On the Relationship Between Learning Sequence and Rate of Acquisition

Karen Jesney
jesney@usc.edu

1. Overview

Error-driven models of gradual learning make predictions about both sequence and rate of acquisition. Similar predictions with:
- Stochastic OT (Boersma 1998, Boersma & Hayes 2001)
- Noisy Harmonic Grammar (Boersma & Pater 2008)
- Maximum Entropy OT (Goldwater & Johnson 2003)

Sequence prediction: More frequent structures should be acquired before less frequent structures (e.g., Boersma & Levelt 2000, 2003, Curtin & Zuraw 2001)

Rate prediction: More frequent structures should be acquired at a faster rate than less frequent structures.

Question: Is there a systematic relationship between sequence and rate of acquisition in child language data?
- Not all structures are acquired at the same rate
- Across-the-board changes vs. gradual changes vs. regressions (Menn 2004)

2. Illustration

Toy language:

<table>
<thead>
<tr>
<th>Input</th>
<th>Probability</th>
<th>Markedness (MaxEnt)</th>
<th>Effect of error (Faithfulness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/A/</td>
<td>.533</td>
<td>▼ (A)</td>
<td>▼ (A)</td>
</tr>
<tr>
<td>/B/</td>
<td>.287</td>
<td>▼ (B)</td>
<td>▼ (B)</td>
</tr>
<tr>
<td>/C/</td>
<td>.133</td>
<td>▼ (C)</td>
<td>▼ (C)</td>
</tr>
<tr>
<td>/D/</td>
<td>.067</td>
<td>▼ (D)</td>
<td>▼ (D)</td>
</tr>
</tbody>
</table>

Mean of 10 MaxEnt learning simulations modeled in Praat

Why? More frequent errors result in faster changes to the values of associated Markedness and Faithfulness constraints.

Overlapping repairs – i.e., a single conflicting Faithfulness constraint – give the effect of higher apparent frequency for all structures.

Mean of 10 MaxEnt learning simulations modeled in Praat – given only general FAITH

3. Child language data

Data set: Longitudinal data from CHILDES (MacWhinney 2000) for six English-acquiring children.
- All target stressed utterance-initial onset clusters and utterance-final coda clusters.
- Morphologically-complex clusters excluded.

<table>
<thead>
<tr>
<th>Child</th>
<th>age range</th>
<th>target onset clusters</th>
<th>target coda clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amahl</td>
<td>2.2 - 3.9</td>
<td>845 199</td>
<td>44 406</td>
</tr>
<tr>
<td>Trevor</td>
<td>0.11 - 3.1</td>
<td>877 120</td>
<td>63 573</td>
</tr>
<tr>
<td>E.</td>
<td>1.0 - 3.9</td>
<td>186 50</td>
<td>20 123</td>
</tr>
<tr>
<td>Alex</td>
<td>1.5 - 3.7</td>
<td>1177 109</td>
<td>216 561</td>
</tr>
<tr>
<td>Ethan</td>
<td>0.11 - 2.11</td>
<td>742 200</td>
<td>55 581</td>
</tr>
<tr>
<td>Lily</td>
<td>1.2 - 4.0</td>
<td>923 152</td>
<td>128 1234</td>
</tr>
</tbody>
</table>

Coding: Clusters were coded as accurate if two consonants appeared without epenthesis or deletion.

Analysis: Logistic regression fitted to each child’s data
- Factors: age in months, syllable position (onset vs. coda), sonority (rising vs. falling)
- Fully crossed models provided a consistently better fit (all $p < .01$).

4. A closer look

Question: Do the predicted associations appear if clusters are considered individually?
- Concern: Effects may be muted by grouping together cluster types.

Trevor – rising sonority onset clusters

1:10.09 pretty [pɪ dɪ] Preferred repair: deletion of /r/
1:11.09 brush [bɹʃ] Preferred repair: deletion of /r/
2:0.03 Trevor [tɹ ɹw] Preferred repair: deletion of /r/
2:0.08 dropped [ɹɪ] Preferred repair: deletion of /r/

Conclusion: There is little consistent evidence for a stable association between sequence of acquisition and rate of learning

See handout for references.