Production-perception relationships in sound change: evidence from East Franconian

Seminar on Speech Production and Perception
VIU, 11/10/12
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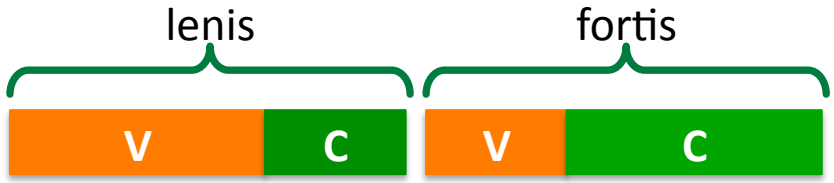
Motivation

- Is there a sound change in progress regarding the intervocalic voicing contrast in the region of East Franconian under the influence of the standard variety?
- Does this change take place in both production and perception?

Introduction

- Phonemic voicing contrast in Standard German
- voiced/voiceless, lenis/fortis, etc. (cf. Braun, 1988)
- /baːdən/ vs. /baːtən/
- hierarchy of perceptual relevant acoustic cues (Kohler, 1979)
  - aspiration, esp. in initial position
  - vowel : stop duration ratio (V:C), esp. in intervocalic position and velar release



  - formant transitions
  - phonetic voicing

(In-)Complete Neutralization

- in syllable **final** position in Standard German, e.g.

(*bath room*) /baːd/

(*sb. requested*) /baːt/ > [baːt]

- incomplete neutralization in the production (Port & O'Dell, 1985) and the perception (Kleber et al., 2010) of the final voicing contrast

- fine phonetic differences (e.g. longer vowel duration) e.g. between *bat* and *Bad* (Port & O'Dell, 1985)

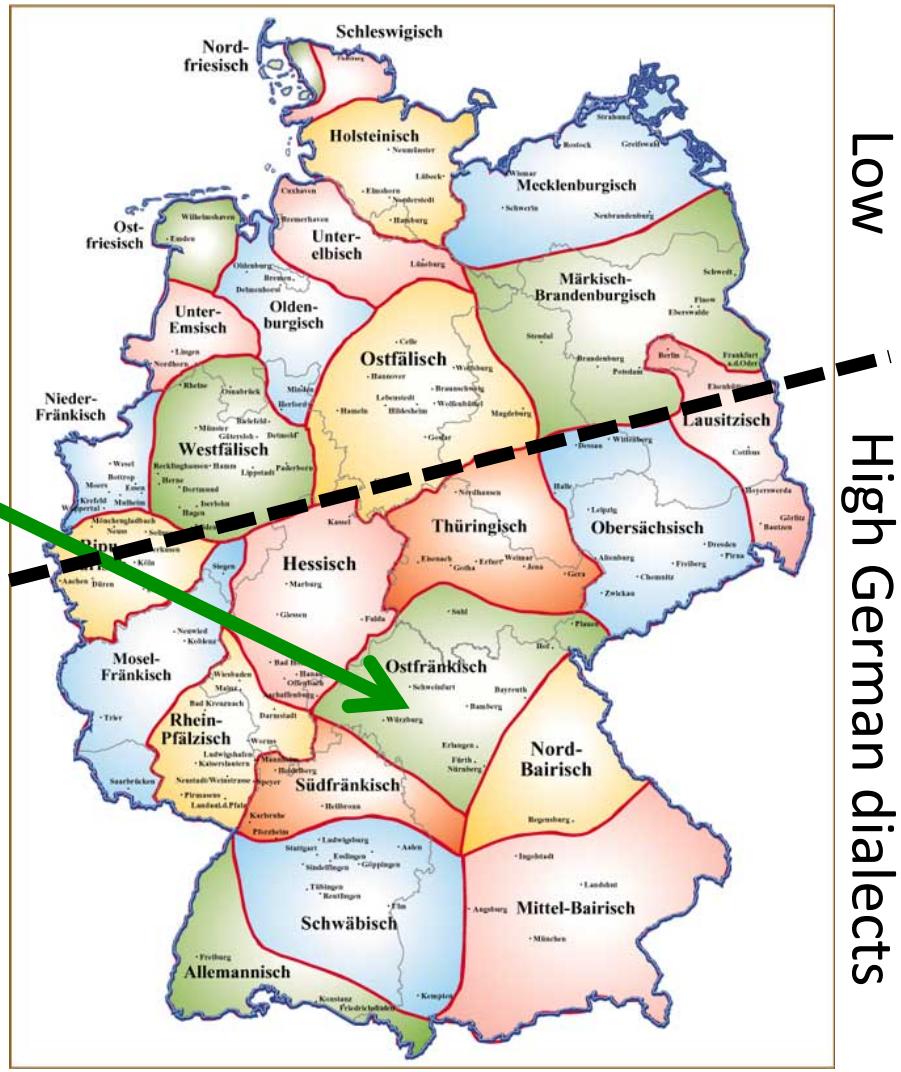
Central German Lenition

Lenition of fortis obstruents in syllable **initial**, i.e. pre-vocalic and/or **intervocalic** position in many High German German dialects (e.g. East Franconian)

(to bath) /baːdən/

(requested) /baːtən/ > [baːdən]

(godparents) /paːtən/



Source: http://www.sprache-reise.de/sprachen-in-deutschland/dialekte-in-deutschland

Research Questions

1. Do East Franconian speakers only incompletely neutralize the voicing contrast?

2. Do older East Franconian speakers show a greater tendency towards neutralization than younger East Franconian speakers?

   Evidence that speakers of a younger generation use less dialect features and tend to a more standard-like pronunciation than older speakers (Lameli, 2004; Wagener, 2002)

Research Questions (cont'd)

3. Is there a more categorical shift in the perception of the lenis/fortis contrast in younger East Franconian listeners and only a gradual change in older East Franconian listeners?

4. Do older East Franconian listeners make more errors in the classification of /d/ and /t/ realizations produced by both speakers of East Franconian and Standard German than younger East Franconian listeners?

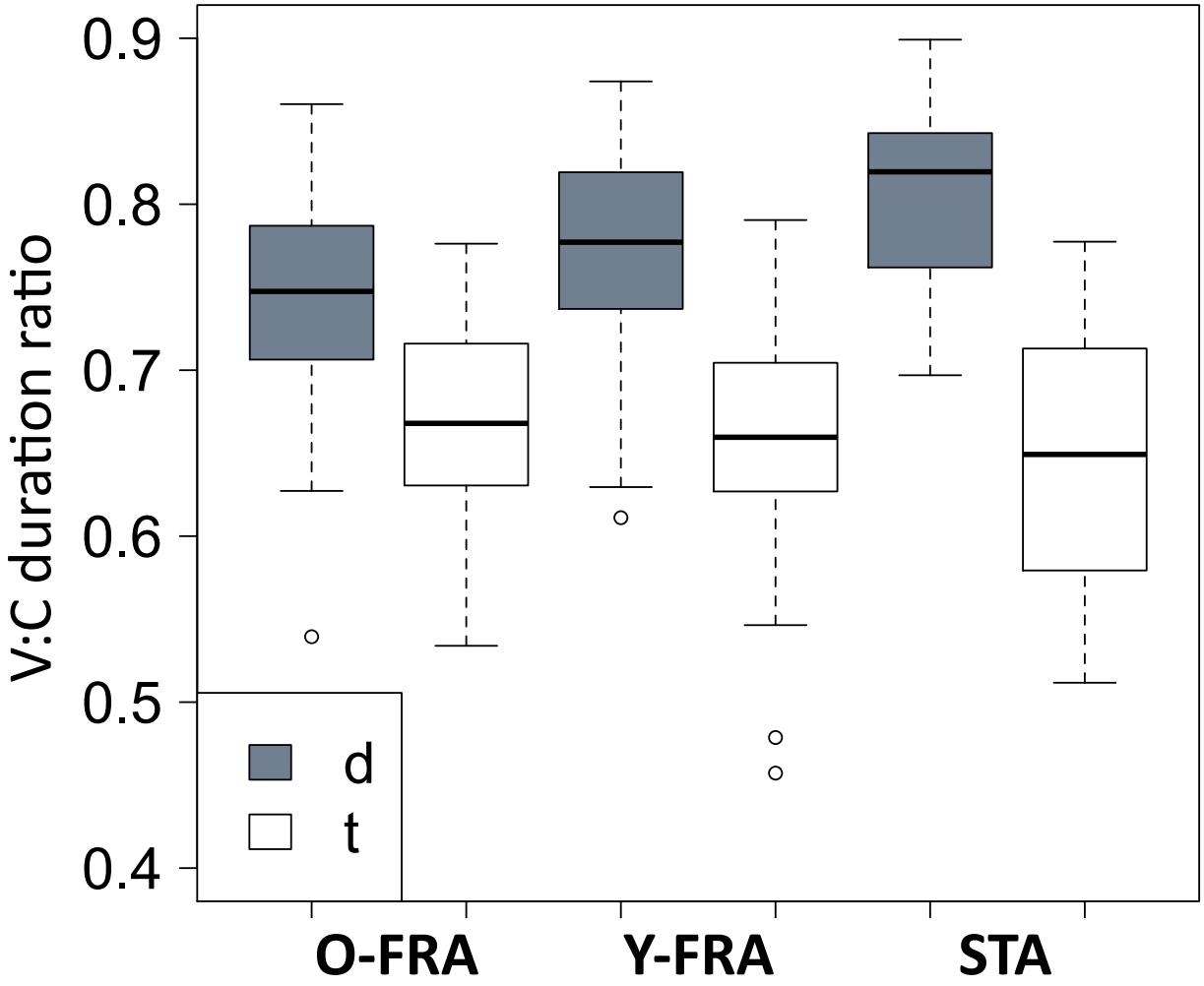
Participants

- 32 East Franconian speakers (FRA)
- two age groups
  - Old (O): 16 speakers between 51 and 74 years
  - Young (Y): 16 speakers between 15 and 25 years
- recording of 5 Standard German speakers (STA)

Production experiment: Method

- minimal pairs
  - /laɪd(ə)n/ - /laɪt(ə)n/
  - /bad(ə)n/ - /bat(ə)n/
  - /miːd(ə)n/ - /miːt(ə)n/
- two conditions: read speech
  - in **isolation,** 7 repetitions / token
  - in **context**, i.e. embedded in a story, 2 repetitions / token
- Measurements of V and C duration (C = closure)
- V:C duration ratio: V/(V+C)

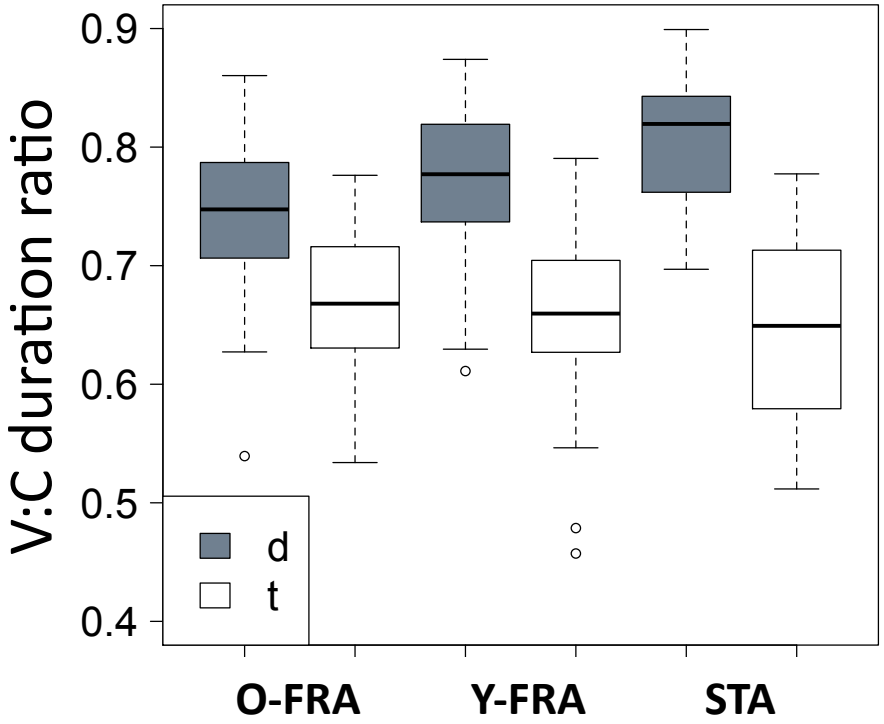
Results



ISOLATED WORDS

- lenis/fortis contrast is maintained by all speaker groups ($\chi^2_2 = 33.2$, $p < 0.001$)
- but obviously to a different extent...

Results



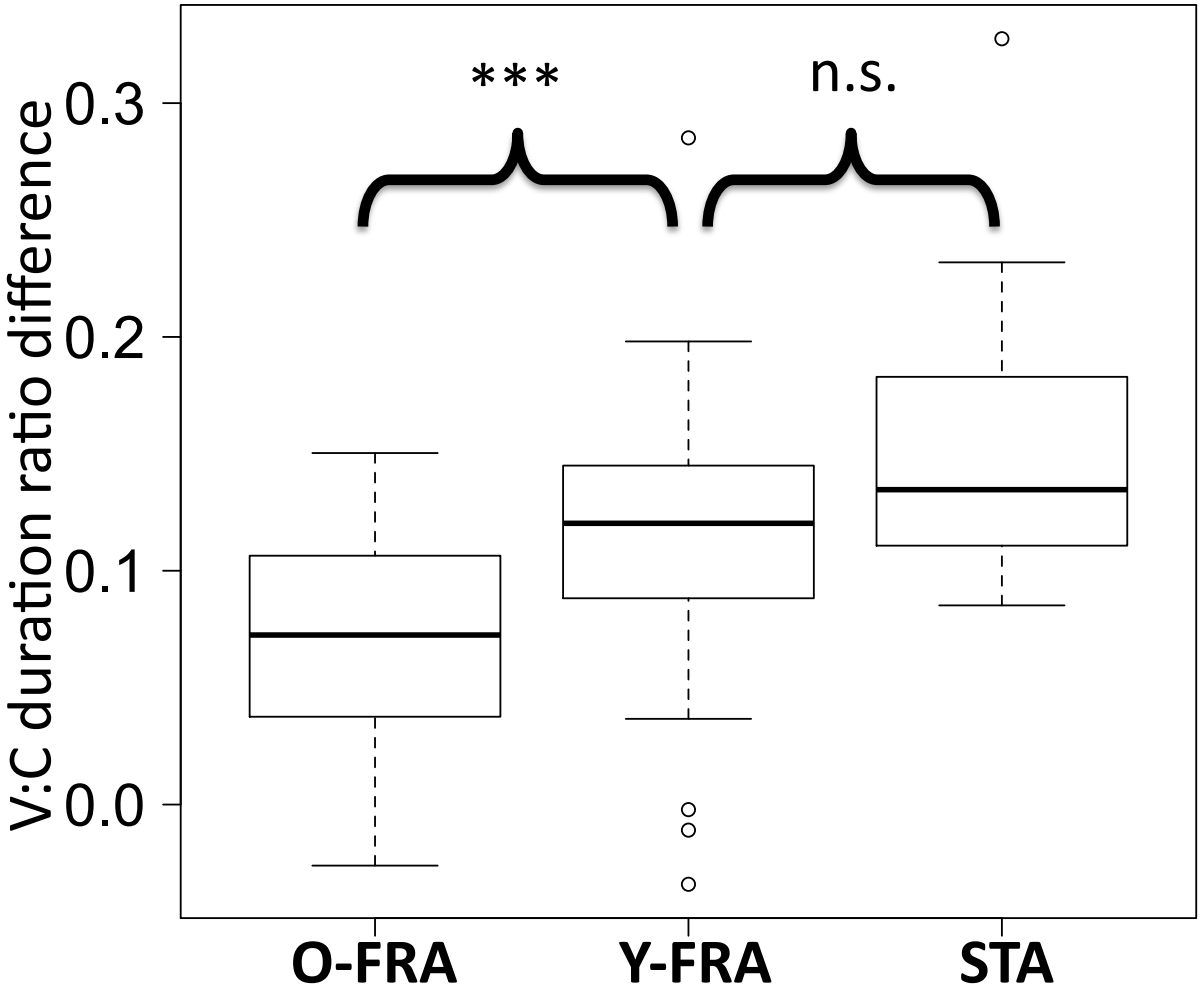
NEUTRALIZATION DEGREE

calculation of the difference between the mean V:C duration ratio of each speaker's /d/-tokens minus the mean V:C duration ratio of each speaker's /t/-tokens

$$(V/(V + C))_{lenis.m} - (V/(V + C))_{fortis.m}$$

V:C duration ratio difference

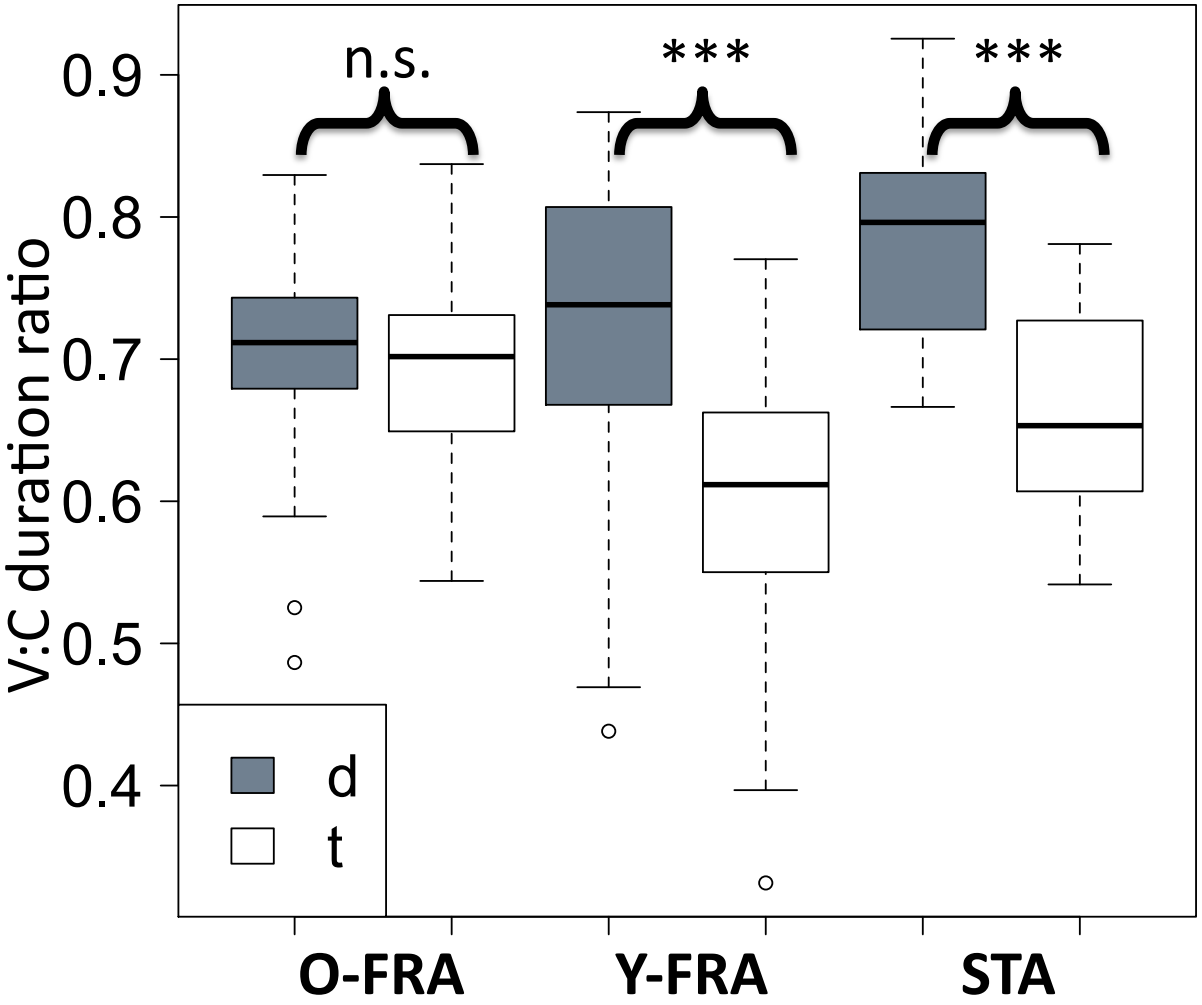
Neutralization degree



ISOLATED WORDS

- FRA incompletely neutralize / maintain the lenis/fortis contrast.
- O-FRA speakers show a significant greater tendency ($\chi^2_2 = 13.9$, $p < 0.001$) towards neutralization than Y-FRA and STA speakers…

Results (cont'd)



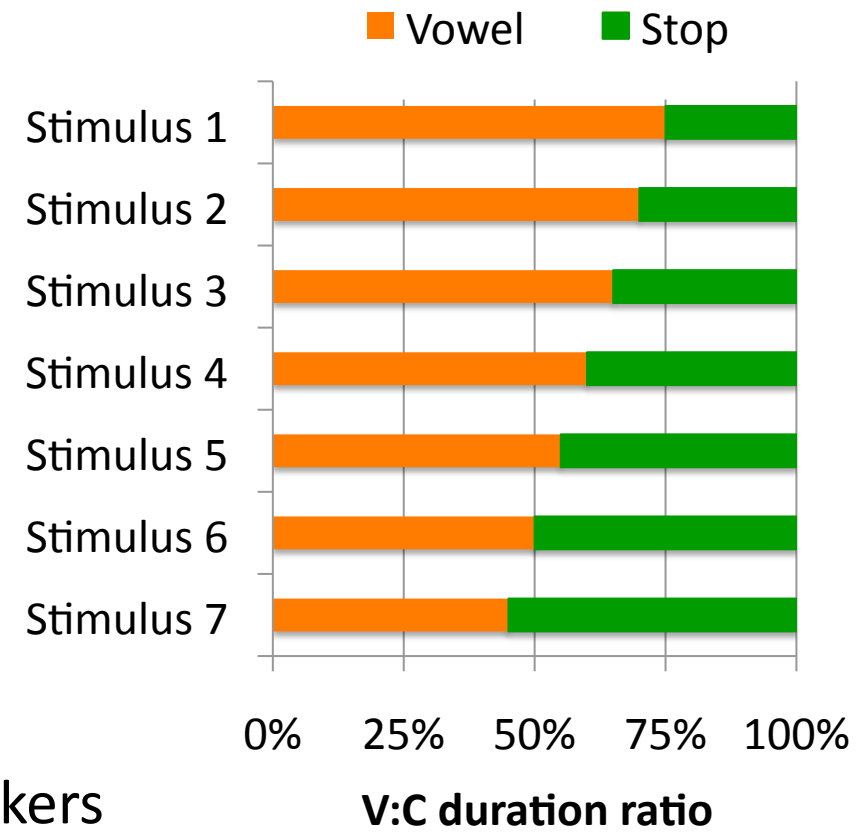
CONTEXT WORDS

… and in context words O-FRA speakers even completely neutralize the contrast

Perception experiment I

Method

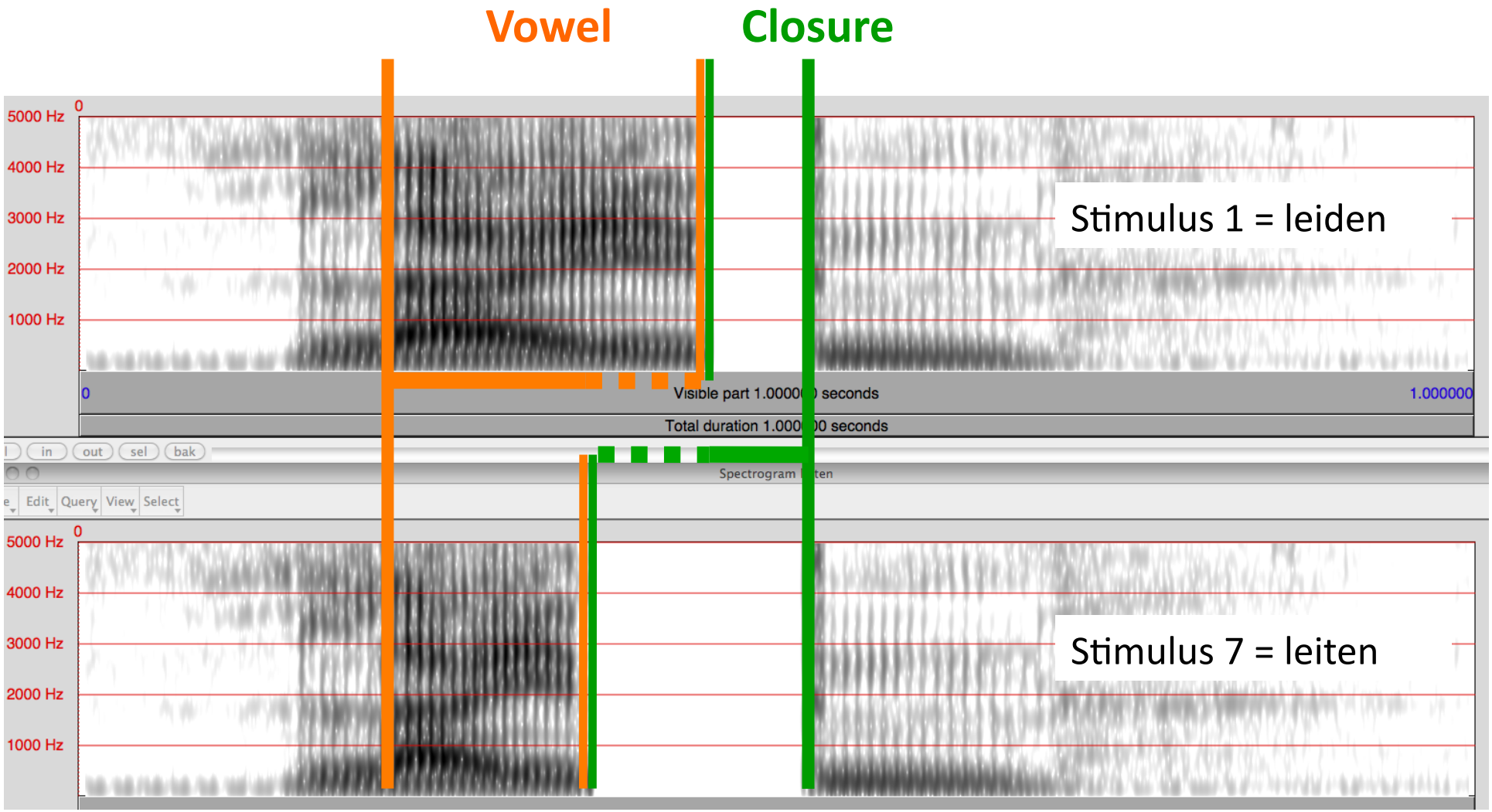
- V:C duration ratio continua
- /laɪdn – laɪtn/, /mi:dn – mi:tn/
- manipulation/resynthesis in praat
- 10 repetitions of each stimulus
- two-alternative forced-choice identification test



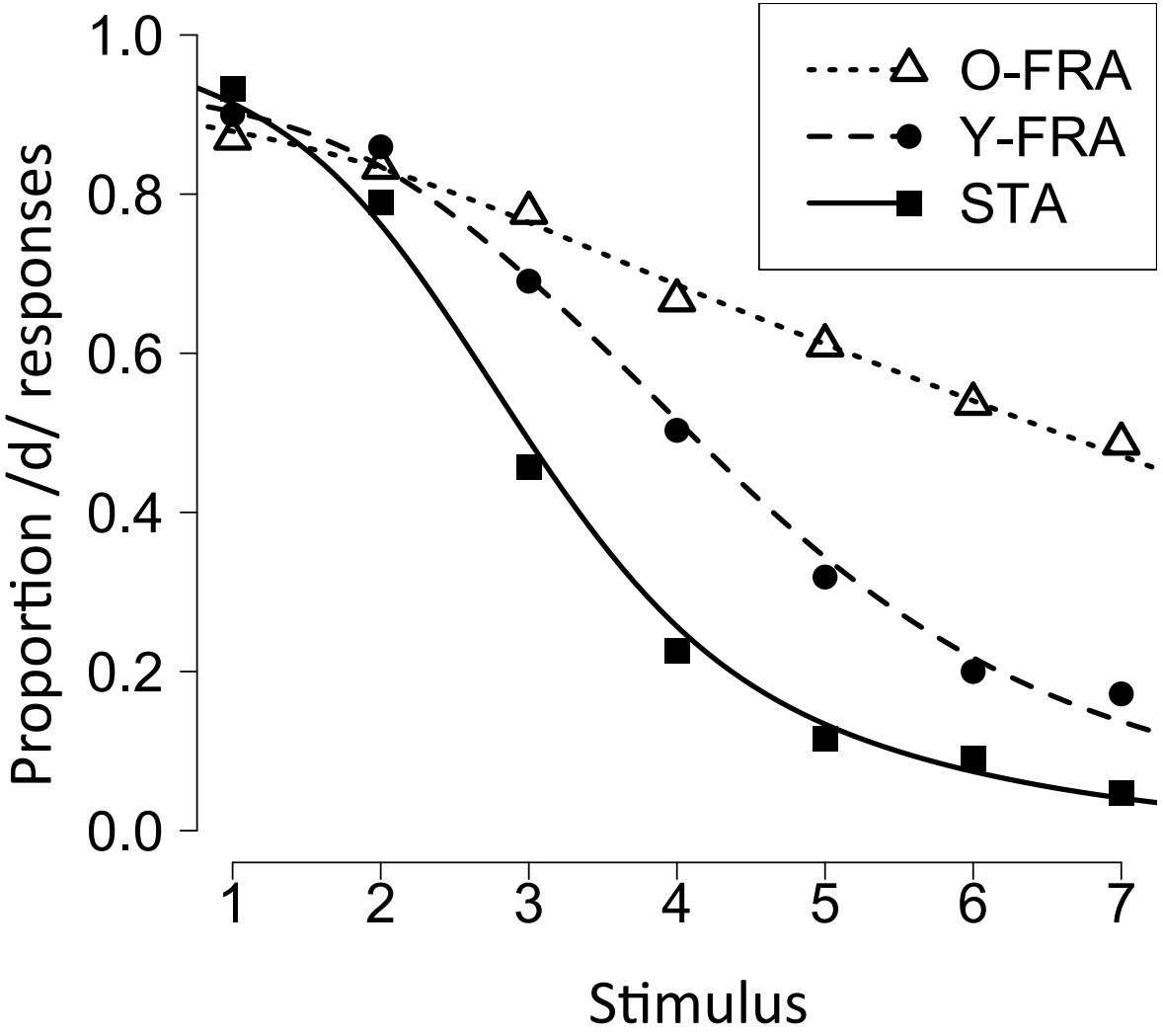
Participants

- the same 32 East Franconian speakers
- plus 21 different Standard German speakers

Perception experiment I: Stimuli



Perception experiment I: Results



SLOPES / BOUNDARIES

- progressively steeper slopes and thus more categorical response curves from O-FRA to Y-FRA to STA ($\chi^2_2 = 25.8$, $p < 0.001$)
- more t → d mis-classifications and no category boundary in O-FRA than in Y-FRA and STA listeners

Interim summary

1. No complete neutralization of the intervocalic lenis/ fortis contrast in East Franconian
2. More neutralization of the /t, d/-contrast in the production of older Franconian speakers

   The degree of contrast for younger Franconian speakers was intermediate between those of older Franconian and Standard German speakers
3. Perception and production were matched: younger Franconian listeners distinguished perceptually between intervocalic /t, d/ whereas older Franconian listeners did not

But what about natural stimuli?

Perception experiment II

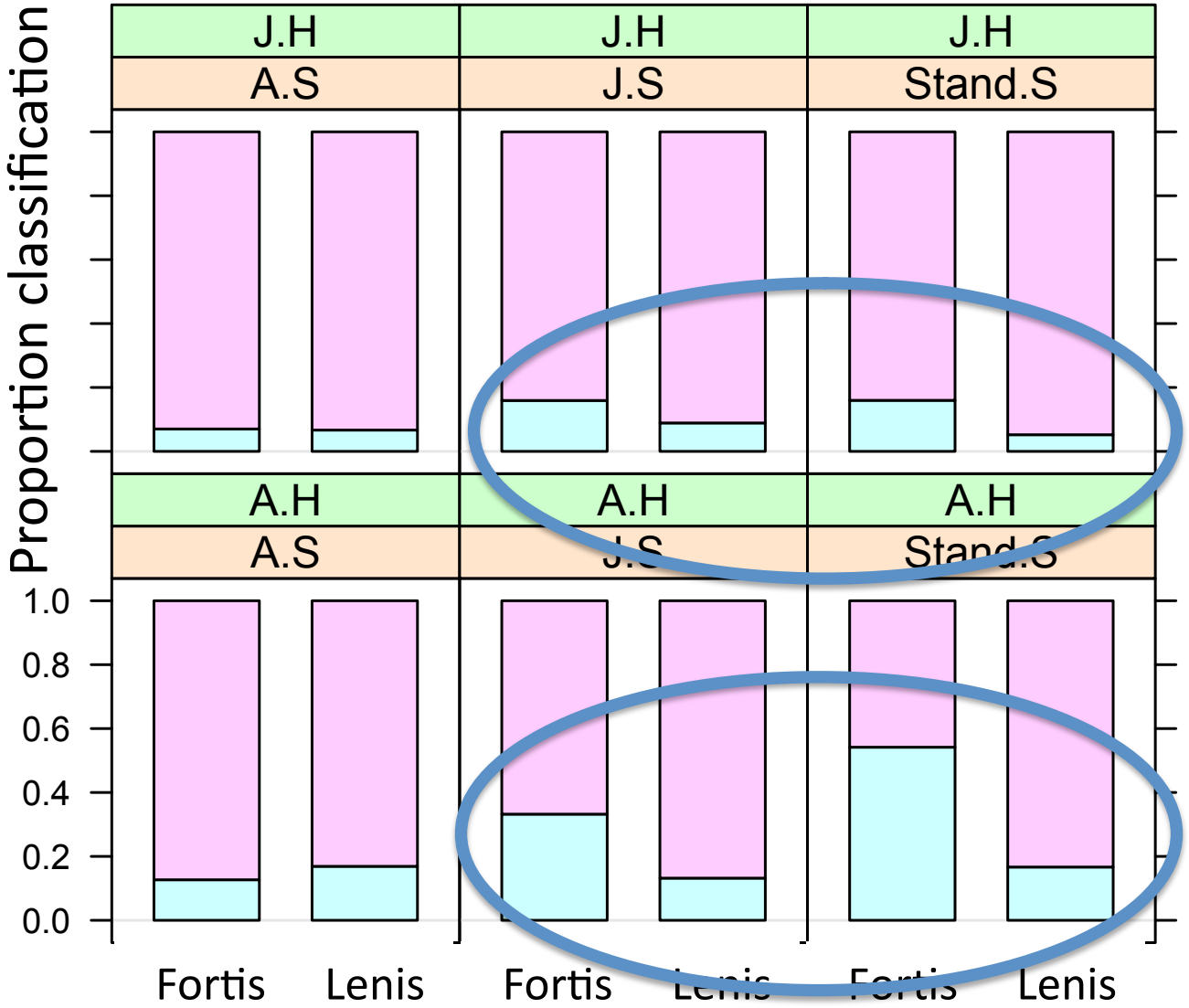
Method

- 1 randomly selected token of each of the isolated *leiden, leiten, mieden,* and *mieten* productions from the first 13 speakers (6 O-FRA, 6 Y-FRA, 5 STA) → 13 x 4 = 52 stimuli
- all productions of *baden* and *baten* by 13 speakers → 13 x 14 = 182 stimuli
- 2AFC identification test ('t' or 'd')
- 198 same speaker-listener responses were excluded

Participants

- the same 32 Franconian listeners

Perception experiment II: Results



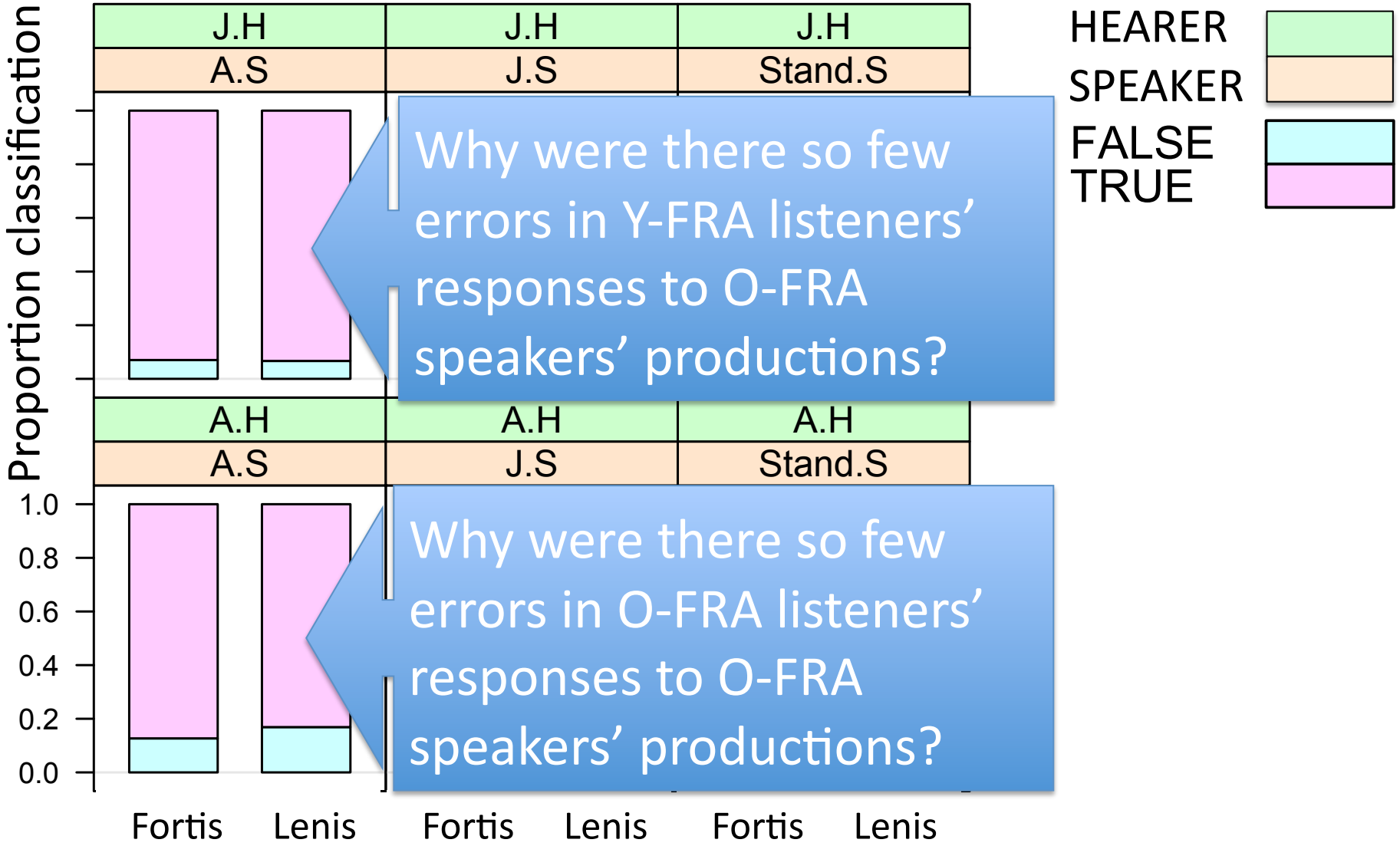
HEARER
SPEAKER
FALSE
TRUE

7290 responses
((52+182) x 32)-198

1. more t → d than d → t mis-classifiactions

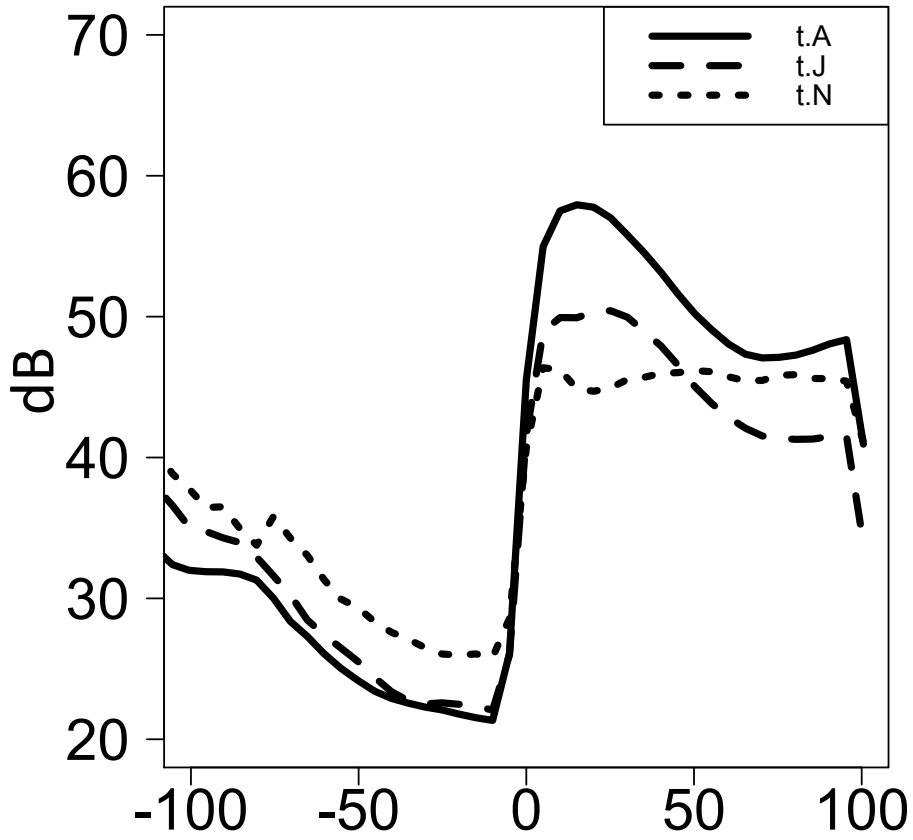
2. more t → d errors in O-FRA than in Y-FRA listeners

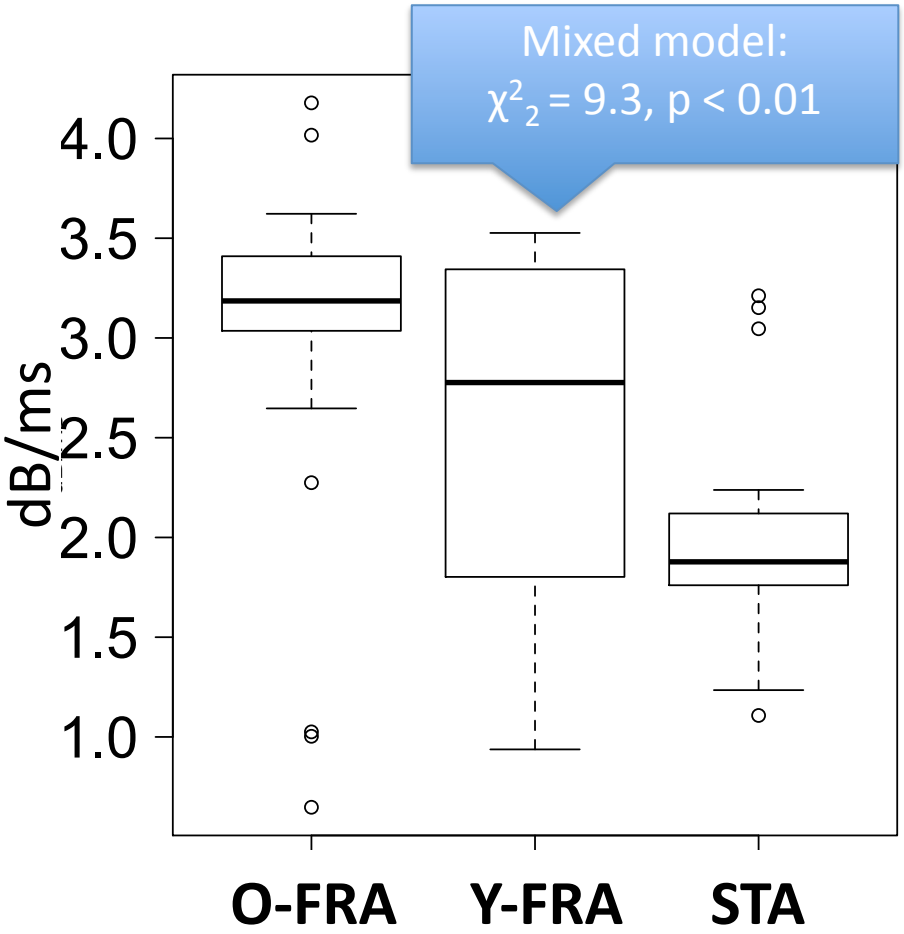
Perception experiment II: Results



Do O-FRA speaker use other cues?

Reanalysis of isolated words with underlying **fortis stops**



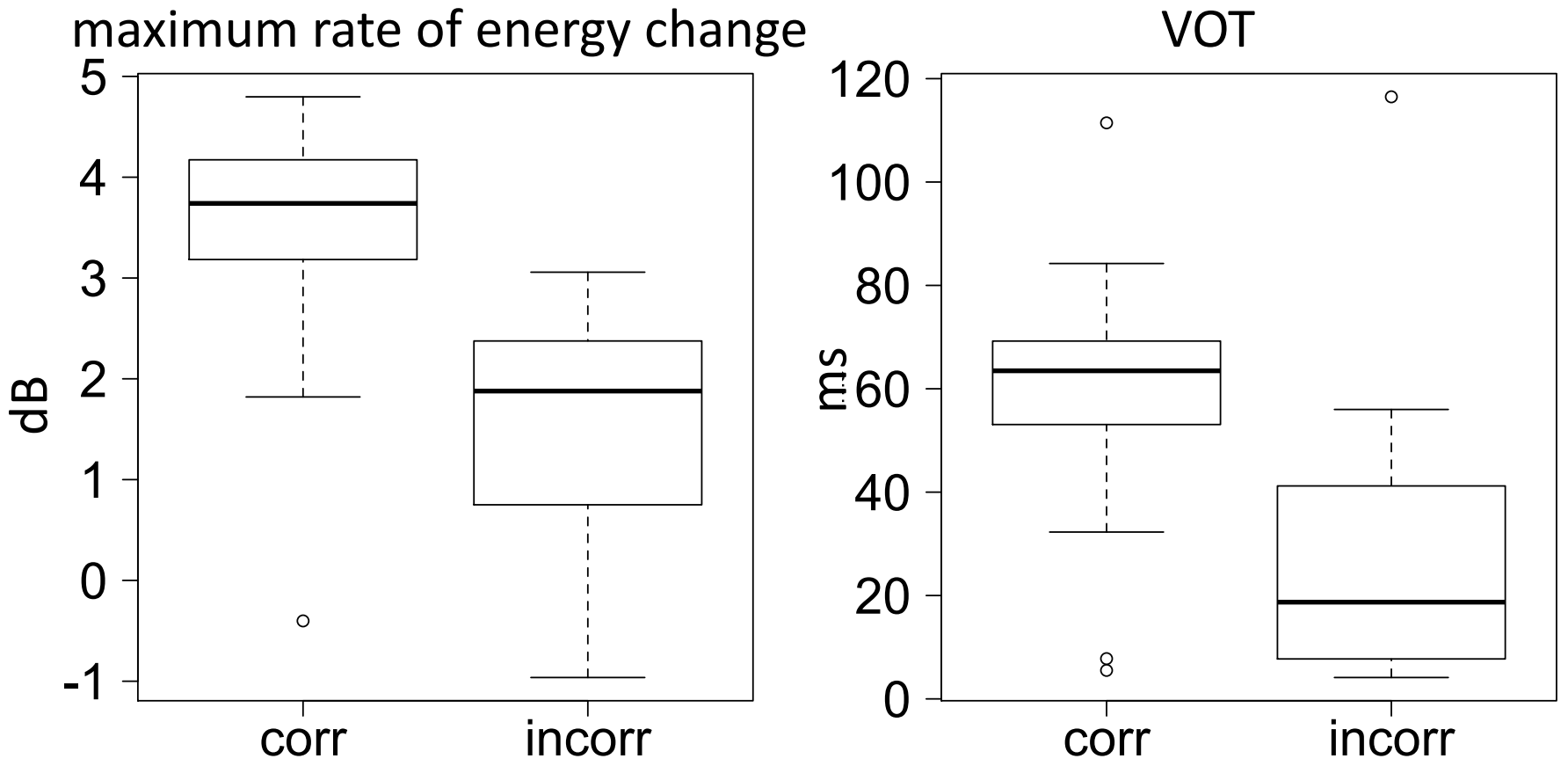


O-FRA speakers produced more strongly released voiceless stops.

Perceptual relevance of Burst

- Reanalysis of responses to natural stimuli
- Stimuli: tokens with underlying fortis stops produced by Y-FRA and STA speakers
- division into a correct and an incorrect group depending on whether they were predominantly (mis)classified by O-FRA listeners
- In what respect differed Y-FRA's and STA's productions that were correctly vs. incorrectly classified by O-FRA listeners

Perceptual relevance of Burst (cont'd)



More misclassifications of stops with lower values on both parameters than those with higher values

Is the V:C duration ratio phonetic for O-FRA but phonological for Y-FRA and STA speakers?

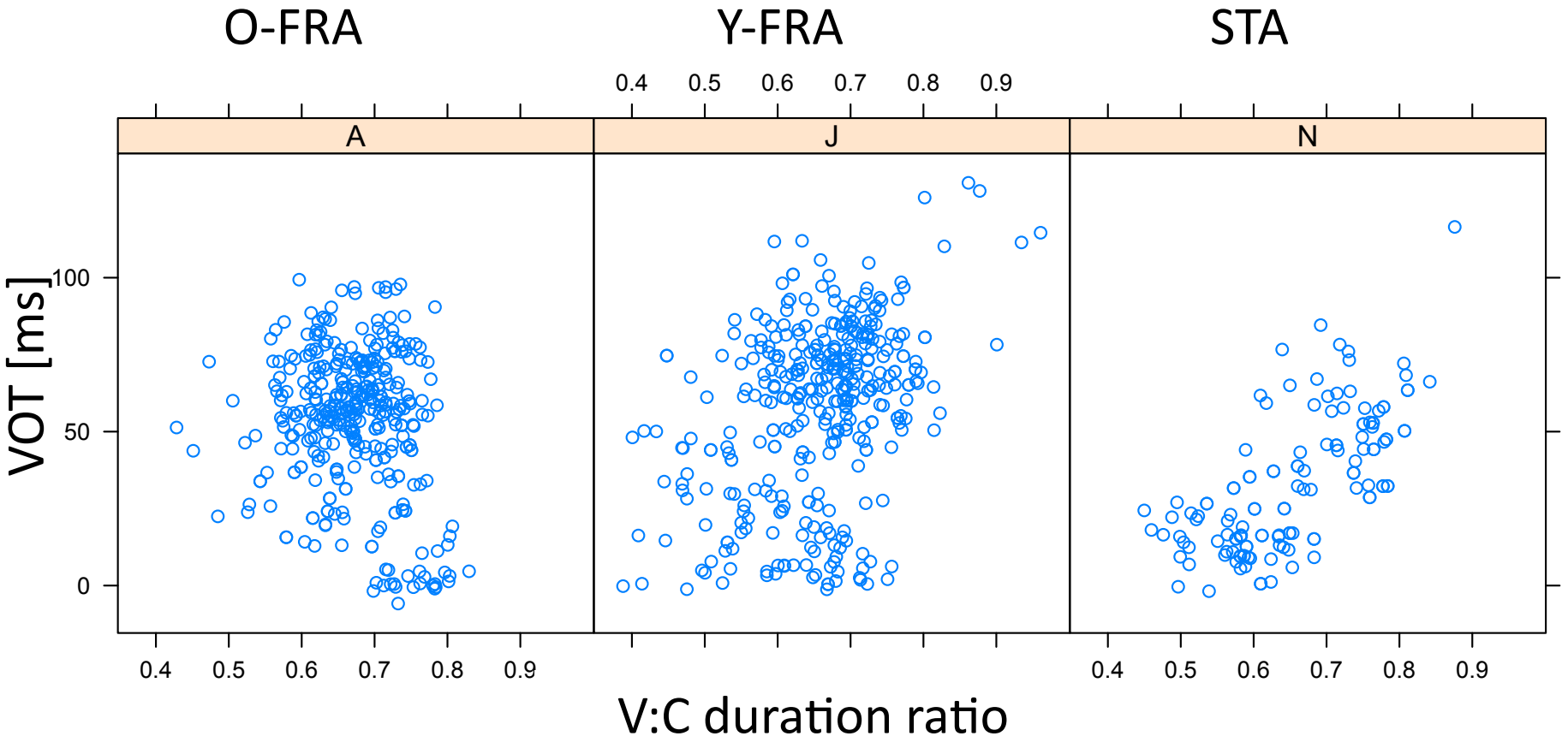
Two possible relationships between the V:C duration ratio and the stop release (cf. Jessen, 1998 for Standard German)

1. If the V:C duration ratio is a **phonetic** consequence of the release, then stronger release cues in /t/ should be associated with more cutback and a shorter V:C duration ratio

2. If the V:C duration ratio is primarily **phonological**, then the release and V:C duration ratio are expected to enter into a trading relationship: a short V:C duration ratio (strong cue for /t/) should be associated with a weak release (weak cue for /t/) and vice-versa.

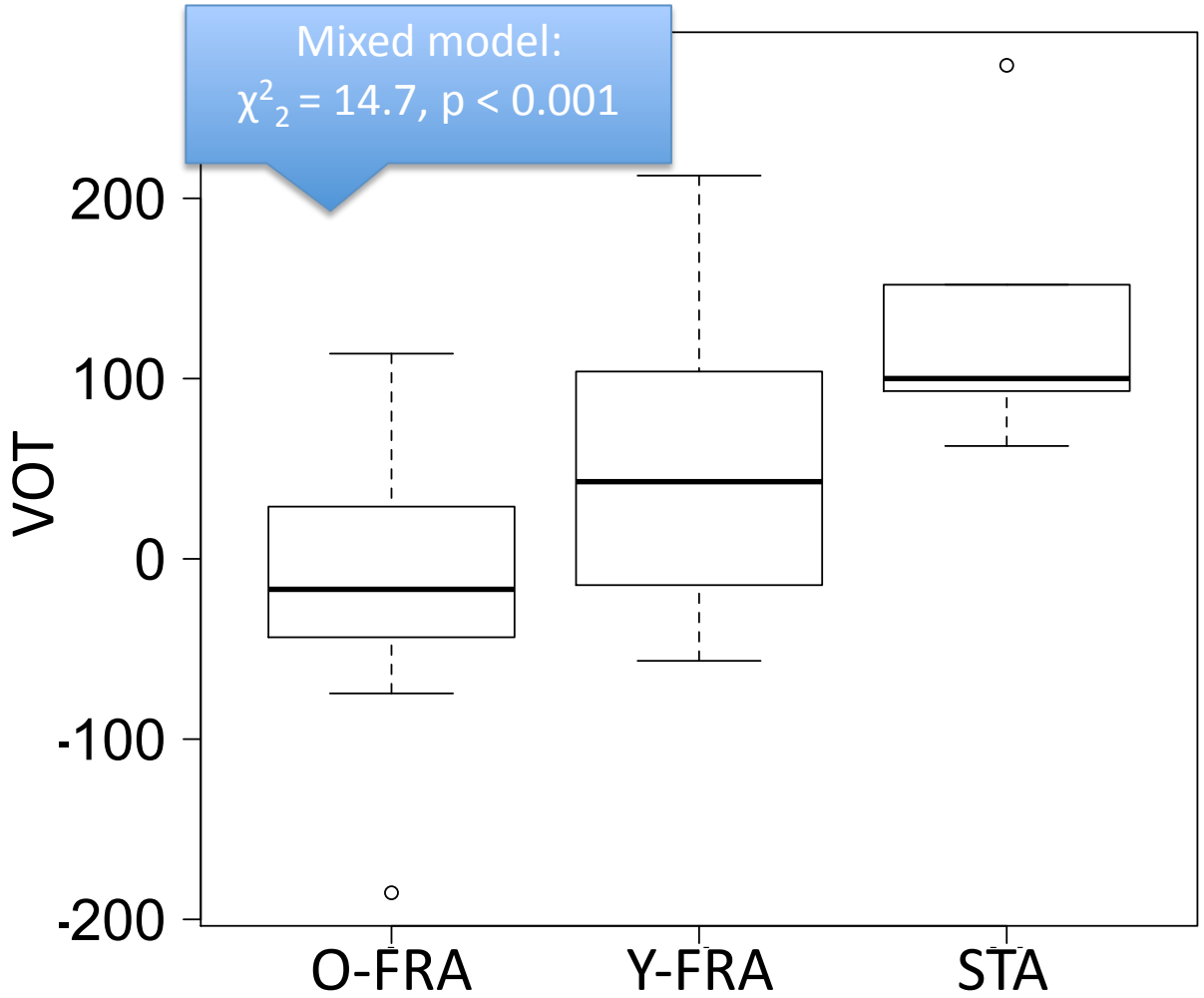
Trading relationship

Reanalysis of isolated words with underlying **fortis stops**



Trading relationship (cont'd)

speaker-specific slope of VOT as a function of the V:C ratio



- **O-FRA**
  weaker association between the V:C duration ratio and VOT
- **Y-FRA / STA**
  larger V:C duration ratios are associated with more prominent stop releases

Discussion

- no evidence of a positive relationship between V:C duration ratio and strength of the /t/ release for O-FRA
- but clear trend for a trading relationship to develop across the three groups which suggests that the sound change is associated with a progressively greater phonologization of V:C duration ratio
- the phonologization of V:C duration ratio implies that short V:C duration ratios are associated with weak releases
- the development of a trading relationship implies that the original source (the stop release) that gives rise to the phonetic effect (short V:C duration ratio) is becoming lost

Further implications

- perhaps analogous to the development of a trading relationship between the extent of vowel nasalisation and duration of the nasal consonant in vowel nasal sequences (Beddor, 2009) …
- … that would ultimately lead not only to the development of phonological vowel nasalization but also to the loss of the conditioning environment (the nasal consonant) that originally caused it

Conclusion

- Sound change in progress
- an intervocalic voicing contrast that is cued by the V:C duration ratio is developing in East Franconian under the influence of the standard variety
- consistent with a model in which phonological categories are probabilistically associated with the speech signal
  - neutralization is not categorical
  - sound change in progress results instead in a gradual change by which a phonological contrast is evolving in young East Franconian speakers that is no (yet) as marked as it is for Standard German speakers
- sound change affects both production and perception

Outlook

- Do perception and production change at the same rate?
- Do changes in perception lead those in production?

Thank you!