The Role of Phonology and Multiple Exponence in the Acquisition of L2 German Plural Allomorphy: Feature Dependency and the Poverty of the Stimulus

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Wiese’s Dilemma

- German plural forms are prosodically homogenous
  
  \((\sigma_{\text{full}} \cdot \sigma_{\text{weak}})\)

- But segmentally heterogeneous:
## The German Plural

<table>
<thead>
<tr>
<th>Singular Form</th>
<th>Plural Form</th>
<th>Affixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelz (fur)</td>
<td>Pelz[ə]</td>
<td>Affixation of -ə</td>
</tr>
<tr>
<td>Kind (child)</td>
<td>Kind[ɐ]</td>
<td>Affixation of -ɐ</td>
</tr>
<tr>
<td>Held (hero)</td>
<td>Helden</td>
<td>Affixation of -n</td>
</tr>
<tr>
<td>Stecken (stick)</td>
<td>Stecken</td>
<td>Ø-Affixation</td>
</tr>
</tbody>
</table>
Wunderlich’s Dilemma

- Central parameters are unpredictable
  - Thron ➔ Thron[ə] (throne)
  - Sohn ➔ Söhn[ə] (son)
  - Mund ➔ Münd[ə] (mouth)
  - Bund ➔ Bünd[ə] (federation)
Umlaut & -n

- Plural -n cannot co-occur with umlaut
  - Pat[ə] ➔ Pate-n/*Päte-n (godparents)
- But non-plural -n can:
  - But Laden (store) ➔ Läden (stores)
Multiple Exponence

• “...in which a category if positively identified at all, would have exponents in each of two or more distinct positions.”

--Mathews (1974: 149)
# Multiple Exponence

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>‘English’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm</td>
<td>Arme</td>
<td>‘arm’</td>
</tr>
<tr>
<td>Vater</td>
<td>Väter</td>
<td>‘father’</td>
</tr>
<tr>
<td>Hals</td>
<td>Hälse</td>
<td>‘neck’</td>
</tr>
</tbody>
</table>
Why do we care as Linguists?

- Violates biuniqueness: 1 form : 1 meaning
- Contra economy principles
• “Multiple exponence is the occurrence of multiple realizations of a single morphosemantic feature, bundle of features, or derivational category within a word.” (Harris, 2017: 9)

• “An alternation introduced by a phonological rule is not considered an exponent, and hence the alternation cannot involve this as one of the two morphemes in a relation of multiple exponence.”

• Phonologically-conditioned morphological phenomena are not ME
Why do we care as Acquisitionists?

- Given the variation in the input, what are the possible learning paths and hypotheses?
- Representationally, what does it look like?
Interfaces

- This is an area where we confront the phonology/morphology interface
• Prosodic Transfer Hypothesis (Goad & White, 2006; forthcoming)
  • Why L2 morphemes are omitted
Embick (2010)

- A local, serial model of the interface
- Distributed Morphology
- Competition for allomorph selection but not competition between complex objects
  - Explored in Archibald (2016)
Trommer (2015)

- Coloured Containment Theory (van Oostendorp, 2006)
  - Distinct morphemes have different morphological ‘colours’
  - All phonological objects affiliated with a given morpheme wear its colour
  - Phonological constraints can’t target specific morphemes (e.g., 3sg)
  - Morphological structure is minimally reflected in phonological representations by colour only
  - Morphological colour is the only morphological information visible to phonological constraints
Exponence

- \([F] \iff \phi\)

- The feature \([F]\) has exponent phi

- E.g. If English present participle, then \([\text{n}^\text{th}]\)
Contextual Allomorphy

\[
\begin{array}{ll}
[F] & \phi_1 \text{ Context}_1 \\
\{ & \\
\phi_2 \text{ Context}_2
\end{array}
\]

(Bonet & Harbour, 2012)
German Plural Allomorphs

• There is only a single [+pl] affix ↔
  • [COR]

• [+pl +fem] ↔ [NASAL]
\text{*umlaut}*_{\text{Root}} + [n]

• Why?
Phonological Architecture

- Feature dependency
- Association lines
# Feature Geometry

<table>
<thead>
<tr>
<th>/t/</th>
<th>/p/</th>
<th>/k/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>Root</td>
<td>Root</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place</td>
<td>Place</td>
<td>Place</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral</td>
<td>Peripheral</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dorsal</td>
<td></td>
</tr>
</tbody>
</table>
Feature Geometry

\[
\begin{array}{ll}
/n/ & /l/ \\
\text{Root} & \text{Root} \\
\text{SV} & \text{SV} \\
\text{Place} & \text{Place} \\
\text{Oral} & \\
\end{array}
\]
Trommer

<table>
<thead>
<tr>
<th>Coronal Consonant</th>
<th>Coronal Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPlace</td>
<td>CPLace</td>
</tr>
<tr>
<td></td>
<td>[COR]</td>
</tr>
<tr>
<td></td>
<td>[n]</td>
</tr>
<tr>
<td>VPlace</td>
<td></td>
</tr>
</tbody>
</table>
Plural

- [+pl] ↔ COR
- [+pl +fem]. ↔ NAS
L2 Learners

- Will they produce umlaut][Root + -n?
- If so, they might be violating phonological universals
How NOT to design a research study

• Don’t do as I do…..
• Let’s gather data from 150 people and see if they don’t do something that Trommer says they shouldn’t do….

• Why is this not a null result?
Prove a platypus doesn’t lay eggs

• Don’t show a picture of a platypus *not* laying eggs
Actual Drawings!
Our Study

• 154 university, classroom learners of German
• Fill in the blanks test of German plurals
  • E.g. given article + noun, the plural would be ________________
• Two data collection times approximately one month apart in Intro German at a Canadian University
  • T1: given spelling of singular noun
  • T2: given picture of singular noun
5. Translation. Translate the following words. (5 Punkte)

1. good, well
   - gut
2. gladly (when you like doing something)
   - gern
3. really, really great
   - äußerst gut
4. a little, a little bit
   - ein bisschen
5. not at all
   - gar nicht

6. Lebensmittel. Please provide the plurals of the following nouns (6 Punkte)

- der Apfel; die Äpfel
- die Wurst; die Würste
- die Tomate; die Tomaten
- die Suppe; die Suppen
- der Salat; die Salate
- das Ei; die Eier
Test Items T2
Most Likely Outcome?

- Coordinate 3 instructors
- Tally all the error forms
- Subjects make all kinds of errors
- Can’t tell anything definitively
  - Usual risk of exploratory research
• I didn’t design or score the tests; this was done by the instructors
• I looked at the wrong answers, and assessed what type of wrong answer it was
  • Type A: choosing the wrong (but possible) allomorph
    • E.g., Wurst; Wurste  ←  Würste
  • Type B: choosing the wrong (but impossible) allomorph
    • E.g., Würsten  ←  Würste
*Würsten
<table>
<thead>
<tr>
<th>English</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Der Apfel (apple)</td>
<td>Die Äpfel</td>
</tr>
<tr>
<td>Die Wurst (sausage)</td>
<td>Die Würste</td>
</tr>
<tr>
<td>Die Tomate (tomato)</td>
<td>Die Tomaten</td>
</tr>
<tr>
<td>Die Suppe (soup)</td>
<td>Die Suppen</td>
</tr>
<tr>
<td>Der Salat (salad)</td>
<td>Die Salate</td>
</tr>
<tr>
<td>Das Ei (egg)</td>
<td>Die Eier</td>
</tr>
</tbody>
</table>
## Time 2 Words

<table>
<thead>
<tr>
<th>German Word</th>
<th>English Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Die Haltestelle ((bus) stop)</td>
<td>Die Haltestellen</td>
</tr>
<tr>
<td>Der Zug (train)</td>
<td>Die Züge</td>
</tr>
<tr>
<td>Das Geschenk ((birthday) present)</td>
<td>Die Geschenke</td>
</tr>
<tr>
<td>Das Taxi (taxi)</td>
<td>Die Taxis</td>
</tr>
<tr>
<td>Der Koffer (suitcase)</td>
<td>Die Koffer</td>
</tr>
<tr>
<td>Die Zeitung (newspaper)</td>
<td>Die Zeitungen</td>
</tr>
<tr>
<td>Das Flugzeug (airplane)</td>
<td>Die Flugzeuge</td>
</tr>
</tbody>
</table>
The Task

- Q: Does this task really tap phonology?

- A: Yes, it does.
Phonology, Silent Reading, and Lexical Activation

- Acoustic influence in letter cancellation. (Corcoran, 1966, 1967)
  - Cross-out the letter $e$
- Visual tongue twister effects (McCutchen, D. and Perfetti, C., 1982)
  - Tongue twisters take longer to read silently
- Prosodic constraints on reanalysis (Bader, 1998)
  - In order to help the little boy put down the package he was carrying.
  - Peter knew the answer would be false.
Phonology, Silent Reading, and Lexical Activation

• Relative clause ambiguity attachment. (Fodor, 2002).
  • Someone shot the servant of the actress [who was on the balcony]
  • Someone shot the servant of the actress [who was on the balcony with her husband]
• Corollory discharge in inner speech (Scott et al., 2013).
  • I.e., categorization effects on imagining and mouthing speech
• Electromyography (McGuian & Dollins, 1989)
  • Muscular activity triggered during silent reading
• Bilingual lexicon and non-selective access (LDT and eyetracking)
  • Differential behavior of interlingual homophones and interlingual homographs in
    • LDT reaction times
    • and eyetracking fixation times
<table>
<thead>
<tr>
<th>SOP Cognates</th>
<th>SO Cognates</th>
<th>SP Cognates</th>
</tr>
</thead>
<tbody>
<tr>
<td>hotel</td>
<td>fruit [frøyt]</td>
<td>news/nieuws</td>
</tr>
<tr>
<td>film</td>
<td>chaos [xaɔs]</td>
<td>boat/boat</td>
</tr>
<tr>
<td>lip</td>
<td>jury [ʒyri]</td>
<td>wheel/wiel</td>
</tr>
<tr>
<td><strong>OP False Friends</strong></td>
<td><strong>O IL Homographs</strong></td>
<td><strong>P IL Homophones</strong></td>
</tr>
<tr>
<td>step (scooter)</td>
<td>glad [xlɐt] (slippery)</td>
<td>‘leaf’ ‘lief’ (dear)</td>
</tr>
<tr>
<td>arts (doctor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kin (chin)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Eyetracking Task

- IL Homographs: An **angel/elbow** can be damaged easily.
- IL Homophones: I had never seen a single **oar/oat** before.
  - Frequency, length and predictability matched
Gaze Duration Results: Interlingual Homophones

- Phonological Condition:
  - Mean Control fixation: 239 ms
  - Mean Experimental fixation: 280 ms
  - $p < .05$
  - +41 ms inhibition
So, lexical activation (including by silent reading) taps into phonology
# German Results

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>87</td>
<td>67</td>
<td>154</td>
</tr>
<tr>
<td>Test Items</td>
<td>522</td>
<td>469</td>
<td>991</td>
</tr>
<tr>
<td>Correct</td>
<td>292</td>
<td>239</td>
<td>593</td>
</tr>
<tr>
<td>Type A Error</td>
<td>225 (43%)</td>
<td>71 (15%)</td>
<td>159 (33%)</td>
</tr>
<tr>
<td>Type B Error</td>
<td>5 (.9%)</td>
<td>2 (.4%)</td>
<td>7 (.7%)</td>
</tr>
</tbody>
</table>
Type B Errors

- Die Zügen (trains)
- Die Zeitüngen (newspapers)
- Die Tömaten (tomatoes)
- Die Würsten (sausages)
- Die Süppen (soups)

- Errors (systematic) or mistakes (random)?
### Chi-squared Results

<table>
<thead>
<tr>
<th></th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>296</td>
<td>151.5</td>
<td>144.5</td>
</tr>
<tr>
<td>Type B</td>
<td>7</td>
<td>151.5</td>
<td>-144.5</td>
</tr>
<tr>
<td>Total</td>
<td>303</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chi-Square: 275.64  
df: 1  
Asymp. Sig: 0.00
## T1 Errors by Item

<table>
<thead>
<tr>
<th>Umlaut Only</th>
<th>Umlaut + e</th>
<th>-n</th>
<th>-e</th>
<th>-er</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apfel (apple)</td>
<td>Wurst (sausage)</td>
<td>Tomate (tomato)</td>
<td>Salat (salad)</td>
<td>Ei (egg)</td>
</tr>
<tr>
<td>Correct</td>
<td>Incorrect</td>
<td>Correct</td>
<td>Incorrect</td>
<td>Correct</td>
</tr>
<tr>
<td>48 (55%)</td>
<td>39 (44%)</td>
<td>38 (43%)</td>
<td>49 (56%)</td>
<td>123 (70%)</td>
</tr>
<tr>
<td>39 (44%)</td>
<td>38 (43%)</td>
<td>49 (56%)</td>
<td>123 (70%)</td>
<td>51 (29%)</td>
</tr>
</tbody>
</table>

n= 87
# T2 Errors by Item

<table>
<thead>
<tr>
<th>Null</th>
<th>Umlaut + e</th>
<th>-n</th>
<th>-e</th>
<th>-en</th>
<th>-s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koffer</td>
<td>Zuge</td>
<td>Haltstelle</td>
<td>Flugzeug</td>
<td>Geschenk</td>
<td>Zeitung</td>
</tr>
<tr>
<td>✓</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>25</td>
<td>17</td>
<td>31</td>
<td>12</td>
<td>35</td>
<td>2</td>
</tr>
<tr>
<td>(Blank)</td>
<td>(25)</td>
<td>(14)</td>
<td>(30)</td>
<td>(62)</td>
<td>(34)</td>
</tr>
</tbody>
</table>

n= 67
• It is not the case that ‘they don’t produce things they don’t hear, and they never hear umlaut+n’.

• Rather ‘they don’t produce illegal structures that they don’t hear but they produce legal structures that they don’t hear’
Type A Errors

- Wursten; Wurste ← Würste
- Apfels; Apfelen ← Äpfel
- Süppe ← Suppen
- Tomate; Tomates ← Tomaten
No impossible Turkish grammars

- Özcelik & Sprouse (2016)
  - Tier-based locality of vowel harmony in Turkish
Vowel Harmony

<table>
<thead>
<tr>
<th>g</th>
<th>ø</th>
<th>z</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>CPI</td>
<td>CPI</td>
<td>CPI</td>
</tr>
<tr>
<td></td>
<td>CPI</td>
<td>CPI</td>
<td></td>
</tr>
<tr>
<td>VPI</td>
<td>VPI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[COR]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Secondary Feature Spreading

\[
\begin{array}{lcccc}
| & r & o & l & e \\
| & CPI & CPI & CPI & CPI \\
| & VPI & VPI & VPI \\
| & [DOR] & [COR] \\
\end{array}
\]
No Crossing Constraint

*\(r\) \hspace{1cm} o \hspace{1cm} l \hspace{1cm} a

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
CPI | CPI | CPI | CPI |
|   |   |   |   |
VPI | VPI | VPI |
|   |   |   |
\[DOR\] [COR]
No impossible German grammars

• Poverty of the stimulus
  • Acoustic cues of umlaut and [n] are very different
  • ‘Sometimes I hear umlaut’ (e.g., Würste)
  • Sometimes I hear -[n] (e.g. Suppen)
  • I never hear umlaut AND plural -[n] but I hear umlaut + [n] in Roots

• Certainly not taught in class
• What IS taught in class?
LERNWORTSCHATZ

Wie heißen die Wörter in Ihrer Sprache? Übersetzen Sie.

Haus/Wohnung
Haus das, wo
Wohnung die, -er
 Balkon der, -
 Raum der, -
 Küche die, -
 Badezimmer das, -
 Balken der, -
 Fenster das, -
 Gart en der, -
 Garten der, -
 Keller der, -
 Licht das, -
 Mauer die, -
 Mülleimer der, -
 A. auch: Müll
 O. auch: Abfall
 Nachbarn der, -
 Nachbar der, -
 Nachbarin die, -
 Quadratmeter das, -
 Stück der, -
 Stockwerk die, -
 Treppe die, -
 A. Stiege die, -
 Vorratsraum der, -
 Waschraum der, -
 vertieren, hat
 vermieten, gemütlich sein
 durchlässiger
 Zimmer das, -
 Arbeitszimmer das, -
 OH Nacht der, -
 Waschraum der, -
 durchlüften das, -

Welche Wörter möchten Sie noch lernen? Notieren Sie.
The Input

- Learners hear ME in the input:
  - ‘Sohn’ -> ‘Söhne’ \{umlaut + [ə]\}
  - ‘Mund’ -> ‘Münder’ \{umlaut + [ə]\}

- So what blocks the hypothesizing of \{umlaut + plural [n]\}? 
  - Remember umlaut + n exists in Roots (e.g. Läden)
  - Indirect -ve evidence?
Trommer Machinery

- No Crossing Lines (aka NoSkipCPlace)
  - A Plc node dominated by a Cplace node may not associate across another Cplace node
Phonological Architecture

- No multiple linking
- [COR] links to EITHER CPlace OR VPlace
- Our subjects’ behaviour is consistent with this principle
• This is not multiple exponence but phonologically-conditioned allomorphy
• IL grammars respect the rules of the morphology/phonology interface
Conclusion

• The IL grammars do not allow Crossing of Association lines
• It’s the 889/991 forms ((90%) that tell the story
• The 7/991 (.7%) are more like marginalia; notable in their absence
• My picture of a platypus not laying eggs fits into a bigger theoretical and empirical picture.
References


• Trommer, J. (2018). The subsegmental structure of German plural allomorphy. Talk given at the University of Victoria.


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