



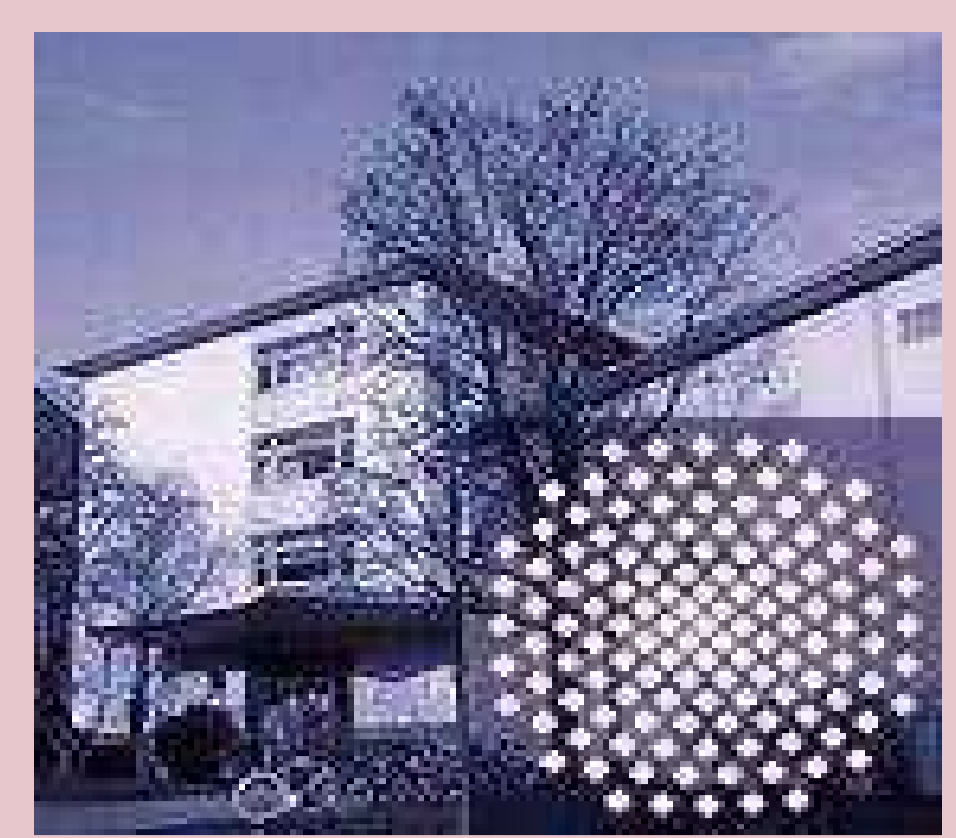
Segmental factors in language proficiency:

Velarization degree as a signature of pronunciation talent

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BACKGROUND

Coarticulation:

articulatory gestures overlap in time \Rightarrow interaction of successive phonetic segments;

Coarticulatory resistance:

degree to which a given segment resists potential interference of neighbouring segments [3],
the extent to which a particular segment is susceptible to coarticulation [2].

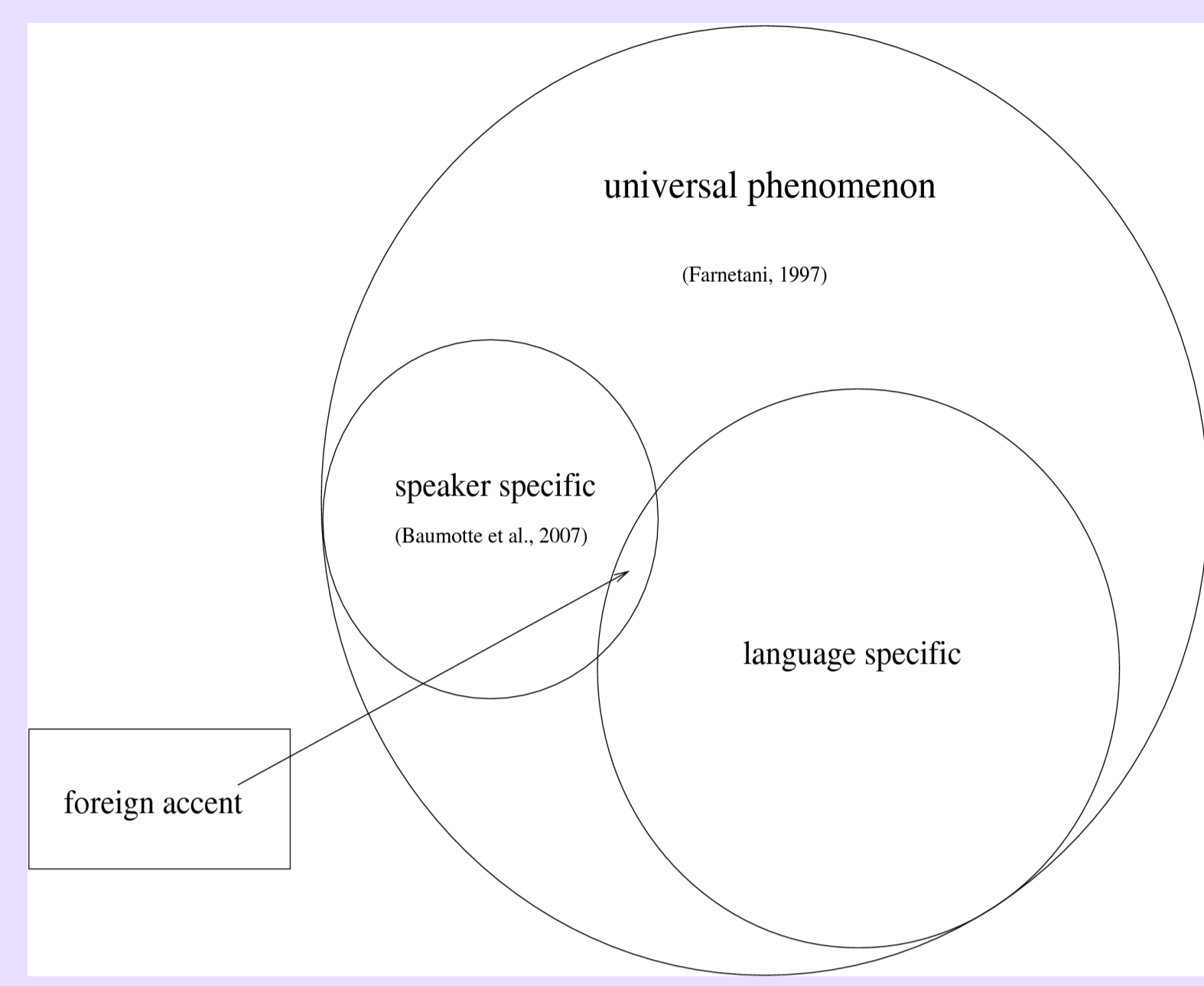


Figure 1. The different aspects of coarticulation and coarticulatory resistance.

Within the large-scale project "Language Talent and Brain Activity", subjects have been categorized as either proficient, average or less proficient (<http://www.susannereiterer.eu/projects/talent/>).

OBJECTIVE

The objective is to compare coarticulation and coarticulatory resistance on /ə/ in different /l/-conditions in proficient vs. average vs. less proficient L2 learners of English. Differences in coarticulation and coarticulatory resistance might be due to one of several reasons why less proficient learners might not be able to overcome their foreign accent.

HYPOTHESIS while grouping languages ([2])

| PARAMETERS | NATIVE-LIKE SPEECH | NON-NATIVE-LIKE SPEECH |
|--------------------------------|---------------------------------|---------------------------------|
| proficiency level | more English (proficient) | more German (less proficient) |
| /l/-variant | more velarized or "dark" | non velarized or "clear" |
| coarticulation | higher F_2 and F_v | lower F_2 and F_v |
| coarticulatory resistance (CR) | more constriction, i.e. more CR | less constriction, i.e. less CR |

METHOD

Subjects

- 41 native speakers of German (24 f, 17 m)
- 11 less proficient, 12 average, 18 proficient learners
- aged between 20 and 42 years ($\bar{O} = 25.7$ y)
- most of them grew up in the Swabian dialect area/South of Germany
- All of them had an academic background.

Priming

- repetition of a short recorded text read by a female Standard British speaker (56 y) to help subjects switch into the target language
- text included one non-word target stimulus in the end for priming purposes

Stimuli (different non-words were used for visual presentation)

Visual orthographic presentation on a computer screen:

- "gelate/gelite/gelute/gelüte" embedded in a target sentence ("I have said [...] twice.")

Procedure

Subjects were asked to read each of the sentences five times while imitating the native speaker as accurately as possible. Digital recordings were made at a 16kHz sampling rate in the sound-proof recording room of the phonetics laboratory at Universität Stuttgart, Germany.

Data analysis

- segmentation on the phone level by automatic forced alignment (Aligner, St. Rapp, IMS)
- label files were manually corrected
- measurements every 10 ms of F_1 , F_2 as well as F_3 in /ə/ with the ESPS formant program
- matching of label file boundaries and vowel formant frequencies with the help of .pl-scripts
- F_1 , F_2 , as well as F_3 were extracted from the middle of the steady state in /ə/

One way ANOVAs (Scheffé-tests) were used to compare the formant values for coarticulation, as well as the formant difference values for coarticulatory resistance in proficient vs. average vs. less proficient learners of L2 English.

EXPERIMENT 1: Coarticulation

Parameters

- F_2 \Rightarrow constriction in the frontal part of the tract (F_2 high \rightarrow large degree of constriction, F_2 low \rightarrow low degree of constriction)
- F_v ($F_2 - F_1 = F_v$) \Rightarrow considers also F_1 known to be inversely related to velarization

RESULTS 1

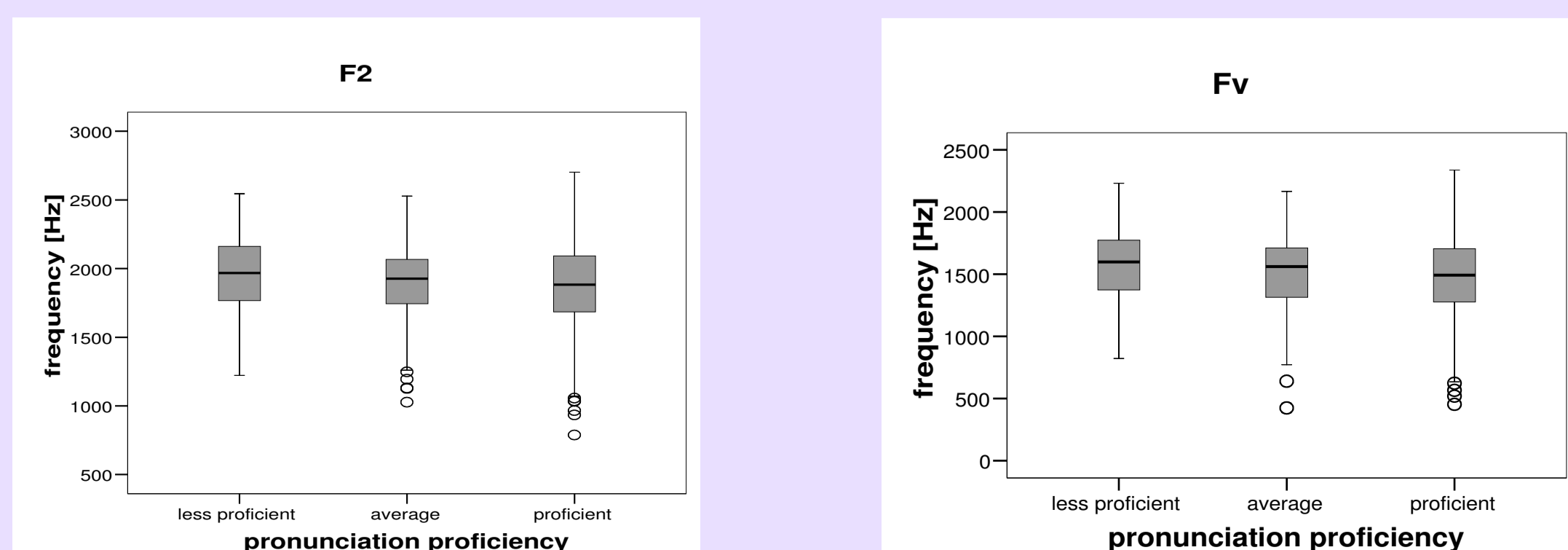


Figure 2. Distribution of F_2 (left), as well as F_v (right) in less proficient vs. average vs. proficient speakers.

| comparison | $F(2)$ | significance |
|------------|--------|--------------|
| F_2 | 5.163 | $p < .006$ |
| F_v | 4.706 | $p < .009$ |

Table 2. One way ANOVA-results after comparison of F_2 , as well as F_v in proficient vs. average vs. less proficient non-native English speech.

CONCLUSION 1

Significant F_2 and $F_2 - F_1$ differences across /l/ do not conform to the hypothesis because the consonant is more velarized in less proficient learners (mean values: $F_2 = 1967.79$ Hz, $F_v = 1578.23$ Hz) of English as an L2 and less velarized for proficient speakers (mean values: $F_2 = 1886.37$ Hz, $F_v = 1493.23$ Hz).

EXPERIMENT 2: Coarticulatory resistance

Parameters

- F_2 \Rightarrow constriction in the frontal part of the tract (F_2 high \rightarrow large degree of constriction, F_2 low \rightarrow low degree of constriction)
- F_2' \Rightarrow considers also F_3 known to indicate roundedness (F_2' high \rightarrow less lip rounding, F_2' low \rightarrow more lip rounding)

RESULTS 2

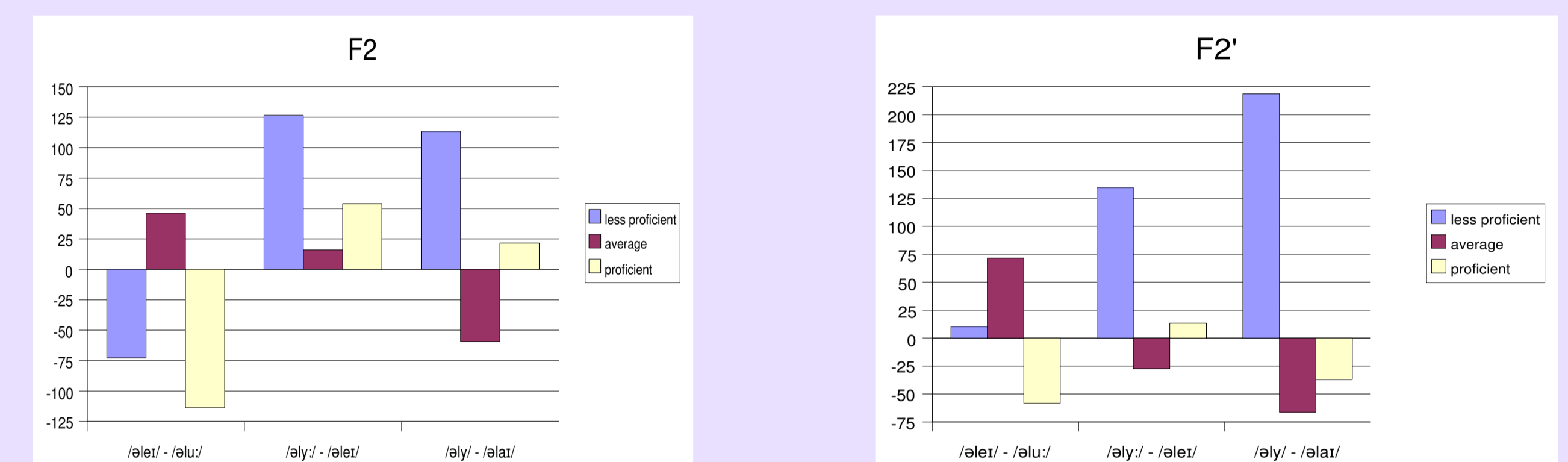


Figure 3. Coarticulatory resistance values for F_2 (left) and F_2' (right) comparisons of /əleɪ/ - /əlu:/, /əly/ - /əleɪ/, as well as /əly/ - /əlaɪ/ in proficient vs. average vs. less proficient learners. Within our study, high positive/negative values indicate coarticulation, while values around 0Hz provide evidence for coarticulatory resistance.

| comparison | $F(2)$ | significance |
|------------------------|--------|--------------|
| F_2 /əleɪ/ - /əlu:/ | 5.413 | $p < .005$ |
| F_2' /əleɪ/ - /əlu:/ | 6.778 | $p < .002$ |
| F_2 /əly/ - /əlaɪ/ | 3.857 | $p < .023$ |
| F_2' /əly/ - /əlaɪ/ | 8.806 | $p < .000$ |

Table 3. Significant ANOVA-results after comparison of /əleɪ/ - /əlu:/, /əly/ - /əleɪ/, as well as /əly/ - /əlaɪ/ in less proficient vs. average vs. proficient learners.

CONCLUSION 2

Coarticulatory resistance results for the comparisons of F_2 in /əleɪ/ - /əlu:/ and /əly/ - /əlaɪ/, as well as of F_2' in /əleɪ/ - /əlu:/ and /əly/ - /əlaɪ/ are significant. F_2 and F_2' in /əleɪ/ - /əlu:/ show more velarization in less proficient speakers than in proficient speakers, while less proficient subjects coarticulate more in /əly/ - /əlaɪ/ concerning F_2 and F_2' . F_2 and F_2' in /əly/ - /əleɪ/ show a similar tendency to /əly/ - /əlaɪ/ for less proficient and proficient speakers.

RESULTS AND CONCLUSION

Results

- Coarticulation: In Experiment 1 significant differences in the production of F_2 and F_v were found. For proficient speakers the values F_2 and F_v were always found to be lower than those for less proficient learners (see Figure 2 and Table 2).
- Coarticulatory resistance: In Experiment 2 significant differences were found between coarticulatory resistance values for the comparisons of F_2 and F_2' in /əleɪ/ - /əlu:/ and /əly/ - /əlaɪ/. ANOVA-values for F_2 and F_2' in the /əly/ - /əleɪ/-comparison were non-significant, but the overall formant frequencies showed the same direction as in the /əly/ - /əlaɪ/-distinction (see Figure 3 and Table 3).

Conclusion

- Experiment 1 probably gives us a hint for less proficient learners not to be too bad, but the proficient learners taken in this experiment might be more conscious of English phonological rules. Higher F_2 - and F_v -values indicate a higher degree of constriction in the frontal part of the mouth standing for a higher degree of velarization, which is more characteristic for /l/ in syllable-final or word-final position in the English language (see also Baumotte [in press] ([1])).
- Experiment 2 underlines these results in the cases of /əleɪ/ - /əlu:/-comparisons for F_2 and F_2' . In these distinctions formant frequency difference values are higher for proficient than for less proficient speakers, which corresponds to previous coarticulation findings for Experiment 1. In the /əly/ - /əleɪ/- and /əly/ - /əlaɪ/-comparisons proficient learners produced a more velarized English [l], more coarticulatory resistance is occurring, because of the consonant being articulated with more constriction in the frontal part of the tract (see Table 1) leading to reduced permeability for the characteristic frequencies of the following vowels (roundedness vs. spreadness, front close vs. front half-close).
- Different results between F_2 and F_2' for /əleɪ/ - /əlu:/ and /əly/ - /əleɪ/- and /əly/ - /əlaɪ/-comparisons must not be seen as a falsification for more velarization in CR of proficient speakers, but should be seen as a consequence of the integration of two maxima along the articulatory dimension concerning un-/roundedness, as well as backness/fronting leading to less clear-cut results. Further research is necessary, investigating the distribution of vowel formant frequencies following the consonant.

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