Learning Constraints that Oppose Native Phonotactics from Brief Experience

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I. Background on Phonotactic Learning and Position-Restricted Consonants

II. Current Experiment Design

III. Results

IV. Discussion/Conclusions
I. Background

Speech Errors Conform to Phonotactics

Phonotactic regularity effect: ~99% of speech errors follow language-wide constraints.

\[ \text{sing a hymn} \]
\[ [\text{sin} \, \text{e} \, \text{him}] \rightarrow [\text{him} \, \text{e} \, \text{him}] \]
\[ \text{or } [\text{sin} \, \text{e} \, \text{him}] \]

but not \[ [\text{nin} \, \text{e} \, \text{him}] \]
\[ \text{or } [\text{sin} \, \text{e} \, \text{hin}] \]

I. Background

Learning Novel Constraints

Dell et al. (2000), Chambers et al. (2002) and others show speakers can implicitly learn novel phonotactic constraints.

Example Trial (experiment-wide constraint - f is an onset):

hes feng neb kep

Restricted by:
- syllable position only
- experimental constraint
- native English constraint
I. Background
Phonological Legality

- Are phonotactic constraints innate and “built-in” or do they emerge from experience? Do lab-learned constraints interact with native phonotactics?

- Treiman and Kessler (2000): speakers are sensitive to degrees of legality of phonotactic sequences

- So, can speakers be taught that “bad” native-language patterns are now “good”? Will this be easier to learn for “less illegal” sequences than for “more illegal” ones?

"Two consonants in English are not found at the beginnings of native (or nativized) words: the velar nasal [ŋ] and the voiced alveopalatal fricative [ʒ]. The histories of these two segments in the language are very different, however, and the status of the initial gaps they result in, we argue, is not the same: ŋ is a systematic gap, whereas ʒ, in the sense just described, is phonologically accidental." Iverson and Salmons, Filling the Gap (2005)
I. Background
Restricted Consonants in English

Betty Nguyen

Jean-Claude Van Damme

[ʒŋkłɒd]

[nuwɛn]

[nɛwɛn]

[wɛn]

[ngujɛn]

II. Current Study

Research Questions: Are experimental phonotactic constraints (“[ŋ] or [ʒ] only initially”) which oppose language-wide constraints quickly and implicitly learnable, like those constraints which conform to native phonotactics? Are both equally learnable?

Quickly: Brief (96 trial) exposure to producing constrained syllable sets

Implicitly: Learning is reflected in speech errors (slips of the tongue)

Learnable: Experimental constraint affects the degree to which errors conform to opposing native constraint
II. Current Study

Stimuli

<table>
<thead>
<tr>
<th>Target consonant: [ŋ/ʒ]</th>
<th>96 sets of 4 syllables generated from these sounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 other consonants:</td>
<td>Example:</td>
</tr>
<tr>
<td>[b, p, m/s, d, t, k, g]</td>
<td>gub ngut mud puk or zhub sut pug duk</td>
</tr>
<tr>
<td>1 vowel: [ʌ]</td>
<td></td>
</tr>
</tbody>
</table>

II. Current Study

Subject Task

Training:
- Teaches subjects initial ŋ or ʒ is possible
- Ensures subjects are able to pronounce initial ŋ/ʒ
- Familiarizes subjects with orthography

Task:
- View a 96-slide powerpoint presentation
- Recite 4 syllables on each slide 4 times:
  - once at 60 bpm
  - 3 times at 150 bpm
- Self paced metronome buttons and slides
II. Current Study
Training

<table>
<thead>
<tr>
<th>Hanging</th>
<th>Longing</th>
<th>Tingling</th>
</tr>
</thead>
<tbody>
<tr>
<td>ngee, ngee, ngee</td>
<td>ngah, ngah, ngah</td>
<td>ngo, ngo, ngo</td>
</tr>
<tr>
<td>ngay, ngay, ngay</td>
<td>ngu, ngu, ngu</td>
<td></td>
</tr>
<tr>
<td>nguf, ngus, nguk</td>
<td>ngug, ngup, ngub</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beijing</th>
<th>Massaging</th>
<th>Rouging</th>
</tr>
</thead>
<tbody>
<tr>
<td>zhee, zhee, zhee</td>
<td>zhah, zhah, zhah</td>
<td>zho, zho, zho</td>
</tr>
<tr>
<td>zhay, zhay, zhay</td>
<td>zuh, zuh, zuh</td>
<td></td>
</tr>
<tr>
<td>zhuf, zhus, zhuk</td>
<td>zhug, zhup, zhub</td>
<td></td>
</tr>
</tbody>
</table>

Sample Task Slide

gub ngut mud puk
II. Current Study

Subjects

- 25 adult monolingual native English speakers between 18 and 30, self-reported normal hearing

- Recordings taken by Marantz solid state recorder (.wav files) in 1 (~30 min) recording per subject

- Sound attenuated booth, floor stand microphone

Error Coding

All speech errors were transcribed; errors where a consonant from the experiment occurs in the wrong position were tallied and combined for all subjects in a condition

subject saw: gub ngut pud muk
but said: gub ngut mud muk
coded as: m onset
III. Findings

Experiment 2 (zh) Errors

<table>
<thead>
<tr>
<th>Sound</th>
<th>Onset</th>
<th>Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>zh</td>
<td>138</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>117</td>
<td>89</td>
</tr>
<tr>
<td>p</td>
<td>118</td>
<td>62</td>
</tr>
<tr>
<td>s</td>
<td>54</td>
<td>93</td>
</tr>
<tr>
<td>d</td>
<td>95</td>
<td>62</td>
</tr>
<tr>
<td>t</td>
<td>119</td>
<td>67</td>
</tr>
<tr>
<td>g</td>
<td>150</td>
<td>62</td>
</tr>
<tr>
<td>k</td>
<td>148</td>
<td></td>
</tr>
</tbody>
</table>

Experiment 1 (ng) Errors

<table>
<thead>
<tr>
<th>Sound</th>
<th>Onset</th>
<th>Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>ng</td>
<td>73</td>
<td>16</td>
</tr>
<tr>
<td>b</td>
<td>247</td>
<td>13</td>
</tr>
<tr>
<td>p</td>
<td>113</td>
<td>113</td>
</tr>
<tr>
<td>m</td>
<td>60</td>
<td>153</td>
</tr>
<tr>
<td>d</td>
<td>128</td>
<td>179</td>
</tr>
<tr>
<td>t</td>
<td>192</td>
<td>142</td>
</tr>
<tr>
<td>g</td>
<td>288</td>
<td>153</td>
</tr>
<tr>
<td>k</td>
<td>163</td>
<td>84</td>
</tr>
</tbody>
</table>
III. Findings

- [ŋ] production accuracy low, despite correct completion of training; [ŋ] sometimes replaced with [ŋ], [ŋ], or [ŋ]

There are few accidental [ŋ] productions

- [ʒ] production accuracy high (rarely replaced with [z] or [dʒ])

- There are many more accidental [ʒ] productions

IV. Discussion

Issues

- How is it possible to tell if an error is due to “movement” or “replacement” vs. coarticulation?

- Are entire phonemes actually being accidentally produced?

- No articulatory data, reliance on native English “ear”
IV. Discussion

Research Questions: Are experimental phonotactic constraints which oppose language-wide constraints quickly and implicitly learnable, like those constraints which conform to native phonotactics? YES

- Subjects' errors conform to experimental constraints over language-wide constraints
- Producing η-initial syllables is possible but very difficult and requires attention
- Ease of learning comparison cannot be made due to η production difficulty

Conclusions

- Effects on production of native language constraints can be undone by experiencing conflicting constraints in brief experiments
- Native language phonotactic constraints are affected by recent experience
- This evidence supports the theory that phonotactic constraints emerge from the sound distributions in languages
References


