A CASE STUDY OF PORTUGUESE AND ENGLISH BILINGUALITY

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Abstract
This study of the acoustic characteristics of European Portuguese and British English fricatives as produced by two bilingual subjects, consisted of time and frequency analysis of words in a carrier sentence. Time-averaged power spectra were calculated and parameterized in order to aid comparisons across speaker, across corpus, and across language, and to gain insight into the production mechanisms underlying the language-specific variations.

1. Background
Previous acoustic phonetic studies of bilingual speech have been mainly focused on categorical language-specific variations. For example, differences in the voicing characteristics of English fricatives /f, v, s, z/ and Portuguese fricatives /s, z/ have been reported (Romani and Costa (2004), Shadle et al. (1997)).

2. Type of Bilinguality
To measure degree of bilinguality, we used language biographies, self-evaluation, and judgments of bilingual production by monolingual speakers of Portuguese and of English as proposed by Hamers and Blanc (2000, p. 40).

Result: our subjects have developed a "balanced and compound bilinguality".

3. Corpus Design and Recording

3.1. Corpus 1
Subjects in this study were two adult bilingual siblings, with no reported hearing or speech disorders.

- Corpus 1a - Sustained fricatives preceded by vowels (Shadle and McCarthy (1997)).
- Corpus 1b - Fricatives sustained at different effort levels (Jesus and Shadle (2002)).

4. Analysis Method
To generate averaged power spectra:

1. Calculate discrete Fourier transforms of the time-averaged 10 ms Hamming windows.
2. Average the amplitudes within place across tokens.
3. Average within place across tokens.
4. Four parameters of each spectrum were then calculated.

A - dynamic amplitude (dB). The difference between the maximum amplitude value of the averaged power spectrum occurring between 500Hz and 20kHz, and the minimum amplitude between 0 and 2kHz.

S' - the slope of the line fit to all the spectral amplitude points from 500Hz to 20kHz.

p - the slope of the line fit to all the spectral amplitude points from 0Hz to 20kHz.

The time waveforms of all the corpus words were produced by the speakers, and were included in the analysis.

5. Results

5.1. Duration and Devoicing

The median duration of the unvoiced fricatives was always greater than that of the voiced fricatives, which agrees with Boulakia (1993) and English (Hegan and Rousay (1980), Crystal and Hone (1988), Stevens et al. (1992), Perillo et al. (1997)) monolingual results.

No significant difference in duration by place of articulation, or between Portuguese and English. For example, /s/ and /f/ were devoiced more often than /v/ and /z/.

Figure 1: Median duration of fricatives /f, v, s, z/ in Corpus 3. Portuguese - solid line; English - dashed line. X = Speaker PS; = Speaker RS.

5.2. Parameterisation of Spectra

On plots of A vs S', A vs S, and S vs S', R, S, and S' plots, there are several clusters of bilatrons and /f, v, s, z/ for Speaker RS.

However, Speaker PS produces 3 clusters: bilatrons, /f, v/, and /s, z/.

Result from both subjects seems, for the most part, to be consistent, and the same for Portuguese and English fricatives.

The A range of the male French monolingual studied by Shadle and Mair (1994) and the two female Portuguese monolinguals studied by Jesus and Shadle (2002) are similar to Rs's.

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Figure 2: Speaker RS results for A vs S' by fricative, for each language.

6. Conclusions

Devoicing occurs more often in word-final than word-initial positions, both for Portuguese and English fricatives.

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