

Coarticulatory organization in beginner readers: a multifactorial interaction approach

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1. Premises

Background

- Phonological awareness (PA) and reading fluency (RF) are closely related [1, 2]
- Phonological awareness and speech fluency, in particular coarticulation degree (CD), are negatively correlated [3].
- Reading fluency and coarticulation degree are negatively correlated [4]
- Aloud reading uses the same coarticulatory mechanisms as conversational speech

Goal



- Test for a three-way interaction between phonological awareness, reading fluency and speech fluency in German, an orthographically transparent language

Predictions

- We expect children with lower levels of PA (a group generally associated with lower reading fluency) to exhibit higher degrees of intersegmental coarticulation

2. Method

Participants:

- 21 x  and 13 x  (mean age 7;05) German native children

Production task:

- Ultrasound tongue imaging of pre-recorded /aməC₁VC₂ə/ pseudowords (V: /i, y, e, o, u/; C₁: /b, d, g/)
- CD measured as a regression between the horizontal coordinates of the highest points of the tongue body measured during the vowel (V) and the consonant (C₁)

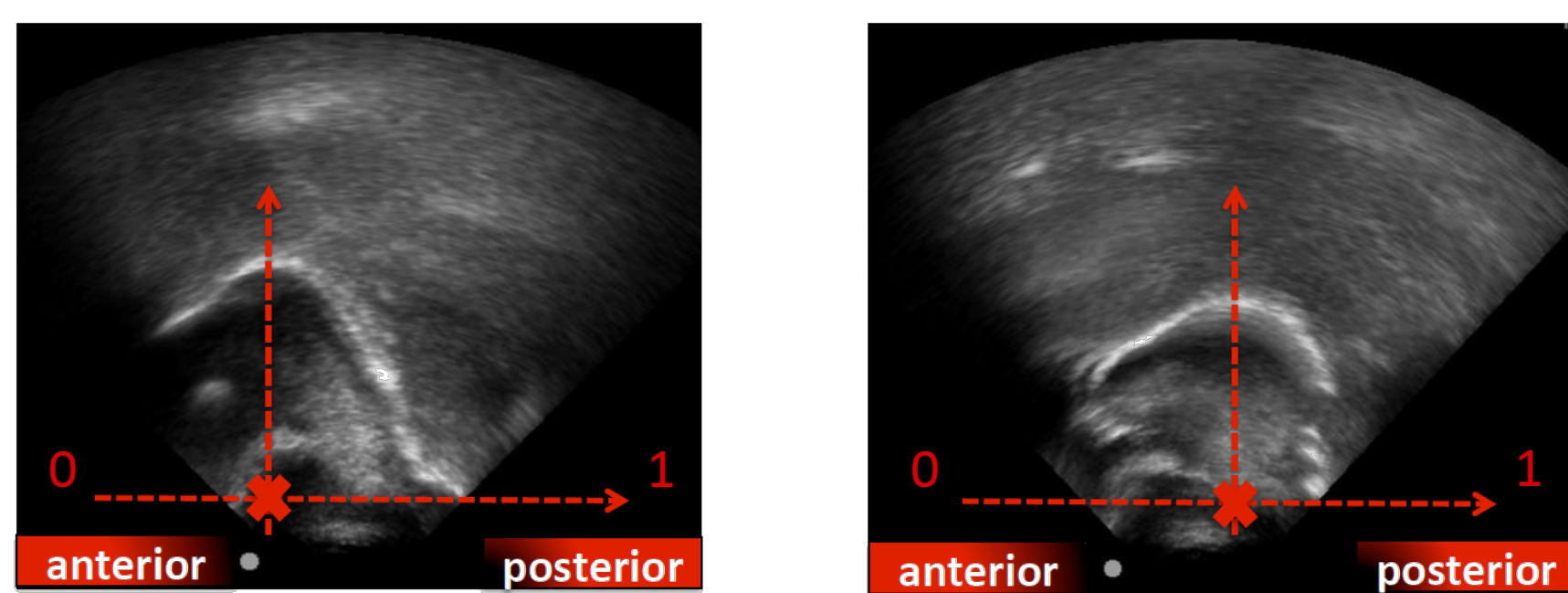


Figure 1: Midsagittal tongue contours at the midpoint of the vowel /i/ (left) and /u/ (right) with the horizontal positions of the highest point on the tongue body

Assessments:

Reading fluency:

- Time and accuracy raw measures for reading real and non words (German SLRT I test)
- RF defined as accuracy/time

Phonological awareness:

- Onset Deletion and Rhyme Production tests (German TBP test)
- Composite score - maximum 24 points
- PA groups based on median value of the data set
 - Lower PA (n=18): from 0 to 21 - 18
 - Higher PA (n=12): from 22 to 24

Statistical analysis:

- General additive models (GAMs):
 - Tensor smooth with PA and RF as interaction terms
 - Participant and consonant (C₁) as random factor smooths

3. Results

Assessments:

- Low positive correlation between PA and RF ($r = 0.5$, $p < 0.001$)
- Lower PA group: participants did not reach high RF scores
- Higher PA group: participants exhibited high variation in RF scores

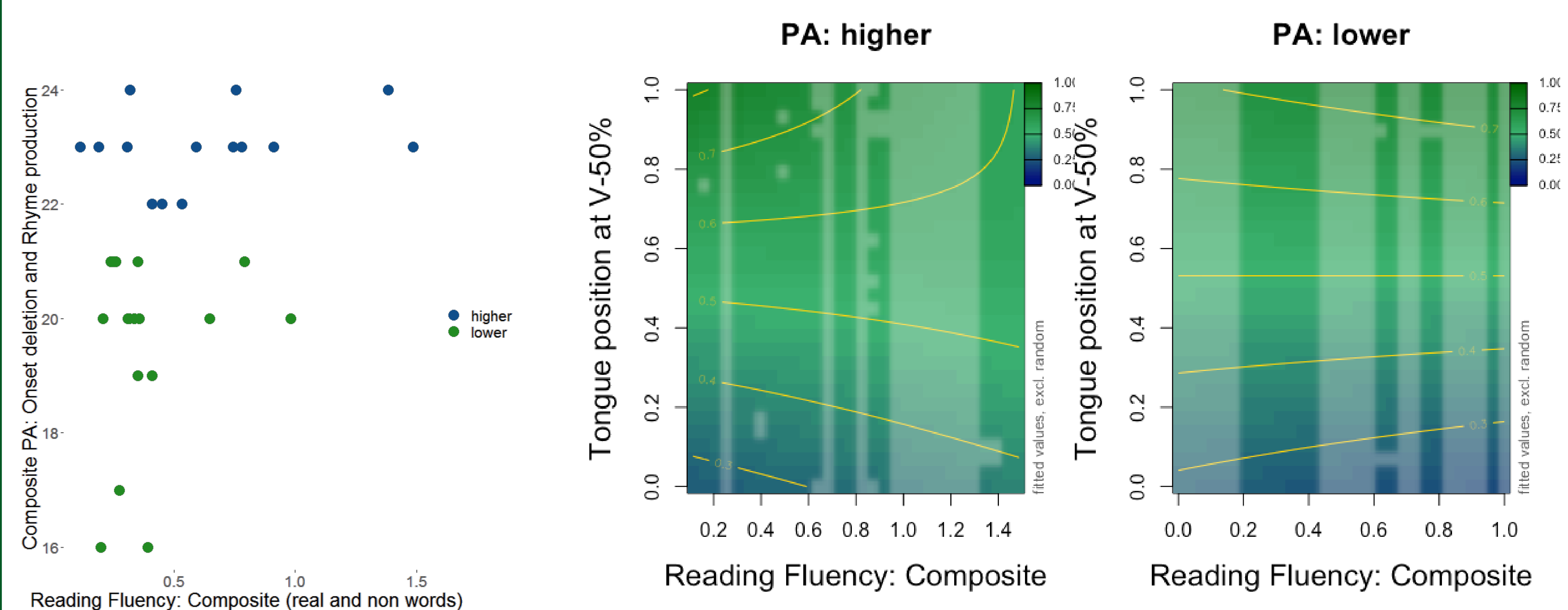


Figure 2: PA as a function of RF (left); Contour plots illustrating changes in the tongue dorsum position during C₁ as a function of tongue dorsum position for target vowels (y-axis) and RF scores (x-axis) for higher and lower PA groups (right)

GAMs:

- CD varies as a function of RF *only* for participants in the higher PA group
- The interaction between CD and RF in the higher PA group are non-linear: increments in RF do not correspond to an equivalent decrease in CD
- Higher PA group: more proficient readers exhibit lower CD (illustrated by the *fan-like* structure of the contour lines)
- Lower PA group: more proficient readers exhibit similar CD (illustrated by the *parallel* disposition of the contour lines)

4. Summary of results

- Highest RF scores are found in children with higher PA scores
- Children with better PA *and* RF exhibit lower degrees of intersegmental coarticulation (i.e. more vocalic anticipation during the consonant)
- RF does not correlate with CD in participants with lower levels of PA

5. Discussion

- Preliminary results indicate that a certain PA level seems necessary to stimulate greater intersegmental speech motor differentiation as a function of reading proficiency
- Results suggest the interaction between PA, RF and CD is dynamic and may well vary with changing levels of proficiency for various skills at different periods of development

Future studies:

- More fine grained measurements are needed for:
 - PA: involving smaller phonological units (phoneme concatenation, phoneme deletion tests)
 - RF: stimuli could include more complex phonotactics (onset and coda clusters) in both real and non word reading tasks

6. References

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- (4) Popescu, A., & Noiray, A., Learning to read interacts with children's spoken language fluency, submitted

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