Final lengthening
Segments
- Mean displacement in mm
- Closing duration in ms
- Vowel duration in ms

Questions
1. For German, the acoustic vowel duration in the phrase-final condition is expected to lengthen for tense vowels. Are lax vowels affected differently compared to tense vowels?
2. Is closing gesture duration towards the consonants longer in duration in phrase-final position?
3. Which kinematic parameters of the closing gesture are affected by final lengthening?

Method & Data
- Tongue movement data via EMA (AG 501, Carstens Electronics) along with acoustic data
- 8 German subjects read 4 target words embedded in carrier sentences (repeated 5 times)
- Boundary strength contexts: phrase medial and phrase-final
- Labeling of closing gesture duration towards consonants in the target word using the custom made MATLAB tool mview (Mark Tedes, Haskins Laboratories)
- Acoustic labeling with Praat (Boersma 2001)
- Speech rate calculated in syllables per sec. (excl. pauses)

Stimuli
Target words: Bahn [ba:h] — Bann [ba:n] 'train — ban'; Beet [be:t] — Bett [be:t] 'bed (bot.) — bed'
Phrase-medial:
Ich fuhr mit der Bahn am Donnerstag. Am Mittwoch wurde noch gestreikt.
'I took the train on Thursday. On Wednesday, there was still a strike'
Phrase-final:
Ich fuhr mit der Bahn. Am Donnerstag wurde noch gestreikt.
'I took the train. On Thursday, there was still a strike.'

Effect on vowel duration
Lax vowels are 31% longer in phrase-final positions. Tense vowels are lengthened by 45%, respectively. Lax vowels are nearly unaffected by increasing speech rate.

Effect on closing gesture duration
Closing duration decreases with faster speech rate, and closing takes longer for tense vowels.

Effect on velocity
Smaller peak velocities for phrase-final positions; interaction of position and tenseness for Beet/Bett.

Effect on amplitude
Tenseness but not position affects articulator displacement.

Summary
1. Tense and lax vowels can be lengthened in phrase-final position. The effect is significantly smaller for lax vowels.
   - Lax vowels seem to be incompressible for faster speech rates, confirming previous findings.
2. Closing gesture duration is longer in phrase-final position.
3. Displacement is not significantly affected by phrase-final position; peak velocity is significantly smaller for phrase-final position. Bahn/Bann and Beet/Bett are affected differently by tenseness.

Conclusion
- The results of this study support the assumption of the n-gesture model and the task-dynamic model, showing a lengthening effect at strong prosodic boundaries for vowels in acoustics and for consonants in articulation.
- Lax vowels can be lengthened in final positions, contrary to findings for speech rate and stress.
- Lengthening of lax vowels seems to be limited by the quantity contrast.

References
Humboldt-Universität zu Berlin, Haskins Laboratories 1, University of Michigan 2, Haskins Laboratories 3, Friedrich-Schiller-Universität Jena 4.