Fake geminates and the phonetics-phonology interface

- Fake geminates: sequences of identical consonants derived by morphological/lexical concatenation
- Two types of analysis possible
  - covariational 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 (Boos 1995:121)
  - gradient in durational terms (Martens & Que´ n 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, with a gradient overlap interpretation.

Research questions

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

Test items

<table>
<thead>
<tr>
<th>Word-initial onset</th>
<th>V/r</th>
<th>pa reizen</th>
<th>pa raden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canonical coda</td>
<td>V/r C</td>
<td>paar mesen</td>
<td>paar louter</td>
</tr>
<tr>
<td>Fake geminate</td>
<td>V/r</td>
<td>paar reizen</td>
<td>paar raden</td>
</tr>
</tbody>
</table>

Method

- 8 speakers of Standard Dutch (5 females)
- 5 found to produce a buched /r/ in coda
- Recording using high-speed Sonix RP ultrasound system (Frame Rate = 121.5 fps)
- Ultrasonic probe stabilised using a headband
- 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- /r/ sequence durations and consonant cluster durations ( /r/C or /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 mesen (coda)
  - Algorithm then used to classify all the data in the dataset, including paar reizen (new data)
  - Heatmap illustrates classification for an example speaker.

Main findings

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

Implications

- No evidence of temporal degemination 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 buched 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

Dutch /r/ allophony

- Increasingly common /r/-allophony pattern in Standard Dutch:
  - uvular fricative [r] / velar trill/tap [r] in onsets, e.g. nezen to travel
  - retrolabial/bunched approx. [r] in codas, e.g. paar ‘couple’
  - sociolinguistically salient (Sebregts 2015)
  - structurally predictable (non-contrastive)
  - largely categorical in nature (Scobbie & Sebregts 2010)
- Theoretically reviving for studying (de)gemination

Dutch /r/ allophony

- Embedded in meaningful carrier phrases
  - ‘Have you made a few trips to Manchester?’
  - ‘Has your father made trips to Manchester?’
- 10 test items + 14 distractors, 5 repetitions

Articulatory dynamics of degemination in Dutch

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Fake geminate context by speaker

- Figure from Strycharczuk & Sebregts (2014)

Duration results

- N(+)C duration results
- N duration results
- N duration results

SS-ANOVA results

- N onset
- N offset
- N onset
- N offset

Dynamic articulatory results

- DF2
- Average results
- DF2
- Average results
- DM5
- Average results
- DM5

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