Contributions of the vocal tract shape to the C-center effect

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- onset consonants are timed in-phase with the vowel
- stable interval: C-center to anchor
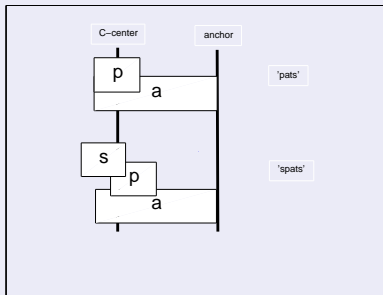
Introduction: Influence of coarticulation
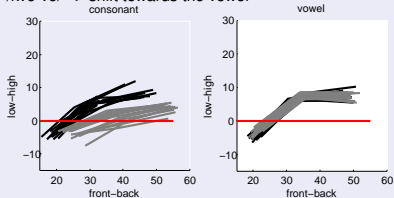
Example from our earlier study:

- C-center effect is influenced by coarticulatory surroundings
- C-center effect is found when the tongue needs to move more to reach the vowel following a singleton than following a cluster
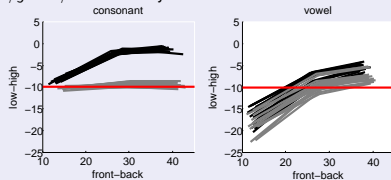
C-center effect

/kve-ve/ –> shift towards the vowel

"negative C-center effect"

/glaɪ-laɪ/ –> shift away from the vowel

Male-female differences in vocal tract shape and articulatory variability

- Fant (1966)
- Honda et al. (1996)
- Simpson (2001)
- Fuchs et al. (2008)
- Winkler et al. (2011)

Hypothesis

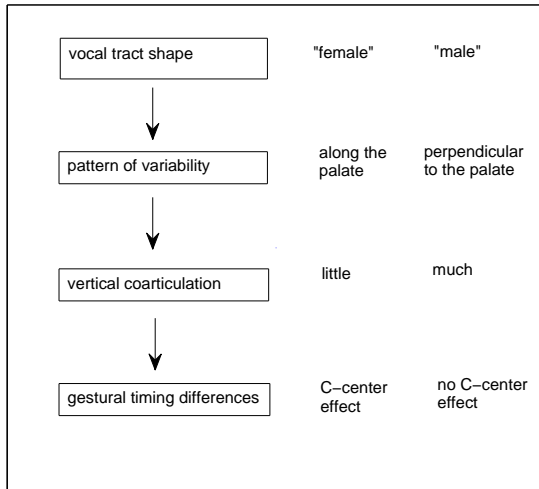**Observation I: the C-center effect depends on coarticulation**

- larger articulatory distance from C to V in CV than in CCV –> C-center effect
- larger articulatory distance from C to V in CCV than in CV –> no C-center effect

Observation II: Articulatory variability depends on a speaker's vocal tract

- longer pharyngeal cavity –> more variability perpendicular to the palate
- longer oral cavity –> more variability along the palate

–> The C-center effect depends on a speaker's vocal tract shape.

Hypothesis: more concrete

vocal tract shape | "female" | "male"

pattern of variability | along the palate | perpendicular to the palate

vertical coarticulation | little | much

gestural timing differences | C–center effect | no C–center effect

- **test condition**: /gl/ cluster –> effect expected
- **control condition**: /pl/ cluster –> no effect expected
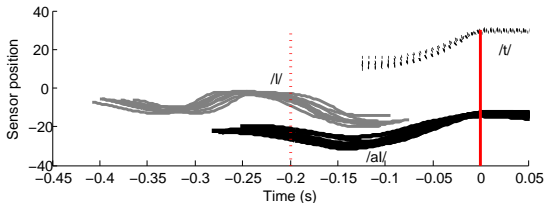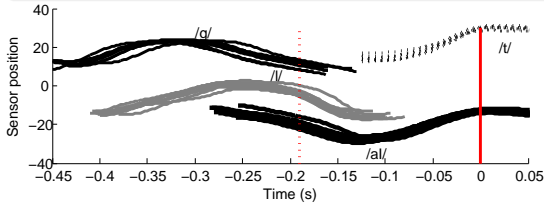
Methods

EMA-experiment

- 8 German native speakers (4m, 4f)
- NDI WAVE system
- TT sensor during /l/ analysed

Speech material

- /gl/-/l/: in initial and medial position, e.g. *gleiten-leiten*
- /pl/-/l/: in initial and medial position, e.g. *plagen-lagen*
- 24 items in a carrier phrase
- 16 repetitions

Methods: C-center analysis

- vowel: plateau offset of prevocalic consonant to plateau onset of anchor vowel
- vowel compression: *vowel_cv − vowel_ccv*

1f

9m

low-high

front-back

front-back

along the palatal outline: triangle

perpendicular to the palatal outline: quadrilateral

Methods: variability patterns (tongue tip)

- all data rotated to a horizontal palatal contour
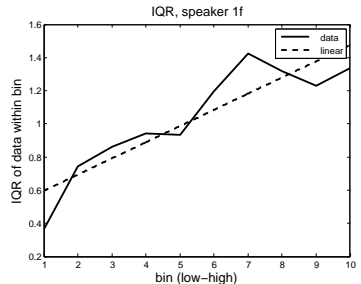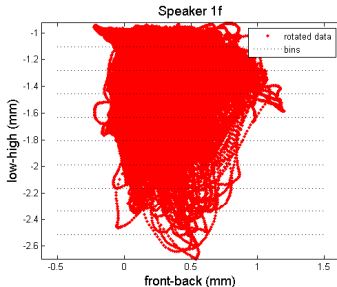- z-normalization to account for size differences

- vertical dimension separated into 10 bins of equal size

- IQR of x-values for each bin
- slope of linear approximation

- correlation between *slope* and *vowel compression*

Results: two examples
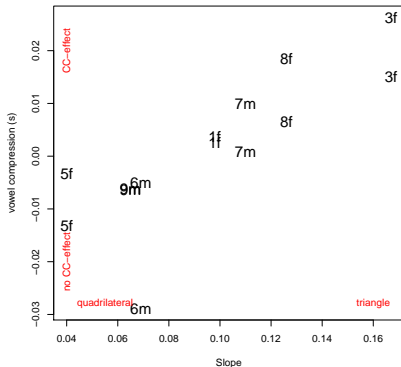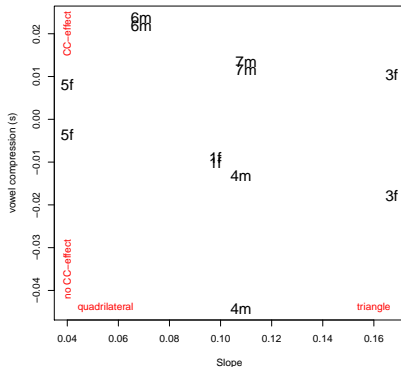
- /gl/: vocal tract shape has an influence on the C-center effect

- /pl/: vocal tract shape has no influence on the C-center effect

Results

CCV word	rho	p
gleiten	.868	.000
glauben	.629	.008
glänzen	.594	.013
begleiten	.744	.001
geglaubt	.780	.001
geglänzt	.602	.011

CCV word	rho	p
plagen	-.014	.517
plauschen	-.226	.760
plätze	.198	.269
geplagt	-.099	.620
geplauscht	.014	.483
geplättet	-.212	.746

- /gl/: vocal tract shape has an influence on the C-center effect

- /pl/: vocal tract shape has no influence on the C-center effect

Summary

- The occurrence of the C-center effect, actually an effect linked to syllable structure, is influenced by a speaker's vocal tract shape.

- In the low vowel context investigated here, there are speakers prone to produce a C-center effect (speakers who vary their tongue position along the palatal outline). And there are speakers without a C-center effect (with variation perpendicular to the palatal outline).

- Present analysis: based on a simple relationship, the one between movement amplitude and duration

- "Quadrilateral" speakers move more in the CCV than in the CV item, "triangular" speakers do not move more.

Discussion

- "The syllable is an abstract phonological constituent without clear phonetic correlates (Ladefoged and Maddieson 1996)." (Zec, 2007) ???
- At least: Measuring this (phonological) effect on phonetic data is difficult.
- interspeaker differences and coarticulation are reasons for the contradictory findings in the C-center literature

Acknowledgments