Using durational measures with non-native speech rhythm

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Introduction

- This study investigates the reliability and effectiveness of various durational rhythmic measures by using non-native speech materials.
- Durational measures like ΔC and %V [1], VarcoC [2], raw consonantal and normalised vocalic PVIs [3] can classify languages into rhythmic clusters.
- These measures were developed using speech materials from native speakers of various languages.
- Some studies also used these measures to investigate non-native speech rhythm, e.g. Taiwan English [4], Dutch, English and Spanish [5].
- Native and non-native speech differ in many aspects. However, the reliability of these rhythmic measures on non-native speech was not clear.
- If the rhythmic measures are robust and reliable, they should classify both native and non-native speech equally well.

Cantonese and Beijing Mandarin

- Cantonese and Beijing Mandarin are syllable-timed languages [6], [7]. The accented English spoken by these speakers also sound syllable-timed [8].
- Both languages have a very simple syllable structure:
  Cantonese: CV, CVN, CVS
  Mandarin: CV, CVN
- Both languages are tone languages.
- Cantonese has no lexical stress and no phonological vowel reduction.
- Mandarin has some phonologically unstressed syllables ('neutral tone').

Research question

- Can the durational rhythmic measures consistently classify Cantonese and Beijing Mandarin (native), Cantonese-accented English and Mandarin-accented English (non-native) as syllable-timed?

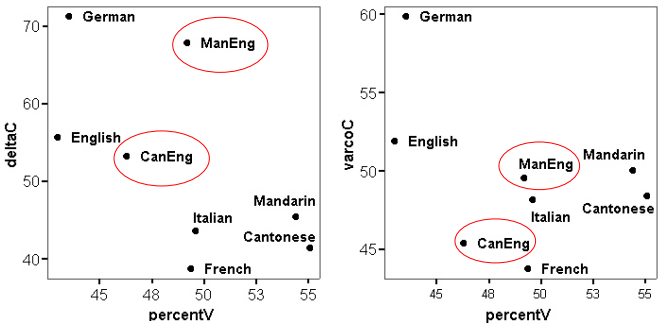
Method

- 6 native speakers of Cantonese and 6 of Beijing Mandarin (3 male, 3 female) were recorded reading the North Wing and the Sun story with a normal speech rate in their native languages and English.
- Duration of vocalic (V), consonantal (C) and syllabic (S) intervals were used with the following rhythmic measures:

ΔC, ΔS, %V, VarcoC, VarcoS, rPVI_C, rPVI_S, nPVI_V, nPVI_S

- The data was compared with four languages in the BonnTempo Corpus [9]: German and British English (stress-timed) and French and Italian (syllable-timed).

Results



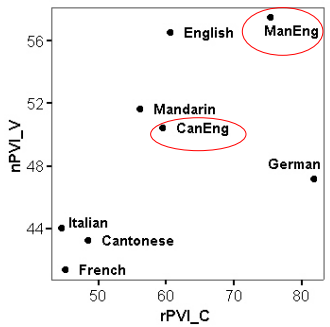


Figure1. ΔC and %V of all the languages (top left).

Figure 2. VarcoC and %V of all the languages (top right).

Figure 3. Normalised vocalic PVI and raw consonantal PVI of all the languages (bottom left).

Lang	ΔS	Lang	VarcoS	Lang	rPVI	Lang	nPVI
MEng	124.5	Eng	51.9	MEng	151.1	Eng	69.7
CEng	106.8	MEng	49.3	CEng	124.7	MEng	60.7
Eng	88.7	CEng	47.4	Eng	115.5	CEng	57.7
Ger	80.8	Ita	46.7	Ger	99.6	Ger	56.4
Man	75.8	Ger	43.5	Man	86.1	Ita	54.8
Ita	67.6	Man	38.2	Ita	82.7	Fr	49.5
Can	57.5	Fr	36.2	Fr	75.9	Man	45
Fr	55.3	Can	30.7	Can	63.6	Can	34.3

Table 1. Values of four rhythmic measures using syllable duration.

Conclusions

- All durational rhythmic measures confirm the syllable-timing of Cantonese and Beijing Mandarin.
- Except VarcoC and %V, the other measures all suggest that the two non-native English accents are numerically closer to stress-timed than syllable-timed languages, contrary to the auditory impression.
- A slower speaking rate and selective-lengthening in non-native speech contribute to this discrepancy.
- Speaking rate normalisation along may not solve the problem because of the higher variability introduced by selective lengthening.
- The durational rhythmic measures may not be reliable for non-native speech.

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