

Direction of coarticulation in vowel-fricative sequences in L1-German children

German has a phonemic /s/-/ʃ/ contrast, the two phonemes being among the last sounds that typically developing L1-German children acquire phonetically (Fox-Boyer, 2009). The contrast is acoustically distinguished by means of differences in the spectral centre of gravity (fricative noise), which varies also as a function of vocalic context: e.g. in the vicinity of rounded vowels /s/ becomes more [ʃ]-like. The fricatives on the other hand affect the degree of lip rounding in vowels. Coarticulation within /ɪʃ/-sequences, for instance, may result in one of two assimilation directions: /ʃ/ may either become more like the German fricative /ç/ (*progressive assimilation*) or /ɪ/ is realized with rounded lips (*regressive assimilation*) possibly resulting in a merger with German /ʏ/. The aims of this study were (1) to examine the degree and the direction of coarticulation between two age groups of L1-German children, and (2) to compare a subset of the data with adult data to test whether the amount of coarticulation decreases with age – as predicted in Nittrouer et al. (1989).

Three repetitions each of the following four words were elicited from eleven younger (4;1–5;1 years) and nine older (5;4–6;3 years) children in a picture naming task: *Kissen* (/kɪsən/, 'cushion'), *küssen* (/kʏsən/, 'to kiss'), *mischen* (/mɪʃən/, 'to shuffle (cards)'), and *Muschel* (/mʊʃəl/, 'seashell'). We measured the second formant at the temporal midpoint of the first vowel and the fricative noise. We then calculated the log. Euclidean distance ratio of each vowel and of each fricative to two speaker-specific /ɪ/ and /ʊ/ centroids and /s/ and /ʃ/ centroids, respectively. A repeated measures ANOVA with F2 as the dependent variable showed significant main effects for Sibilant ($F[1,18] = 545.1$, $p < 0.001$) and Lip rounding ($F[1,18] = 189.6$, $p < 0.001$) and a significant interaction between these two, but no Age effect (Fig. 1). A second repeated measures ANOVA with Noise as the dependent variable showed again significant effects for Sibilant ($F[1,18] = 47.0$, $p < 0.001$) and Lip rounding ($F[1,18] = 12.0$, $p < 0.01$) and a significant interaction between Age*Sibilant*Rounding ($F[1,18] = 4.6$, $p < 0.05$). Both age groups produced the /s/-/ʃ/ contrast by means of differences in fricative noise (Fig. 2). /ɪ/ before /ʃ/ was generally realized as [ʏ] although younger children show a greater tendency towards /ɪ/-realizations (Fig. 1) which may be associated with the more [s]-like fricatives in *mischen* (Fig. 2).

A comparison of the children's /ɪs/ and /ɪʃ/ tokens with /ɪs/ and /ɪʃ/ words produced by 22 female adults revealed that the *progressive* influence of /ɪ/ on the /s-ʃ/-distinction decreases with increasing age (Fig. 3, bottom row; see also Nittrouer et al., 1989). However, the *regressive* influence of /ʃ/ on /ɪ/ did not decrease in the older children of this study. Only adults showed diminished regressive assimilation (Fig. 3). This finding demonstrates the necessity of incorporating the direction of coarticulation when modelling the acquisition of coarticulatory patterns (Kühnert & Nolan, 1999). Syllable vs. segment-based accounts of children's speech production will be discussed (e.g. Nittrouer et al., 1989).

Fig. 1: Log. Euclidean distance ratios of unrounded (white) and rounded (grey) vowels to /i/ in *Kissen* and /u/ in *Muschel*. Negative values indicate vowels with higher F2 and positive values vowels with lower F2; a value of zero corresponds to a point equidistant between *Kissen* and *Muschel*.

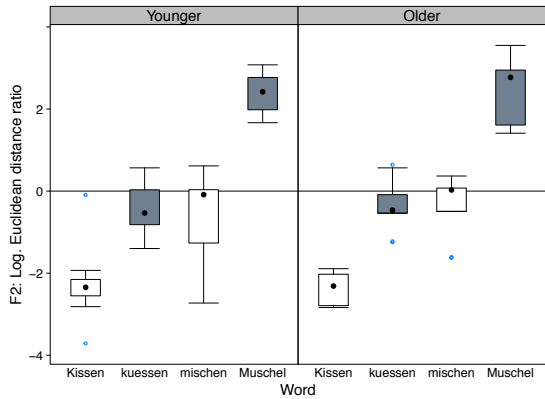


Fig. 2: Log. Euclidean distance ratios of /s/ (white) and /ʃ/ (grey) tokens to /s/ in *Kissen* and /ʃ/ in *Muschel*. Negative values indicate more [s]-like tokens and positive values more [ʃ]-like tokens; a value of zero corresponds to a point equidistant between *Kissen* and *Muschel*.

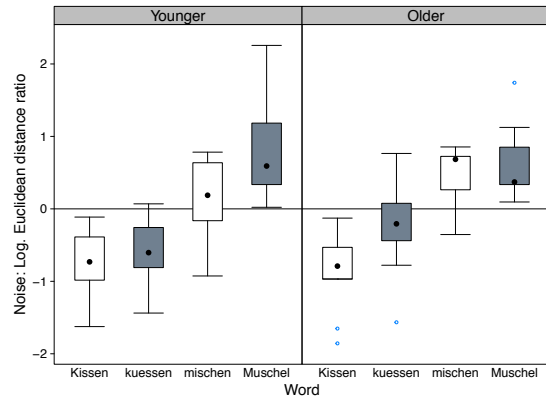
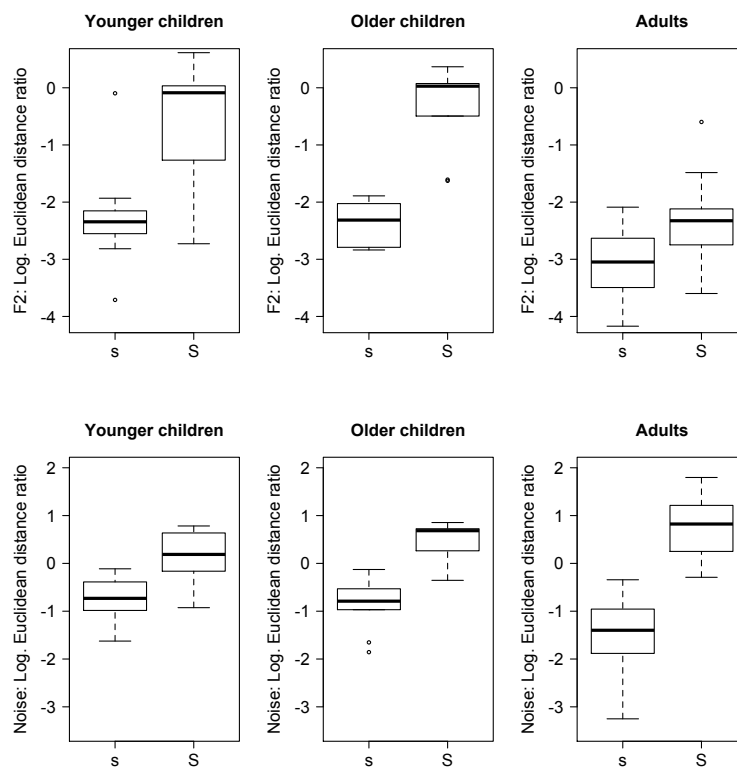


Fig. 3: Log. Euclidean distance ratios of each /i/ token to /i/ in *Kissen* and /u/ in *Muschel* (top) and of each /s/ and /ʃ/ token to /s/ in *Kissen* and /ʃ/ in *Muschel* (bottom) separately for /s/ (s) and /ʃ/ (S) in younger and older children and adults.



References

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- Nittrouer, S., Studdert-Kennedy, M. & McGowan, R. (1989). The emergence of phonetic segments: evidence from the spectral structure of fricative-vowel syllables spoken by children and adults. *Journal of Speech, Language, and Hearing Research* 32, 120–132.