Tone Production in Cantonese Speakers with Aphasia

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Background

- Only one study has investigated the effect of intonation on tone production in individuals with aphasia.¹
- In this Thai study, Gandour and colleagues¹ reported preserved tonal contrasts in different sentence positions for speakers with fluent and non-fluent aphasia.
- Similar to typical healthy peers, the patients produced significantly lower fundamental frequency (F0) for the Thai tones embedded in the sentence-final position.
- Hence, it was suggested that Thai sentence intonation might be manifested as final lowering.
Background (cont.)

- Similar investigations for Chinese speakers with aphasia are lacking but a recent study on typical speakers found gradual F0 declination over time for Cantonese sentences.\(^2\)
- Moreover, previous studies on tone production at word level seemed to show that tone production deficit is more evident in Chinese speakers with aphasia than Thai speakers with aphasia.\(^3-5\)
- This implies that there might be fine differences among tone languages.

Aim of Study

- This paper reports our recent findings on the effect of intonation on 3 contour tones in Cantonese – high rising (tone 2,5), low rising (tone 2,3), and low falling (tone 2,1), produced by speakers with aphasia.
- While previous studies measured mean F0, this study investigated the amount of change in the tone contour – frequency excursion.
- It was hypothesized that, due to the effect of gradual F0 declination over time on tone contour, the mean frequency excursion would be high at sentence-initial, followed by sentence-medial and sentence-final for the rising tones and a reversed pattern would be observed for the falling tone.
Method

The participants were 6 individuals with aphasia (2 males & 1 female with Broca’s aphasia, 2 males & 1 female with Wernicke’s aphasia; aged 50-76 years) and 10 normal individuals (8 males & 2 females aged from 50-79 years).

The speech stimuli were 54 sentences:
- With 18 real words, from 3 root words /si/, /ji/, /jmu/ by 6 tones.
- Each word was embedded in initial, medial, or final positions in 3 short carrier sentences. For example:

  Sentence: 史字好難寫。
  Phonetic transcription: /si23 zi23 hou23 naan21 se25/
  English translation: “History” is difficult to write.

Method (cont.)

Speech samples were recorded using a digital recorder (Zoom H4) in a quiet room.

The vocalic segment of each target word was identified manually, using Praat (version 5.1.04).

Using a Praat script, each vocalic segment was divided into 10 equal smaller intervals, giving rise to 11 evenly-spaced time points.

F0 was measured at the 2nd, 4th, 6th, 8th, & 10th time points, using an autocorrelation algorithm.

Frequency excursion was calculated by subtracting Minimum F0 from Maximum F0 (see slide 7).
Frequency Excursion Measurement

\[ \text{Frequency excursion} = 172\text{Hz} - 122\text{Hz} = 50\text{Hz} \]

Results – Broca’s Group

- Elevated frequency excursion at sentence-final for tone 2,3 and at sentence-initial for tone 2,1.
Results – Wernicke’s Group

The results conformed to the hypothesized patterns.

Results – Normal Speakers

The results conformed to the hypothesized patterns, except for the increased value at sentence-final for tone 2,5.
Conclusion

- The results generally supported the hypothesis of gradual F0 declination for Cantonese sentences.
- The increased frequency excursion at sentence-final for tone 2,5 in normal speakers was probably because some of the speakers emphasised the target words when they were embedded in the sentence-final position.
- The influence of sentential intonation on tone production was preserved in speakers with Wernicke’s aphasia but disrupted in speakers with Broca’s aphasia.
- Frequency excursion may be a useful indicator for disruption of sentential intonation as a result of dysfluency.

References