Articulatory settings of English-French bilinguals reanalyzed by SS-ANOVA

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What we did

• Analyzed tongue shape data from ultrasound and to compare tongue shapes used Smoothing Spline Analysis of Variance (SS-ANOVA) – "newer method" for English and French articulatory setting.
• Compared the above models with a previous method – "previous method" – that had measured 4 points on the tongue and had used the alveolar ridge.

Introduction

• One possible way to improve a second language speaking skill is to be aware of the underlying tongue position for a language, particularly when pausing for a short time between utterance; called inter-speech posture (ISP) [1].

Method

Participants and Data Collection (from [1]):

• 11 bilingual English-French speakers, of whom 4 (ELB, NNG, PHI, PLA) had both languages’ pronunciation perceived to be native.

Data Analysis:

• Previous Method

  - Figure 3 shows measurement by original 4-points method using MATLAB calculation.
  - Alveolar point is determined by having participants’ swallow.
  - By clicking above the alveolar ridge point in the image, a straight line was drawn through this point and the probe center in MATLAB program.
  - Tongue root point is determined clicking above the hyoid shadow in the image and straight line was drawn same to alveolar ridge.
  - Two more straight lines are drawn that intersected the angle between the two lines.
  - Clicked on the four points where each line intersected the surface of the tongue and calculated distance between each point and probe center by MATLAB.

• Previous Method

  - EdgeTrak [4] detected tongue surface in ISP data (see Figure 1).
  - Made traces (Figure 2) and model from coordinate data using SS-ANOVA.
  - Calculated center point of probe and drew 4 lines toward tongue surface through center point.

Results

• SS-ANOVA method shows that tongue root is more retracted in English. Also the newer method showed all participants had higher tongue dorsum in English.

• In seven cases the newer method showed differences in tongue position that previous method failed to show. However, in four cases the newer method showed differences that the previous method could show (Table1).

Discussion and Conclusions

• We used 2 measurement methods to statistically analyze ultrasound ISP data. Newer method showed more differences in the posterior tongue, but the previous method showed a few more in the anterior tongue.
• Newer method is not based on alveolar ridge or any stable bone point, while previous method is. That may result in measuring a slightly different tongue part in each method because alveolar ridge is difficult to pinpoint.
• Further to lip differences found in [1], newer method was able to find previously unknown differences between English and French ISP in tongue dorsum and tongue root.
• This ability may be due to greater variability in tongue tip and tongue body position across ISPs in a given language. The TT/TB is freer to move and may be less resistant to coarticulation with phonemes before/after ISP.

References


Table 1: Differences between English and French ISP for 4 tongue points in 4 participants. Shaded in red is it is different result in each method. “--” means no difference between E and F.