

Temporal and Devoicing Analysis of European Portuguese Fricatives *(Notes)*

Luís M. T. Jesus and Christine H. Shadle

Slide 2

- Such data are needed in order to do Portuguese speech synthesis.

Slide 5

- Here is the LX signal.
- Here's the acoustic signal.
- Point out the boundaries we identified.

Slide 6

- The time waveforms of all the corpus words were **manually analysed** to detect the **start of the vowel-fricative (VF) transition**, the **start** and **end of the fricative**, and the **start of the fricative-vowel (FV) transition**.
- Both the **acoustic** and **laryngograph signals** were used to determine the VF and FV boundaries.

Slide 7

- We see a clear pattern here of voiceless fricatives having a longer duration than voiced, and later we'll show you results of ANOVAs checking on the significance.
- But one possibility is that the difference is an artifact of the difficulty of segmenting voiced fricatives.
- So we looked at the duration of the transitions on either side as well...

Slide 8

- There is no clear pattern of voiced - voiceless, and so the segmentation cannot explain the differences in duration of the steady-state parts.
- There are slight differences between VF and FV transitions, and so on, and again say that this has all been analysed.

Slide 8

- In Corpus 3, for 3 of the 4 subjects (not CFGA) the mean duration of the fricative is greater than that of the VF and FV transitions, and
- the mean duration of the VF transition is greater than that of the FV transition.

Slide 9

- In Corpus 4, the mean duration of the fricatives is greater than the duration of the VF and FV transitions;
- the VF and FV transitions do not differ significantly in duration for any of the speakers.

Slide 11

- There was a significant effect of the factor **speaker** on the duration of fricatives /f, s, ʃ/ in both Corpus 3 and 4.
- There was no significant effect for /v, z, ʒ/ in Corpus 3, but in Corpus 4 there was a significant effect.

Slide 11

- There was a significant effect of the factor **place** on the duration of fricatives /f, s, ʃ/ and /v, z, ʒ/ in both Corpus 3 and 4.
- There was a significant linear trend. In Corpus 3, as the place of articulation moved posteriorly, duration increased proportionately.

Slide 11

- There was a significant effect of the factor **position in word** on the duration of fricatives /f, s, ʃ/ and /v, z, ʒ/ in both Corpus 3 and 4.
- There was a significant linear trend, indicating that as the position of the fricative moves from initial, through medial, to final word position, duration increased proportionately.

Slide 12

- Remind people of our definition of total as opposed to partial devoicing.
- Corpus 3 results for all four subjects showed that
 - 55% (70 out of 127) of /v/ tokens,
 - 74% (79 out of 107) of /z/ tokens, and
 - 86% (92 out of 107) of /ʒ/ tokenswere totally devoiced.

Slide 12

- In Corpus 4,
 - 44% (77 out of 177) of /v/ tokens,
 - 78% (86 out of 110) of /z/ tokens, and
 - 71% (89 out of 126) of /ʒ/ tokenswere totally devoiced.

Slide 13

- Percentage of total devoicing by position in word, word - initial (I), word - medial (M) and word - final (F), fricatives /v, z, ʒ/ combined. The black portion of each bar in the graph corresponds to fricatives in a stressed syllable and the white portion to fricatives in an unstressed syllable. There are no Portuguese fricatives in final stressed position.

Slide 13

- In Corpus 3, most word-final fricatives (93% – 55 out of 59) were totally devoiced, and the percentage of devoicing increased as the place of articulation moved posteriorly.
- The Corpus 4 fricatives devoiced mostly word-finally, but less often than in Corpus 3.

Slide 15

- There was a significant effect of the factor **speaker** on the voicing of fricatives /v, z, ʒ/ in Corpus 3, but no significant effect in Corpus 4.

Slide 15

- There was a significant effect of the factor **place** on the voicing of fricatives in both Corpus 3 and 4.
- There was a significant linear trend. In Corpus 3, as the place of articulation moved further back the amount of devoicing increased proportionately.

Slide 15

- There was a significant effect of the factor **position in word** on the voicing of fricatives in Corpus 3, but no significant effect in Corpus 4.
- There was a significant linear trend. In Corpus 3, as the position of the fricative moves from initial, through medial, to final word position, the amount of devoicing increased proportionately.