

Post stressed high vowel lenition in Brazilian Portuguese: evidence from a perceptual experiment

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The aim of this study is to investigate the relationship between the perception of devoiced vowels and the lengthening of voiceless alveolar fricatives in Brazilian Portuguese (henceforth BP). A significant number of languages have been reported to exhibit high vowel devoicing in different contexts (e.g., Tsuchida, 1997; Torreira and Ernestus, 2010). Acoustic studies of vowel devoicing in BP have suggested that, in cases where the vowel seems to be impressionistically deleted, some phonetic cues to its identification remain in the signal.

Meneses (2012) and Meneses and Albano (submitted) showed that, in some cases, these vowels are simply weakened while, in others, they are devoiced, and that this can eventually result in apocope as a final step of vowel lenition. These hypotheses are supported by the following results: quantitative evidence of centralization; lower average centroid of /s/ where the vowel is not visible; and longer duration of /s/ where the vowel is totally devoiced. Moreover, in an ensuing perceptual experiment, full devoicing led to misidentification. Two of these results are particularly intriguing: errors in the identification of vowels and /s/ lengthening.

As to perception, minimal voicing is sufficient for vowel recognition, while complete devoicing leads to errors, which suggests a gradient path to apocope. Regarding /s/ duration, “compensatory” lengthening occurs when the vowel is fully devoiced: /s/ with devoiced vowels is significantly longer than /s/ with partially devoiced or voiced vowels. The consonant stretches to compensate vowel devoicing and maintain syllabicity. Based on Meneses and Albano’s (submitted) results, this study investigates whether “compensatory” lengthening of /s/ with full devoicing has a bearing on vowel detection.

In order to explore the nature of such a process, we elaborated and applied a forced choice identification test to six speakers from a dialect with an ongoing devoicing change. Stimuli were selected through the following steps: (i) triads of words such as [‘fas], [‘fa.si] and [‘fa.su] were recorded by an informant with a high rate of devoicing; (ii) typical occurrences of devoicing were selected; (iii) vowel devoicing was identified as complete absence of voicing and formant structure, preceded by an acoustic signal identifiable as fricative noise; (iv) the duration of preceding /s/ was measured and normalized by z-score; (v) selected tokens were then classified into three categories: stretched (i.e., with “compensatory” lengthening), having mean duration (i.e., z-score equal to zero), or coming from a vowel-less word. The perception test consisted in presenting thirty-five stimuli to each subject.

The subjects heard only one word at a time and had to choose between: /s/ with /i/, /s/ with /u/ or /s/ without vowel. Scalar scores were assigned to hits and errors. Partial hits, i.e., incorrect vowel identification (e.g. [‘pa.si] for [‘pa.su]) were assigned an intermediate score. After identification, subjects indicated the confidence level of their answer (1 - very low, 2 - low, 3 - average, 4 - high, 5 - very high), and this was used to weigh the scores. The nonparametric Kruskal-Wallis test was used to evaluate the difference between the three stimulus classes. The results presented in Figure 1 show that “compensatory” lengthening of consonants in devoicing contexts is a decisive cue for the detection of vowel presence ($H=6.33$, $df=2$, $p<0.04$). Stretched consonants had higher hit or partial hit rates, whereas noise with average duration had a higher error rate. As seen in Figure 2, Figure 2 shows the relatively low error rate of this condition as compared to those of average /s/ and final /s/. By contrast, final /s/, which is acoustically neutral albeit subject to confusion due to the three-way forced choice, has the highest hit rate as expected.

Figure 1: Mean score weighted by confidence for stretched/s/, mean length /s/ and /s/ without vowel

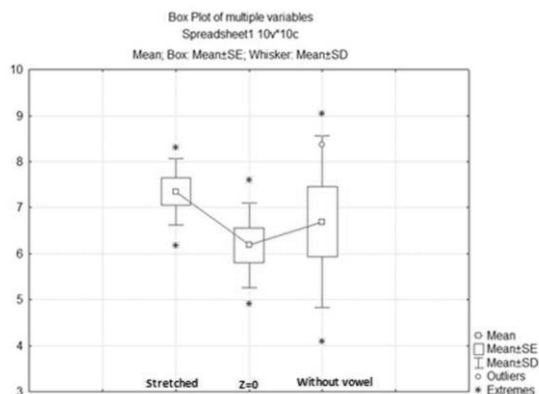
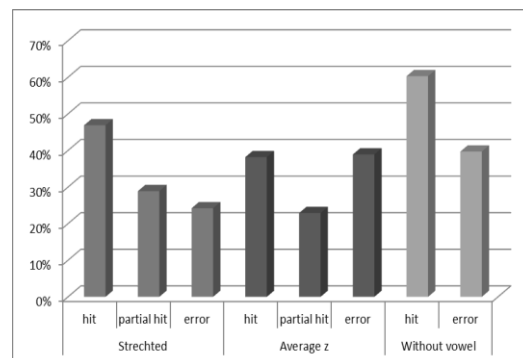


Figure 2: Rate of hits, partial hits and errors in the identification of stretched /s/, mean length /s/ and /s/ without vowel



It should be noted that the subjects showed a bias for /i/. This may be related to two factors: the proximity of the constriction locations of /s/ and /i/; and greater frequency of occurrence of /i/ in final unstressed syllables in PB.

Finally, besides being a compensation factor for syllabic weakening, "compensatory" lengthening of /s/ with full devoicing seems to carry some vocalic information that provides the listener with clues to vowel identity. The data presented here corroborate the results of a production experiment from Meneses and Albano (submitted) that claim that the consonant stretches to maintain syllabicity. This kind of gradient process, involving degrees of weakening, from reduction to apocope, is consistent with a dynamical view of speech production and perception.

References

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