Simulating speech errors in Swedish, Norwegian and English

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Speech acquisition across languages

Order of acquisition

Universal

• plosives < fricatives
• coronals < velars
• ...

Language-specific

• /v/ in Swedish < English
• Eng: monosyllabic first words vs. Swe: disyllabic
• ...

Vihman (1993); Lee et al. (2010), …

Ingram (1988); Vihman (1993), …
Speech acquisition across languages

Speech error patterns

**Universal**

- velar fronting
- stopping
- deletion of pre-tonic syllable
- ...

**Language-specific**

- Different effects in different languages…?

Yavaş (2014); Bernhardt et al. (2017), …
Speech acquisition across languages

- Changes in complexity?
- Difference from target?
- Language-specific effects
  - Different effects in different languages…?
Speech acquisition across languages

Coronal backing worse than /r/-weakening?

Cluster reduction more severe than stopping?
The question

How are commonly observed speech error patterns ranked by phonological effects across Swedish, Norwegian and English?

What speech error patterns have the most detrimental effects on intelligibility?
**Corpus data: child-produced speech**

<table>
<thead>
<tr>
<th>Corpus</th>
<th>Description</th>
<th># Token</th>
<th># Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>Spontaneous adult-child interactions; 1;0-6;0 years</td>
<td>125 150</td>
<td>11 220</td>
</tr>
<tr>
<td>Norway</td>
<td>Spontaneous adult-child interactions; 1;0-4;0 years</td>
<td>73 740</td>
<td>5 500</td>
</tr>
<tr>
<td>England</td>
<td>Spontaneous adult-child interactions; 0;7-8;0 years (CHILDES)</td>
<td>2 097 000</td>
<td>15 700</td>
</tr>
</tbody>
</table>

NB! Orthographic transcriptions, not audio recordings.
**Procedure**

<table>
<thead>
<tr>
<th>Orthographic transcripts</th>
<th>Lexicon + g2p</th>
<th>Phonological transcriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4623 ja</td>
<td>ja &quot;jA:&quot;</td>
<td>4623 &quot;jA:&quot;</td>
</tr>
<tr>
<td>3645 de</td>
<td>de de:</td>
<td>3645 de:</td>
</tr>
<tr>
<td>3349 den</td>
<td>den dEn</td>
<td>3349 dEn</td>
</tr>
<tr>
<td>2979 e</td>
<td>e E</td>
<td>2979 E</td>
</tr>
<tr>
<td>2476 å</td>
<td>å O</td>
<td>2476 O</td>
</tr>
<tr>
<td>2419 ä</td>
<td>ä E</td>
<td>2419 E</td>
</tr>
<tr>
<td>2354 ha</td>
<td>ha &quot;hA:&quot;</td>
<td>2354 &quot;hA:&quot;</td>
</tr>
<tr>
<td>2353 dä</td>
<td>dä &quot;dE:&quot;</td>
<td>2353 &quot;dE:&quot;</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Procedure

Orthographic transcripts → Lexicon + g2p → Phonological transcriptions

CORONAL BACKING

4623 "jA:
3645 ge:
3349 gEN
2979 E
2476 O
2419 E
2354 "hA:
2353 "gE:
...

phonological transcriptions

Simulation
Procedure

VELAR FRONTING
CORONAL BACKING
STOPPING
/r/-WEAKENING
DELETION OF PRE-TONIC SYLLABLE
CLUSTER REDUCTION
Procedure

Phonological effect?

Phonological transcriptions

Simulation of misarticulation

"Misarticulated" phonological transcriptions
Procedure

Phonological effect?

Difference from target?
- PCC (Percentage Consonants Correct)
  Shriberg & Kwiatkowski (1982)

Changes in complexity?
- WCM (Word Complexity Measure)
  Stoel-Gammon (2010); Marklund et al. (in prep.)
Results

Increasing severity
Results

May 24, 2018
Sofia Strömbergsson
Results
Results

Reduced complexity

WCM

![Chart showing reduced complexity for different languages]
Results

Reduced complexity
Results

Reduced complexity

WCM

eng
nor
tswe
Discussion

**Coronal backing** most severe across all languages

- Also the only atypical speech error pattern included
  

- Increasing complexity?! Yes, because later acquired sounds considered more complex than earlier acquired sounds.
  
  Stoel-Gammon (2010)
Discussion

- **Stopping** second most severe across all languages
  - More severe in English than in the Scandinavian languages

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**Least severe**
- the
- is
- this
- that
- ...

**Most severe**
- den
- är
- det
- där
- ...

CORONAL BACKING

STOPPING
Discussion

Deletion of pre-tonic syllable does surprisingly little damage
→ Because few opportunities in child-produced speech?

Lexical selectivity; Vihman (1993)
Discussion

- Limitations
  - Systematic in absurdum? Segmental in absurdum?
    - Still the best option with current limited data…?
  
  - Syntagmatic error patterns? Metatheses etc.
    - Computationally challenging…
  
  - Other effect metrics?
    - Yes, on the way!
Conclusions

- Demonstration of a novel approach to cross-linguistic investigations of consequences of speech errors

- Frequent words in children’s speech are made up of sounds that are phonologically available early in speech acquisition

- Clinical implication: coronal backing should be prioritized in speech intervention
References


