Seen But Not Heard:

An Acoustic & Articulatory Investigation of Coronal Fricatives in Hul'q'umi'num'

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Introduction

Topic:

- Acoustic and articulatory investigation of Hul'q'umi'num' coronal fricatives *s*, *th*, and *lh*
- Motivated by perceptual ambiguity, and articulatory difficulties in Hul'q'umi'num' L2 speakers

Background:

English fricatives:

- *s* = sibilant
- *th* = non-sibilant
- differentiated by spectral properties, noise duration, & amplitude (Jongman, Wayland, & Wong, 2000)
- perceptually distinct to English L1 speakers

Salish fricatives:

- *s*/*th* perceptually confusable to English L1 speakers
- contrast between *s*/*th* studied in ʔayʔaǰuθəm
- differentiated by duration, peak frequency trajectories, & formant transitions in some environments (Mellesmoen, 2017)
- articulatory difficulties distinguishing *th* and *lh* for Hul'q'umi'num learners

Research Question:

Do the acoustic and articulatory properties of coronal fricatives in Hul'q'umi'num' explain their perceptual ambiguity when pronounced by L1 speakers?

Primary

Secondary

How do coronal fricatives compare in L1 and L2 speech?

Methodology

Acoustic

- **Participants:** 1 L1 Speaker & 1 L2 Speaker
- **Procedure:** Acoustically analyzed previously-recorded Hul'q'umi'num' sound files
- **Analysis:** Fricative Duration, Intensity & Center of Gravity (COG) measurements taken using Praat

Articulatory

- **Participants**: 1 L1 Speaker & 2 L2 Speakers
- **Stimuli**: Hul'q'umi'num' word list of 17 words, with 25 target fricatives (*s*, *th*, *lh*)
- **Procedure**: Coronal ultrasound (US) recordings taken by Tess Nolan at HLCC in Duncan, B.C.
- **Analysis** :
  - tongue contours hand marked for each fricative using "ImageJ" program
  - contours were overlaid on single ultrasound image to create a visual representation of tongue grooving

Results

L1 Fricative Tongue Contours

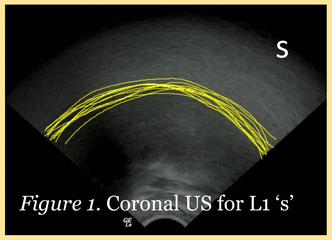

Figure 1. Coronal US for L1 's'

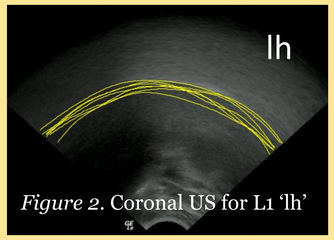

Figure 2. Coronal US for L1 'lh'

Figures 1-3:

- show little variation in *s* and *lh*
- *th* articulations more variable in tongue shape

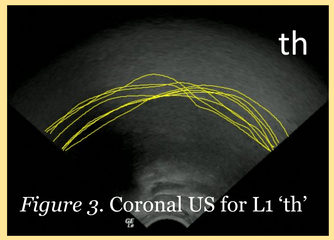

Figure 3. Coronal US for L1 'th'

L1/L2 Comparison:

- different articulation patterns for L2 *s*
- 1 L2's *s* shows similar patterns to L1
- L2 US shows variability in *lh* and *th*

Acoustic Data

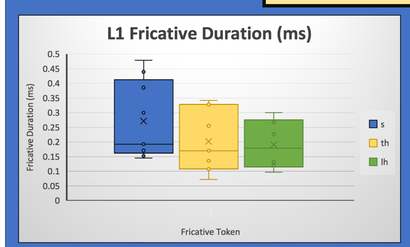

Figure 4. Shows the longer duration of *s* in comparison to *th* & *lh* in L1 speech

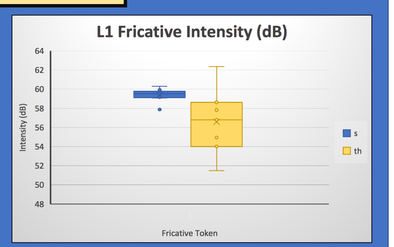

Figure 5. Shows high intensity of *s* in comparison to *th* in L1 speech

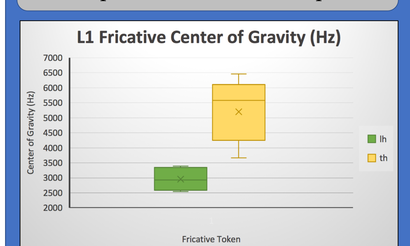

Figure 6. Shows distinguishability of *th* & *lh* in L1 speech based on COG

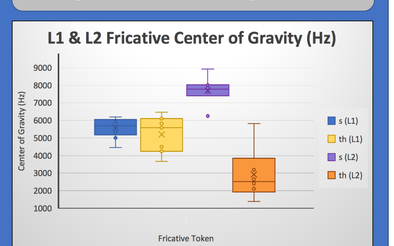

Figure 7. Shows COG as a way to distinguish *th* & *s* in L2 but not L1 data

Acoustic findings ***lh*/*th*: most differentiated by COG in L1 data**
***s*/*th*: most differentiated by intensity in L1 data**

Discussion

L1 results show support for *perceptual ambiguity*

th shows significant variability in acoustic and articulatory data

Acoustic overlap

- *s* has distinct frequency range, where variability of *th* causes frequency overlap
- *s* has longer mean duration than *th*, however variability in both *s* and *th* causes overlap

Articulation variability

- *s* has a distinct tongue shape
- *th* has much more variable tongue grooving

How does this compare to English?

- Hul'q'umi'num' *s*/*th* not as distinguishable as sibilants/non-sibilants in English

BUT

- *s*/*th* in Hul'q'umi'num' definitively characterized by intensity, and sometimes by spectral properties and duration (as in English)

L2 acoustic data shows possible influence of English first language

- *s*/*th* very distinguishable by COG for L2
- frequency (a spectral property) differentiates *s*/*th* in English

Articulatory differences between L1 & L2 *lh*/*th* suggest more than phonological error

- L1 has very systematic pronunciation of *lh*
- no visible pattern of L2 pronunciation of *lh*
- difficult acquisition of *lh* possibly due to articulatory similarities to *th*

Conclusion

Contribution

- Provided insight into what aspects of fricatives make them difficult to perceive and pronounce for Hul'q'umi'num' learners

Future Investigations

- A larger acoustic study including controlled stimuli and more participants
- A perception study with L2 speakers that manipulates various acoustic characteristics to help learners' recognition of fricative contrasts

Acknowledgments

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References

Jongman, A., Wayland, R., & Wong, S. (2000). Acoustic characteristics of English fricatives, *Journal of the Acoustical Society of America, 108*(3), 1252-1263.

Mellesmoen, G. M., (2017). *A Dynamic Phonetic Analysis of /s/ and /θ/ in ʔayʔaǰuθəm (Mainland Comox Salish)*. (Unpublished qualifying paper). Department of Linguistics, University of British Columbia.