The effects of age on tongue motion and speech duration.

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Differences between older and younger speakers have been uncovered in many components of speech, such as voice quality, oral sensation and motor function. Differences in articulation due to age have not been as frequently studied, however. This study examined age related differences in speech articulation and coarticulation to consider how they might reflect changes in motor control due to age. First, consonant and vowel articulation was compared, because consonants are often more affected than vowels in speech disorders and might be more sensitive to the effects of aging than vowels. Many dysarthrias are characterized by slurred consonants, indicating that when coordination is reduced, consonants are more affected. It is not entirely certain whether consonant errors are greater than vowels or simply more acoustically salient. If there is a reduction in coordination due to aging, would this be seen more particularly in the tongue motion or the acoustic durations of consonants than vowels? A second aspect of phoneme production that was studied was age related differences in tongue coarticulation for phonemes whose lingual constraints were greater (/s/, /r/, /i/) vs. lesser (/S/, /u/, /a/). All of speech articulation is characterized by coarticulation or coproduction. However, some sounds are more resistant to coarticulation than others due to features that must be produced for normal acoustics. The Degree of Articulatory Constraint (DAC) model ranks phonemes based on how much they resist coarticulation with other phonemes. The highly constrained phonemes may show a greater difference in shape between age groups if there is difference in motor control.

To test these ideas a data set of 10 older and 10 younger women were studied saying /CVp/ utterances. Midsagittal ultrasound movies and synchronized audio were collected. Measures of duration were made from the audio files for the phonemes, the CV and the entire utterance. Tongue surface contours were extracted from the ultrasound images and overlaid on the palatal trace for each subject (Epstein and Stone, 2005). Tongue displacement was measured for each phoneme at the location of maximum vocal tract constriction and a non-constriction location, which was the location of maximum constriction of the adjacent phoneme. Of the two regions of the tongue, the constriction location was expected to have maximal articulatory constraint due to its acoustic importance. The non-constriction was expected to have much less articulatory constraint because it would need to accommodate the large constraints of the adjacent sound, for which it was the constriction. Results of the tongue data showed that displacement at the non-constriction location was significantly affected by context, supporting this as a region with considerable coarticulation. Age, however, did not significantly affect displacement or variability in the tongue measures. The older subjects had significantly longer durations, though, for all the acoustic measurements that were made, except schwa duration.