Systematic analogical effects in regular past-tense production in Dutch

Adult production and children’s acquisition

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Final voicing in Dutch

- All word-final obstruents are voiceless.
  - *stop* [stɔp] ‘stop’
  - *schrob* [sxɔp] ‘scrub’
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  - *stop* [stɔp] ‘stop’
  - *schrob* [sxɔrp] ‘scrub’

- The voicing of morpheme-final obstruents within words (final voicing) is unpredictable.
  - *stop-en* [stɔpen] ‘to stop’
  - *schrob-en* [sxɔrbən] ‘to scrub’
Final voicing really unpredictable?

- 1697 morphemes (nouns, verbs, and adjectives) ending in an obstruent from CELEX;
- TiMBL: Possible predictors of final voicing?
Final voicing really unpredictable?

- 1697 morphemes (nouns, verbs, and adjectives) ending in an obstruent from CELEX;
- TiMBL: Possible predictors of final voicing?
- TiMBL: Rhyme is predictor of final voicing.
- CART grouped the morphemes into 11 classes. Morphemes ending in the same rhyme were grouped together. Rhymes were grouped together if they shared their preference for final voicing.

(Ernestus & Baayen, 2003)
## CART Classification

<table>
<thead>
<tr>
<th>Morphemes ending in:</th>
<th>% voicing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. {εi, au, œy, a:, e:, o:, ϕ:, i, u} {-, j, l, m, n, r}P</td>
<td>0.0%</td>
</tr>
<tr>
<td>2. {εi, au, œy, a:, e:, o:, ϕ:, i, u} {-, j, l, m, n, r}T</td>
<td>37.2%</td>
</tr>
<tr>
<td>3. {εi, au, œy, a:, e:, o:, ϕ:, i, u} {-, j, l, m, n, r}S</td>
<td>76.5%</td>
</tr>
<tr>
<td>4. {f, k, p, s, t, x} {P, T, S}</td>
<td>1.9%</td>
</tr>
<tr>
<td>5. {a, ε, l, c, e, y} {-, m, r} {P, T, S}</td>
<td>13.5%</td>
</tr>
<tr>
<td>6. {a, ε, l, c, e, y} {l, n} {P, T, S}</td>
<td>35.7%</td>
</tr>
<tr>
<td>7. {εi, au, a:, e:, o:, ϕ:, y} {-, j, l, r, m, n} {F, X}</td>
<td>99.2%</td>
</tr>
<tr>
<td>8. {i, u} {-, m} F</td>
<td>77.8%</td>
</tr>
<tr>
<td>9. {a, ε, l, c, e} {-, m} F</td>
<td>9.1%</td>
</tr>
<tr>
<td>10. {a, ε, l, c, e, i, u} {l, r} F</td>
<td>87.5%</td>
</tr>
<tr>
<td>11. {a, ε, l, c, e, i, u} {-, j, l, r, m, n} X</td>
<td>95.3%</td>
</tr>
</tbody>
</table>
Also predictable for native speakers?

- Production experiment. 28 participants were presented with 192 pseudo stems.
- Can they predict the final voicing?
- Do their responses reflect the CART-classification?

(Ernestus & Baayen, 2003)
Past-tense production

- Participants produced past-tenses.
- Past-tense formation: Add
  - *-te* if the stem-final obstruent is voiceless within words;
  - *-de* otherwise.
- Perfectly rule-governed, according to the standard literature.
Results: \( r_s = 0.50, p < 0.001 \)
Results for each participant
Stochastic behavior

- Participants based their choice of the voicing of the final obstruent on the phonologically similar words.
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- If the analogical support for voicing was greater, more participants chose *de*.
- If the analogical support for voicing was greater, a given participant chose *de* more often.
Stochastic behavior

- Participants based their choice of the voicing of the final obstruent on the phonologically similar words.
- If the analogical support for voicing was greater, more participants chose de.
- If the analogical support for voicing was greater, a given participant chose de more often.
- The participants showed stochastic behavior.
Existing words

- Is there any role for the analogical support for voicing in everyday speech?
- In everyday speech, speakers have all information necessary to apply the deterministic rule of past-tense formation.

(Ernestus & Baayen, 2004)
Existing words

- Is there any role for the analogical support for voicing in everyday speech?
- In everyday speech, speakers have all information necessary to apply the deterministic rule of past-tense formation.
- Same experiment, with existing words.
- 28 participants were presented with 176 verbs (wij schrobben ‘we scrob’) and produced past-tenses.

(Ernestus & Baayen, 2004)
Non-standard forms

- Main predictor: Proportion of words falling in the same CART class that do not support the voicing of the final obstruent of the verb.
- That is, the analogical probability on a non-standard form.
Example

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- Morpheme-final bilabial stops following short vowels tend to be voiceless (86.5%).
- *schrob-en* is an exception. Analogical probability on a non-standard form is 86.5%.
- Many participants created *schrohte* (25%).
- *stop-en* is not exceptional, and no participant created *stopde*. 
Reaction Times

• The higher the analogical probability on a non-standard form, the more slowly the participant provided the standard form.

• Evidence for competition between the stored standard form and the non-standard form. This competition is stronger if the analogical probability on the non-standard form is higher.
Magnitude of analogical effects

- The analogical effects may be greater if the patterns in the lexicon are more pronounced.

(Mak & Ernestus, in preparation)
Magnitude of analogical effects

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• We tested for past-tense formation whether:
  • Analogical effects increase with age.
  • Analogical effects are larger for native than for non-native speakers.

(Mak & Ernestus, in preparation)
Children’s production

- 461 children between 9 and 12 years old completed past-tense forms in a story.
- 11 congruent verbs with a low analogical probability on the non-standard form (e.g. stoppen).
- 11 incongruent verbs with a high analogical probability on the non-standard form (e.g. schrobben).
Congruency * Age, \( p < 0.001 \)

![Graph showing the percentage of standard forms congruent and incongruent across different ages.](image)
**Congruency * Language, $p = 0.05$**

The diagram illustrates the percentage of standard forms in different conditions:

- **Native Congruent**
- **Native Incongruent**
- **Non-native Congruent**
- **Non-native Incongruent**

The data shows a systematic analogical effect in regular past-tense production in Dutch adult production and children's acquisition.
Conclusions

- Regular past-tense formation in Dutch depends on the exemplars that speakers have stored in their mental lexicons.
- It supports an approach in which rules are viewed as on-line analogical generalizations over continuously updated experience.
- The stored exemplars may provide conflicting information, which leads to stochastic behavior.