Applications of speech production models in pathologies

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Abstract

In the first part of this presentation an articulatory model (Kröger 2003) is introduced. The model is based on static and dynamic MRI-data of a single speaker of Standard German (Kröger et al. 2000, Kröger et al. in press) and is capable of visualizing movements of the speech articulators within the midsagittal plane. The articulatory model is controlled by a set of functional parameters (e.g. vocalic height, vocalic fronting, lip protrusion, consonantal narrowing of lips, tongue tip, and tongue body, velum height, glottal width). Vocalic parameters affect the position of all articulators (i.e. lips, tongue, jaw, velum, larynx) while consonantal parameters exclusively affect articulators in certain local functional regions (i.e. labio-mandibular, apico-lingual, and linguo-mandibular region). Coarticulation is modelled basically by superimposing consonantal articulation on vocalic articulation. Thus vocalic articulation serves as a temporal enduring basis for the calculation of articulatory movements. In addition to this basic "vowel-consonant-coarticulation" coarticulation resulting from synergetic movement effects of spatially adjacent articulators (e.g. lips and tongue body via lower jaw) are modelled rudimentarily. The model is embedded in a user-friendly program interface called "speechtrainer" and free available via internet (Kröger 2004). It is possible to prompt orthography (Standard German) or phonetic transcriptions for generating animations of articulatory movements. Phonetic sound symbols can be clicked in a phonetic sound table for the generation of static medisagittal views of the articulation of these sounds. Orthography, phonetic transcription and (if wanted) articulatory flow charts (i.e. gestural scores) of words or short sentences can be loaded, saved, generated, and edited in visual stimulus lists. Additionally articulatory flow charts can be synchronized with external (i.e. naturally) produced sound files and saved in audio-visual stimulus lists.

In the second part of this presentation fist results concerning the application of this model as a tool in therapy of speech disorders are presented and discussed. So far the model was used in therapy of one patient suffering from apraxia of speech (Gotto 2004, Gotto et al. 2004). The therapy method used was a cognitive oriented training which comprised contrasting of segments on phoneme and syllable level, with main focus on training of simple up to complex syllables and anchoring them in mnemonic words. The visualization (animation) of articulatory movements in the midsagittal plane generated by the articulatory model was used as a basic intervention technique for relearning the articulation of single sounds and particularly simple up to complex syllables.

A control test was carried out for checking whether the patient becomes familiar with the visual stimuli generated by the articulatory model (Kröger et al. 2004). In this test the patient was asked to reproduce (i.e. to mimic) the articulatory speech movements presented by the model. The test was accomplished at the beginning (baseline), within, directly after ending, and three month after ending of therapy (follow-up). Before running the baseline test, the pa

tient was familiarized with the midsagittal view of the vocal tract and with the basic movements of speech articulators produced by the model (consonants: labial, apical and dorsal closing and opening gestures; vowels: tongue raising and lowering, tongue fronting and backing, lip spreading and rounding gestures). The results indicate that the patient was capable of reproducing significantly more sounds and syllables after being exposed to the visual stimuli generated by the model (Gotto 2004).

References

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