Articulatory dynamics of degemination in Dutch

Patrycja Strycharczuk[a] and Koen Sebregts[b]

[a]CASL, Queen Margaret University, [b]Utrecht University

Fake geminates and the phonetics-phonology interface

▶ Fake geminates: sequences of identical consonants derived by morphological/lexical concatenation

▶ Two types of analysis possible:
  ▷ distinct phonological representation governed by specific phonological operations (e.g. McCarthy 1986)
  ▷ instantiation of a more general process of gestural overlap (e.g. Scobbie & Pouplier 2010, Oh & Redford 2012)

▶ In Dutch, fake geminates are subject to degemination, which has been treated as either phonological or phonetic by different sources
  ▷ categorical, phonological process, consisting in the deletion of one of the two consonants (Booij 1995:121)
  ▷ gradient in durational terms (Martens & Quené 1994 on Dutch fricatives), and consequently treated as phonetic (Ernestus 2000).

▶ This study: articulatory evidence shows that both underlying coda and onset gestures are preserved in the fake geminate context, consistent with a gradient overlap interpretation.
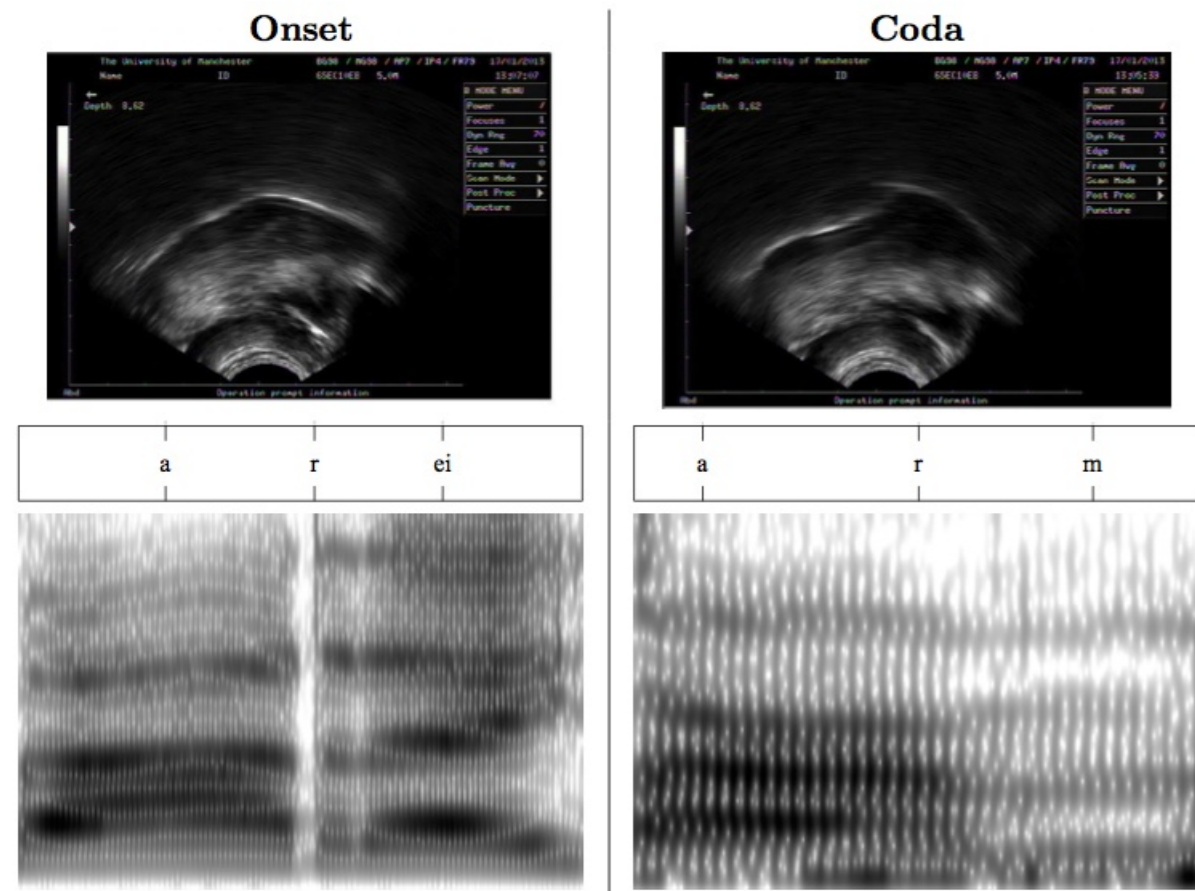
Dutch /r/ allophony

Figure from Strycharczuk & Sebregts (2014)

▶ Increasingly common /r/-allophony pattern in Standard Dutch:
  ▷ uvular fricative [ʁ] / alveolar trill/tap [r,ɾ] in onsets, e.g. *reizen* 'to travel'
  ▷ retroflex/bunched approx. [ɻ] in codas, e.g. *paar* 'couple'

▶ sociolinguistically salient (Sebregts 2015)
▶ structurally predictable (non-contrastive)
▶ largely categorical in nature (Scobbie & Sebregts 2010)
▶ theoretically revealing for studying (de)gemination

Research questions

▶ How is allophony between /r/ in words such as *paar* and *reizen* realised in sandhi context *paar reizen*?
▶ Do we find degemination?
▶ How does (de)gemination affect the gestural realisation of sandhi /r/?

Test items

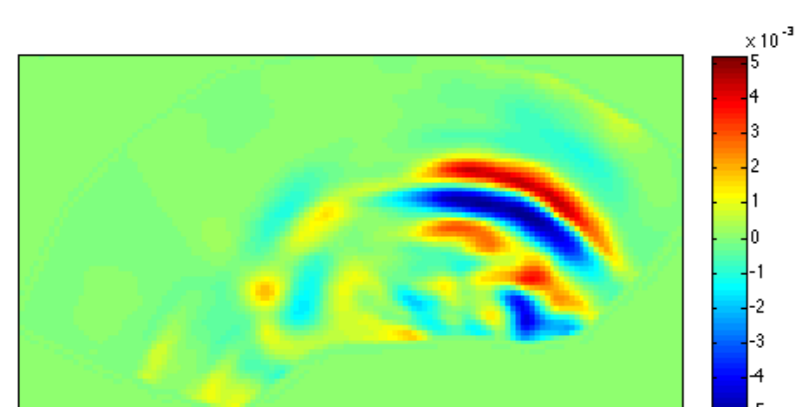|			
Word-initial onset	V#r	*pa reizen*	*pa raden*
	VrV	*Parijzenaar*	*parade*
Canonical coda	Vr#C	*paar meisjes*	*paar baden*
	Vr#V	*paar eisen*	*paar ademen*
Fake geminate	Vr#r	*paar reizen*	*paar raden*

▶ embedded in meaningful carrier phrases
  ▷ *Heb je een paar reizen naar Manchester gemaakt?* 'Have you made a few trips to Manchester?'
  ▷ *Heeft je pa reizen naar Manchester gemaakt?* 'Has your father made trips to Manchester?'
▶ 10 test items + 14 distractors, 5 repetitions

Method

▶ 8 speakers of Standard Dutch (5 females)
  ▷ 5 found to produce a bunched /r/ in coda
▶ Recording using high-speed Sonix RP ultrasound system (Frame Rate = 121.5 fps)
▶ Ultrasound probe stabilised using a headset
▶ Occlusal plane image using a bite plate
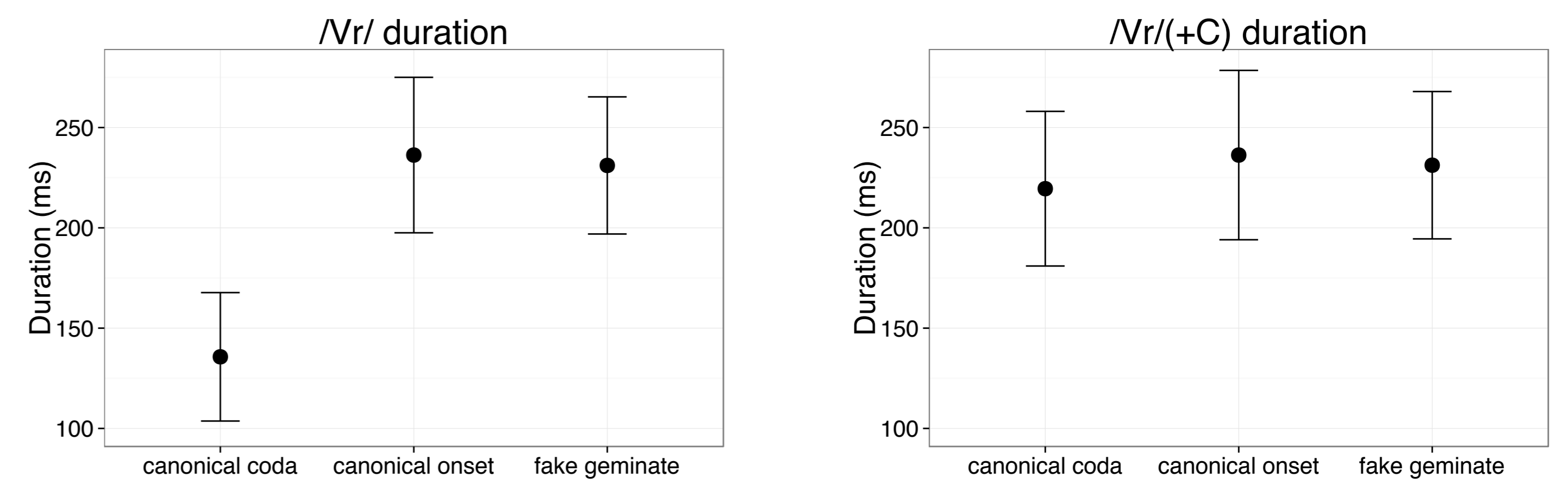▶ Synchronisation of the audio signal and ultrasound capture using AAA version 2.15 Articulate Instruments Ltd (2014)

Analysis

▶ Duration analysis
  ▷ based on acoustic boundaries
  ▷ comparison of V+/r/ sequence durations and consonant cluster durations (r#r vs. r#C)
  ▷ no attempt to separate vowel from the following /r/ due to continuous acoustic transition
  ▷ analysis using linear mixed effects regression

▶ Static articulatory analysis
  ▷ Tongue shape compared at three time points
    1. (acoustic) onset of the vowel and point of maximum /r/ constriction
    2. /r/-constriction
    3. acoustic offset of /r/
  ▷ Tongue contours compared using SS-ANOVA (Gu 2013, 2014, Davidson 2006)

▶ Dynamic articulatory analysis
  ▷ all ultrasonic frames exported from AAA as jpg files
  ▷ the exported frames submitted to a Principal Component Analysis of pixel intensity implemented using TRACTUS (Carignan 2014)
  ▷ PCs corresponding to 80% of variance imported into R
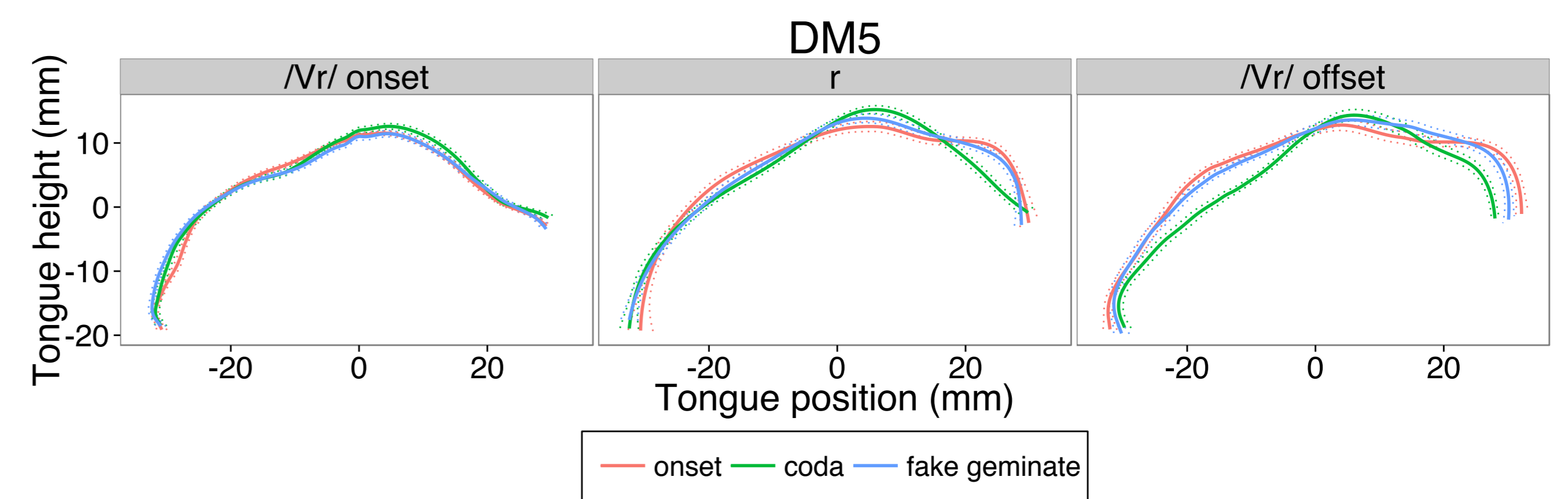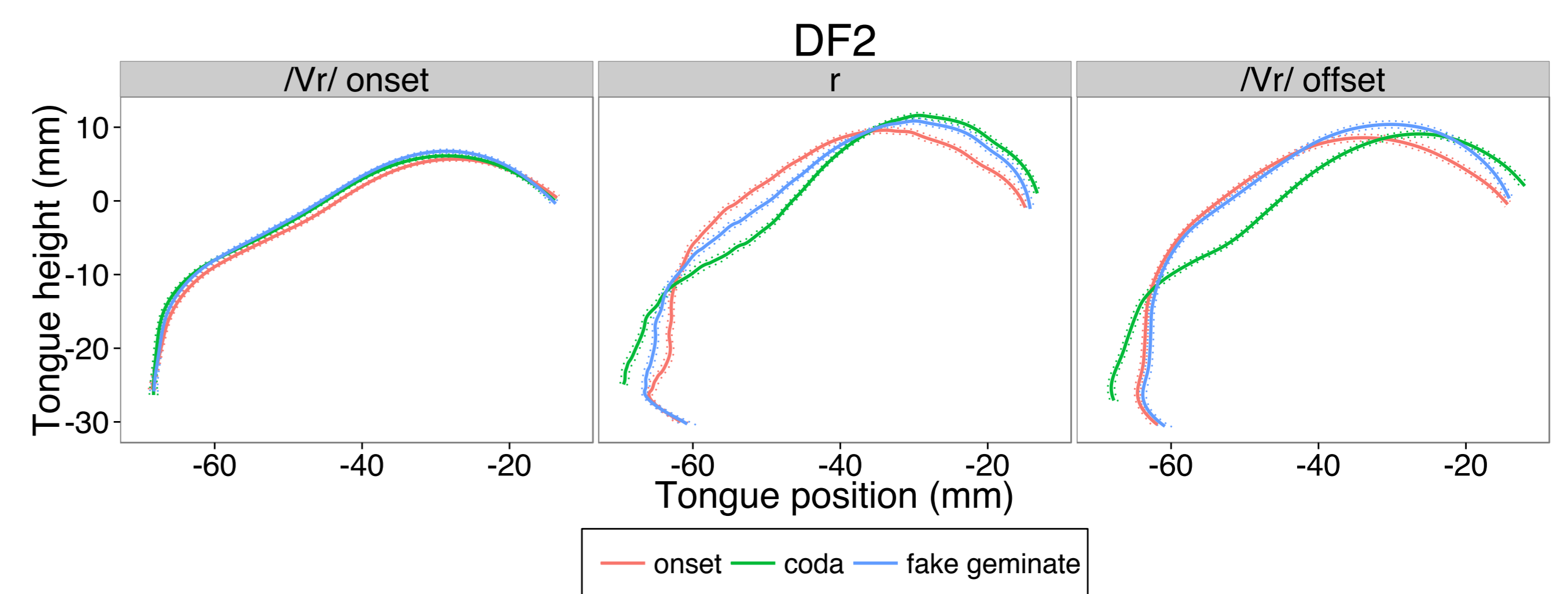 ▷ Linear Discriminant Analysis (LDA) used on data corresponding to the acoustic /ar/ sequence in each test item

▶ LDA trained to distinguish /ar/ in *pa reizen* (onset) from /ar/ *paar meisjes* (coda)
▶ Algorithm then used to classify all the data in the dataset, including *paar reizen* (new data)
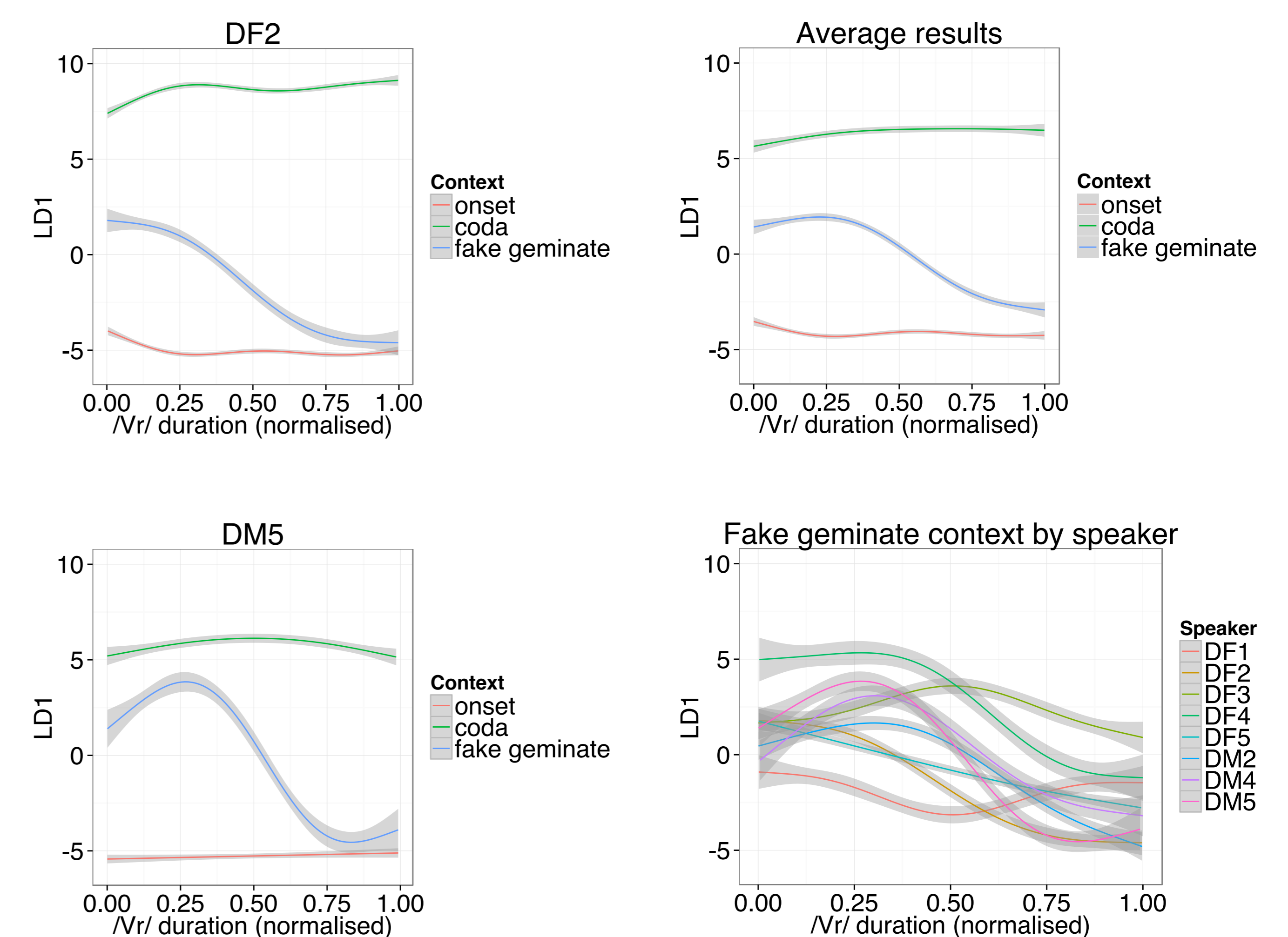▶ Heatmap illustrates classification for an example speaker.

Duration results

/Vr/ duration

/Vr/(+C) duration

SS-ANOVA results

DF2

DM5

Dynamic articulatory results

DF2

Average results

DM5

Fake geminate context by speaker

Main findings

▶ /Vr#r/ sequences not longer compared to singleton onset /V#r/
▶ However, /Vr#r/ (and /V#r/) are equally long to heterorganic clusters (/Vr#C/)
▶ Fake geminate /r/ in Dutch combines spatial characteristics of coda and onset /r/

Implications

▶ No evidence of temporal gemination in Dutch /r/ (no consonant lengthening beyond what is possible in a singleton)

▶ At the same time, fake geminate /r/ behaves like a cluster of coda and onset /r/
  ▷ its acoustic duration equals that of /r#C/
  ▷ the gestural properties of underlying onset and coda are preserved, although the bunching coda gesture is reduced

▶ No need for specific gemination or degemination rules in the phonology
▶ Both temporal and spatial characteristics are consistent with more general principles of gestural overlap

Acknowledgments

[a]pstrycharczuk@gmail.com, [b]k.sebregts@uu.nl