Functional Load modulates speech production, but not speech perception? Evidence from Thai vowel length

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Introduction

- High Functional Load (FL) of a phonemic contrast has been shown to correlate with a resistance to mergers (Wedel, Kaplan, & Jackson 2013)
- Do these diachronic tendencies come about in day-to-day speech?
- Example: FL helps predict singleton/geminate contrast duration ratio (Tang & Harris 2014)

Research Question

- Does FL have real-time effects on speech production and/or perception?
- Bangkok Thai vowel length as a case study

Predictions

<table>
<thead>
<tr>
<th>Production</th>
<th>Perception</th>
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<tbody>
<tr>
<td>a</td>
<td>a:</td>
</tr>
<tr>
<td>ɛ</td>
<td>ɛː</td>
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Confusion matrices in previous work (Onsuwan et al. 2013) do not seem to reflect modulations of FL

Production

Data collection

- FL is extracted from a unigram model derived from the Thai National Corpus (monosyllabic words only, ~22 mln tokens)
- FL(x,y) = \( \frac{H(L) - H(L_{xy})}{H(L)} \) (Surendran & Niyogi 2006)
- 20 native speakers of Bangkok Thai
- Stimuli: 189 attested Thai words with all licit phonotactic and tone combinations embedded in a carrier sentence

Data analyses

- Correlations of (i) grand mean vowel duration ratio and log(FL) and (ii) Bhattacharyya Distance and log(FL)
- Pearson’s r and Kendall τ rank correlations

Results

- Duration ratio displays a correlation with log(FL) (\( p = .3, r = .71, R^2 = .53 \))
- Bhattacharyya Distance displays a correlation with log(FL) (\( p = .8, r = .61, R^2 = .64 \))

Perception

Data collection

- 15 native speakers of Bangkok Thai
- ABX discrimination task
- Stimuli: nonce words of shape [f/i/u/e/ɔ/a] p
- We modified vowel duration of the stimuli into 11 steps

Data analyses

- Mixed effect logistic regression comparing models with and without the interaction of duration step and vowel quality
- Correlation of the grand mean of the reaction time for step 4-8 (ambiguous stimuli) and log(FL)

Loglikelihood ratio tests indicate that model structure should include both duration steps and vowel quality (\( \chi^2(4) = 46.423, p < .001 \)) but not the interaction (\( \chi^2(40) = 52.553, p = .088 \))
- Mean reaction times do not show a correlation with log(FL) (\( p = .18, r = .2, R^2 = .03 \))

Conclusion

- The results show that FL modulates the production of short-long vowel contrast, but it does not affect perception
- Production ≠ Perception? Different basic units (segments/gestures vs words)?
- Sound change not based on perception alone, but on "stability" in production, modulated by FL
- FL may be accommodated in a dynamical model of speech production, like the task dynamic model of Articulatory Phonology, by modulating gestural durations via feedback-based suppression (Tilsen 2016)

References


