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Differences in reading proficiency correlate with variations in vowel duration and dynamics

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The present study investigates the production of vowels in three speech modalities (repeated vs. read aloud vs. phonics style primed read speech) in German children (second and third graders) and adults with varying levels of reading proficiency. Recent studies have shown that speech production interacts with metalinguistic skills, such as phonological awareness [1] and reading proficiency [2]. Beginning readers of transparent alphabetical scripts use grapheme-phoneme correspondences to decode (non)words one grapheme at a time. With practice phonological decoding becomes more fluent and automatic. In this study we investigate to what extent reading proficiency (i.e., decoding capabilities) influences vowel duration and formant trajectories in different modalities (i.e., read vs. repeated speech). In addition to the classic reading and repetition modalities we add a third, inspired by synthetic phonics, a reading instruction method which uses phoneme decomposition and spelling out letters before putting them together to form a word (e.g., d-o-g – dog). This is a standard method used for transparent languages such as German [3]. We expect poorer readers to show greater variability in vowel duration and formant trajectories across modalities. In more proficient readers vowel production should not vary as a function of modality, indicating a more automated decoding process.

A total of 48 native German participants were recorded: 16 monolingual 2nd graders (age span: 7;03 (Y;MM) – 8;03), 16 monolingual 3rd graders (age span: 8;03 – 9;05) and 16 adults were recorded. Stimuli for all three modality blocks consisted of C₁VC₂∅ pseudowords (C=/b,d,g/, V=/i,e,a,o,u/, C₁≠C₂) following the indefinite article /amə/. The production task was split into three sequential sections corresponding to the three modalities: reading (stimuli appeared on screen), repetition (pre-recorded audio stimuli) and primed reading (C₁ and V of each stimulus appeared separately before the word). Reading proficiency was evaluated using the standard SLRT-II test for German [4]. Measures of vowel duration and spectral dynamics (F2 trajectories) were carried out in Praat. Vowel duration was evaluated using linear mixed models with modality, proficiency, cohort, and their interaction as predictors. GAMM binary difference smooths [5] were used to analyze differences in formant trajectories between modalities for different proficiency levels.

We present preliminary findings from 12 speakers, the two best and poorest readers from each cohort (adults – A, 2nd graders – P2, 3rd graders - P3). Results indicate that vowel duration is significantly longer in the reading compared to priming and shortest for the repetition modality in poorer readers, including adults. This is not the case for the best readers for whom vowels have comparable duration in the reading and primed-reading conditions (Figure 1). This suggests that poorer readers benefit from seeing the letters of the first syllable prior to decoding the printed word. These patterns are reflected in spectral dynamics – with significant differences in formant trajectories based on modality noted only for poorer readers. These findings indicate unskilled phoneme decoding is reflected in segmental duration and formant transitions.

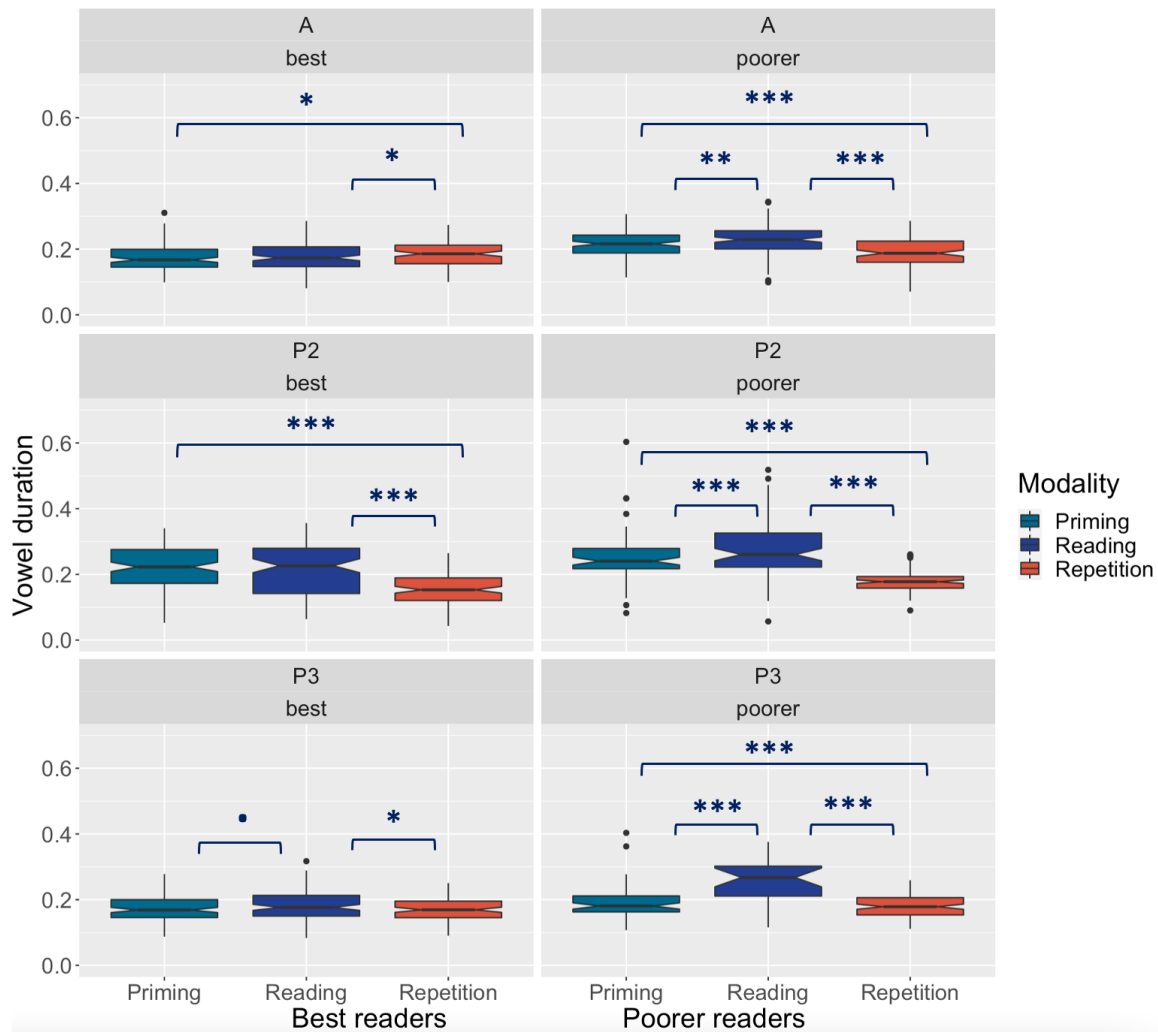


Figure 1: Vowel duration (s) as a function of modality (repeated, read and primed-read speech), cohort (adults – A, 2nd graders – P2, 3rd graders P3) and reading proficiency (best vs. poorer readers). Data from 12 speakers.

References:

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