Evaluating the inevitability of a phonological change: /æ/ in Philadelphia

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Evaluating the inevitability of a phonological change: /æ/ in Philadelphia

What is happening to /æ/ in Philadelphia?
2 allophones of /æ/:
• “Tense”: [iə ~ ɛ:].
• “Lax”: [æ].

The complex Philadelphia System (Philly) of distributing these allphones is being replaced by the simpler Nasal System (Nasal).

Questions:
Overarching question:
• Is it inevitable that a system as complex as Philly would be replaced by Nasal?

Specific questions:
• What is the likelihood that given Philly input data, learners would hypothesize a Nasal grammar?
• Once both Philly and Nasal grammars are available, is Nasal destined to win in grammar competition?
Outline

• A brief overview of the Philly and Nasal systems.
• A productivity analysis to see whether a Nasal grammar is plausible given Philly input.
• A grammar competition analysis to see whether Nasal is destined to replace Philly.
  • A brief diversion into challenges we faced when trying to apply grammar competition models to phonology.

The Philadelphia and Nasal Systems

The Philadelphia System

Lexical Exceptions:

- if $\alpha \in L_{tense}$ then $\alpha$
- if $\alpha \in L_{lax}$ then $\alpha$

Phonological Regularity

- if $\alpha \in x$ and $\{\alpha\}_{\text{stem}}$ and $x \in P$ such that
  - $P = (\text{nasals} \cup \text{voiceless fricatives}) \cap \text{anterior}$
  - then $\alpha$
- else $\alpha$

The Philadelphia System

Anteriority:

- lax $\rightarrow$

<table>
<thead>
<tr>
<th>ham</th>
<th>ban</th>
<th>cash</th>
<th>bang</th>
</tr>
</thead>
<tbody>
<tr>
<td>calf</td>
<td>path</td>
<td>pass</td>
<td></td>
</tr>
</tbody>
</table>

Syllabicity:

- lax $\rightarrow$

<table>
<thead>
<tr>
<th>ham</th>
<th>hammer</th>
</tr>
</thead>
<tbody>
<tr>
<td>cast</td>
<td>castle</td>
</tr>
</tbody>
</table>
The Philadelphia System: Abstractness

Affixation ← tense lax →
class classes classing classic
man Manning manning

Truncation ← tense lax →
mathematics math
examination exam

Syncope ← tense lax →
family:
[fæ.mə.li] & [fæm.li]
camera:
[kæ.mə.ro] & [kæm.ro]

Assimilation ← tense lax →
fan club: [fæn.ˈklʌb] [fæn.ˈkləb]
fang club: [fæŋ.ˈklʌb] [fæŋ.ˈkləb]

The Philadelphia System: Lexical Exceptions

$L_{lax}$ \{(ran, swam, began, and, can, than), aspirin, carafe, alas\}

$L_{tense}$ \{mad, bad, glad\}
The Philadelphia System  

Basic segmental conditioning  
+ Complicated morphological interactions  
+ Lexical exceptions  

Tensing of /æ/ before anterior, tautosyllabic [nasals, voiceless fricatives]  

Applies at stem level  

Inflectional vs. derivational morphemes  

Learned words  

Class 3 strong verbs (past tense)  

Mad, bad, glad  

- ask  
- aspirin  
- carafe  
- ran  
- swam  
- began  
- mad  
- bad  
- glad  

Productivity Analysis  

The similarity between Philly and Nasal  

Philly: Tensing of /æ/ before anterior, tautosyllabic [nasals, voiceless fricatives]  
Nasal: Tensing of /æ/ before [nasals]  

<table>
<thead>
<tr>
<th>Condition</th>
<th>Example</th>
<th>Philly</th>
<th>Nasal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ant. tautosyll. voiceless Fric</td>
<td>pass</td>
<td>tense</td>
<td>lax</td>
</tr>
<tr>
<td>MBG exceptions</td>
<td>mad, bad, glad</td>
<td>tense</td>
<td>lax</td>
</tr>
<tr>
<td>Anterior tautosyll. nasals</td>
<td>man, ham</td>
<td>tense</td>
<td>tense</td>
</tr>
<tr>
<td>Anterior heterosyll. nasals</td>
<td>hammer, manage</td>
<td>lax</td>
<td>tense</td>
</tr>
<tr>
<td>Posterior nasals</td>
<td>hang, bank</td>
<td>lax</td>
<td>tense</td>
</tr>
<tr>
<td>Nasal exceptions</td>
<td>ran, and</td>
<td>lax</td>
<td>tense</td>
</tr>
<tr>
<td>Elsewhere</td>
<td>cat</td>
<td>lax</td>
<td>lax</td>
</tr>
</tbody>
</table>

Yang’s Productivity Model  

Tolerance Principle: A productive rule can handle $N / \ln(N)$ exceptions  

Is the Nasal system a plausible rule, given Philly input?  

<table>
<thead>
<tr>
<th>Token (Philly)</th>
<th>Expectation (Nasal)</th>
<th>Exception?</th>
</tr>
</thead>
<tbody>
<tr>
<td>mǣn</td>
<td>mǣn</td>
<td>no</td>
</tr>
<tr>
<td>cæt</td>
<td>cæt</td>
<td>no</td>
</tr>
<tr>
<td>bāed</td>
<td>bāed</td>
<td>yes</td>
</tr>
</tbody>
</table>

$T = \text{total number of exceptions}$  

$N = \text{total number of } /æ/ \text{ words}$
Applying Tolerance Principle
CHILDES database (MacWhinney, 2000)

Applying Tolerance Principle: most frequent words

Productivity Wrap Up

Grammar Competition
Philly and Nasal in competition

Yang’s Grammar Competition Model

Fitness (G) = proportion of unambiguously ‘G’ clauses it generates out of all the clauses it generates.
If Fitness(G1) > Fitness(G2), G1 wins.

V2 and SVO competing

The Challenge in Applying Competition to Phonology

<table>
<thead>
<tr>
<th>Ambiguous</th>
<th>Fitness(G) = proportion unambiguous</th>
</tr>
</thead>
<tbody>
<tr>
<td>h[ǣ]m, clæt</td>
<td>0.8</td>
</tr>
<tr>
<td>Nasal Advantage</td>
<td>h[ǣ]mmer, h[ǣ]ng, clæ[st], blæid</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Philly Advantage</td>
<td>h[ǣ]mmer, h[ǣ]ng, clæ[st], blæid</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

The Challenge in Applying Competition to Phonology

<table>
<thead>
<tr>
<th>Ambiguous</th>
<th>Fitness(G) = lax where other has tense</th>
</tr>
</thead>
<tbody>
<tr>
<td>h[ǣ]m, clæt</td>
<td>0.8</td>
</tr>
<tr>
<td>Nasal</td>
<td>h[ǣ]mmer, h[ǣ]ng</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Philly</td>
<td>clæ[st], blæid</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

van der Feest & Fikkert (2015) found children detected default-for-marked errors, but not marked-for-default.

Noisy Harmonic Grammars

Constraint Set =

\[ æ, *ä, *æ, \ldots \]

\[ æm, *äm, *æm, \ldots \]

\[ æn, *än, *æn, \ldots \]

\[ æs, *äš, *æs, \ldots \]

\[ æp, *äp, *æp, \ldots \]

...}

10 chains, 9,000 training iterations

Harmonic Grammar Results

Conclusions
Conclusions