Everything (or some things at least) you always wanted to know about Hul’q’umi’num’ phonetics:

Summary of findings from LING 486 projects

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General context and methodology

- LING 486: Introduction to experimental phonetics
  - Students normally free to choose a topic
  - This year: option of choosing a Hul’q’umi’num’ topic
    - 7/10 teams worked on Hul’q’umi’num’ phonetics
- Research teams:
  - LING 486 students
  - Hul’q’umi’num’ Language Academy (HLA) MA students

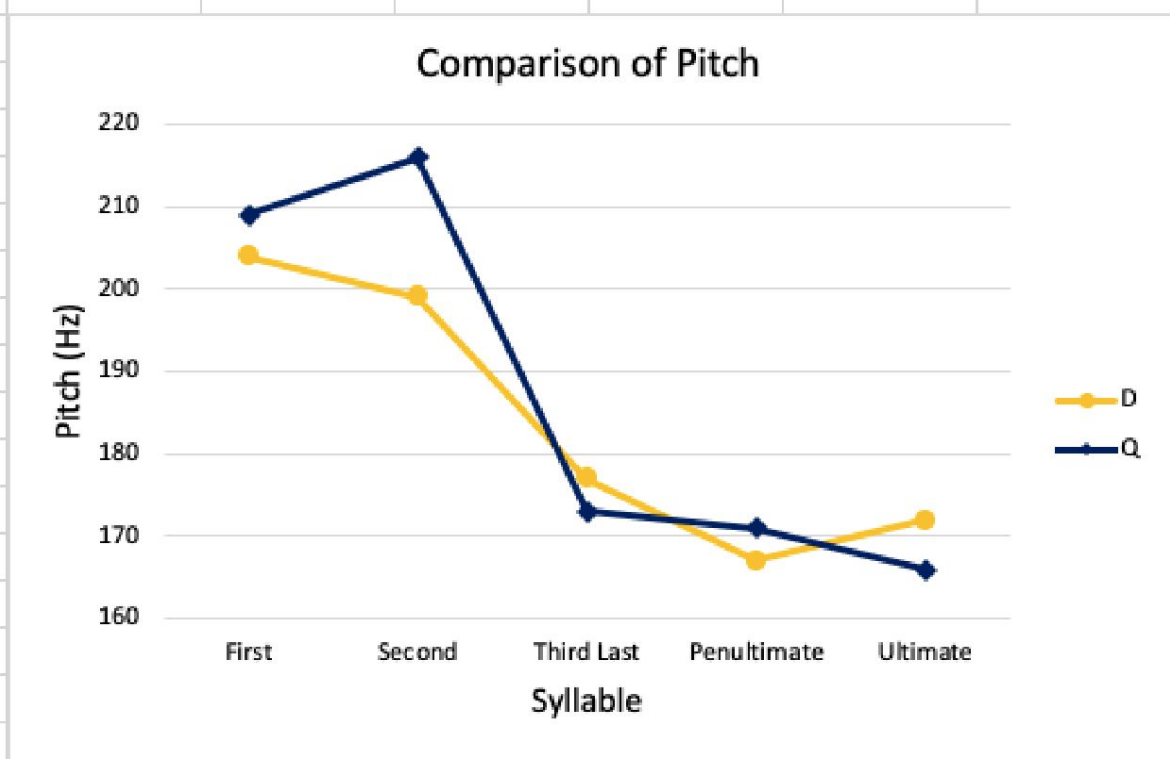
Projects

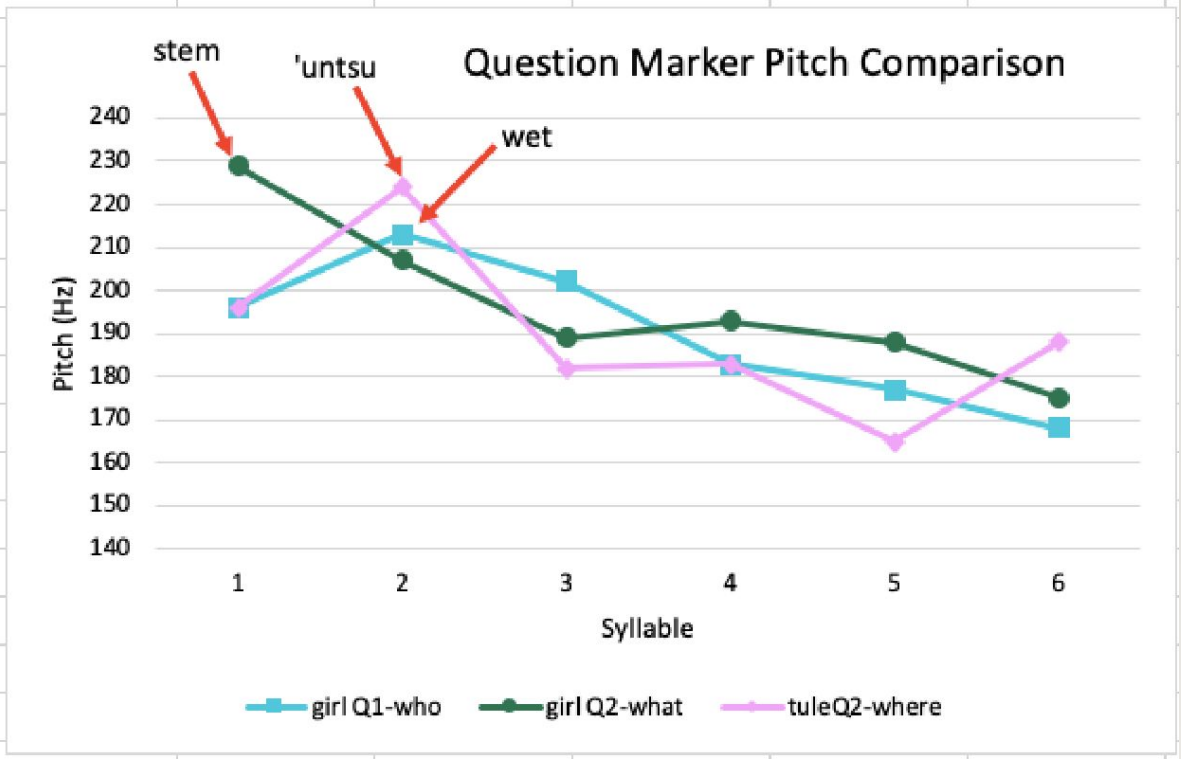
- Intonation in wh-questions vs. statements (L1)
- Stress in Hul’q’umi’num’ words (L1)
- Production of /th lh s/ (L1 and L2)
- Production of /kw kw’ qw qw’/ (L1 and L2)
- Production of word-initial consonant clusters (L2)
- Perception of word-initial consonant clusters (L2)
- Perception of glottalization (English listeners)

Intonation in wh-questions vs. statements Methods

- Speakers: Ruby and Gina
- Materials:
  - Two pictures used as prompts
  - Question words:
    - wet (who)
    - stem (what)
    - ‘untsu (where)
- Procedure: Gina provided questions and answers in English; Ruby translated them into Hul’q’umi’num’

Intonation in wh-questions vs. statements Results



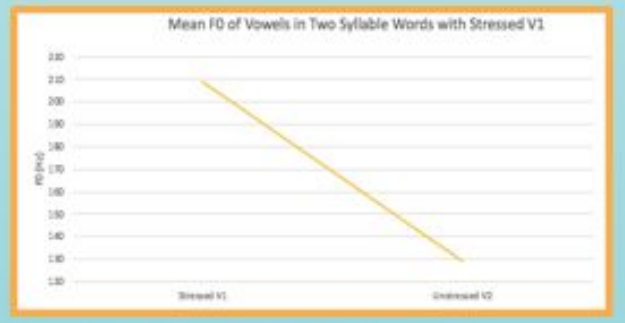
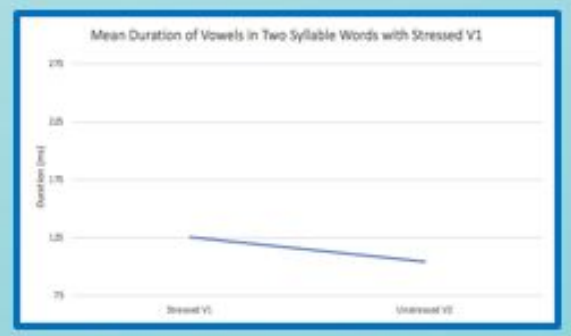
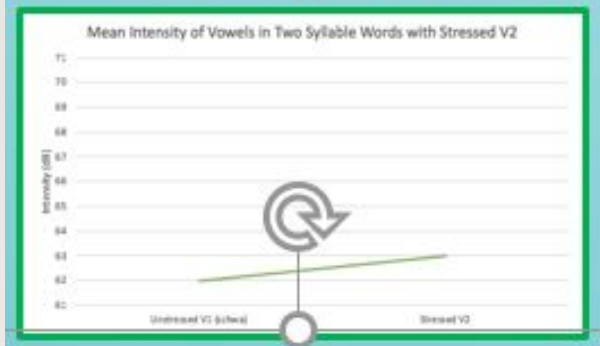
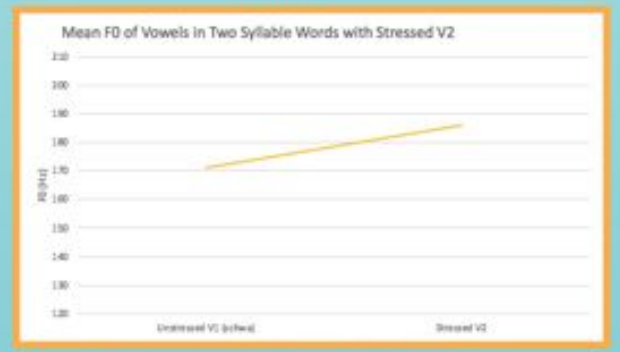
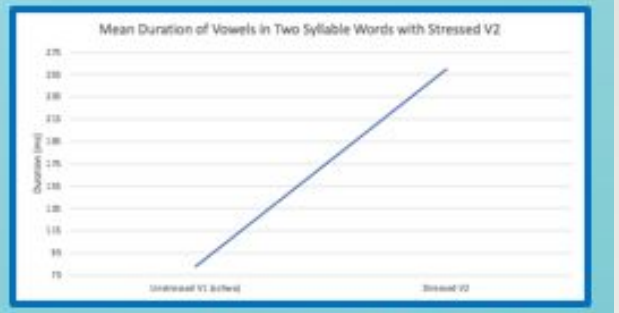


Word-level stress Methods

- Speaker: Ruby
- Materials:
  - 6 bisyllabic words (V-u; u-V)
    - Confound: u-V ~ u-V□
  - 4 trisyllabic words (V-u-u; V-u-V)
- Procedure: Donna provided English words; Ruby translated them (one at a time)

#	Word	Meaning	# syllables
1	Yasa'qw	Hat	2
2	Yaaysa'qw	Work hat	2
3	Ts'ewut	Help him	2
4	Ts'ewutham'sh	Help me	3
5	Qw'aqwut	Club him/it	2
6	Qw'aqwutham'sh	Club me	3
7	Qw'aqw'uqwut	Clubbing him/it	3
8	Qw'aqw'uqwutham'sh	Clubbing me	4
9	Liyaam	Devil	2
10	'e'uhwiin'	Little.dim	3
11	'uhwiin'	little	2

Word-level stress
Results: disyllabic words

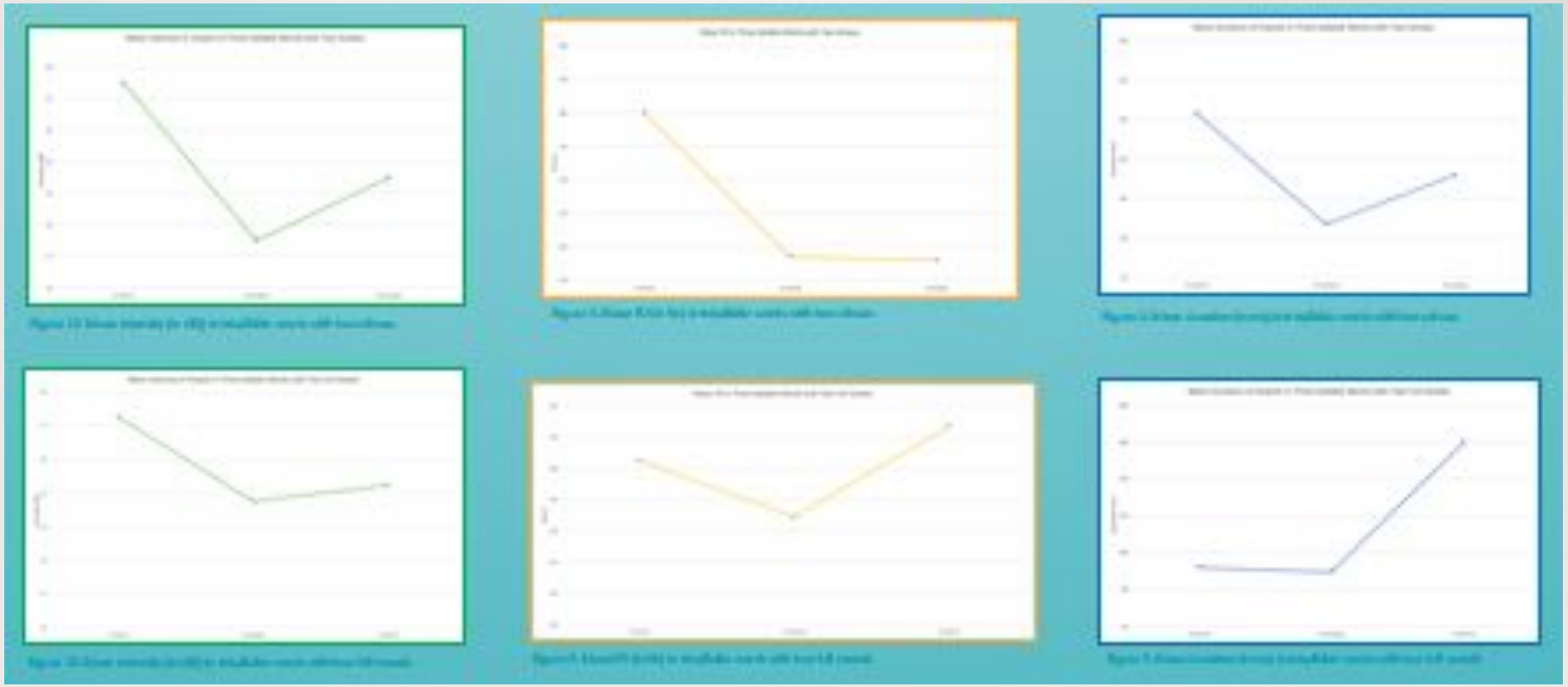
	intensity	pitch	duration
V-u (ts'ewut)	 Figure 10. Mean intensity (in dB)) in bisyllabic words with stressed V1	 Figure 6. Mean F0 (in Hz) in bisyllabic words with stressed V1	 Figure 2. Mean duration (in ms) in bisyllabic words with stressed V1
u-V ('uhwiin')	 Figure 11. Mean intensity (in dB)) in bisyllabic words with stressed V2	 Figure 7. Mean F0 (in Hz) in bisyllabic words with stressed V2	 Figure 3. Mean duration (in ms) in bisyllabic words with stressed V2

Word-level stress
Results: trisyllabic words

intensity | pitch | duration

V-u-u
(qw’aqw’uqwut)

V-u-V
(qw’aqwutham’sh)



/kw kw’ qw qw’/ Methods

- Speakers:
  - Ruby (audio)
  - Delores (ultrasound)
  - One L2 speaker (audio and ultrasound)
- Materials: 8 words
  - 2 words each: /kw kw’ qw qw’/ in initial position
- Procedure: words spoken one at a time

/kw kw’ qw qw’/
Results – plain~ejective contrast

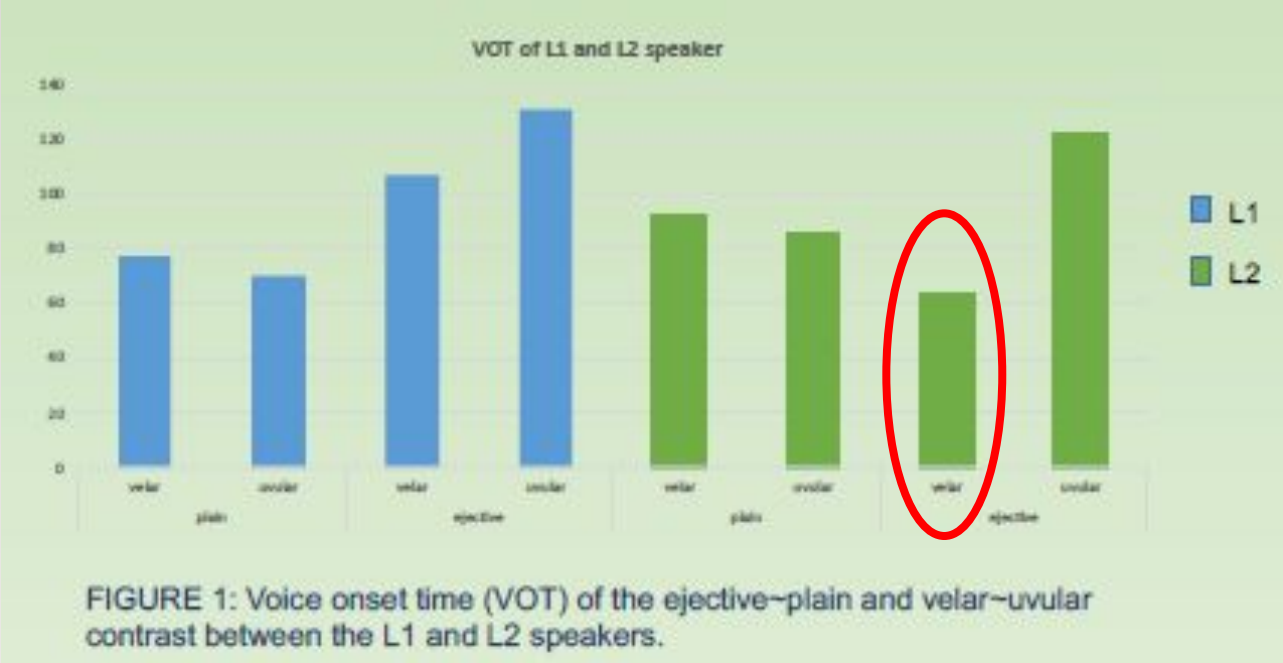


FIGURE 1: Voice onset time (VOT) of the ejective~plain and velar~uvular contrast between the L1 and L2 speakers.

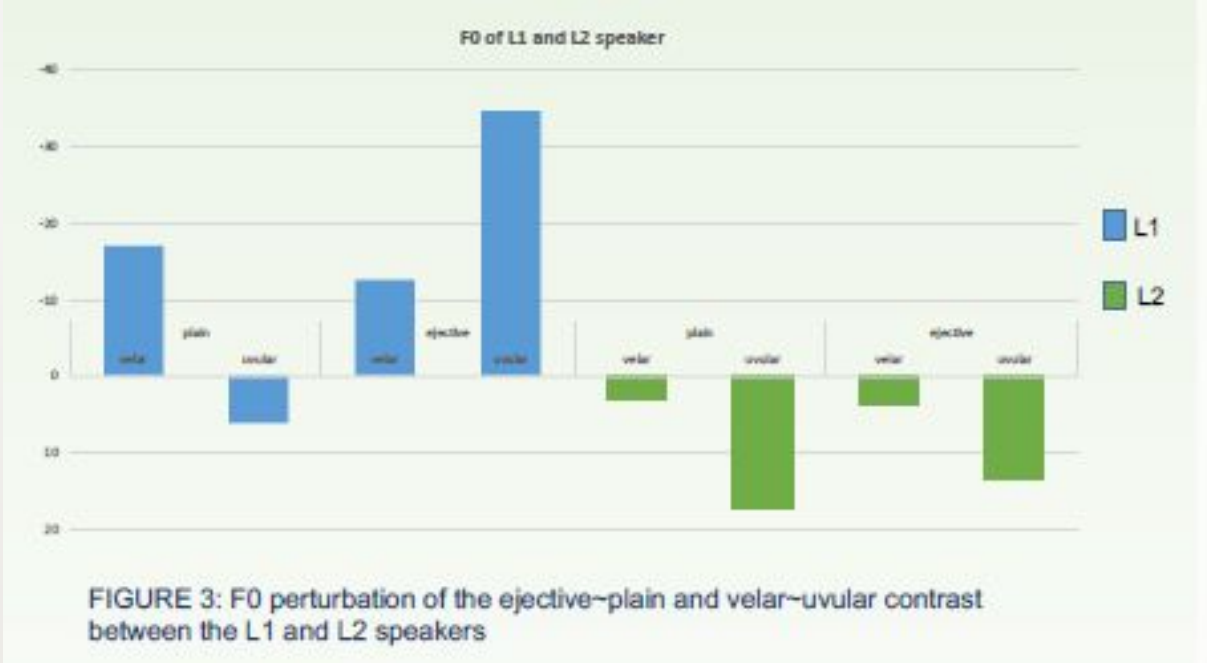


FIGURE 3: F0 perturbation of the ejective~plain and velar~uvular contrast between the L1 and L2 speakers

/kw kw’ qw qw’/
Results – velar~uvular contrast

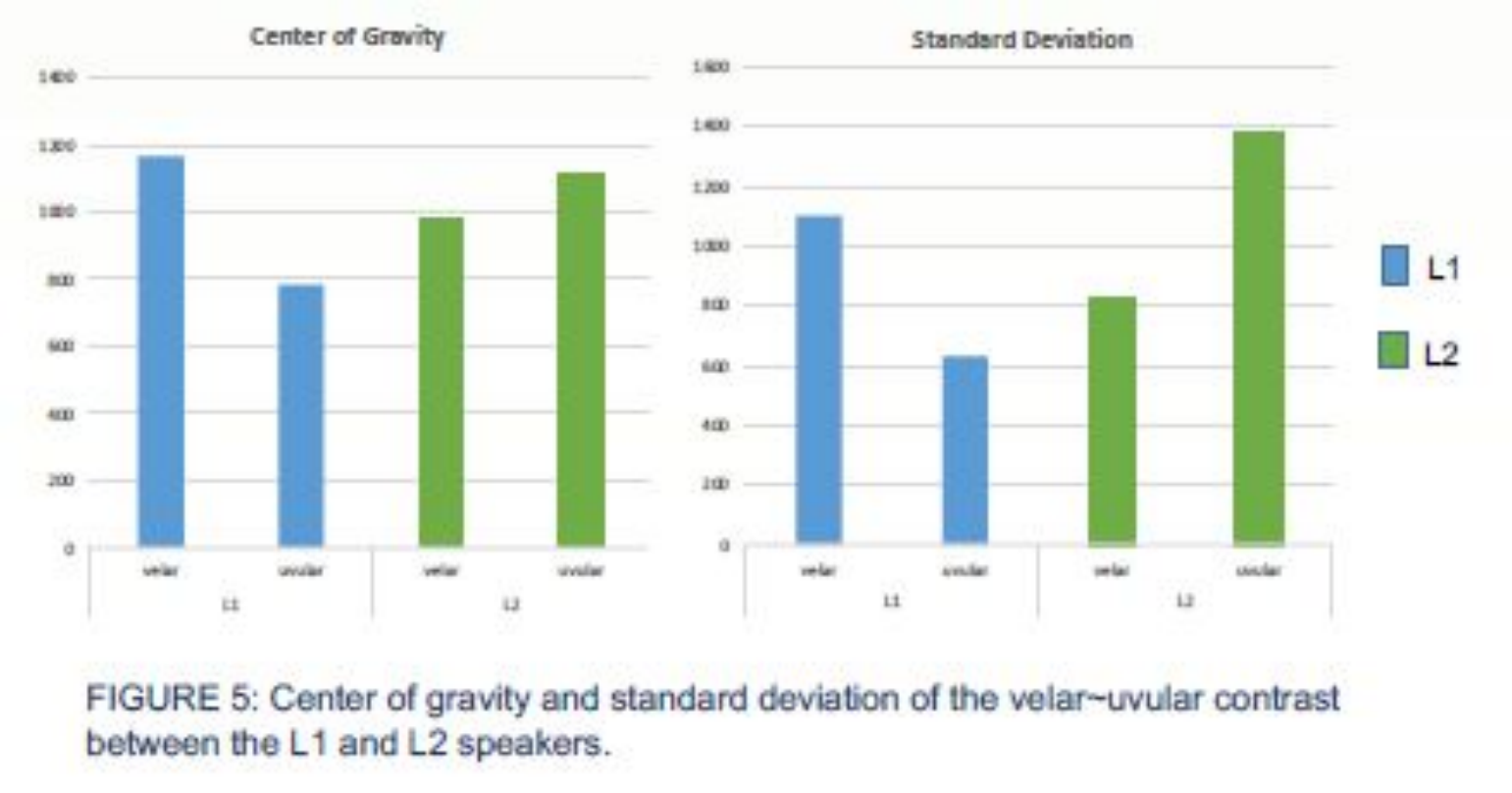


FIGURE 5: Center of gravity and standard deviation of the velar~uvular contrast between the L1 and L2 speakers.

/kw kw’ qw qw’/
Results – velar~uvular contrast

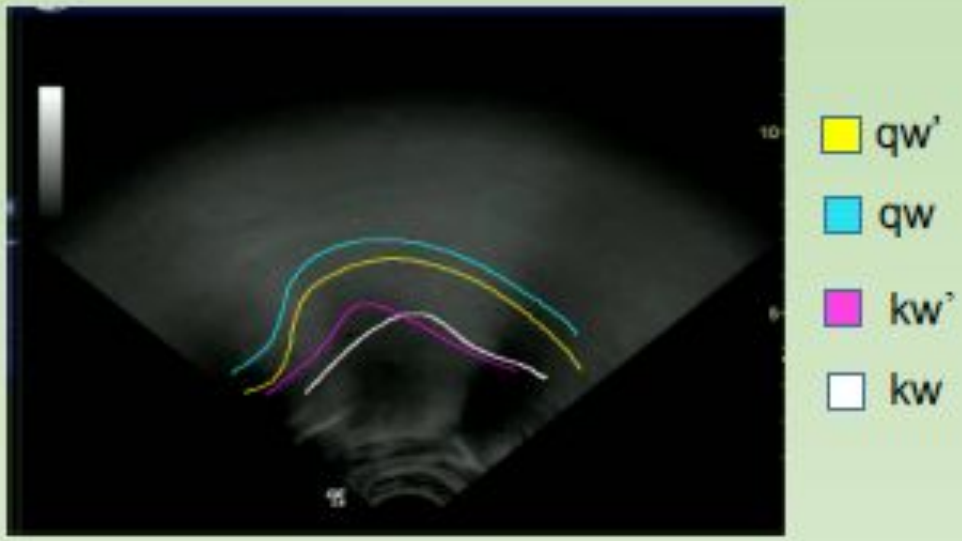


FIGURE 6: Ultrasound image of uvular~velar and ejective~plain contrast in word medial position of L1 speaker.

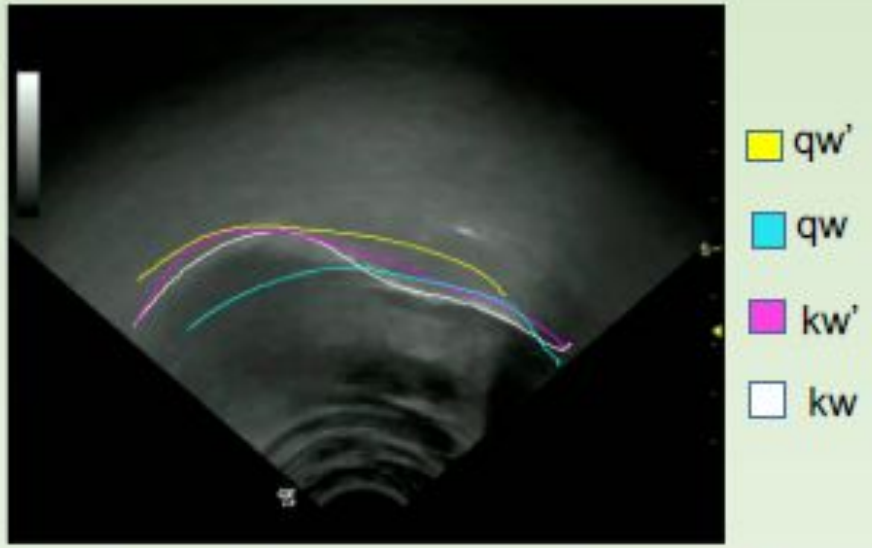
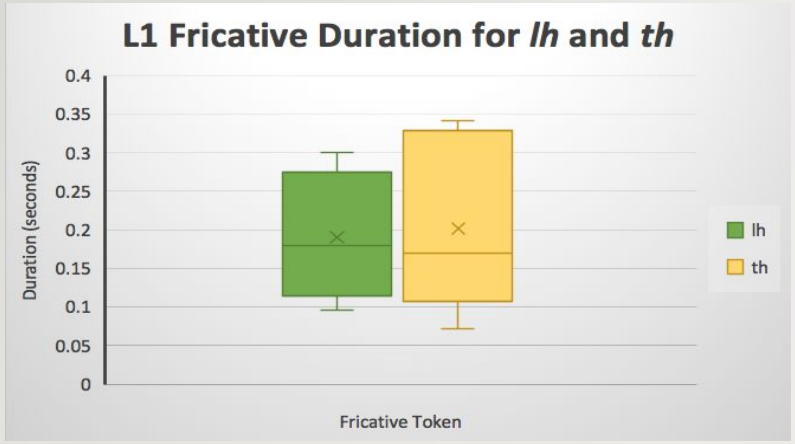


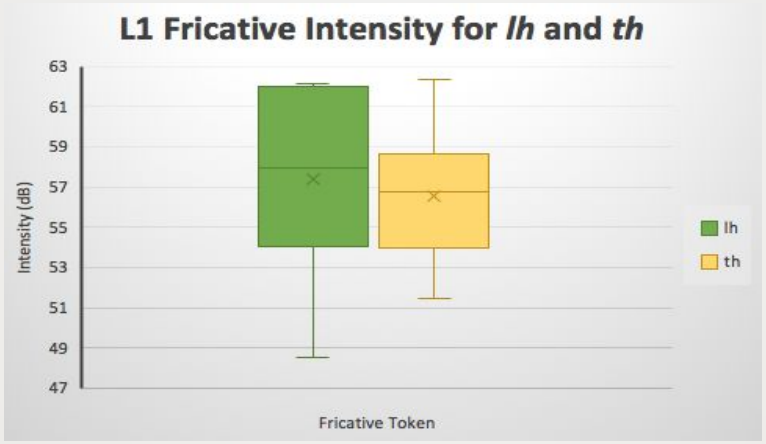
FIGURE 7: Ultrasound image of uvular~velar and ejective~plain contrast in word initial position of L2 speaker.

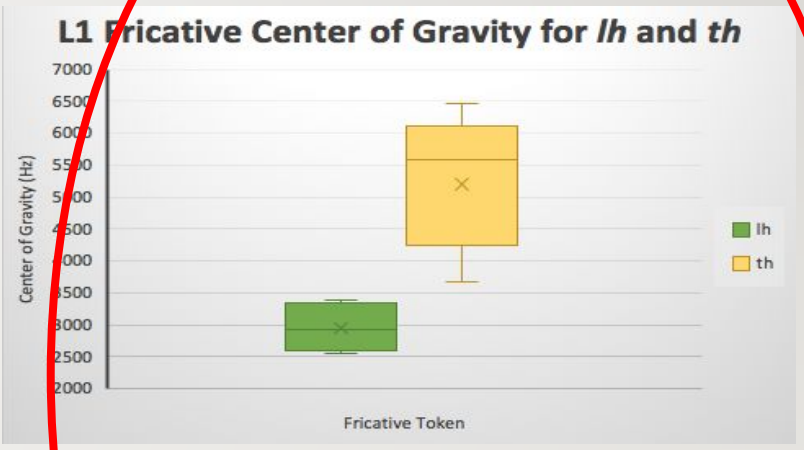
/lh th s/ Methods

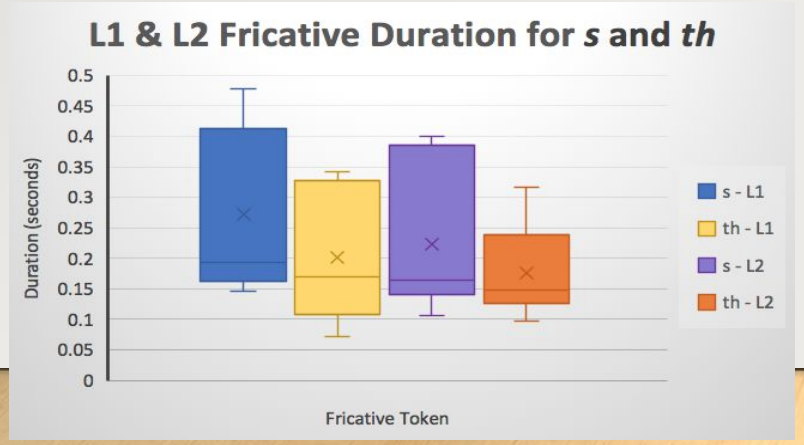
- Speakers:
  - 2 L1 speakers
    - one for acoustic study and one for articulatory study
  - 1 L2 speaker
- Materials:
  - Short word lists with target sounds
  - Pre-recorded using audio and ultrasound
- Data analysis:
  - acoustic measures (duration, intensity, COG) + tongue contours

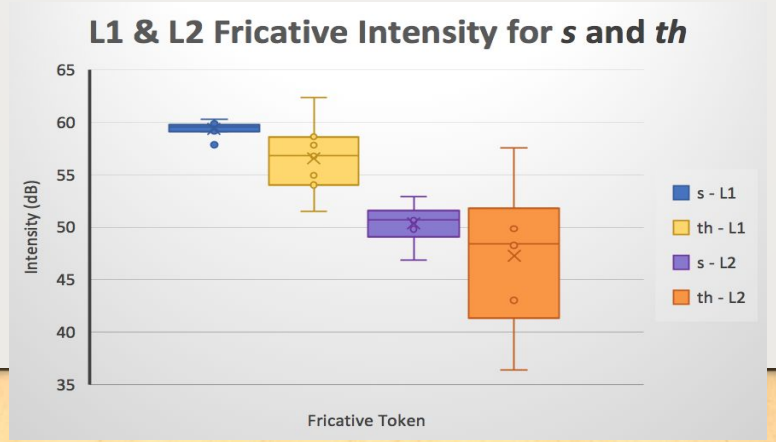
/lh th s/
Results - acoustics

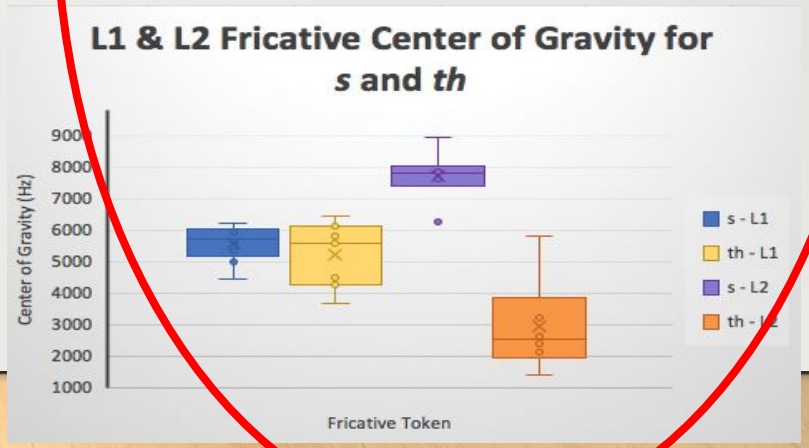




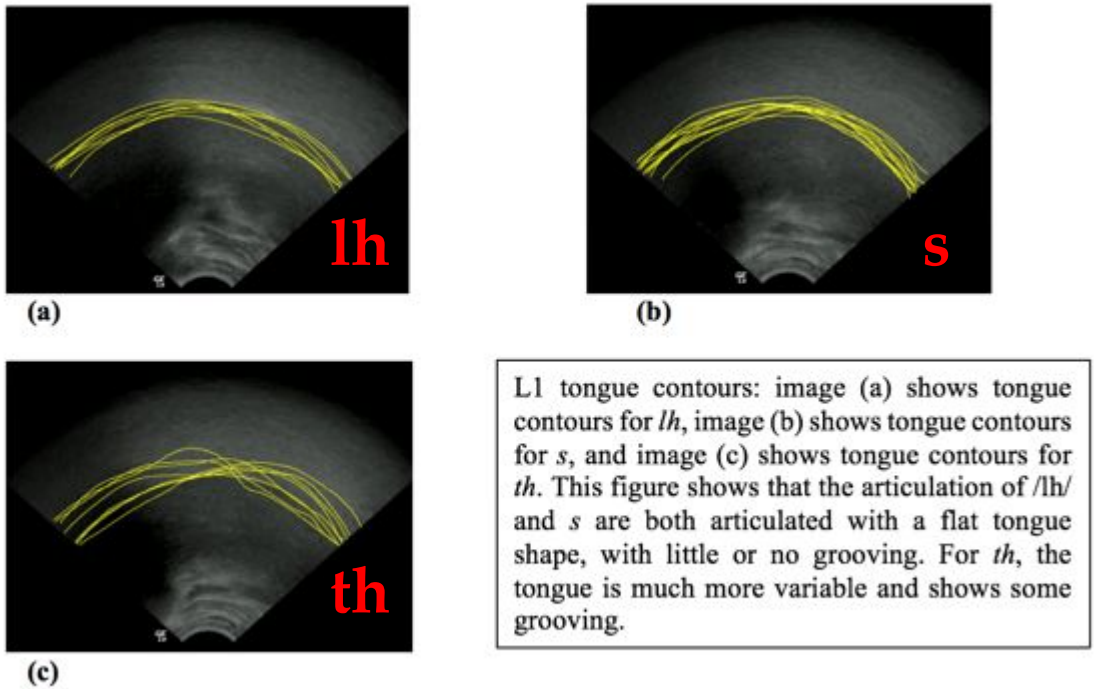






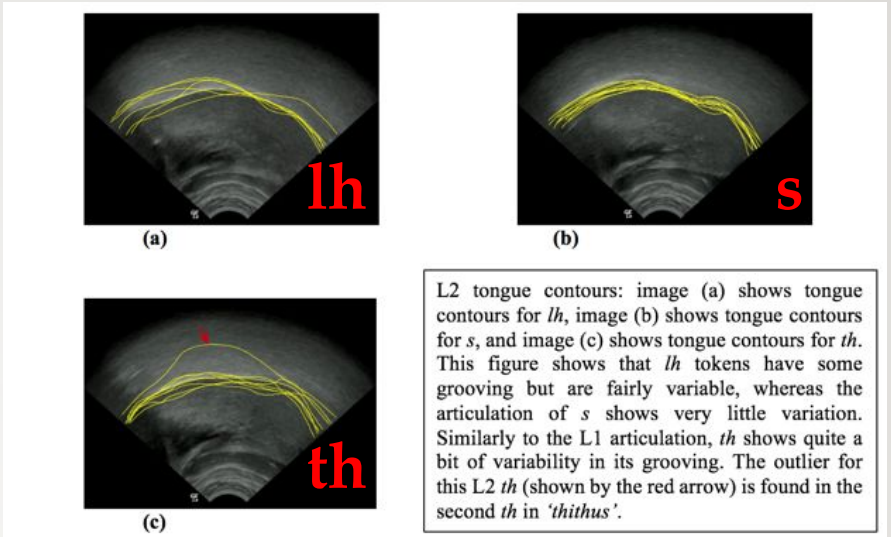


/lh th s/
Results - articulation



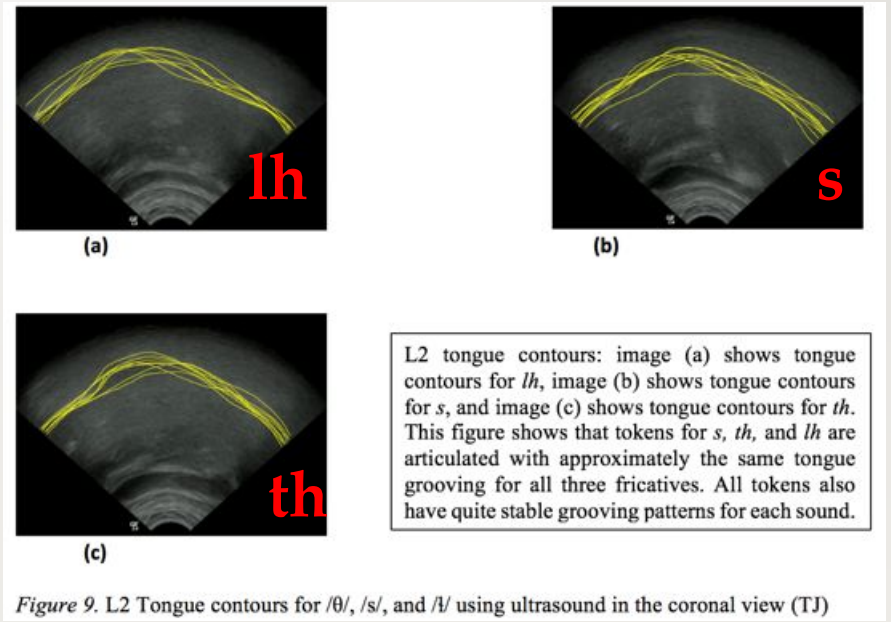
L1 tongue contours: image (a) shows tongue contours for *lh*, image (b) shows tongue contours for *s*, and image (c) shows tongue contours for *th*. This figure shows that the articulation of /lh/ and *s* are both articulated with a flat tongue shape, with little or no grooving. For *th*, the tongue is much more variable and shows some grooving.

Figure 7. L1 tongue contours for /θ/, /s/, and /ɬ/ using ultrasound in the coronal view. (DL)



L2 tongue contours: image (a) shows tongue contours for *lh*, image (b) shows tongue contours for *s*, and image (c) shows tongue contours for *th*. This figure shows that *lh* tokens have some grooving but are fairly variable, whereas the articulation of *s* shows very little variation. Similarly to the L1 articulation, *th* shows quite a bit of variability in its grooving. The outlier for this L2 *th* (shown by the red arrow) is found in the second *th* in *'thithus'*.

Figure 8. L2 tongue contours for /θ/, /s/, and /ɬ/ using ultrasound in the coronal view (RCB)



L2 tongue contours: image (a) shows tongue contours for *lh*, image (b) shows tongue contours for *s*, and image (c) shows tongue contours for *th*. This figure shows that tokens for *s, th,* and *lh* are articulated with approximately the same tongue grooving for all three fricatives. All tokens also have quite stable grooving patterns for each sound.

Figure 9. L2 Tongue contours for /θ/, /s/, and /ɬ/ using ultrasound in the coronal view (TJ)

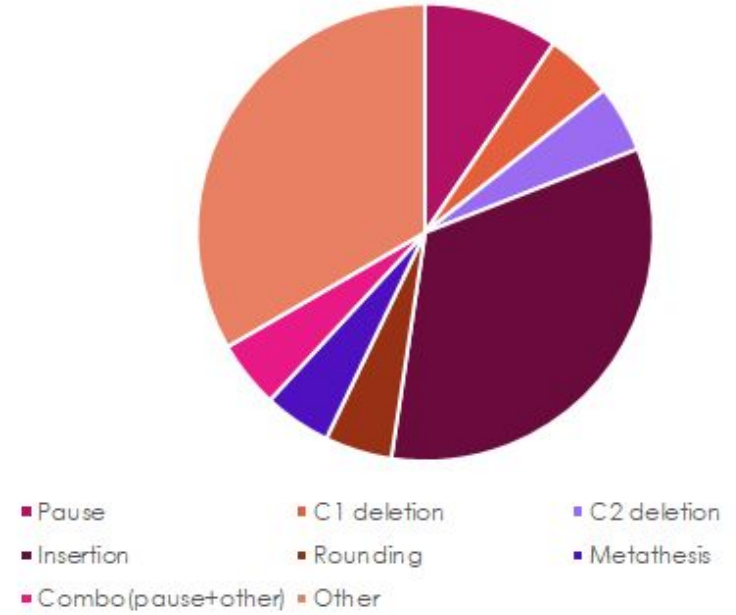
Word-initial consonant clusters - production Methods

- Speakers: 2 L2 speakers
- Materials: 12 words with initial clusters
- Procedure: L2 speakers repeated after L1 speakers; also had access to written words (cluster session, December 2018)

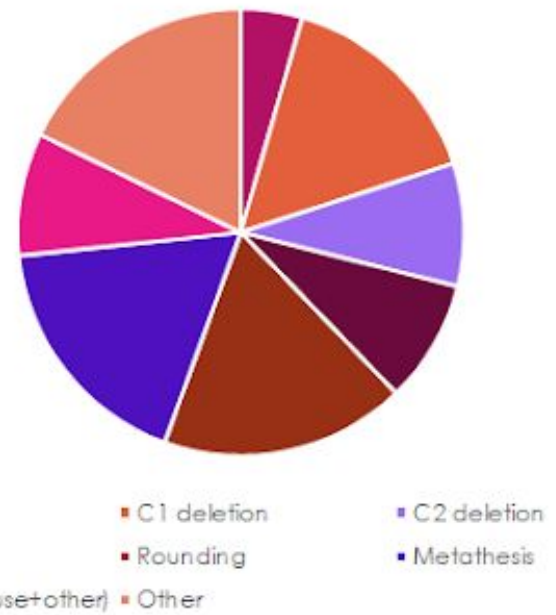
Hul'q'umi'num'	English
Tstl'um	Jump
Ts'lh hwulmuhw	Fellow Indians
Lhhwiws	Three frogs
T-hwlhhwiws	Only three
Tslhteti'	Fellow paddlers
Ts'qw'alstun	Fork
Sxt'ekw'	Carving (noun)
Hwtth'xwasum	To wash (your) face
Lhxilush	Stand up
Stslhal'we'lh	Above
Xthum	Drum; box
Tth'xwulnusum	To brush (your) teeth

Word-initial consonant clusters – production Results

L2 speaker 1



L2 speaker 2



Word-initial consonant clusters - perception Methods

- Listeners:
  - 6 L2 Hul'q'umi'num' speakers
  - 3 UVic UG students
    - minimal Hul'q'umi'num' experience; phonetics training
- Materials: 14 words with initial clusters
- Procedure: words read aloud by 2 L1 speakers and transcribed by L2 speakers

Hul'q'umi'num'	English
Tstl'um	Jump
Ts'lhhwulmuhw	Fellow Indians
Lhhwiws	Three frogs
T-hwlhhwiws	Only three
Tslhteti'	Fellow paddlers
Ts'qw'alstun	Fork
Sxt'ekw'	Carving (noun)
Hwtth'xwasum	To wash (your) face
Lhxilush	Stand up
Stslhal'we'lh	Above
Xthum	Drum; box
Tth'xwulnusum	To brush (your) teeth
Stseelhtun	Salmon
Sxlhas	food

Word-initial consonant clusters - perception Results

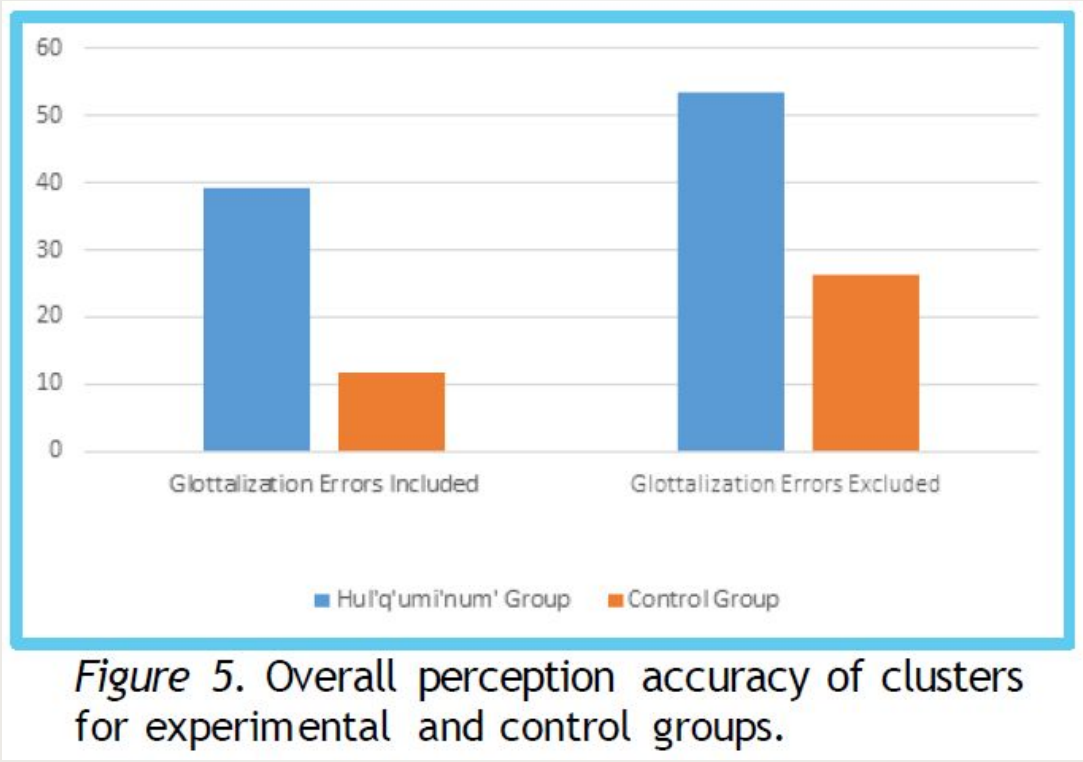


Figure 5. Overall perception accuracy of clusters for experimental and control groups.

Word-initial consonant clusters - perception Results

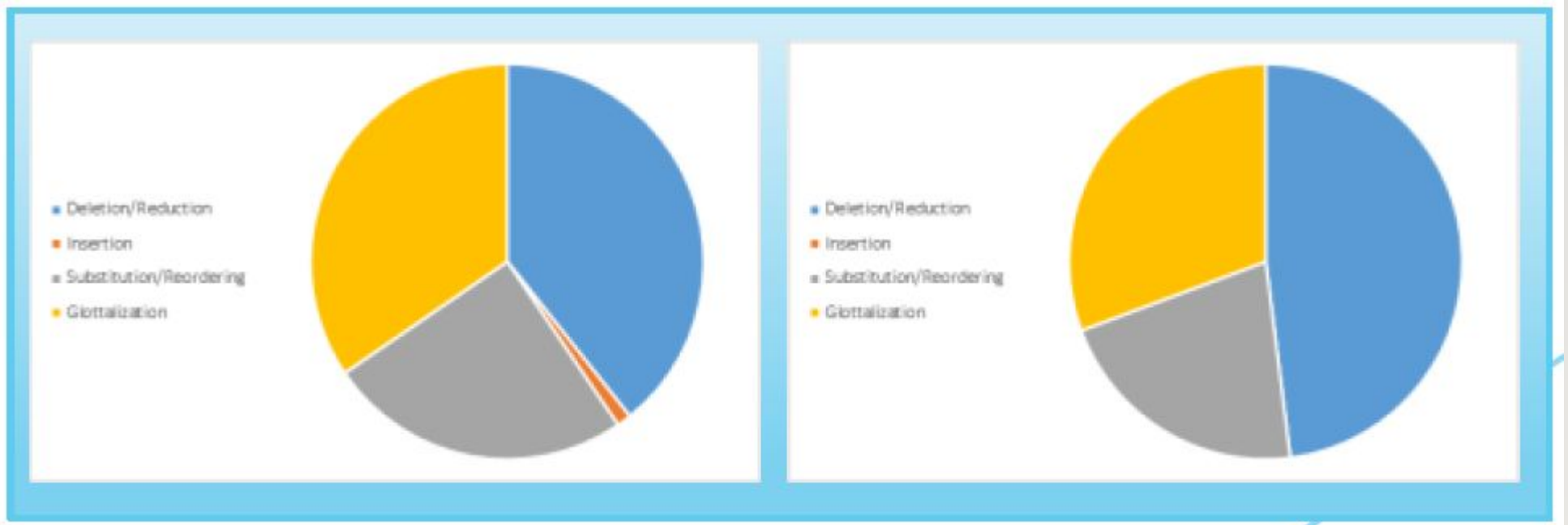


Figure 6. Experimental group perception errors.

Figure 7. Control group perception errors.

Final glottalization – perception Methods

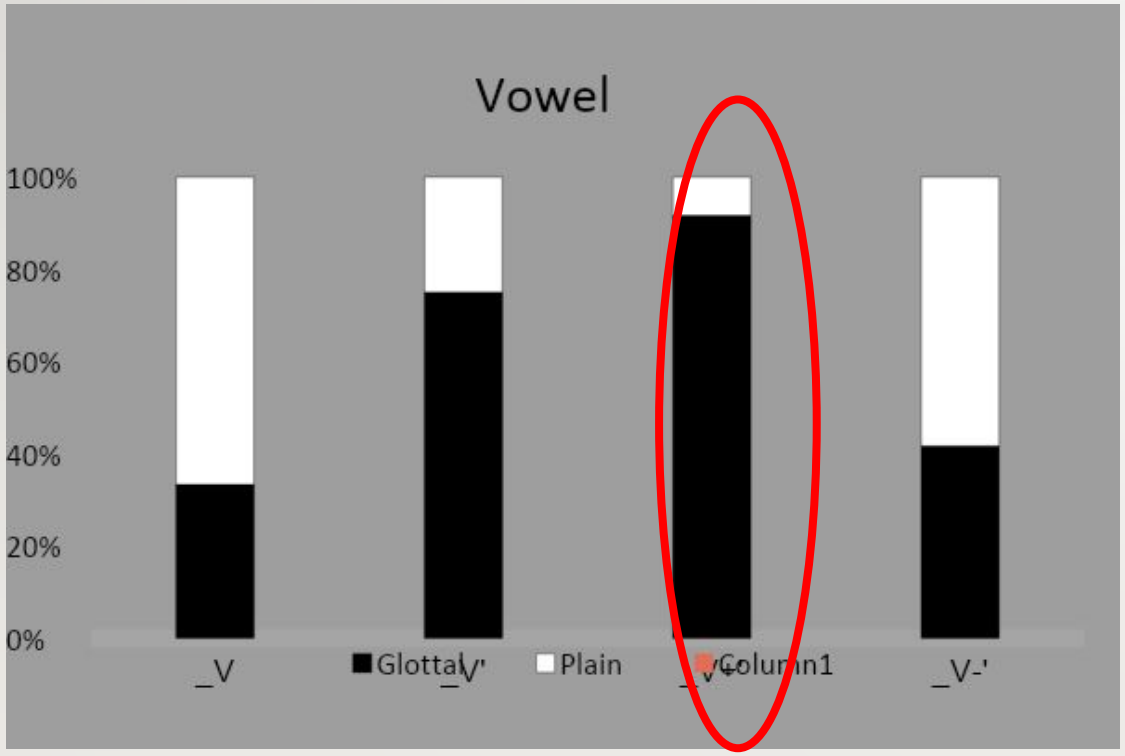
- Listeners: 6 English speakers
- Materials:
  - Words ending in V, V’, R, R’ (2 each = 8 total)
  - + Modified words (8 total):
    - V and R: release added ≈ V’ R’
    - V’ and R’: release removed ≈ V R
- Procedure: listeners circle the word they hear

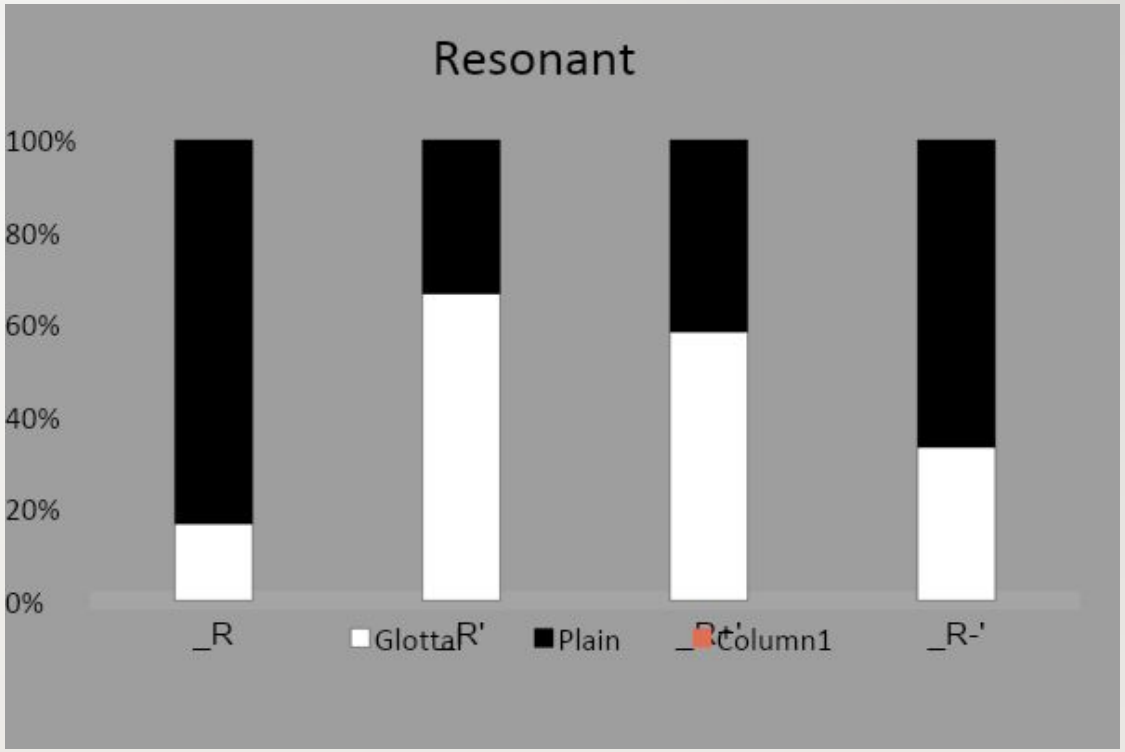
V/R	English
Kwushou	Cow
Nuwu	You
Tlam	
S’itth’um	Clothes
V/R	English
Stqeeye’	Wolf
Yuxwule’	Bald eagle
Stth’am’	Bone (?)
T’at’ulhum’	flea

Final glottalization – perception Methods

- Kwushou 
- Kwushou + release 
- Squlew’ 
- Squlew - release 

Final glottalization – perception Results





Final glottalization – perception Results

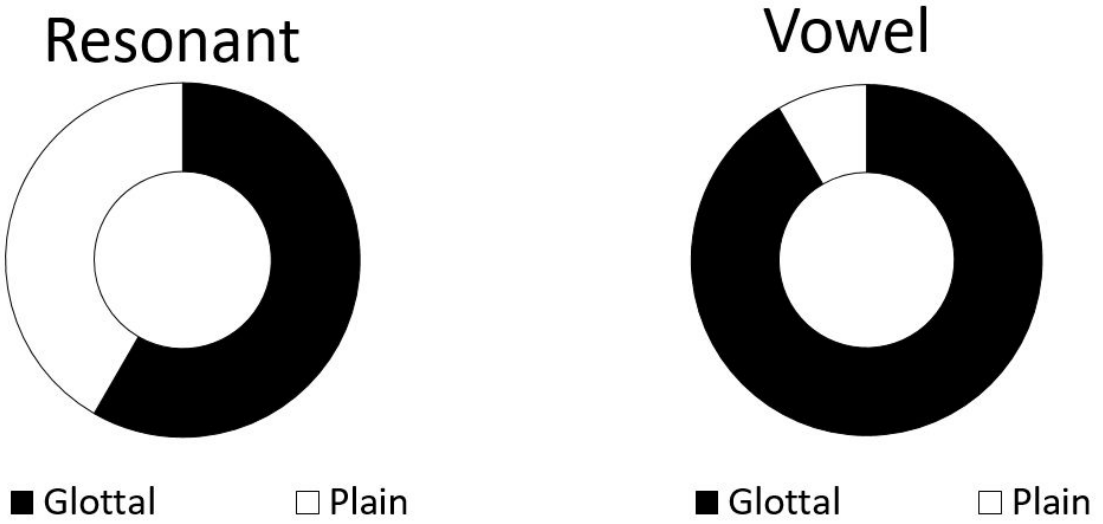


Figure 4. Percentages of glottal versus plain responses in (_V+'/_R+').

Lessons learned

- Collaborative work in the context of a one semester course is really challenging!
  - Time commitment is difficult to make
- Clear expectations at the outside are really important
  - Goals and outcomes, methods, assigned work
  - Research teams
    - Who are the team members?
    - What is each team member's contribution?
      - Research question(s), methods, data analysis and interpretation, final report
    - How often will team members communicate, and at what stages?
    - How will team members communicate?
  - Materials
    - What materials are available and accessible? (organize and prepare them beforehand)
    - When is it better to use existing materials vs. to elicit new materials?

Summing up

- Some robust findings
  - Intonation

- Some areas for further exploration
  - Word-level stress – morphological effects
  - /th lh s/
  - Cluster production: better vs worse strategies; errors by type of cluster
  - Clusters perception: errors by type of cluster
  - Perception of glottalization

- Some non-robust but expected findings, which we can move ahead with in terms of developing pedagogical tools
  - /kw, kw’, qw, qw’/

What's next?

- /lh th s/ - ultrasound; palatography?
- Clusters – listening tests
  - Designed as tests for students, but on a research platform so we can extract responses and analyze them