Ultrasound Overlay Videos and their Application in Indigenous Language Learning and Revitalization

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Acknowledgements

• We gratefully acknowledge that we are on the unceded territory of the Musqueam, Squamish, and Tsleil-Waututh First Nations

• Sincere thanks to Noreen Breaker, Lou Claxton, Ashlee Cooper, Natalie Creighton, Shirlee Crowshoe, Emmeline Felix, Nick Henry, Tiffany Joseph, Katia Olsen, and Elizabeth Phillips for sharing their languages with us

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Ultrasound in L2 acquisition

• L2 learners make use of both auditory and **visual** information to acquire new sounds

• Ultrasound has been demonstrated to be an effective tool for facilitating visualization of the articulatory processes involved in speech production

• With ultrasound, learners can...
  • ... directly observe their articulator movements
  • ... compare them with those of an instructor or native speaker
  • ... make articulatory adjustments to improve their pronunciation

• Challenges:
  • Best used in one-on-one contexts or with small groups
  • Interpreting the displays requires specialized knowledge
Meeting the challenges

• **Ultrasound overlay videos**
  • combine ultrasound images of tongue movement in speech with external profile views of a speaker’s head
  • accessible and interpretable to a broader audience
  • can be used in online, blended, and/or flexible learning paradigms

• **Video library** ([enunciate.arts.ubc.ca](enunciate.arts.ubc.ca))
  • 91 videos, corresponding to each sound in the IPA
  • Intended users: university-level linguistics students and learners of widely studied languages such as Japanese, French, Spanish, German, etc.
Ultrasound overlay videos for Indigenous languages

• Unexpected outcome
  • Broad and unsolicited interest from First Nations communities and allies
  • Recognition of the potential benefits of using this technology in Indigenous language learning and revitalization

• Our response: Customization
  • Developing strategies to streamline the overlay process
  • e.g., Custom-made software package to automate ultrasound overlay

• This talk: Case studies on our work-in-progress on developing ultrasound overlay video resources for Indigenous languages in West Canada
Case Study #1: Halq’eméylem (Coast Salish)

- One L1 speaker (Elizabeth Phillips)

- Rich consonant inventory, including plain, ejective, and labialized obstruents at various places of articulation.
  - Many contrasts that are challenging for learners (mostly L1 English)
  - We recorded near-minimal pairs that highlight the challenging contrasts

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Word 1</th>
<th>Word 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain/Ejective</td>
<td>tá:l</td>
<td>t’á:l</td>
</tr>
<tr>
<td></td>
<td>qwélqwel</td>
<td>qw’él</td>
</tr>
<tr>
<td>Alveolar/Dental</td>
<td>tale</td>
<td>th’ále</td>
</tr>
<tr>
<td>Velar/Uvular</td>
<td>k’ák’elha</td>
<td>q’áq’el</td>
</tr>
</tbody>
</table>
• The intention is to use the resulting ultrasound overlay videos in the production of digital storybooks for language teaching purposes.
Case Study #2: Secwepemc (Interior Salish)

• Rich phonetic inventory that poses challenges for learners

• Splatsin Tsm7aksaltn has produced a resource that exemplifies the sounds of the language with words from the Eastern dialect

• Ultrasound overlay videos will supplement these resources
• We are collaborating with the community to develop ultrasound overlay videos
• Not only a teaching tool, the videos can inform our understanding about the phonetic inventory of the language
• Ultrasound can help clear up some confusion about under- or mis-documented sounds
  • e.g., orthographic “r” is described as velar (same place of articulation as “k”)
  • but early impressions from ultrasound suggest otherwise (uvular/pharyngeal)
Case Study #3: SENĆOŦEN (Northern Straits Salish)

- Few L1 speakers, but vibrant language revitalization program, including language nest & immersion school
- Pronunciation regarded as important; learners need to develop “SENĆOŦEN muscles” [3]
Collaboration and capacity-building

- We are working with language apprentices to create ultrasound overlay videos
- This project aims to build capacity and expertise for language resource development within the community
- Apprentices selected words that illustrated challenging sounds and clusters, as well as early vocabulary such as numerals
- Recorded productions of one L1 speaker, four advanced adult learners (the apprentices), and two children in the immersion program
- Resulting educational resource is intended for use by parents whose children are in the immersion program
Case Study #4: Blackfoot (Plains Algonquian)

• **Focus:** word-final vowels /-a/ and /-i/
  • Seen as emblematic of language loss
  • Assumed to be absent in the grammars of younger speakers and/or disappearing from certain dialects [4, 6]

• **Variation** across speakers
  • *Voiceless*
  • “*Soundless*” -- for some speakers, the vowels are articulated but inaudible [7]
  • “*Ghosts*” -- for other speakers, they are not articulated at all, but are nevertheless phonologically active

• This variation – and the fact that they are auditorily “weak” – makes the vowels challenging for learners
• We are developing ultrasound overlay videos with speakers of **three dialects** in order to help learners understand the range of variation in pronunciation
Discussion

• Challenges of pronunciation learning can be compounded for Indigenous languages
  • scarcity of resources (including small numbers of speakers)
  • pressures faced by heritage learners to preserve their ancestral language in an authentic way
  • latent speakers may be inhibited due to perceived concerns with their pronunciation, particularly in the presence of elders

• Ultrasound overlay videos
  • ...may give learners a new way to learn pronunciation
  • ...create documentation for future generations
Future Directions

• Evaluation
  • Few studies evaluating effectiveness of ultrasound overlay videos in L2 learning
  • No studies on their effectiveness in Indigenous language learning

• Other languages
  • Expressions of interest from communities and allies for the following languages:
    • Heiltsuk
    • Hul'q'umi'num'
    • Kwak’wala
    • Skwxwu7mesh
References


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