



Rhythm Metrics and Second Language Speech: Korean Learners of English

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AIM: Evaluation of the rhythm metrics and suggestions on experimental techniques for second language speech

Rhythm of Speech and Language

• Speech rhythm: a perceptual consequence of the arrangement of strong and weak linguistic units

Standard British English

- Typically stress-timed
- Word stress; vowel reduction in unstressed syllables
- Relatively complicated syllable structure

Seoul Korean

- Possibly more syllable-timed than French or Spanish
- No word level stress
- Phrase-level accent: Accentual Phrases with underlying (H/L)HLH patterns^[5]
- Simple syllable structure (i.e., (C)(S)V(C)); no phonemic vowel length distinction
- In a perception experiment with *flat-sasasa* type of stimuli, Korean was discriminated from Italian and English, but not from Japanese^[2]

Quantification of Speech Rhythm

Interval Measures^[9] and their normalisation^[3]

- %V, ΔC, ΔV, VarcoΔV, VarcoΔC

PVIs (Pairwise Variability Indices)^[6]

- Vocalic PVI with speaking rate normalisation (nPVI-V), consonantal PVI (rPVI-C)

Prediction: Stress-timed languages would show higher ΔV, ΔC, VarcoΔV, VarcoΔC, nPVI-V, rPVI-C and lower %V scores than syllable-timed languages.

Rhythm of Second Language Speech

- L2 learners go through transitional stages when their L1 and L2 are rhythmically distinct^[8]
- Native Korean speakers' English sounds more syllable-timed than that of native English speakers.
- Hypothesis: L2 speakers' rhythm scores would lie between those of the respective L1 groups; advanced group of speakers would show closer scores to native speakers of L2

Speech Materials (English)

1. Many independent activists ended up facing detention.
2. Economic aspects of pensions have been one of the issues.
3. The monkey's job is to pick bunches of bananas.
4. He had omitted the questions on the back of the sheet.
5. She can buy the map of the city at coach stations.

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Experiment

Participants

- L1 groups: Southern British English speakers (Eng), Seoul Korean speakers (Kor), 5 speakers for each group
- L2 groups: Korean learners of English at intermediate level (K-E: int, 5 speakers), at advanced level (K-E: adv, 7 speakers)
- Five sentences were used from 15 sentences read by each speaker.

Table 1. L2 speakers' profile (the means and standard deviations)

	K-E:int	K-E:adv
Age of first exposure to L2		
11 years (3.13)	12 years (7.87)	
Age of arrival to L2-speaking country		
31 years (5.96)	18 years (11.18)	
Length of residence in L2-speaking country		
12 months (10.59)	54 months (26.01)	
L2 proficiency test^[7]		
17.00/25 (3.39)	22.14/25 (1.46)	

Segmentation

- The vocalic and intervocalic intervals were segmented by auditory and visual inspection using Praat^[1]
- The first consonantal intervals, the final vocalic intervals and the following consonantal intervals were excluded, due to the unclear boundary of the utterance-initial consonants and the utterance-final lengthening effects.
- Glottalisation periods between successive vowels were excluded, and the durations of the two adjacent vocalic intervals were summed up and counted as one interval.
- Vowel insertions by L2 speakers in English utterances were marked as vocalic intervals.

Results

General

- Metrics showing the hypothesised distribution
- Unexpected scores of L2 groups

Table 2. Means and standard errors of rhythm metrics for all participant groups

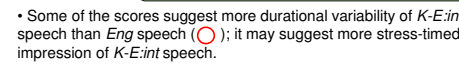
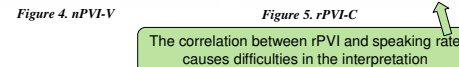
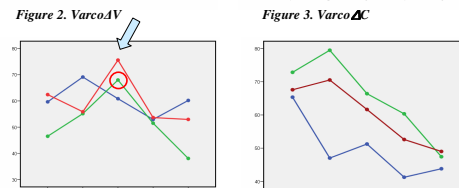
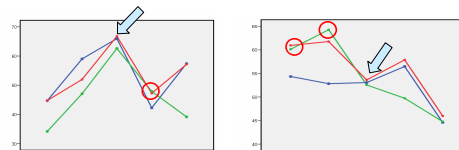
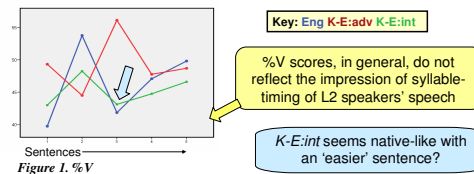
	Eng	K-E:adv	K-E:int	Kor
Interval measures				
%V	46.44 (0.38)	48.44 (1.17)	45.08 (0.94)	53.36 (0.52)
VarcoΔV	54.91 (2.45)	52.72 (2.06)	46.05 (0.96)	46.20 (0.55)
VarcoΔC	52.26 (1.01)	56.80 (2.95)	54.74 (1.34)	49.49 (0.99)
PVIs				
nPVI-V	60.54 (2.53)	58.73 (2.74)	51.52 (2.08)	49.16 (1.20)
rPVI-C	49.74 (3.64)	62.03 (5.13)	68.08 (3.06)	42.30 (3.52)
Speech rate				
Syl/sec	6.41 (0.20)	5.32 (0.16)	4.92 (0.15)	7.07 (0.17)

- The results of ΔV and ΔC are not reported due to the significant correlation with speaking rate.^[4]
- Only nPVI-V and VarcoΔV show the expected distribution: L2 speakers scores are between those of Eng and Kor, with K-E:adv showing closer scores to Eng.

Results (continued)

Analyses of English-speaking Groups by Each Sentence

Figure 1-5 Mean scores of each metric (Y-axis) for each sentence (X-axis)



- Some of the scores suggest more durational variability of K-E:int's speech than Eng speech (○); it may suggest more stress-timed impression of K-E:int speech.
- However, it does not imply that they have native-like speech rhythm.
- The degree of 'foreign accented rhythm' of L2 speakers may be better demonstrated with the deviation from the scores of Eng speech; for all sentences, |Eng - K-E:adv| is smaller than |Eng - K-E:int|
- K-E:int's scores do not considerably differ from Eng for Sentence 3, which was 'easier to read' than the other sentences used in the experiment.

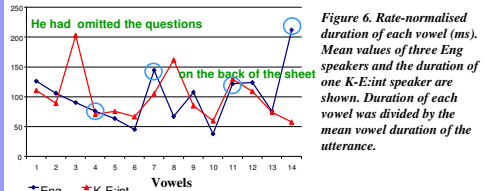
Discussion

What do the rhythm metrics tell us?

- The higher VarcoΔV and nPVI-V may not necessarily imply more 'stress-timing' of speech, although the syllable duration may be highly variable; it is difficult to find the causes of the durational variability, particularly in L2 speech.
- It is not clear to what extent 'timing' is correlated to the perceivable rhythm.
- The acoustic approach may not be the best solution; metrics with consonantal intervals do not capture the distinctive rhythmic differences between languages with speaking rate normalisation.
- What is the best candidate for a rhythm unit?

Discussion (continued)

Application of rhythm metrics to L2 speech



- The rhythm scores of L2 speakers that are similar to those of L1 speakers may not necessarily reflect native-like rhythm of L2 speech; L2 speakers lengthen syllables regardless of the stress pattern of the utterances (Figure 6, stressed syllables are marked with ○).
- To what extent is 'the measured rhythm' correlated to the degrees of foreign accent?
- Speech rhythm or fluency in reading?: L2 speakers' rhythm scores are affected by the 'readability' of the reading materials, even though they were given enough time to practice.

Methodological Issues

- Careful design of speaking materials is necessary. e.g., the control of vowel type; systematic arrangement of stressed vs. reduced vowels, phonologically long vs. short vowels^[6]
- Treatment of lengthening effects at prosodic boundaries: disfluencies and slower speaking rate of L2 speakers → the larger number of prosodic phrases within an utterance: should it be considered in measuring speech rhythm?

Conclusions

- The use of nPVI-V and VarcoΔV are supported in comparison to other metrics.
- Durational variability within utterances is captured by the metrics; however, the relationship between perceivable rhythm and the degree of foreign accent is not clear.
- It is difficult to apply the rhythm metrics with L2 speech, due to the problems in speaking material design and confounding effects of speech rhythm and fluency in reading.
- To obtain clearly interpretable results, it is necessary to control the arrangement of long and short syllables in the speech materials.

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