Variation in Compensatory Strategies as a Function of Target Constriction Degree in Post-Glossectomy Speech

Christina Hagedorn¹, Yijing Lu², Asterios Toutios³, Uttam Sinha⁴, Louis Goldstein⁵, Shrikanth S. Narayanan⁶
¹ College of Staten Island – CUNY, ² USC Dornsife College of Letters, Arts and Sciences, ³ USC Viterbi School of Engineering, ⁴ USC Keck School of Medicine

**BACKGROUND & MOTIVATION**

**Post-Glossectomy Speech**

Individuals with advanced lingual cancer oftentimes undergo hemi-glossectomy, involving partial removal of the tongue. Following glossectomy, individuals often compensate to produce consonants, using articulators other than those typically used to make vocal tract constrications.

• Velar stops → Pharyngeal stops 
• Alveolar fricative production differs in patients and typical speakers 
• Alveolar stops → Labiodental stops 
• Alveolar fricatives → Velar fricatives

Do compensatory strategies used by individual patients vary systematically as a function of target manner of articulation (e.g., oral stop, nasal stop, fricative, lateral) at a given place of articulation (e.g., alveolar)?

**HYPOTHESES**

1. Compensatory strategies (articulators used, and the extent to which they are used) will have a 1:1 mapping with articulators used in target/unimpaired production.
2. Compensatory strategies used for each target manner of articulation will vary in subtle yet meaningful ways.

**METHODS**

Two patients (F1, M1) with oral tongue and oral and base of tongue cancer who underwent partial glossectomy, neck dissection, free flap reconstruction and radiation therapy. Vocal tract image digitized using real-time MRI.

• Spatial resolution: 68 x 68 pixels
• Temporal resolution: 23.18 f.p.s

Stimuli:

• TIMIT sentences and Rainbow Passage excerpts

**ANALYSIS**

1. Fine-grained, manual, frame-by-frame analysis was completed for all speech segments produced. Articulatory behavior at the point of maximum constriction (regardless of constriction location) for all consonants was logged.
2. Image data segmented along air-tissue boundaries.
3. Labial, alveolar, palatal and velar regions are defined anatomically for each speaker.
4. Within each region, all possible cross-distances in pixels are calculated and coordinates at which minimum cross-distances occurs are determined.

**RESULTS**

How do constriction degrees differ in patients and typical speakers?

**CONCLUSION**

Compensatory strategies used for each target manner of articulation do tend to vary in subtle yet meaningful ways.

- Compensatory behavior is complex in nature
- Does not simply involve switching out behavior of one articulator, or set of articulators for another.
- When target constriction degree at a particular constriction location cannot be preserved, patients may leverage ability to finely modulate constriction degree at multiple remaining constriction locations to compensate.
- A considerable amount of inter-speaker variability exists.

**SELECTED REFERENCES**


**ACKNOWLEDGEMENTS**

Research supported by NIH Grants DC007124-01, DC008780-05 and DC00975-01.