Assessing head-and-neck cancer patient speech with the vowel dispersion index

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1. Introduction

- Surgical treatment for head-and-neck cancer patients changes anatomy and physiology of articulators [1, 4]
- Vowel space area decreases [6]
- Patients adopt diverse strategies to maintain intelligibility and social acceptability
- Lingering question is what those strategies are
- **Hypothesis: patients will disperse vowels throughout vowel space but show decreased vowel space as time elapses post treatment**

2. Methods

- 333 recordings of the zoo passage from 107 head-and-neck cancer patients at different stages pre- and post-surgery (pre, 1 mo., 6 mos., 1y)
- Vowel dispersion index (VDI) [3] and vowel space area calculated on each recording
- VDI based on vowel space density [5] & represents total change in density in vowel space (see Figure 2)
  1. Calculate discrete gradient of vowel space density
  2. Sum the magnitudes of the gradients
- LMER for VDI with area and time point as predictors
- LMER for area with time point as predictor

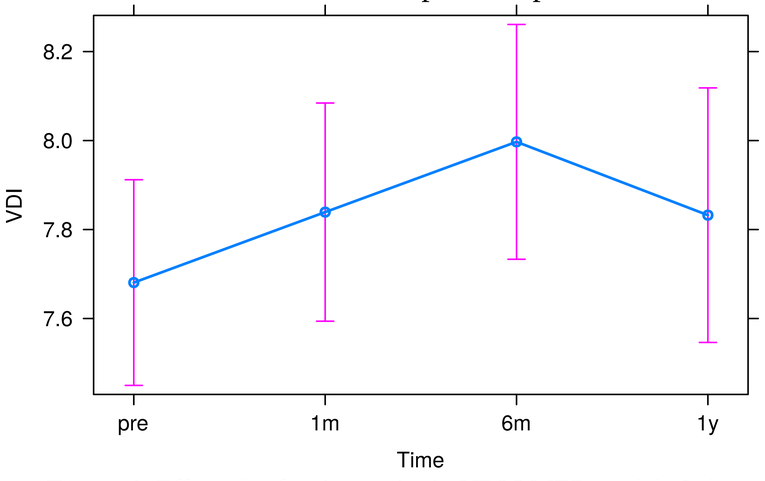

Figure 1. Effect plot for time point in VDI LMER model. Only 6 mos. time point is significantly different from pre-surgery.

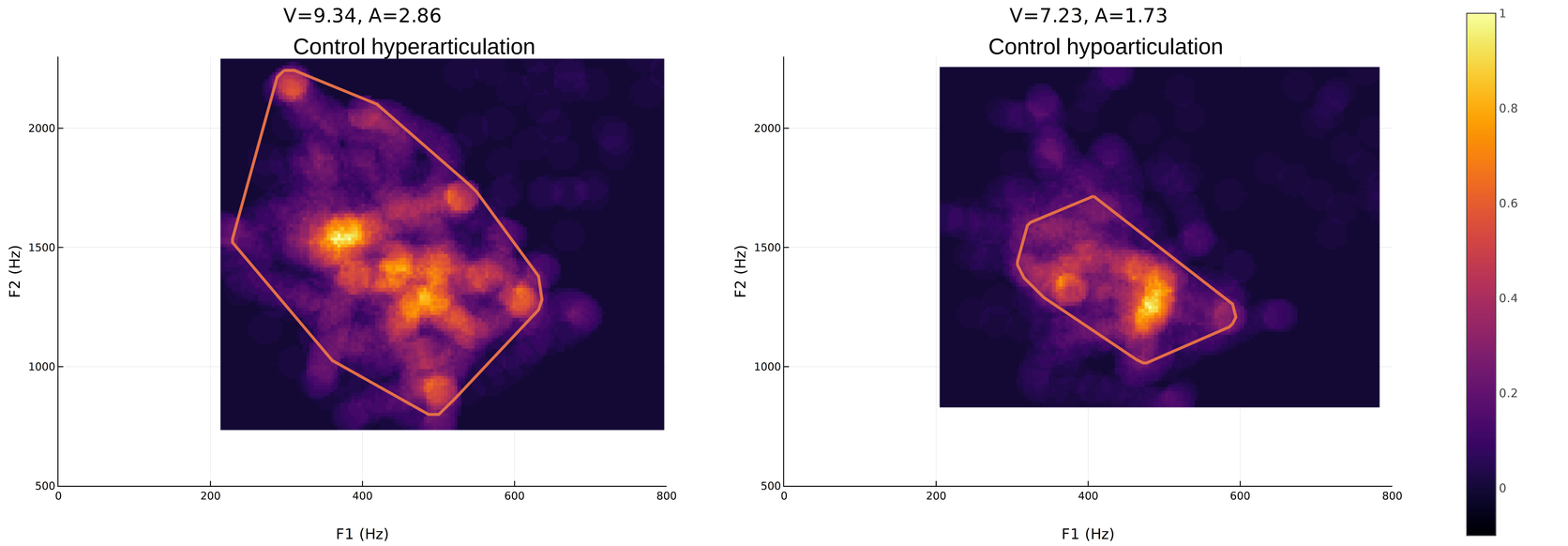

Figure 2. Example vowel space density, vowel dispersion index, and vowel space area for healthy male control. Note that the VDI and area were calculated in a normalized space unique to each recording, but the axes are presented in unnormalized Hz for easier interpretation.

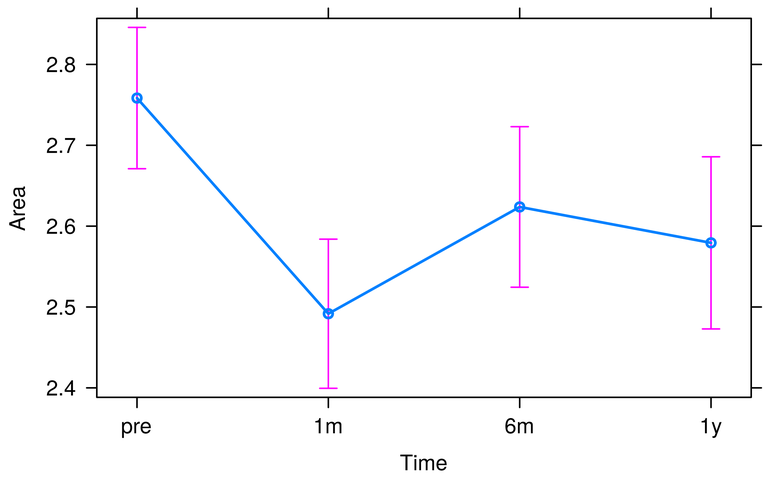

Figure 3. Effect plot for time point in the vowel space area LMER model. All post-surgery time points are significantly different from the pre-surgery time point.

3. Results & Discussion

- For vowel dispersion index, vowel space area and 6 mos. time point (Figure 1) significant predictors
  - Suggests patients retain control of dispersion
  - Vowel space area constrains amount of dispersion
- For vowel space area, all points significant predictors (Figure 2)
  - Vowel space area decreasing, likely due to anatomical and physiological changes
- Vowel dispersion may reflect increased articulatory effort (similar to hyperarticulation [2])
- Smaller vowel space area decreases articulatory capacity (similar to hypoarticulation [2])
- Increase in dispersion at 6 mos. may be strategy learned to compensate for smaller vowel space with more effortful speech

References

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