Adaptation of ultrasound imaging to the investigation of tongue control in toddlers
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The present study is aimed at adapting the technique of ultrasound imaging to the developmental field. In the past 10 years, ultrasound imaging has been increasingly popular in speech research with recent interest for speech therapy and reeducation (Bernhardt et al. 2005, Bock et al. 2007). In that respect, we developed an experimental protocol that allows us to track lingual motion in young children using ultrasound imaging in short speech tasks. Because of the small size of children’ vocal tract, a 3 cm ultrasound finger probe is used to fit the small length of the young participants’ chin. The transducer is positioned in a light customized probe holder made of Plexiglas that allows us to maintain the probe stable under children chin while speaking and obtain a good image quality of the tongue on the midsagittal plane (from tongue tip to root). The small probe holder is held on both sides with large elastic bands inserted in the customized split of the probe holder. The bands are covered with soft material to avoid discomfort and clipped to the sides of a sport helmet (e.g. basketball, bike helmet). Also, the system allows children relatively free head motion and natural speech while preserving the quality of the experimental data collected.

The setup consists in a digital recording of tongue shapes at 127 Hz, adapting part of HOCUS system (Whalen et al. 2005). The speech signal is simultaneously acquired at 22 kHz with a head mounted microphone. Ultrasound and audio data are post-synchronized via pulse sequences that are simultaneously captured by the audio and Ultrasound devices. For older children, the system can be augmented with either 3D Optoelectrical tracking of lip and head motion (Optotrak IREDs) or similar tracking via Vicon system.

We are testing the experimental reliability of the system with American English children aged from 5 to 8 years of age. The study aims to investigate the evolution of coarticulatory patterning through the course of development and determine the constriction location and degree for 7 monophtongs /i, I, e, æ, ə, ɔ, u/. Sequences are elicited via a picture-naming task after preliminary familiarization with the experimenter and ultrasound setting.

In the future, we believe that this system can be adapted to younger children to track the evolution of tongue control for vowel and consonant production and applied to clinical research for early speech disorders assessment both at the diagnostic stage and prognostic stage (refining the nature of the speech disorder and individualizing intervention strategies).