Investigating articulatory differences between upright and supine posture using 3D EMA

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Background: Previous work [e.g., 1-4] has shown that for some speakers, the effects of gravity and posture can have a pronounced effect on the articulators during speech. With the growing importance of MRI for vocal tract and speech production analysis, this effect must be accounted for.

Overview: In this pilot study, we investigate the posture effect using 3D EMA, systematically varying the three parameters *posture*, *masking noise*, and *presence of EMA coils*.
Preliminary analysis of acoustic and articulatory results are presented, further work will focus on kinematics and relevance of individual articulators.

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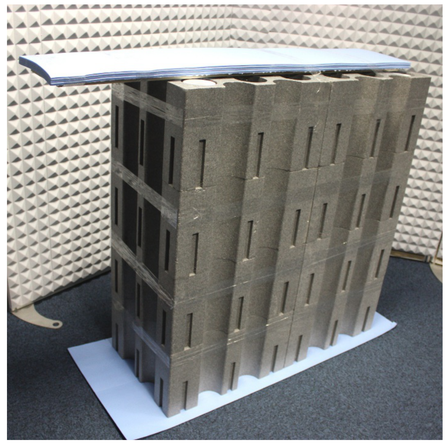
Speaker in upright position in AG500

Measurement coils on tongue tip center, tongue blade left/right, tongue mid center/ left/right, tongue back center, lower incisor, upper lip (reference coils on bridge of nose and behind each ear)

Speaker in supine condition in AG500

Prompts presented via stethoscope to compensate for lack of display visibility, and to provide white noise in masking condition

Audio prompts generated using TTS; CV syllable duration and pitch can have priming effect for production

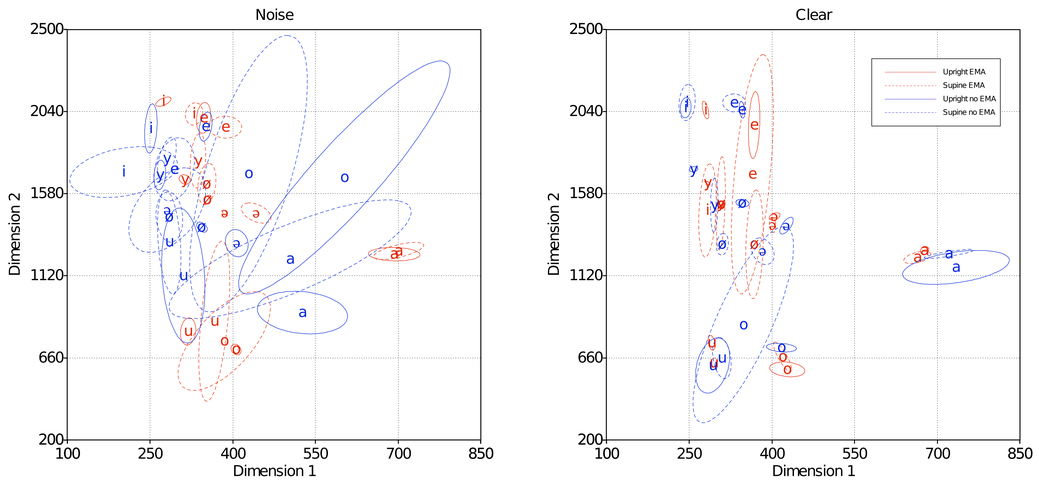


Leightweight gurney made from non-metallic materials

Utterances include sustained vowels [a, e, i, o, u, y, ø, ə], repetitive CV syllables of these vowels and [p, t, k, m, n, ŋ, f, θ, s, ʃ, ç, x, l, ɬ], and 10 German and 10 English sentences.

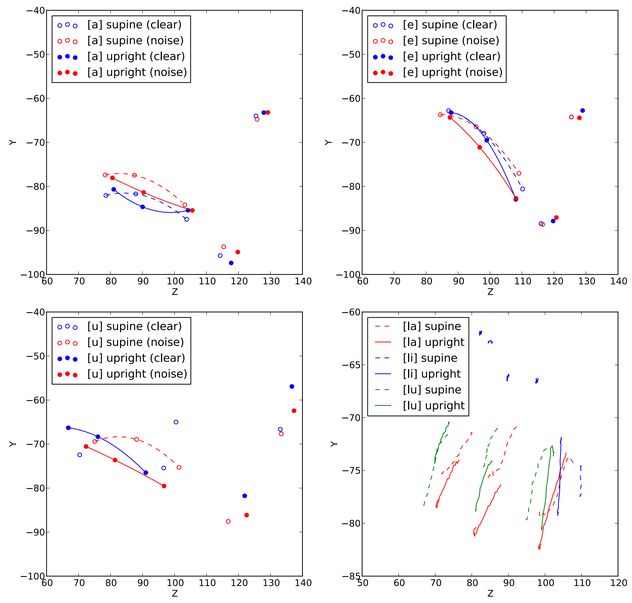
Acoustics: discriminant analysis of first two formants of sustained vowels (middle 80% of frames, smoothed by 5-sample rectangular window) in both masking conditions

Note: automatic formant tracking (using Praat) resulted in wide scatter for some vowels



Articulation: Positions of EMA coils in mid-sagittal plane for sustained vowels [a, e, u] Anterior on right, coils shown (from left to right): tongue back, mid, tip center (tongue contour approximated by curve), lower incisor, upper lip;

Bottom right: traces of mid-sagittal tongue coils for three CV syllables [la, li, lu] in upright and supine position, under noise condition



Discussion: several phenomena are observible, including:

- formant shifting and tongue position changes especially during noise conditions

- (over-)compensation for gravity and posture

- changes in dynamics, depending on articulatory relevance