies. Both MLR and AR were examined by Towell et al. (1996) in advanced learners' productions before and after an international exchange and showed significant improvement. MLR, however, contributed more to an increase of fluency (average improvement of 22.67% vs. 8.29% for AR).

Based on this review, there are inconsistent findings related to phonetic rhythm, AR, and IPU length in L2 French. Some studies suggest that prosodic rhythm is hard to improve within a course context, while others show that it is possible for advanced learners to match the performance of native speakers. In addition, MLR either does not improve or shows the greatest improvement, whereas AR shows more modest progress if it is studied at all. Such differing observations about the ability of L2 French learners to acquire phonetic rhythm and improve their AR and MLR may originate from differences in the study designs, tasks completed, and participants' background in French learning. In the Canadian context, the clearest dichotomy in L2 French learning background is between French immersion and core French programs offered in the public school system. In core French programs "[s]tudents learn French as a subject;" whereas in French immersion "students learn French as a subject and take […] other subjects where French is the language of instruction" (Government of Ontario). Overall, the immersion program teaches French in a more natural environment with greater exposure to the target language compared to those in the more traditional core French program. This generally translates into different proficiency levels in L2 French, as well as better fluency for immersion students (Freed et al., 2004).

To our knowledge, there has been no study on phonetic rhythm, AR, and IPU lengths in L2 French conducted within a pronunciation university class and using pre- and post-tests that takes into consideration participants' previous core versus immersion L2 French learning. Our preliminary study (Kaminskaïa et al., accepted) explored phonetic rhythm in L2 French in pre-tests and, like previous analyses described earlier in this paper, used individual averages. Here, we add post-tests and consider speech rhythm, AR, and length of runs across a series of all IPUs uttered by participants. This allows for more comprehensive and robust comparisons.

Research Questions and Hypotheses

We examine if former immersion and core French programs learners 1) have different speech rhythms, ARs, and IPU lengths in L2 French vs. L1 English; 2) if these prosodic aspects differ between the two groups of learners; 3) between pre-tests and post-tests, and 4) if the participants match L1 speakers of French for temporal features.

Following Guilbeault (2002), Tennant (2011) and our preliminary findings (Kaminskaïa et al., accepted), we expect that learners' speech rhythm in French will differ from their English and approach the level of native speakers of French. For AR and IPU length, we expect that learners will speak slower and produce shorter IPUs in their L2 French than in L1 English. Both groups are expected to improve in AR and IPU length between pre- and post-tests, following Towell et al. (1996) and Inceoglu (2019), and those who were previously immersion learners should match native performance.

METHODS

Participants and Data

We analyzed text readings by 12 Anglophone undergraduate intermediate-advanced university students learning French in a 2nd-year phonetics course in Southwestern Ontario. Participants, aged 20-25 (mean 21.17, SD 1.47), were native English speakers, spoke no other languages, and had never sojourned in a Francophone region. They were balanced for gender and French instruction format. The average onset age of learning French was 6.1 years (SD 2.1).
Students read an English and a French text at the start of the course, before any formal instruction on French prosody or pronunciation (pre-test). At the end of the course, they submitted a reading of the same French text (post-test). The French text is an adapted excerpt from the text "Le Premier Ministre, ira-t-il à Beaulieu?" – text used in the international project *InterPhonologie du français contemporain* (Detey & Kawaguchi, 2008) targeting L2 French pronunciation learning. The recordings were collected between January 2017 and April 2020.
For comparison, we used similar excerpts of recordings of the text by native speakers of French from Southwestern Ontario. The French L1 samples included three females and three males, aged 17-41. We thus examine four datasets: L1 English, L2 French pre-test, L2 French post-test, and L1 French.

Procedures and Analyses

Recordings were analyzed in Praat (Boersma & Weenink, 2022). From vocalic intervals, %V, VarcoV, and Vnpvi were calculated. A higher %V value correlates with simpler syllabic structures - mostly consonant-vowel - and the absence of vocalic reduction, which points to a more syllable-timed rhythmic pattern. Higher values of VarcoV and Vnpvi metrics suggest a less syllable-timed rhythm because greater variability of interval durations points to the presence of vocalic reduction in the data.

IPUs were identified as stretches of speech between two silent pauses of at least 100 ms. This silence threshold applies only to the breaks in the speech flow and does not include silence necessary for consonant articulations. Filled and silent pauses, hesitations, and corrections were excluded from the analysis as well as IPUs that had only one vocalic interval because at least two are necessary for computing VarcoV and Vnpvi. For each IPU, we measured its length in the number of syllables and its duration. Articulation rate for each IPU was calculated and registered in syllables per second.

To assess our research questions, we fit linear mixed-effects models using R software (R Core Team, 2020). For the analysis of speech rhythm, the values of each metric were the dependent variables; the independent factors were Language (French, English), Task (pre-test, post-test), and the type of participant (former core French vs. immersion learner, or native speaker). For the analysis of AR and IPU length, we built models with the same independent variables.

Recent studies have found that rhythm metrics can be sensitive to IPU *duration* (Clopper & Smiljanic, 2015) and despite rate normalization, to AR (Yazawa & Kondo, 2022). To control their effects, we included AR and IPU *length* (NmbSyll) as covariates in the models built for the metrics. Gender and learning onset were also included but were not significant. Skewed continuous variables were transformed using a square root or logarithm to satisfy symmetry assumptions for response variables of linear mixed-effects models. All models tested main effects and interactions of the factors and had a random intercept for each speaker.

For the four sets of recordings, we analyzed 30.2 minutes of fluent uninterrupted speech in total, or between 266 and 398 IPUs per dataset. We compared the learners' L2 French pre-tests to their English productions (to determine if their L2 and L1 prosodies differ). We then compared the pre-tests to post-tests (to see if there is a change between the beginning and the end of the course). Finally, both L2 tests were compared to the native control group (to understand if the learners approximated the L1 French patterns). We focused only on the independent factors.

RESULTS: ARTICULATION RATE AND IPU LENGTH

Table 1 lists the average AR and IPU length across the four datasets. These means reveal observed trends. However, we formally assessed our hypotheses using average ARs and IPU lengths resulting from linear mixed-effects models that account for the dependence between observations across different IPUs from the same speaker. We elaborate on our findings from these linear mixed-effects models below.

Table 1
Observed Averages (and STDEV) of the AR and IPU length in English, L2 French pre-test and post-test, and in the native control group

	AR (syll/s)	IPU length (syll)
L1 English (Core)	4.91 (1.07)	7.99 (4.93)
L1 English (Immersion)	5.14 (1.25)	7.18 (4.21)
Pre-test (Core)	4.04 (0.81)	5.59 (3.25)
Pre-test (Immersion)	4.66 (1.02)	5.46 (3.96)
Post-test (Core)	4.00 (0.68)	6.77 (4.42)
Post-test (Immersion)	4.59 (0.69)	8.07 (5.32)
L1 French	4.63 (1.06)	4.83 (3.44)

L2 French pre-test vs. L1 English

We first compared the pre-tests and English readings. Both core and immersion groups articulated faster in English than in French and had similar ARs ($p = .34$). However, the difference between the two languages was greater for former immersion learners ($p = .006$) than former core French learners ($p = .03$). Regarding IPU length, there was no significant difference between the learner groups ($p = .63$), but the average IPU length in English was considerably higher than in the French pre-test ($p < .001$).

L2 French pre-test vs. post-test

When comparing L2 French pre-tests with post-tests, there was no difference between the tasks ($p = .58$), but in both, former core French learners articulated more slowly than former immersion learners ($p = .04$). Both groups of learners had significantly longer average IPU lengths in the post-test, but the difference was more pronounced for the immersion French participants ($p = .003$). In the pre-test, the IPU lengths were similar between the core and immersion groups ($p = .74$).

L2 French pre- and post-tests vs. L1 French

At the pre-test stage, the immersion learners and native speakers had similar ARs ($p = .92$) and IPU lengths ($p = .37$). Core French learners had slower ARs than the other two groups combined ($p = .04$); they also had longer IPUs than the other two groups, but this difference was not statistically significant ($p \geq .21$). At the post-test stage, the average AR for the core French group was significantly slower than that of the immersion group ($p = .04$) and of the native French speakers ($p = .04$). As for the IPU lengths, both groups of learners had significantly longer utterances compared to the native speakers ($p \leq .03$). The difference between the groups of learners was not significant ($p = .17$).

To summarize, we observed slower ARs and shorter IPUs in L2 French pre-tests compared to L1 English. In post-tests, both groups of learners showed longer IPUs compared to their pre-tests. For the immersion group, this increase was more pronounced. Learners' ARs did not increase between pre- and post-tests. However, during both tests, the immersion group articulated at a similar rate as the native control group. Former core French students had significantly slower ARs in both tests. Unexpectedly, both groups of learners produced IPUs similar in length to the native speakers during the pre-test and longer than them at the post-test.

RESULTS: PHONETIC RHYTHM

Table 2 lists averages of the three rhythm metrics across the four datasets. For English, Varco and Vnpvi values were the highest, and %V was the lowest. This aligns with the expectation of differences between more stress-timed English rhythm and more syllable-timed French rhythm. Linear mixed-effects models confirmed that all English rhythm metrics were significantly different from the learners' pre-test metrics ($p \leq .03$). Comparisons between pre-tests and post-tests revealed no differences between tasks or between former core and immersion learners ($p \geq .07$). Our participants therefore produced different prosodic rhythms in their L1 and L2. Finally, average L2 French values are very similar to L1 French values, suggesting that our participants have acquired at least some aspects of L2 French phonetic rhythm.

Table 2
Observed Averages (and STDEV) of the rhythm metrics in English, L2 French pre-test and post-test, and in the native control group

	L1 English	Pre-test	Post-test	L1 French
VarcoV	46.93 (1.04)	37.67 (0.92)	38.00 (0.99)	40.99 (1.20)
Vnpvi	47.49 (0.98)	42.19 (1.05)	40.48 (1.04)	45.35 (1.49)
%V	42.03 (0.48)	52.66 (0.49)	52.24 (0.59)	50.88 (0.67)

To conclude, learners produce a French-like rhythm at both the pre-test and the post-test. All rhythm metrics showed a syllable-timed pattern in L2 French – different from L1 English and typical for L1 French.

CONCLUSIONS AND DISCUSSION

Using temporal prosodic measures – AR, IPU length, and phonetic rhythm – we compared speech productions from L2 French learners having different language learning backgrounds. Comparisons included pre-test and post-test, participants' L1 English, and a native control group. Regarding our first research question, we found that the learners had different phonetic rhythms in L1 English and L2 French, but their ARs and IPU lengths in L2 were different from their L1. In other words, they seemed to have acquired phonetic rhythm but had difficulty with speed fluency and organization/parsing. Regarding our second research question, we found that both groups of learners demonstrated a strongly syllable-timed rhythm and similar IPUs, but the immersion group had faster ARs. As for the third question, between pre- and post-tests, AR did not change in either group, whereas IPUs increased in both. Finally, learners had longer IPUs and more syllable-timed rhythm than the native speakers. The immersion group had similar ARs to native speakers, and both these groups articulated significantly faster than the core group at post-test.

Except for AR not improving between pre- and post-test, all our hypotheses were confirmed. We note, however, that the immersion group had the same AR as the native speakers. Our results do not follow Towell et al. (1996) where students' AR improved after studying abroad. However, they align with these authors and with Inceoglu (2019) regarding the increase of IPU length, but not with Drouillet et al. (2024), Kennedy et. al (2013), and Trofimovich et al. (2017). Different ARs between core and immersion groups and a significant increase of IPU length in the latter aligns with Freed et al. (2004), who observed better speech fluency in immersion French program students. Our results for phonetic rhythm echoed previous findings based on Canadian English learners of French (Guilbeault, 2002; Tennant, 2011) and our own preliminary findings.

That AR did not change between pre-test and post-test may be explained by the nature of the task (text reading) and the effort of the learners to articulate carefully for their assignment. This result also suggests that learners may have reached an AR ceiling in L2 French. Increase in IPU length shown by both groups of learners and their better performance at post-test compared to the native speakers can be explained by training, thus suggesting that this aspect of utterance fluency can be improved.

In understanding the results, it is tempting to conclude that the learners have achieved native-like performance. However, since rhythm metrics express *surface* patterns in durational variation, underlying reasons for the observed results in L2 French may deviate from those of L1 French. Therefore, an analysis of the surface rhythmic patterns in an L2 should be accompanied by an examination of the phonological processes relevant to the target language. For instance, a high proportion of vocalic material (%V) might result from a lower rate of schwa omissions, even in required contexts, such as before a vowel (e.g., "ministrE a" instead of "ministr' a") or in set phrases (e.g., "qu'est-cE qui" instead of "qu'est-c'qui"). Another error contributing to a high %V value could be the non-realization of liaison consonants. For example, "pâte**s** italiennes" and "circuit**s** habituels," where liaison is optional, "gran**d** émoi" and "gran**d** honneur," where it is obligatory, are often produced without linking consonants between two words. Additionally, very low values of VarcoV and Vnpvi could result from insufficient final lengthening associated with primary stress in French. In other words, the French-like rhythmicity suggested by rhythm metrics may not originate from French-like productions but from differences in prosodic organization and phonetic realization that result in similar measurements. A systematic analysis of pre- and post-tests is needed to support these preliminary observations. Among other future directions, also pointing to limitations of our study are analyses of pauses and corrections, and of other oral tasks.

Our results show that pronunciation training may contribute to learners' progress but that the development of temporal aspects of prosody in L2 French is not uniform across various measures or learners, suggesting that the learning of prosody is a multilayered process. To help learners achieve a target-like mastery of oral production, instructors must address fundamental concepts of French phonology, such as the liaison and schwa omissions.

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