

# THE TIMING OF ACCENTUAL PHRASES IN READ AND SPONTANEOUS SPEECH: DATA FROM ACADIAN FRENCH

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## 1 Introduction

In recent years, researchers have developed rhythm metrics to capture patterns of timing in speech. Based on acoustic measures of vocalic and consonantal intervals, these metrics focus on variability in the durations of these segmental intervals; certain metrics (pairwise variability measures) measure the variability of pairs of immediately adjacent intervals while other metrics (interval measures) quantify variation of intervals over an entire utterance. These rhythm metrics have been applied in different areas of research including automatic speech recognition, dialectology, disordered speech, language typology and second language phonology.

Some researchers have looked beyond measures of vocalic and consonantal intervals to examine duration variability in larger units such as syllables and feet [1]. Their work is motivated by a conception of rhythm that rests on notions such as grouping and patterns of prominence. In this paper, we measure the variability of durations of units known as accentual phrases (APs). Also referred to as interstress units, *pieds accentuels*, *groupes rythmiques*, *mots prosodiques* and *syntagmes accentuels*, APs are groups of syllables that are demarcated by a stress. In French, these groups are generally realized by a sequence of unstressed syllables that ends in a stressed syllable; they tend to correspond to short syntactic units. APs are also basic units in the analysis of French intonation [2]. Classical phonetic studies of duration in French – see the summary in [3] – show that length of APs varies according to speech style.

The main elicitation technique in rhythm research has been reading, which is used in order to control for phonotactic effects on the stability of rhythmic measures. Of the small number of studies that include spontaneous speech, several show that spontaneous speech has greater variability in interval duration variation than reading [4, 5]; however, a few researchers find no between-style timing differences [6].

The goal of the present study is to apply rhythm metrics based on AP durations to speech data from a dialect of Acadian French spoken in New Brunswick (Canada). We compare speech from two elicitation methods – reading and spontaneous storytelling – and examine how well rhythm metrics based on AP durational variability can distinguish between the two styles. Our hypothesis is that spontaneous speech will show more variability (i.e. higher scores) than read speech.

## 2 Methodology

### 2.1 Speakers and speech materials

The corpus consists of recordings by 12 native speakers of Acadian French from the municipality of Tracadie in northeastern New Brunswick [7]. The speakers are stratified by age and gender. There are three age groups, each with four speakers: younger (mean age: 23.5 years), middle-aged (41.6 years) and older adults (76.3 years); each age group has an equal number of males and females.

Speech materials are from sociolinguistic interviews conducted according to the protocol of the *Phonologie du français contemporain* project ([www.projet-pfc.net](http://www.projet-pfc.net)), which compares dialects of French spoken around the world. Among the interview tasks are: reading a passage and telling a story about a personal event. The personal stories were told spontaneously with no preparation and, because the interviews were carried out by a member of the speaker's family, these stories come close to representing an informal or vernacular speech style. The total corpus of speech studied is reasonably large: about 34 minutes (almost 3 minutes per speaker).

### 2.2 Procedure and measurements

Ten (out of a total of 21) sentences were extracted from the reading passage. Similarly, between 2 and 3 minutes (per speaker) of the spontaneous speech were divided into utterances that were of varying lengths. All pauses, hesitations, and false starts were excluded from analysis. The speech data from both styles were segmented, first automatically with *EasyAlign* and then manually, into vocalic and consonantal intervals using *Praat* and following generally accepted segmentation criteria.

The task of identifying the APs in the reading and spontaneous story data was carried out by two native speakers of Acadian French. The transcribers were instructed to divide the speech into 'chunks' that 'are spoken together as a unit'; the transcribers also determined whether the boundary between these units is major or minor. Over 2,300 APs were identified: 1,112 in the reading texts and 1,237 in the spontaneous speech.

Durations of APs (in ms) were extracted using a *Praat* script. To calculate rhythm metrics for the APs for each speaker for both speech styles, we used the same formulas as for duration-based rhythm metrics. Two pairwise variability indexes – nPVI-AP, rPVI-AP – and two interval-based indexes – deltaVP, VarcoVP – were calculated.

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### 3 Results

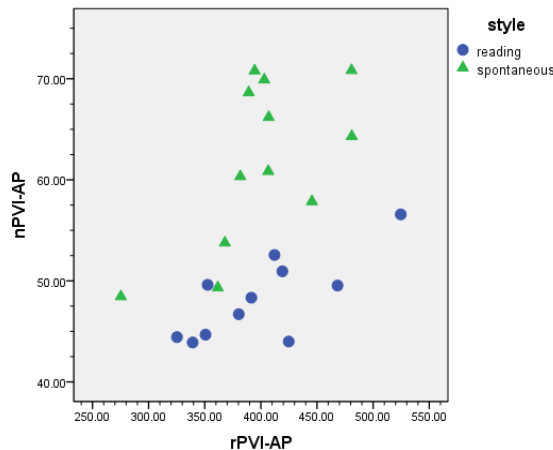
Articulation rates, which exclude pauses and hesitations, tend to be slightly higher (i.e. there is a faster tempo) in spontaneous speech than in the reading style (5.2 vs. 4.8 syllables per second;  $p < .171$ ), although this difference is not statistically significant in the data studied here. Mean AP durations are significantly shorter in spontaneous speech than in reading (667.3 vs. 824.0 ms;  $p < .0001$ ).

Descriptive statistics for the AP-based rhythm metrics are given in Table 1. For normalized measures, variability of AP durations is significantly greater in spontaneous speech (i.e. higher scores) than in read speech (based on repeated measures ANOVAs). No effect is found for non-normalized measures.

	reading	spontaneous	$p$ -level
nPVI-AP	48.3 (4.1)	61.8 (8.0)	.002
rPVI-AP	399.0 (59.8)	399.5 (55.4)	.993
VarcoAP	43.8 (3.8)	52.0 (4.2)	.002
deltaAP	361.9 (50.6)	343.1 (34.5)	.270

**Table 1:** Means and standard deviations of four rhythm metrics for two styles. Statistical significance is shown in the final column.

To determine which metrics contribute most to distinguishing between styles, we carried out linear discrimination analyses. Best discrimination was obtained with the two PVI-based metrics, achieving 91.3% correct classification. Figure 1 presents the plot of speaker scores.



**Figure 1:** Distribution of speakers in the (rPVI-AP, nPVI-AP) plane by style.

Noticeable in Figure 1, for both normalized (nPVI) and non-normalized (rPVI) scores, are the large between-speaker variations in reading and in spontaneous styles. A similar spread of scores occurs in the (deltaAP, VarcoAP) plane. Strong correlations exist between the two normalized, ((nPVI-AP, VarcoAP)  $r = .853$ ), and the two non-normalized, ((rPVI-AP, deltaAP)  $r = .844$ ), metric scores.

### 4 Discussion and Conclusion

The results confirm three patterns found in studies of rhythm that use segmental-based metrics. First, spontaneous

speech has more variability than read speech, as shown by the higher normalized metric scores. While this may appear to be an expected result, the existence of stylistic differences has been demonstrated in only a small number of studies. Second, there is considerable between-speaker variation in both speech styles. This source of variability remains a challenging shortcoming for metric-based research on speech timing. Finally, normalized metrics are better than non-normalized metrics in differentiating between the speech varieties.

The present study demonstrates that AP-based rhythm metrics can characterize stylistic differences in French. Followup (phonetic, phonological, syntactic) research is needed to uncover the nature of this variability. In addition, a study by [8] shows that, when considered with articulation rate, AP-based metrics discriminate among national, regional and contact varieties of French. Both results invite more extensive applications of these metrics to other varieties of French.

One implication of this study is that AP-based rhythm metrics contribute to a framework for the comparison of read and spontaneous speech materials. More generally, this research supports the claim that rhythm metrics can be useful in characterizing interesting patterns of speech timing that are located at levels above vocalic and consonantal segments.

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