Poster presentation at Phonetik und Phonologie 9 (P&P 9),
Zürich, Switzerland, October 2013.

Articulatory basis of vowels in Saxon vs. Standard High German as suggested by acoustic-to-articulatory inversion using state-of-the-art articulatory speech synthesis

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We conducted an articulatory-phonetic simulation study on the high and mid-high vowels [i: e: y: ø: u: o:] in Saxon-accented vs. Standard High German pronunciation. The goal was to find out whether a *systematic* shift in articulation is present across these varieties. This could be interpreted as an indication of a specific *articulatory basis* (Honikman, 1964; Laver, 1978; Sweet, 1890; Gick et al., 2004) for Saxon-accented speech.
A restricted-scenario acoustic-to-articulatory inversion algorithm suggested possible vocal tract shapes in a three-dimensional virtual speaker (Birkholz, 2006). The algorithm closely matched the formant structure of vowels recorded from a bilingual human speaker, while at the same time providing corresponding articulatory configurations.
The articulatory suggestions were evaluated in four ways, with the following results: Informal *auditory* evaluation: The simulations sounded very similar to the human target vowels. *Acoustically*, they showed the desired formant frequencies. Visually, we firstly checked the *articulatory* targets for plausibility. Secondly, the articulatory behavior was analyzed for each Saxon vs. Standard German vowel pair: A lowering and, where possible, fronting in articulation was found in the Saxon-accented vowels. To *perceptually* validate the vowel simulations, a formal web-based listening test with 126 participants was carried out (Draxler, 2011). The vowels were embedded in two-syllable words of comparable phonological structure, with the target vowel in a stressed position. The words carrying the intended Saxon vowels were rated significantly more Saxon than the simulated Standard High German ones, and vice versa.
The articulatory suggestions hint at a possible lowered and fronted articulatory basis for the Saxon accent. This seems in line with impressionistic descriptions of Saxon articulation (Rues et al., 2007, 91ff). Although the simulations have been checked for articulatory plausibility, a comparison with real articulatory data should be performed. Furthermore, future work could cover more vowels, and also consonants. The study illustrates how state-of-the-art articulatory synthesis may complement instrumental articulation research (Mennen et al., 2010; Stone, 2010) by providing a picture of the entire vocal tract within one single coordinate system.

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