The Department of Linguistics Presents

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CRessLLC

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Vocal Tract Scaling, Surface Curvature, Aerodynamic and the Development of Speech

If a child is to produce adult-like speech, then that child's spectrogram should be a scaled version of that of an adult. This means that a child, whose vocal tract is scaled up by the ratio of its vocal tract length to that of an adult, should, at the very least, produce a sequence of area functions that resembles those of the adult, because formant frequencies are determined by area functions.

We explore two types of difficulties that very young children (9 to 24 month old) could have in producing adult-like speech according to the scaled spectrogram criterion, described above. We state the first type of difficulty in terms of hypotheses regarding the curvature of the tongue surface. In two dimensions, curvature can be conceived to be a measure of "waviness" of a curve, and this measure can be applied to sagittal and lateral outlines, such as those of the tongue and palate surfaces. The hypotheses regard limitations on highly curved tongue outlines for children. It will be shown that these hypotheses are consistent with observations of children's production of syllable-initial, strong /ɹ/, undifferentiated tongue gestures during velar stop, and the two sibilant fricatives of English with diminished acoustic distinction.

The other kind of difficulty regards the fact that formant frequencies and some spectral properties of aerodynamic noise sources do not scale in the same way. This is illustrated with oft reported fronting of velar stop consonants in children. It is argued that the child cannot simultaneously produce the expected formant frequency pattern and the expected time evolution of the noise spectrum after the release of an aspirated velar consonant.

If time permits, we speculate on the relation between back vowel variability in children and limits on tongue curvature, as well as findings on the relative sizes of the mouth and pharynx in the developing child. We conclude by emphasizing that physical detail should be considered when we study children's speech development.