Ultrafest VII

Production of English liquids by Mandarin speakers

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Introduction

- English liquids /l/ and /r/ often present challenges to non-native speakers.
- Acoustic characteristics of English liquids by Mandarin speakers
  - Non-native final /l/-vocalization (Deterding, 2006)
  - Non-native initial /l/s were much lighter than English /l/s (Smith, 2010)
  - Non-native initial /r/s approached native English /r/s (Smith, 2010)
- Articulation of English liquids involve multiple articulators
  - /l/: tongue tip (T.T) raising + tongue root (T.R) retraction
  - /r/: T.T/tongue body (T.B) raising + T.R retraction + lip rounding

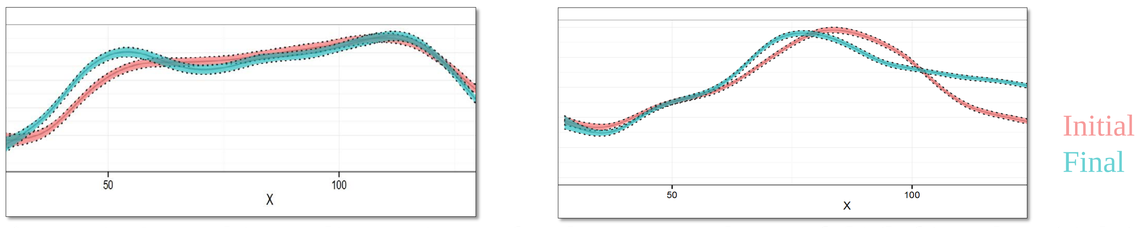


Figure 1: Smoothing spline estimate for the tongue shape of /l/ (left) and /r/ (right)

- Chinese liquids
  - /l/: only initial /l/, no syllable final /l/
  - /r/: Mandarin /r/ is known to be quite different from English /r/
    - Articulatorily, a bunched or retroflex alveolar /r/ in English, vs. an apical post-alveolar /r/ in Mandarin (Lee & Zee, 2003)
    - Acoustically, significantly higher F2 for Mandarin /r/ than for English /r/ (Smith, 2010); sometimes audible frication noise due to greater tongue tip constriction in Mandarin (Duanmu, 2000)
- Other than some descriptive studies, there is no experimental data on the production of English liquids produced by Chinese speakers.
- **The present study:** We examine articulatory patterns in both native and non-native liquid production using ultrasound imaging
  - explore the effect of native phonological systems on production patterns
  - investigate detailed articulatory characteristics of foreign categories.

Methodology

- Participants
  - Three native Mandarin speakers (**LT**, ZJ, TS) and one Canadian English speaker
- Test conditions
  - Language: Native (Chinese) vs. Non-native (English) liquids
  - Vowel contexts: Chinese: /u a i/ English: /u ɑ i/ (e.g. /ulu ala ili/)
  - Syllable position: Initial vs. Final
- Stimuli (short pseudo-address phrases, 5 repetitions)
  - Native liquids:

e.g. /məŋk**u l**upan mən/ ‘The Luban Gate in Menggu’ **(**u#lu**)**
e.g. /tɕiniŋ xwap**ur pʰu**/ ‘The Huabu Shop in Jining’ **(**ur#bu**)**

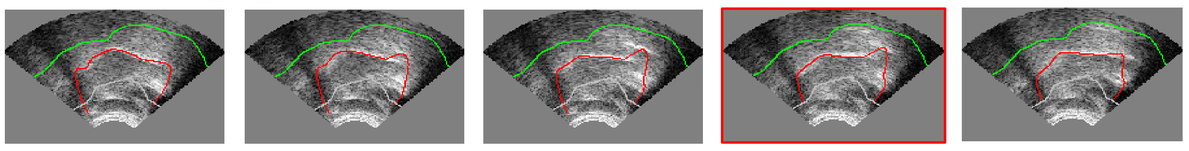
  - Non-native liquids:

e.g. 22 **L**oop Peak **(**u#lu**)**
e.g. 13 Moo**r** Boulevard **(**ur#bu**)**

  - Fillers:

e.g. /wəntʂoʊ ɕiŋma lu/ ‘The Xingma Road in Wenzhou’
e.g. 24 Peek Street

- Data collection and analysis
  - Echo B ultrasound with AAA (Articulate Assistant Advanced) software
  - 90° field-of-view, 60 fps
  - Smoothing Spline ANOVA for statistical analyses



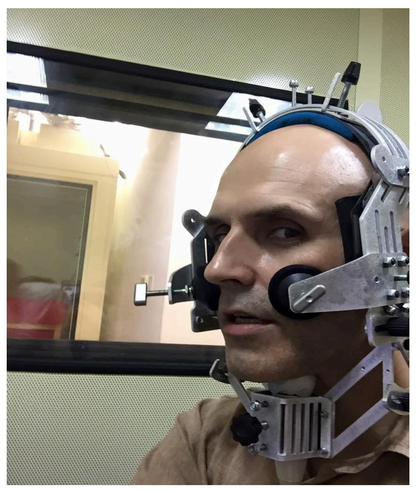


Figure 2: A headset used for head and transducer stabilization.

Figure 3: The frame of most raised tongue front position during acoustic /r/ and /l/ is extracted in AAA.

Results

- **Native vs. non-native initial /l/**
  - Not significantly different (/i/ and /u/ differences not consistent)
  - No velarization of the T.R

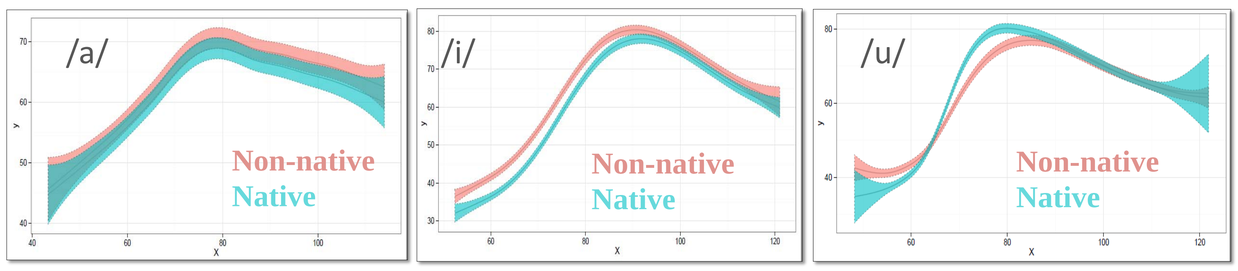


Figure 4: Smoothing spline estimate for the tongue shape of non-native and native /#la/, /#li/ and /#lu/

- **Non-native /l/ in initial vs. final position**
  - T.T is significantly lowered for final /l/ than for initial /l/ for all vowel contexts, suggesting /l/-vocalization in final position

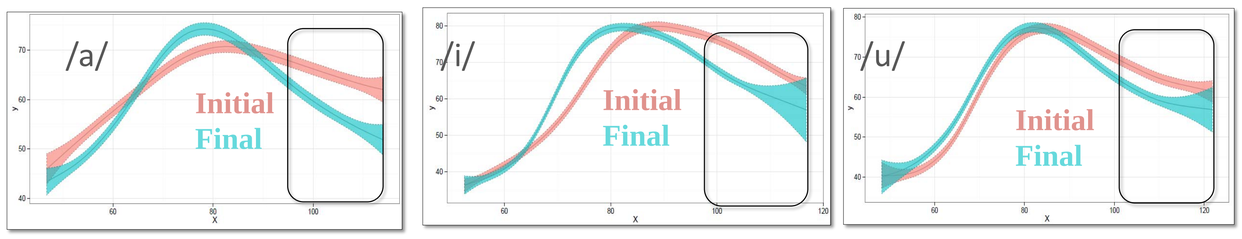


Figure 5: Smoothing spline estimate for the tongue shape of non-native initial and final /l/ in the contexts of /a/, /i/ and /u/

- **Native vs. non-native initial /r(a)/**
  - T.T. and T.B more back in non-native than in native /r/

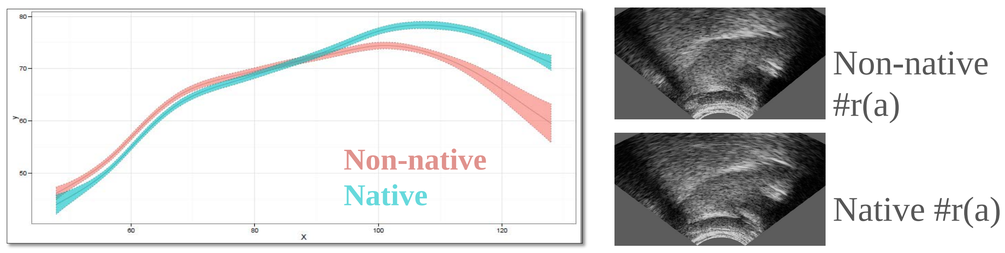


Figure 6: Smoothing spline estimate for the tongue shape of non-native and native

- **Effect of vowel context in non-native production for /r/**
  - For /a/, front-up
  - For /i/ and /u/, mid-bunched

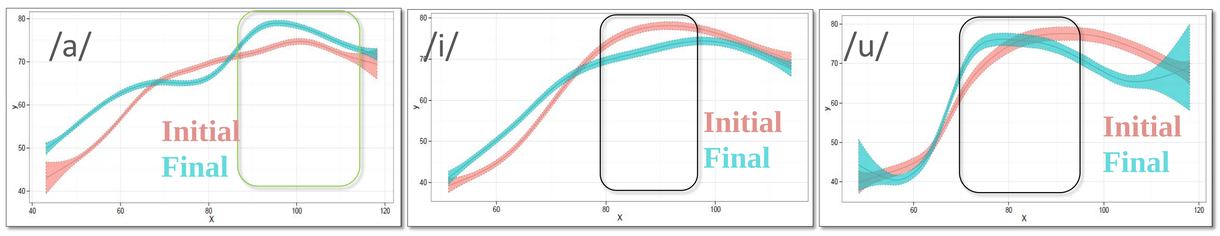


Figure 7: Smoothing spline estimate for the tongue shape of non-native initial and final /r/ in the contexts of /a/, /i/ and /u/

Discussion & Conclusion

- LT final /l/ has T.T. lowering (likely vocalization) not found in the Canadian English speaker.
- LT seems to have one category for both native and non-native /l/, while two separate categories for /r/.
  - Coherent with Smith’s (2010) observations that non-native /r/
- Due to larger perceptual differences between non-native and native /r/ over /l/, Mandarin speakers seem to more easily establish a separate category for English /r/ (consistent with the Speech Learning Model (Flege, 1995))
- However, due to vowel coarticulatory effects, the effect of the separate categories is easier to see in the low vowel context. For the high vowels, the tongue is already raised due to coarticulation with the vowel, so a difference in T.T. height between the native and non-native /r/ is not easily seen.
  - The difference in tongue back between native and non-native /r/ is likely due to coarticulatory effects of the backness differences between the native/non-native vowels.

References

Deterding, D. (2006). The pronunciation of English by speakers from China. *English World-Wide*, 27(2), 175–198.

Duanmu, S. 2000. *The phonology of standard Chinese*. New York: Oxford University Press.

Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 233–277). Timonium, MD: York Press.

Lee, Wai-Sum; Zee, Eric (2003), "Standard Chinese (Beijing)", *Journal of the International Phonetic Association* 33 (1): 109–112, doi:10.1017/S0025100303001208

Smith, J.G. (2010). *Acoustic properties of English /l/ and /ɹ/ produced by Mandarin Chinese speakers*. MA Forum Paper: University of Toronto.