Sources of asymmetries in category-specific phonology

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0. On category-specific phonology, and why it is interesting
Traditionally: **Lexical category** (N, A, V) is a matter for morphology and syntax

However: **Phonological phenomena**—processes, phonotactics—sometimes apply differently to words of different lexical categories

(see, e.g., Cohen 1964; Postal 1968; Kenstowicz & Kisseberth 1977; Smith 1997, 2001, 2011; Myers 2000; Bobaljik 2008)

**Example:** Spanish stress (Harris 1983) | N, A have a contrast while V are predictable

<table>
<thead>
<tr>
<th>N</th>
<th>contrast</th>
<th>A</th>
<th>contrast</th>
<th>V</th>
<th>no contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stress on any of last three syllables</strong></td>
<td><strong>Stress on any of last three syllables</strong></td>
<td><strong>Determined by inflectional form</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[sáˈβa.na]</td>
<td>‘sheet’</td>
<td>[me.tó.ði.k-o]</td>
<td>‘methodical’</td>
<td>[lá.β-o]</td>
<td>‘wash-1sg.pres.ind’</td>
</tr>
</tbody>
</table>
(3) What is responsible for phonological differences between lexical categories?

*Hypothesis A: Nothing*—Any apparently category-specific phonology is really caused by something else, such as the free/bound distinction or paradigm uniformity (e.g., Kenstowicz 2006; Cable 2005; McCarthy 2005)

- Some apparent cases have these explanations, yes
- But crucially, category-specific phonology overall does not reduce to these kinds of effects (see Smith 2011 for discussion)
(3) What is responsible for category-sensitive phonological phenomena?

*Hypothesis B:* **Category-sensitive phonological grammar**

- **Option 1**—Universal: Category-specific phonology is available to all speakers in the absence of explicit phonological data
  - Perhaps because of (innate) UG
  - Perhaps because of a **universal learning bias** (analytic bias)

- **Option 2**—*Induced from ambient data*, subject to pressures from acquisition/diachronic transmission (channel bias)
  - Frequency/salience in learner’s input
  - Prosodic factors
  - Morphological factors (complexity?)
(4) Focus of this talk:

• What are some key characteristics of category-sensitive phonological phenomena?
  - Typological evidence → asymmetries
  - Experimental evidence → are the asymmetries productive?

• What conclusions can we draw about the nature of the category-sensitive components of the phonological grammar?

(a) Some aspects are universal (innate or universally induced)
  • These have implications for various aspects of the grammatical system

(b) Some aspects are induced from ambient data
Some disclaimers

- I assume that the **categories** involved are the actual morphosyntactic category labels used elsewhere in the grammar
  
  - Alternative: They are ‘typical’ phonological indexation classes that happen to (approximately) track the morphosyntactic labels
  
  - We can test this by tracking how (morphosyntactically) accurate the phonologically relevant ‘category’ classes are

- I assume **richness of the base**: anything phonologically illegal in a language must be explicitly ruled out by the phonological grammar
  
  - Many of the points I make today about a role for lexical categories in the phonology are relatively framework-independent, but RotB is fundamental to my thinking
(6) Outline

§1 Typological asymmetries in category-specific phonology
§2 The hierarchy of phonological privilege — a grammar-internal soft bias
§3 On the ‘prosodic skew’ — segmental vs. prosodic patterns
§4 Some formal implications of category-specific phonology
§5 Conclusions and future directions
1. Typological asymmetries in category-specific phonology
Survey: 20 languages with (categorical) category-specific phonology (Smith 2011)

(a) Comparatively small-scale survey—examples hard to search for (new exx welcome!)

(b) For each language in the survey:

• **Which lexical categories, if any, show phonological privilege?**
  - ‘privilege’ = resistance to positional neutralization (Trubetzkoy 1939; Steriade 1995), or susceptibility to positional augmentation (Smith 2005)
  - roughly, the *ability to support greater phonological complexity*

• **What kinds of phenomena are category-sensitive?**
The findings indicate two asymmetries:

- details, references: Smith (2011)

(a) Skew toward **prosodic phenomena** (accent, tone, word shape) rather than segmental or featural phenomena

- The two V>N ‘segmental’ cases involve deletion, and are potentially open to reinterpretation as prosodic phenomena (involving syllable structure)

- N>V segmental case not included in original survey: Kɔnni (Cahill 2007; Jesney 2016) has more vowel-quality contrasts in N than in V
The findings indicate two **asymmetries**:

- details, references: Smith (2011)

(b) **Hierarchy** of phonological privilege: $\text{N} > \text{A} > \text{V}$ — as seen in patterns where:

  i  only nouns are privileged  
      $\text{N} > \{ \text{A}, \text{V} \}$  | Japanese

  ii only verbs are restricted  
     $\{ \text{N}, \text{A} \} > \text{V}$  | Spanish

  iii adjectives are intermediate  
     $\text{N} > \text{A} > \text{V}$  | Hebrew
(9) More on the hierarchy of phonological privilege

(a) The hierarchy isn’t just N > A > V — evidence for proper-noun (PrN) privilege

• PrN in Jordanian Arabic are exempt from a syncope process that affects common N (Jaber 2011, Jaber & Omari 2018)

• Other cases of distinct phonology for PrN (not necessarily with PrN privilege): Sezer (1981), Sugawara (2012)

(b) Does PrN > N > A > V reflect a continuum: from prototypical designators to prototypical predicates?

• See §4.2 for discussion
This talk examines each of these asymmetries in turn and proposes that:

(a) The **hierarchy of phonological privilege** is a **grammar-internal soft bias**
    - Implications for positional privilege, markedness scales

(b) The **prosodic skew** is not enforced by the grammar proper
    - Must come about through **extragrammatical factors**
      (such as acquisition, diachronic change)

Category-specific phonology has potential implications for...

- positional privilege (positional neutralization) in phonology
- learning biases in language acquisition and their effect on typology
- markedness scales in natural language
- the phonology/morphosyntax interface
2. The hierarchy of phonological privilege — a grammar-internal soft bias

§2.1 The hierarchy of privilege is defeasible
§2.2 The hierarchy of privilege is universally available
§2.3 Theoretical implications
2.1 The hierarchy of privilege is defeasible
(12) There are exceptions to N > A > V

(a) N, V can have distinct, but equally predictable, patterns

(b) Some languages have privilege reversals

- The basic hierarchy is a **grammar-internal soft bias** — can be **overridden**
Category-specific phonology sometimes merely shows **distinct patterns** for N, V.

- Lenakel stress (Lynch 1975, 1978) | N, V have different *predictable* stress patterns.

<table>
<thead>
<tr>
<th>N</th>
<th>secondary stresses <strong>prefer right edge</strong></th>
<th>V</th>
<th>secondary stresses <strong>prefer left edge</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned leftward from main-stress syllable</td>
<td>Assigned rightward from initial syllable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| [kɑ̀.mɑ.dó.a] | ‘kind of taro’ | [ɾɪ.mɔl.ɡɛ́j.ɡɛ́j] | ‘he liked it’ |
| [ni.mʷʊ.ɡə.lú.ɡəl] | ‘beach’ | [nì.ma.ɾəl.ɡɛ́j.ɡɛ́j] | ‘you (pl.) liked it’ |
| | | [tì.na.ɡə.ma.ɾəl.ɡɛ́j.ɡɛ́j] | ‘you (pl.) will be liking it’ |

(a) Predictable = enforced by the markedness system

(b) Neither N nor V is privileged
(14) Category-specific phonology sometimes shows ‘**privilege reversals**’

- Ewe tone (Ansre 1961) | V has a contrast while N is predictable — reverse of N > V

<table>
<thead>
<tr>
<th>V</th>
<th>contrast</th>
<th>N</th>
<th>no contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Voiced obstruent onset + either high or non-high tone</strong></td>
<td></td>
<td><strong>Voiced obstruent onset + only non-high tone</strong></td>
</tr>
<tr>
<td>[bú] ‘to be lost’</td>
<td>—</td>
<td>[βù] ‘blood’</td>
<td></td>
</tr>
<tr>
<td>[bù] ‘to respect’</td>
<td>—</td>
<td>[dà] ‘snake’</td>
<td></td>
</tr>
<tr>
<td>[vó] ‘to rot’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[vò] ‘to be free’</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2 The hierarchy of privilege is universally available
Claim: The hierarchy of privilege is present for all language learners

(a) Typological survey (§1): Most category-specific effects follow the hierarchy

(b) Empirical evidence from English nonce blends
Experiments on English nonce blends (Moreton, Smith, Pertsova, Broad, & Prickett 2017 [Sporklab 2017]) find emergent effects of:

(a) **N privilege** compared to V

(b) **Proper N (PrN) privilege** compared to common N

Emergent effects are those for which there is no direct evidence in the ambient language data

- Term originates from ‘emergence of the unmarked’ (McCarthy & Prince 1994)
- Emergent effects are seen in L2 phonology, loanwords, etc. (Broselow, Chen, & Wang 1998; Jacobs & Gussenhoven 2000; Ito & Mester 2001; Zhang 2013; Jesney 2014)

Must come from UG or other universal basis (e.g., analytic bias)
(18) Lexical blend: (Intentional) word-formation process (Pound 1914; Wentworth 1934; Algeo 1977; Bat-El 2006; Renner et al. 2012)

- Combines two or more source words, as in \textit{sp(oon)} + (f)\textit{ork} \rightarrow \textit{spork}

(19) Blending can force a choice of which source word to be faithful to

(a) Blends are usually shorter than combined source words (Gries 2004; Bauer 2012)

- Which source word’s \textit{segments} are preserved?

(b) English blend outputs have only one main word stress (Arndt-Lappe & Plag 2013)

- Which source word’s \textit{stress} is preserved?
(20) Nonce-blend experiments (methodology based on Shaw 2013; Shaw et al. 2014)

(a) Take two words that can be blended in two different ways
   • One of the blends is more faithful to the crucial source word

(b) Have participants match the two blends to a pair of definitions
   • The crucial source word has a different category assignment in each definition

→ Are English speakers, in forming blends, more faithful to segments/stress originating in words of one category vs. another?
(21) **N vs. V, segmental condition:** “Ambi-blendable” source-word pairs

- Pair of words that can be blended at two different switchpoints (Shaw 2013)
- The crucial word is ambiguous between N and V

<table>
<thead>
<tr>
<th>fling</th>
<th>f l i ɲ</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>language</td>
<td>l æ ɲ g w ð</td>
</tr>
</tbody>
</table>

- The earlier switchpoint preserves more of Word1

| fling + language | N+N – sweet words you say during a romantic fling | V+N – words you carelessly fling around when angry |

(22) **Definitions:** Two meanings presented

- Do participants preserve more Word1 segments ([flɪŋgwidʒ]) when it is N or V?
N vs. V, stress condition

- Pairs of words that can be blended with two different stress patterns
- The crucial word is ambiguous between N and V

<table>
<thead>
<tr>
<th>Word 1</th>
<th>Word 2</th>
<th>Stress pattern of blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>trochaic</td>
<td>iambic</td>
<td>trochaic</td>
</tr>
<tr>
<td><strong>blúbber</strong></td>
<td><strong>babóon</strong></td>
<td><strong>blúbboon</strong></td>
</tr>
</tbody>
</table>

- The trochaic blend preserves the stress of Word1

Definitions: Two meanings presented

<table>
<thead>
<tr>
<th>blúbber+babóon</th>
<th>N+N</th>
<th>a baboon with extra body fat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V+N</td>
<td>a baboon that weeps noisily</td>
</tr>
</tbody>
</table>

- Do participants preserve Word1 stress (**blúbboon**) when it is N or V?
(25) **PrN vs. N, segmental condition:** chihuahua + werewolf

<table>
<thead>
<tr>
<th>Blends</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ʧɪwɑwʊl]</td>
<td>PrN+N a werewolf who is from Chihuahua, Mexico</td>
</tr>
<tr>
<td>[ʧɪwɛ.iwʊl]</td>
<td>N+N a werewolf who, in wolf form, resembles a chihuahua</td>
</tr>
</tbody>
</table>

• The crucial word is ambiguous between PrN and N
• Words were presented to participants in all capital letters (CHIHUAHUA)
• Do participants preserve more Word1 segments ([ʧɪwɑwʊl]) when it is PrN or N?

(26) **PrN vs. N, stress condition:** türkey + tycóon

<table>
<thead>
<tr>
<th>Blends</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>türcooön</td>
<td>PrN+N someone who made a lot of money in Turkey</td>
</tr>
<tr>
<td>turcóon</td>
<td>N+N someone who made a lot of money in turkey</td>
</tr>
</tbody>
</table>

• Do participants preserve Word1 stress (türcooön) when it is PrN or N?
We analyzed the data in two ways (following Shaw 2013):

(a) By participant  (b) By response

For the “By-Participant” analysis:

- How many participants gave a majority of responses showing N>V or PrN>N?
  (a) Participant coded as 1 if gave a majority of N>V or PrN>N responses, else as 0
  (b) Observed proportion of ‘1’ responders was compared to chance (=0.5) using a one-sided exact binomial test
- When observed proportion of participants is significantly greater than chance: Participants tended to show a N>V or PrN>N hierarchy of privilege
(29) For the “By-Response” analysis:

- How many responses (pooled across subjects) showed N>V or PrN>N?

  (a) Response was coded as 1 if showed N>V or PrN>N, else as 0

  (b) A mixed logistic-regression model was fit using the *lmer* method in the *lme4* package of the statistical software R (Bates, Maechler, & Bolker, 2011)

  - The model had a single fixed term, the intercept, with random intercepts for each participant and each of the nine items.

  (c) Intercept compared to chance level (=0)

- When intercept significantly greater than chance:
  Responses tended to show a N>V or PrN>N hierarchy of privilege
Summary of N>V, PrN>N effects found—statistically significant?

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Position</th>
<th>Segments</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>participant</td>
<td>response</td>
</tr>
<tr>
<td>3a &amp; 4a</td>
<td>Noun</td>
<td>yes</td>
<td>—</td>
</tr>
<tr>
<td>3b &amp; 4b</td>
<td>Noun</td>
<td>yes</td>
<td>—</td>
</tr>
<tr>
<td>5a &amp; 6a</td>
<td>Proper noun</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>5b &amp; 6b</td>
<td>Proper noun</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

These results are consistent with the hypothesis that blend formation is affected by emergent effects of a hierarchy PrN > N > V, for both segments and stress.

(a) The hypothesis is strongly supported for PrN > N

(b) Support for N > V is a little less strong

- Further investigation is needed to better understand whether this difference in effect strength is real, or an artifact of the experiment.
2.3 Theoretical implications
Summary

(a) There is a hierarchy of phonological privilege $\PrN > N > A > V$
   - Emergent status of $\PrN > N$, $N > V$ supported by experimental evidence

(b) Typological evidence shows that this hierarchy is not absolute
   - Some languages have $V > N$ or $N > \PrN$
   - Some languages have $N \neq V$ and $\Pr \neq N$ distinct defaults
(33) **Theoretical implications**

(a) A phonological model of category-specific phonology must be able to treat the hierarchy of privilege as a *grammar-internal soft bias*

- Encode the PrN > N > A > V hierarchy as a **default**
- Allow this hierarchy to be **overridden** in the presence of relevant data

(b) The grammar must be able to refer to each category, even the endpoints

(34) **Predictions** for artificial-language experiments (Smith 2014a & work in progress)

- N-privilege patterns should be easier to learn than V-privilege patterns
- But, V-privilege patterns should still be learnable
3. On the ‘prosodic skew’ — segmental vs. prosodic patterns

§3.1 Experimental evidence for the learnability of segmental category-specific patterns
§3.2 Statistical noun/verb differences in the English lexicon
§3.3 Experiment
§3.4 Theoretical implications
3.1 Experimental evidence for the learnability of segmental category-specific patterns
Typological survey (§1) indicates: category-specific phonology typically involves **prosodic** rather than **segmental** phenomena

- Unexpected skew: If some part of the grammar is relativized to lexical category, why should the type of phonological phenomenon matter?

- Does the observed typology actually reflect the space of possible languages?
Experimental-phonology approaches to these questions:

(a) Surfeit-of-the-stimulus experiments (Becker, Ketrez, & Nevins 2011)
    Have participants learned a N/V difference that is found in their lexicon?

(b) Artificial-language experiments
    Can participants learn a N/V phonological difference in the lab?
    • Are **segmental** and **prosodic** patterns equally easy to learn?

Prediction:

• If the prosodic skew in category-specific phonology is enforced by the grammar, then a **segmental pattern will not be learned as easily** as a prosodic one

• But this is not what we find!
3.2 Statistical noun/verb differences in the English lexicon
The English lexicon has statistical noun/verb phonotactic differences involving:

(a) **stress** — a *prosodic* property
   - Productive for nonce words (Kelly & Bock 1988; Guion et al. 2003)
     - Oral production of nonce words presented in N or V frames, plus (Guion et al.) forced-choice stress preference judgments for nonce words in N or V frames

(b) **fricative voicing** and **vowel backness** — *segmental* properties
   - No evidence previously found for productivity (Albright 2008)
     - Wordlikeness judgments for nonce words presented in N or V frames
   - But: Some evidence for psychological reality of N/V segmental differences in actual words of English (e.g., Sereno & Jongman 1990; Farmer et al. 2006)
   - Blend experiments (Sporklab 2017; §2) showed emergent effects of PrN>N, N>V privilege for segmental deletion as well as stress faithfulness
(39) **Stress:** Disyllabic N more likely to be *trochee*; V, *iamb* (Chomsky & Halle 1968)


<table>
<thead>
<tr>
<th></th>
<th>Disyllables used <em>only</em> as...</th>
<th>total</th>
<th>Initial stress</th>
<th>Final stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nouns</td>
<td>3002</td>
<td></td>
<td>94%</td>
<td>6%</td>
</tr>
<tr>
<td>Verbs</td>
<td>1021</td>
<td></td>
<td>31%</td>
<td>69%</td>
</tr>
</tbody>
</table>

$\chi^2(1)=1757.56, p<0.0001$; Yates chi-square, corrected for continuity

<table>
<thead>
<tr>
<th></th>
<th>All disyllabic items that are...</th>
<th>total</th>
<th>Initial stress</th>
<th>Final stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nouns</td>
<td>4218</td>
<td></td>
<td>89%</td>
<td>11%</td>
</tr>
<tr>
<td>Verbs</td>
<td>1676</td>
<td></td>
<td>46%</td>
<td>54%</td>
</tr>
</tbody>
</table>

$\chi^2(1)=1241.1, p<0.0001$; Yates chi-square, corrected for continuity
(40) **Fricative voicing:** Stronger final voiceless skew in N (Albright 2008; Jespersen 1942)

- Data from CELEX (Baayen et al. 1995): Out of the 1000 most frequent N and V, how many are monomorphemic and end in a voiceless or voiced fricative? (query based on Berg 2000)

(a) *Only* nouns and verbs with **no** voicing counterpart (excludes *hou*[s]e, *hou*[z]e)

<table>
<thead>
<tr>
<th></th>
<th>voiceless fricative</th>
<th>voiced fricative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nouns</strong></td>
<td>78 (83.0%)</td>
<td>16 (17.0%)</td>
</tr>
<tr>
<td><strong>Verbs</strong></td>
<td>86 (56.6%)</td>
<td>66 (43.4%)</td>
</tr>
</tbody>
</table>

χ²(1)=17.05, *p*<0.0001; Yates chi-square, corrected for continuity

(b) *All* nouns and verbs (includes *hou*[s]e, *hou*[z]e)

<table>
<thead>
<tr>
<th></th>
<th>voiceless fricative</th>
<th>voiced fricative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nouns</strong></td>
<td>95 (85.6%)</td>
<td>16 (14.4%)</td>
</tr>
<tr>
<td><strong>Verbs</strong></td>
<td>86 (52.4%)</td>
<td>78 (47.6%)</td>
</tr>
</tbody>
</table>

χ²(1)=30.87, *p*<0.0001; Yates chi-square, corrected for continuity
(41) **Vowel backness**: N more likely than V to have back vowel in main-stress syllable (Sereno & Jongman 1990; Berg 2000)

- Data from CELEX (Baayen et al. 1995, as reported by Berg 2000):
  Out of the 1000 most frequent N and V, how many are monomorphemic and have a front or back main-stress vowel?

<table>
<thead>
<tr>
<th></th>
<th>back vowel</th>
<th>front vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nouns</td>
<td>245 (54.3%)</td>
<td>206 (45.7%)</td>
</tr>
<tr>
<td>Verbs</td>
<td>217 (46.6%)</td>
<td>249 (53.4%)</td>
</tr>
</tbody>
</table>

χ²(1) = 5.21, p = 0.0225; Yates chi-square, corrected for continuity

- Chi-square test still shows proportions are significantly different for N vs. V
  - But: Magnitude of difference certainly not as large here
3.3 Experiment
(42) Surfeit-of-the-stimulus experiment (Smith 2016):

(a) Are the segmental N/V differences that are found in the English lexicon 
**productive** — used to classify nonce words?

(b) How do they **compare** to stress?

(43) **Task**: Intended to emphasize noun/verb differences (more than in Albright 2008)

(a) Hear nonce-word minimal pairs (auditory presentation only)

(b) Label each pair as “**NOUN...VERB**” or “**VERB...NOUN**”

• Two-alternative forced-choice design
Stimuli: 36 nonce-word pairs | 3 conditions

(a) 12 pairs differed in stress ([ˈpɛl.tækt~pɛl.ˈtækt]); all disyllabic
   • Control condition—identical to stimuli from past studies
     (Kelly 1988; Guion et al. 2003)

(b) 12 pairs differed in the voicing of a final fricative ([plɛf~plɛv])
   • Fricative pairs used were [f]~[v], [θ]~[ð], [s]~[z]

(c) 12 pairs differed in the backness of the stressed vowel ([pə.ˈdʒɔd~pə.ˈdʒæd])
   • Vowel pairs used were [uː]~[i:], [ou]~[ei], [a]~[æ]

(d) Presentation order within pairs counterbalanced; pairs randomly sequenced
   • Fricative and vowel pairs included monosyllables, trochees, and iambs

Participants: 80 English-speaking adults, recruited through Mechanical Turk
(46) **Predictions**

(a) If the typological skew toward prosodic patterns in category-specific phonology is a direct result of a restriction in the grammar, participants should show productive knowledge of the stress pattern only

(b) If the prosodic skew has an extragrammatical source, participants should show equally productive knowledge of all three patterns
Results — analyzed in two ways

(a) By response: How many responses overall conformed to the lexical pattern?

(b) By participant: How many participants had >50% conforming responses?
(48) Analysis by response (960 responses/pattern)

(a) All three phonological patterns had an effect significantly greater than chance
   • More responses mapped the pattern to a noun/verb pair as predicted than would be expected due to chance

(b) The stress pattern and the fricative voicing pattern had the strongest effect
   • Magnitude of effect not significantly different

(c) The vowel backness pattern was perhaps not quite as strong
   • Magnitude of effect marginally significantly different from that of stress
   • Coefficient estimates and standard errors from logistic-regression model (see Smith (2016)) were used to derive 95% confidence intervals for each coefficient; logits converted to proportions
Analysis by participant, all items (80 participants)

All three phonological patterns had an effect significantly greater than chance

- More participants mapped the pattern to a noun/verb pair as predicted than would be expected due to chance

- How many participants had more than 6 out of 12 (>50%) conforming responses?
  
  Exact binomial test, one-tailed (compare >6 participants with <6; chance=50%)

  \[
  \begin{align*}
  58/(80–11) (84\%) & \quad p<0.00001 \\
  51/(80–12) (75\%) & \quad p=0.00002 \\
  51/(80–9) (72\%) & \quad p=0.00015
  \end{align*}
  \]
3.4 Theoretical implications
Summary of results

(a) All three patterns (stress, fricative voicing, vowel backness) had an effect significantly greater than chance

(b) The stress (control) pairs replicated findings (Kelly 1988; Guion et al. 2003) that trochaic nonce-words (vs. iambs) are more likely to be labeled as nouns

(c) Effect also found for [-voice] final fricatives (vs. [+voice]), and for [+back] stressed vowels (vs. [−back])
   • Vowel backness effect marginally statistically weaker than stress effect
(51) Implications for category-specific phonology

- The grammar is **capable of learning** a segmental N/V asymmetry as thoroughly as a prosodic one

- The **typological skew** toward prosodic patterns must therefore arise through **extragrammatical factors**
4. Some formal implications of category-specific phonology

§4.1 Category-specific phonology in the grammar
§4.2 The hierarchy of privilege as a “category squish”?  
§4.3 A formal analysis of category-specific phonology: Indexed constraints
4.1 Category-specific phonology in the grammar
What these experiment results suggest about category-specific phonology

- The phonological grammar is not directly responsible for the **prosodic skew**
  - Interesting questions for the study of channel bias!

- We need to model the **hierarchy of privilege** as ...
  - **universally available** (because of emergent effects)
  - a **defeasible bias** (it can be overridden, given appropriate learning data)
What are some options for **modeling** lexically specific phonology?

(a) Where should the differences among categories be located?

phonological computation vs. morphological structure vs. lexical storage

- To the extent that category-specific behavior is consistent and productive, that argues for situating it in the **phonological computation system**

(b) How should the computation system represent category-specific phonology?

indexed constraints (Pater 2000, 2009)
vs. cogrammars (Inkelas & Zoll 2007)
vs. sublexica (Gouskova, Newlin-Łukowicz, & Kasyanenko 2015)

- The hierarchy of privilege suggests modeling with **indexed constraints**

  - Lexical-category continuum as a prominence/markedness scale (as in ‘prominence alignment’; Prince & Smolensky 2004)
4.2 The hierarchy of privilege as a “category squish”?
(54) Hierarchy of privilege: PrN > N > A > V

- Evidence from the typology of category-specific phonology
- Evidence from emergent effects in blends experiment

(55) **Hypothesis**: The hierarchy of privilege is a continuum from *prototypical designators* (PrN) to *prototypical predicates* (V)

- This hierarchy converges with certain lexical-category hierarchies, or “squishes”, proposed in the domain of morphosyntax

  (a) Based on a continuum of morphosyntactic behavior (e.g., Ross 1972)

  (b) Based on arguments concerning, e.g., conceptual prototypes or discourse roles (e.g., Hopper & Thompson 1985; Langacker 1987; Croft 1990)

- Could be innate; could be (universally) induced
(56) **Prediction:** Languages can further subdivide the class of V (or A) such that more-prototypical predicates within that class have less phonological privilege

- We should find languages where V phonological patterns split along lines of **transitivity** (Hopper & Thompson 1985) or **agentivity/ergativity** (Perlmutter 1978)

- A preliminary study (Smith 2014b) suggests that such a pattern can be found in Tokyo Japanese pitch accent, with *unergative intransitives > agentive intransitives*
(57) The hierarchy of privilege looks like another example of a *markedness scale*

- A prominence-based scale that gives rise to structured sets of constraints

  (a) Analogues in phonology: sonority (Prince & Smolensky 2004), place of articulation (Lombardi 2001), nasalization (Walker 1998), etc.

  (b) Analogues in morphosyntax (see also Aissen 2003 for a review): animacy (Silverstein 1976), case (Keenan & Comrie 1977), definiteness (Croft 1988)

→ Potential for insights into a general relationship between markedness scales and the role of learning biases in acquisition to be gained from comparisons here
4.3 A formal analysis of category-specific phonology: Indexed constraints
If N and V have different phonological behavior, then some piece of the grammar needs to be relativized to N and/or to V

- Indexed constraints (Beckman 1999; Zoll 2004; Smith 2001; Pater 2000, 2009):
  Individual constraints can be indexed to (made to evaluate only) N, V, etc.

Approaches to indexed constraints

(a) **Positional faithfulness** — faithfulness constraints indexed to ‘strong’ positions

- \text{Faith}\{Property\}_N \hspace{1cm} \text{(Beckman 1999; Casali 1996)}

(b) **Positional markedness** — markedness constraints indexed to ‘weak’ positions

- \text{No}\{Property\}_V \hspace{1cm} \text{(Steriade 1995; Lombardi 2001)}

(c) **Positional licensing** — markedness constraints indexed to ‘strong’ positions

- \text{License}\{Property\}, N \hspace{1cm} \text{(Ito, Mester, & Padgett 1995; Zoll 2004, Jesney 2016)}
Example: A language where N contrast in stress, but V stress must be penultimate

- **Positional faithfulness** implementation: Faithfulness constraint indexed to N

\[ S_{\text{STRESSFAITH-N}} \]
Assign one * when an output form that is a N has stress in a different location from its corresponding input form

<table>
<thead>
<tr>
<th>/pótima/N</th>
<th>STRF-N</th>
<th>PENULT</th>
<th>STRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ (a) pótima</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) potíma</td>
<td>*\text{w}</td>
<td>\text{L}</td>
<td>*(\text{w})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/lásona/V</th>
<th>STRF-N</th>
<th>PENULT</th>
<th>STRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) lásona</td>
<td>✓</td>
<td>*\text{w}</td>
<td>\text{L}</td>
</tr>
<tr>
<td>▶ (b) lasóna</td>
<td>✓</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

- No V can ever violate \( S_{\text{STRESSFAITH-N}} \), whether stress is actually faithful or not
- This ranking preserves contrast in N and enforces predictability in V
(61) How is the hierarchy of privilege implemented, assuming indexed constraints?

- A ranking bias in the grammar learner:

(a) In the absence of evidence to the contrary...

(b) given faithfulness or licensing constraint $C$,
there is a ranking $C_{-PrN} \gg C_{-N} \gg C_{-A} \gg C_{-V}$

- The PrN > N > A > V hierarchy functions like a ‘prominence’ scale (see §4.2)
5. Conclusions and future directions
(62) Proposal: Typological asymmetries in category-specific phonology

(a) Hierarchy of phonological privilege N > A > V is a grammar-internal soft bias
   • Universally available
   • Can be overridden, given appropriate data
   • May reflect a continuum from prototypical designator to prototypical predicate

(b) The skew toward prosodic phenomena is due to extragrammatical factors
   • Experiment results: Both segmental and prosodic patterns are learnable
   • Prosodic skew might be related to salience or lower complexity of prosodic (vs. segmental) contrast systems
(63) The formal analysis of category-specific phonology

(a) Implemented as indexed constraints

(b) N > A > V (etc.) as a ranking bias in the grammar learner
   • Category hierarchy becomes a new case of a markedness scale
(64) Future directions: Typology and learnability

(a) Does an expanded survey still show the asymmetries identified in §1?
   • Continue collecting and classifying examples of category-specific phonology

(b) Are gradient and categorical patterns subject to the same asymmetries in category-specific phonology?
   • Expand the typological survey to gradient patterns

(c) To what extent are typological asymmetries driven directly by restrictions in the grammar?
   • Conduct further surfeit-of-the-stimulus and artificial-language experiments on category-specific phonology
Future directions: Implications for the formal linguistic system

(a) Within the phonology proper
   • Can category-specific phonology shed light on how we should approach positional privilege more generally?

(b) At the phonology/morphosyntax interface
   • Is the evidence from phonology more compatible with some theories of morphosyntax than with others?

(c) Markedness scales in the linguistic system — at the formal/functional interface
   • To what extent is the hierarchy of phonological privilege related to other scales? Do they share formal properties, or have similar relationships to factors outside the grammar?
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For additional discussion
What are the “categories” in the phonology?
What does “category-specific” phonology actually mean? Some options:

(a) The lexical categories in question are the same as those in the morphosyntax

(b) The apparent “lexical categories” are no different from any other arbitrary class of roots/stems/lexemes that show exceptional phonological patterns
   • The parallel with “real” categories from morphosyntax is an epiphenomenon

How could we decide which is right?

(a) Determine whether the “category”-specific behavior closely tracks the morphosyntactic categories — or is the phonology just a loose fit?

(b) Determine whether theory-internal arguments rule out either approach
Starting point: Pursue some formal implications of the assumption that the lexical category “labels” in phonology are those from the morphosyntax.

Traditional view of lexical categories in morphosyntax: Roots have category information stored as part of their lexical entry.

(a) On this view, an input string of morphemes already has category information.
(b) Indexed constraints in the phonology can be given access to this information.
(70) Roots as category-free (e.g., Marantz 1997; Embick 1997; Baker 2003; Borer 2003, 2005ab)

(a) Roots are stored with meaning only, no category information

(b) Roots acquire category in the syntax:
   • DM approach (as implemented in Embick & Marantz 2008): Roots combine with functional heads n, v, a to become “N,” “V”, “A”
   • Exo-skeletal approach (Borer 2003, 2005ab; see also Baker 2003): Roots acquire a category when they combine with functional shells such as TP (→ “V”), DP (→ “N”), or with derivational morphology that imposes a category

(c) If the phonology operates over a form where category information is available, that form must consist of the functional categories as well as the root (stem)
   • This is compatible with approaches in which which not individual terminal elements, but larger syntactic domains, are made available to the phonology (example: Embick’s (2010) phase-based approach)
(71) Taking stock: Some things we would like to know

(a) Do the “categories” relevant for category-specific phonology exactly or only nearly match those provided by the morphosyntax in each language?

(b) Are the phonological facts consistent with the point in the derivation at which morphosyntactic category information becomes available to the phonology?
Category-specific phonology — Implications for theories of positional privilege/neutralization
Bigger picture: Positionally indexed constraints are typically used to model cases of positional privilege, which is a general phenomenon in phonology.

(a) Positional privilege = contrast preservation in “strong” positions, neutralization in “weak” positions (Trubetzkoy 1939; Steriade 1995)

\[ \text{• Typical cases: onset vs. coda, stressed vs. unstressed syllable, root vs. affix} \]

(b) Positional privilege can also lead to positional augmentation = enforcement of perceptually salient properties in strong positions (Smith 2005)

\[ \text{• Category-specific phonology broadens our perspective on positional privilege} \]
Like other types of positional privilege, category-specific phonology shows positional augmentation effects (strong positions → perceptually salient; Smith 2005)

- Chuukese (Muller 1999) | N-specific word-minimality effect

<table>
<thead>
<tr>
<th>N</th>
<th>undergoes augmentation</th>
<th>V</th>
<th>no augmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>If too small (CVC) after truncation, vowel lengthens</td>
<td>CVC forms legal; contrast with CV:C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| / fæn / → * [ fæn ] → [ fæ:n ] ‘building’ | / mær / → [ mær ] ‘move, be shifted’ |
| / mær:ri / → [ mær:r ] ‘grow (plant)’ |

- Consistent with N > V privilege
However, classic positional neutralization examples typically involve a difference in behavior between a particular privileged position and everything else.

- Category-specific phonology is not exactly like this

(a) Indexing to more than just N is necessary

  - V-faithfulness needed for privilege-reversal cases like Ewe tone in (14)

(b) Indexing of markedness constraints — not just faithfulness — is necessary (see Pater (2000) for additional support for this claim; but see also Jesney (2016) for implications of Harmonic Grammar for positionally indexed constraints)

  - Needed to account for distinct-patterns cases like Lenakel stress in (13)
The \(N > A > V\) hierarchy is only a soft bias — Implications for the theory of positional privilege?

(a) Are other cases of positional privilege likewise universal, but overrideable?
   - Look for other patterns that have ‘privilege reversals’

(b) Possibility: The category hierarchy is overrideable because \textit{all} the categories (not just \(N\)) have a label (from morphosyntax?) that can serve as an index
   - Other strong/weak pairs may only have labels for the strong position ("\(\sigma^*\)")
   - Possible parallel case: root/affix (McCarthy & Prince 1999 on root privilege vs. Revithiadou 1999 on derivational-affix (‘head’) privilege) — is affix privilege another example of privilege reversal, where roots and affixes both have labels?
References


Smith, Jennifer L. 2014a. Prosody vs. segments in laboratory learning of category-specific phonology. LAGB 2014; Oxford University, September 5.


