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Sources of asymmetries in category-specific phonology

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0. On category-specific phonology, and why it is interesting

(1) 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)

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

N | contrast *Stress on any of last three syllables*		A | contrast *Stress on any of last three syllables*		V | no contrast *Determined by inflectional form*	
[s**á**.βa.na]	‘sheet’	[me.t**ó**.ðik-o]	‘methodical’	[lá.β-o]	‘wash-1SG.PRES.IND’
[sa.β**á**.na]	‘savanna’	[fa.βo.r**í**.t-o]	‘favorite’	[la.β-é]	‘wash-1SG.PRET.IND’

(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

(5) 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

(7) Survey: 20 languages with (categorical) category-specific phonology (Smith 2011)

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

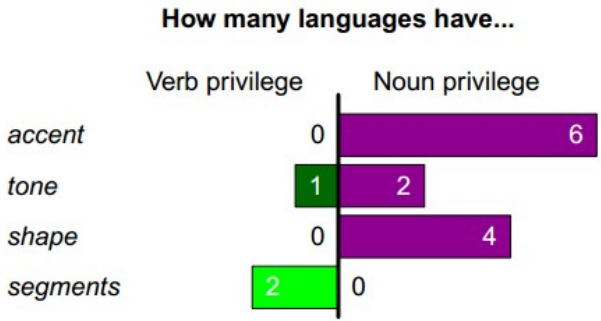
(b) For each language in the survey:

- **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?

(8) The findings indicate two **asymmetries**:

• details, references: Smith (2011)

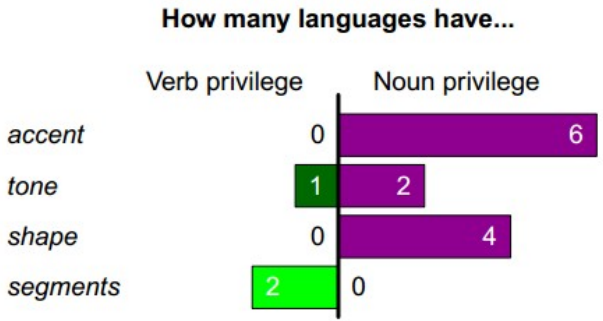


(a) Skew toward **prosodic phenomena** (accent, tone, word shape) rather than segmental or featural phenomena

- 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

(8) The findings indicate two **asymmetries**:

• details, references: Smith (2011)



(b) **Hierarchy** of phonological privilege: N > A > V — as seen in patterns where:

i	only nouns are privileged	**N** > { A , V }	Japanese
ii	only verbs are restricted	{ N , A } > **V**	Spanish
iii	adjectives are intermediate	N > **A** > 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

(10) 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)

(11) 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**

(13) Category-specific phonology sometimes merely shows **distinct patterns** for N, V

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

N | secondary stresses **prefer right edge** *Assigned leftward from main-stress syllable*		**V** | secondary stresses **prefer left edge** *Assigned rightward from initial syllable*	
[kə̀.mɑ.dó.a]	‘kind of taro’	[ɾɨ̀.mɔl.gɛ́j.gɛj]	‘he liked it’
[nɨ.m^{w}ə̀.gə.lɑ́.gəl]	‘beach’	[nɨ̀.mɑ.ɾɔl.gɛ́j.gɛj]	‘you (pl.) liked it’
		[tɨ̀.nɑ.gə̀.mɑ.ɾɔl.gɛ́j.gɛj]	‘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

V | contrast *Voiced obstruent onset + either high or non-high tone*				N | no contrast *Voiced obstruent onset + only non-high tone*			
[b**ú**]	'to be lost'	[v**ó**]	'to rot'	—		—	
[b**ù**]	'to respect'	[v**ò**]	'to be free'	[βù]	'blood'	[dà]	'snake'

2.2 The hierarchy of privilege is universally available

(15) 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

(16) 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

(17) 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 *sp(oon)* + (f)ork → *sp*ork

(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 **segments** are preserved?

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

- Which source word's **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

fling	**f**	**l**	**ɪ**	**ŋ**				
		↓		↓				[**flɪŋ***gwɨʤ*], [**fl***æŋgwɨʤ*]
language		l	æ	**ŋ**	**g**	**w**	**ɨ**	**ʤ**

- The earlier switchpoint preserves more of Word1

(22) Definitions: Two meanings presented

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

- Do participants preserve more Word1 segments ([**flɪŋ***gwɨʤ*]) when it is N or V?

(23) **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

Word 1	Word 2	Stress pattern of blend	
trochaic	iambic	trochaic	iambic
blúbber	*babóon*	**blúb***boon*	blub***bóon***

- The trochaic blend preserves the stress of Word1

(24) Definitions: Two meanings presented

blúbber+*babóon*	**N**+N	a baboon with extra body fat
	V+N	a baboon that weeps noisily

- Do participants preserve Word1 stress (**blúb***boon*) when it is N or V?

(25) **PrN vs. N, segmental condition:** chihuahua + *werewolf*

Blends	Definitions	
[**tʃɪwɑw***ʊlf*]	PrN+N	a werewolf who is from Chihuahua, Mexico
[**tʃɪw***ɛɹwʊlf*]	N+N	a werewolf who, in wolf form, resembles a chihuahua

- 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 ([**tʃɪwɑw***ʊlf*]) when it is PrN or N?

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

Blends	Definitions	
túr*coon*	PrN+N	someone who made a lot of money in Turkey
tur***cóon***	N+N	someone who made a lot of money in turkey

- Do participants preserve Word1 stress (**túr***coon*) when it is PrN or N?

(27) We analyzed the data in two ways (following Shaw 2013):

(a) By participant (b) By response

(28) 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

(30) Summary of N>V, PrN>N effects found—statistically significant?

Experiment	Position	Segments		Stress	
		participant	response	participant	response
3a & 4a	Noun	***yes***	—	*marginal*	—
3b & 4b	Noun	***yes***	—	***yes***	***yes***
5a & 6a	Proper noun	***yes***	***yes***	***yes***	***yes***
5b & 6b	Proper noun	***yes***	***yes***	*marginal*	***yes***

(31) 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

2.3Theoretical implications

(32) 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 ≠ V and Pr ≠ 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

(35) 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?

(36) 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?

(37) 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

(38) 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)

- Kelly & Bock (1988: 391), reporting stress data from Francis & Kučera (1982)

(a)

Disyllables used *only* as...	total	Initial stress	Final stress
Nouns	3002	**94%**	**6%**
Verbs	1021	**31%**	**69%**

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

(b)

All disyllabic items that are...	total	Initial stress	Final stress
Nouns	4218	**89%**	**11%**
Verbs	1676	**46%**	**54%**

$\chi^2(1)=1241.1$, $p<0.0001$; 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_N, *hou*[z]e_V)

	voiceless fricative	voiced fricative
Nouns	78 (**83.0%**)	16 (**17.0%**)
Verbs	86 (**56.6%**)	66 (**43.4%**)

$\chi 2(1)=17.05$, $p<0.0001$; Yates chi-square, corrected for continuity

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

	voiceless fricative	voiced fricative
Nouns	95 (**85.6%**)	16 (**14.4%**)
Verbs	86 (**52.4%**)	78 (**47.6%**)

$\chi 2(1)=30.87$, $p<0.0001$; 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?

	back vowel	front vowel
Nouns	245 (**54.3%**)	206 (**45.7%**)
Verbs	217 (**46.6%**)	249 (**53.4%**)

$\chi^2(1)=5.21$, $p=0.0225$; 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

(44) **Stimuli**: 36 nonce-word pairs | 3 conditions

(a) 12 pairs differed in **stress** (['**pɛl**.tækt~pɛl.'**tækt**]); 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** ([plɛ**f**~plɛ**v**])

- Fricative pairs used were [f]~[v], [θ]~[ð], [s]~[z]

(c) 12 pairs differed in the backness of the stressed **vowel** ([pɚ.'dʒ**ɑ**d~pɚ.'dʒ**æ**d])

- Vowel pairs used were [uː]~[iː], [oʊ]~[eɪ], [ɑ]~[æ]

(d) Presentation order within pairs counterbalanced; pairs randomly sequenced

- Fricative and vowel pairs included monosyllables, trochees, and iambs

(45) **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

(47) **Results** — analyzed in two ways

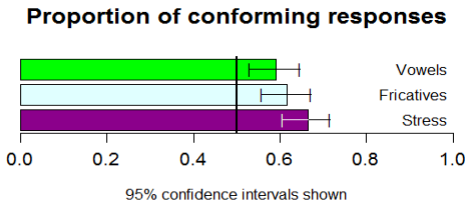
(a) By **response**: How many responses overall conformed to the lexical pattern?

(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

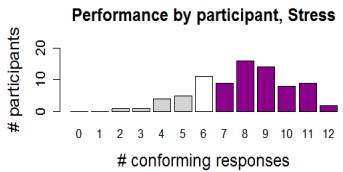
(49) Analysis **by participant**, all items (80 participants)

All three phonological patterns had an effect significantly greater than chance

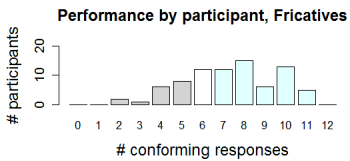
- More participants mapped the pattern to a noun/verb pair as predicted than would be expected due to chance

- How many participants had more than 6 out of 12 (>50%) conforming responses?

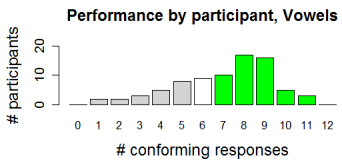
  Exact binomial test, one-tailed (compare *>6* participants with *<6*; chance=50%)



58/(80–11) (84%) $p<0.00001$



51/(80–12) (75%) $p=0.00002$



51/(80–9) (72%) $p=0.00015$

(50) 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

(52) 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)

(53) 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

(58) 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.

(59) Approaches to indexed constraints

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

- FAITH{*Property*}-N (Beckman 1999; Casali 1996)

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

- NO{*Property*}-V (Steriade 1995; Lombardi 2001)

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

- LICENSE({*Property*}, N) (Ito, Mester, & Padgett 1995; Zoll 2004, Jesney 2016)

(60) Example: A language where N contrast in stress, but V stress must be penultimate

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

  StressFaith-N Assign one * when an output form <u>that is a N</u> has stress in a different location from its corresponding input form

/pótima/N	StrF-N	Penult	StrF
▶ (a) pótima		*	
(b) potíma	*W	L	*(W)

/lásona/V	StrF-N	Penult	StrF
(a) lásona	✓	*W	L
▶ (b) lasóna	✓		*

- No V can ever violate 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 $C\text{-}_{\text{PrN}} \gg C\text{-}_{\text{N}} \gg C\text{-}_{\text{A}} \gg C\text{-}_{\text{V}}$

- 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

(65) 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?

(66) 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

(67) 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

(68) Starting point: Pursue some formal implications of the assumption that the lexical category "labels" in phonology are those from the morphosyntax

(69) 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?

(72) 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)

- 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)

- Category-specific phonology broadens our perspective on positional privilege

(73) 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

N | undergoes augmentation *If too small (CVC) after truncation, vowel lengthens*	V | no augmentation *CVC forms legal; contrast with CV:C*
/ fæne / → *[fæn] → [fæːn] 'building'	/ mære / → [mær] 'move, be shifted' / mæːri / → [mæːr] 'grow (plant)'

- Consistent with N > V privilege

(74) 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)

(75) 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 *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 ("σ́")
- 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

Albright, Adam. 2008. How many grammars am I holding up? *WCCFL* 26: 1–20.

Algeo, John. 1977. Blends, a structural and systemic view. *American Speech* 52.47–64.

Ansre, Gilbert. 1961. *The tonal structure of Ewe*. Hartford: Hartford Studies in Linguistics.

Arndt-Lappe, Sabine & Ingo Plag. 2013. The role of prosodic structure in the formation of English blends. *English Language and Linguistics* 17: 537–563.

Baayen, R. H., R. Piepenbrock, & L. Gulikers. 1995. CELEX2 LDC96L14. Philadelphia: LDC.

Baker, Mark. 2003. *Lexical categories.* Cambridge: CUP.

Bat-El, Outi. 2006. Blend. In Keith Brown (ed.), *Encyclopedia of language and linguistics*, 2nd edn., 66–70. Oxford: Elsevier.

Bates, Douglas, Martin Maechler, & Ben Bolker. 2011. lme4: Linear mixed-effects models using S4 classes. R package version 0.999375-39.

Bauer, Laurie. 2012. Blends: Core and periphery. In Renner, Vincent, François Maniez, & Pierre J. L. Arnaud (eds.), *Cross-disciplinary perspectives on lexical blending*, 11–22. Berlin: Mouton de Gruyter.

Becker, Michael, Nihan Ketrez, & Andrew Nevins. 2011. The surfeit of the stimulus: Analytic biases filter lexical statistics in Turkish laryngeal alternations. *Language* 87: 84–125.

Beckman, Jill N. 1999. *Positional Faithfulness.* New York: Garland.

Berg, Thomas. 2000. The position of adjectives on the noun–verb continuum. *ELL* 4: 269–293.

Bobaljik, Jonathan David. 2008. Paradigms (Optimal and otherwise): A case for skepticism. In Asaf Bachrach & Andrew Nevins (eds.), *Inflectional Identity.* 29–54. Oxford: Oxford University Press.

Borer, Hagit. 2003. Exo-skeletal vs. endo-skeletal explanations: Syntactic projections and the lexicon. In J. Moore & M. Polinsky (eds.), *The nature of explanation in linguistic theory*, 31–67. Stanford: CSLI.

Borer, Hagit. 2005a. *In name only*. Structuring Sense, vol. 1. Oxford: OUP.

Borer, Hagit. 2005b. *The normal course of events*. Structuring Sense, vol. 2. Oxford: OUP.

Broselow, Ellen, Su-I Chen, & Chilin Wang. 1998. The emergence of the unmarked in second language phonology. *Studies in Second Language Acquisition* 20: 261–80.

Cable, Seth. 2005. Phonological noun-verb dissimilarities in Optimal Paradigms. Ms., MIT.

Cahill, Michael C. 2007. *Aspects of the morphology and phonology of Kɔnni*. Dallas: SIL International and University of Texas at Arlington Publications in Linguistics.

Casali, Roderic F. 1996. *Resolving hiatus*. PhD dissertation, UCLA.

Chomsky, Noam, & Morris Halle. 1968. *The sound pattern of English.* New York: Harper & Row.

Cohen, Marcel. 1964. Catégories de mots et phonologie. In Carroll E. Reed (ed.), *Études phonologiques dédiées à la mémoire de M. le Prince N. S. Trubetzkoy*, 36–42. University, AL: U. of Alabama Press.

Croft, William. 1988. Agreement vs. case marking and direct objects. In Michael Barlow & Charles Ferguson (eds.), *Agreement in natural language*, 159–180. Stanford: CSLI.

Croft, William. 1990. A conceptual framework for grammatical categories. *Journal of Semantics* 7: 245–279.

Embick, David. 1997. *Voice and the interfaces of syntax*. PhD dissertation, University of Pennsylvania.

Embick, David. 2010. *Localism versus globalism in morphology and phonology*. Cambrige, MA: MIT Press.

Embick, David, & Alec Marantz. 2008. Architecture and blocking. *Linguistic Inquiry* 39: 1–53.

Farmer, Thomas A., Morten H. Christiansen, & Padraic Monaghan. 2006. Phonological typicality influences on-line sentence comprehension. *PNAS* 103: 12203–12208.

Francis, W. Nelson, & Henry Kučera. 1982. *Frequency analysis of English usage: Lexicon and grammar*. Boston: Houghton Mifflin.

Gouskova, Maria, Luiza Newlin-Łukowicz, & Sofya Kasyanenko. 2015. Selectional restrictions as phonotactics over sublexicons. *Lingua* 167: 41–81.

Gries, Stefan Th. 2004. Shouldn't it be *breakfunch*? A quantitative analysis of blend structure in English. *Linguistics* 42:639–67.

Guion, Susan G., J. J. Clark, Tetsuo Harada, & Ratree P. Wayland. 2003. Factors affecting stress placement for English non-words include syllabic structure, lexical class, and stress patterns of phonologically similar words. *Language and Speech* 46: 403–426.

Harris, James. 1983. *Syllable structure and stress in Spanish*. Cambridge, MA: MIT Press.

Hopper, Paul J., & Sandra A. Thompson. 1985. The iconicity of the universal categories 'noun' and 'verb'. In John Haiman (ed.), *Iconicity in syntax*, 151–183. Amsterdam: John Benjamins.

Inkelas, Sharon, & Cheryl Zoll. 2007. Is grammar dependence real? A comparison between cophonological and indexed constraint approaches to morphologically conditioned phonology. *Linguistics* 45:133–171.

Ito, Junko, & Armin Mester. 2001. Covert generalizations in Optimality Theory: the role of stratal faithfulness constraints. *Studies in Phonetics, Phonology and Morphology* 7: 3–33.

Ito, Junko, Armin Mester, & Jaye Padgett. 1995. Licensing and underspecification in Optimality Theory. *Linguistic Inquiry* 26: 571–614.

Jacobs, Haike, & Carlos Gussenhoven. 2000. Loan phonology: perception, salience, the lexicon and OT. In J. Dekkers et al. (eds.), *Optimality Theory: Phonology, Syntax, and Acquisition*, 193–210. Oxford: OUP.

Jaber, Aziz. 2011. High vowel syncope in Jordanian Arabic: A positional faithfulness treatment. Ms., UNC Chapel Hill.

Jaber, Aziz, & Osama Omari. 2018. Proper name subcategory: a prominent position. *Language Sciences* 69: 113–124.

Jesney, Karen. 2014. A learning-based account of L1 vs. L2 cluster repair differences. In C.-Y. Chu et al. (eds.), *Selected Proceedings of the 5th Conference on Generative Approaches to Language Acquisition—North America* (GALANA 2012), 10–21. Somerville, MA: Cascadilla Proceedings Project.

Jesney, Karen. 2016. Positional constraints in Optimality Theory and Harmonic Grammar. In J. McCarthy & J. Pater (eds.), *Harmonic Grammar and Harmonic Serialism*, 176–220. London: Equinox.

Jespersen, Otto. 1942. *A Modern English grammar on historical principles*, vol. 6. London: Allen & Unwin.

Keenan, Edward, & Bernard Comrie. 1977. Noun phrase accessibility and universal grammar. *LI* 8: 63–99.

Kelly, Michael H. 1988. Phonological biases in grammatical category shifts. *JML* 27: 343–358.

Kelly, Michael H. 1992. Using sound to solve syntactic problems: The role of phonology in grammatical category assignments. *Psychological Review* 99: 349–364.

Kelly, Michael H., & J. Kathryn Bock. 1988. Stress in time. *J Exp Psych: Human Perception and Performance* 14: 389–403.

Kenstowicz, Michael, & Charles Kisseberth. 1977. *Topics in phonological theory.* New York: Academic Press.

Kenstowicz, Michael. 1996. Base identity and uniform exponence: Alternatives to cyclicity. In Jacques Durand & Bernard Laks (eds.), *Current trends in phonology: Models and methods,* 365–394. Salford: University of Salford.

Langacker, Ronald W. 1987. *Foundations of Cognitive Grammar*, vol. 1. Stanford: Stanford University Press.

Lombardi, Linda. 2001. Why Place and Voice are different. In Linda Lombardi (ed.), *Segmental phonology in Optimality Theory*, 13–45. Cambridge: Cambridge University Press.

Lynch, John D. 1975. Lenakel phonology. *U. of Hawaii Working Papers in Linguistics* 7(1). i–vii and 1–244.

Lynch, John D. 1978. *A grammar of Lenakel*. (Pacific Linguistics B55.) Canberra: Australian National U.

Marantz, Alec. 1997. No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. In Alexis Dimitriadis, Laura Siegel, Clarissa Surek-Clark, & Alexander Williams (eds.), *Proceedings of the 21st Annual Penn Linguistics Colloquium*, 201–225. Pennsylvania Working Papers in Linguistics 4.2. Philadelphia: Penn Linguistics Club.

McCarthy, John J. 2005. Optimal paradigms. In Laura Downing, Tracy Alan Hall & Renate Raffelsiefen (eds.), *Paradigms in phonological theory.* 170–210. Oxford: Oxford University Press.

McCarthy, John J., & Alan S. Prince. 1994. The emergence of the unmarked: Optimality in prosodic morphology. *NELS* 24, vol.2: 333–79.

McCarthy, John J., & Alan S. Prince. 1995. Faithfulness and reduplicative identity. In Jill N. Beckman, Laura Walsh Dickey & Suzanne Urbanczyk (eds.), *Papers in Optimality Theory*. 250–384. University of Massachusetts Occasional Papers in Linguistics 18. Amherst, MA: GLSA.

Moreton, Elliott, Jennifer L. Smith, Katya Pertsova, Rachel Broad, & Brandon Prickett. 2017. Emergent positional privilege in novel English blends. *Language* 93(2): 347–380.

Myers, Scott. 2000. Boundary disputes: The distinction between phonetic and phonological sound patterns. In Noel Burton-Roberts, Philip Carr & Gerard Docherty (eds.), *Phonological knowledge: Conceptual and empirical issues*. 245–272. Oxford: Oxford University Press.

Muller, Jennifer S. 1999. A unified mora account of Chuukese. *WCCFL* 18: 393–405.

Nurse, Derek. No date. Ewe. In Christa Beaudoin-Lietz, John Hewson, Derek Nurse, & Sarah Rose (eds.), Verbal categories in Niger-Congo. Ms., Memorial University of Newfoundland. [http://www.mun.ca/linguistics/nico/]

Olson, Kenneth S. 2005. *The phonology of Mono*. Dallas: SIL International.

Pater, Joe. 2000. Nonuniformity in English stress: the role of ranked and lexically specific constraints. *Phonology* 17: 237–274.

Pater, Joe. 2009. Morpheme-specific phonology as constraint indexation and inconsistency resolution. In Steve Parker (ed.), *Phonological Argumentation*, 123–154. London: Equinox.

Perlmutter, David M. 1978. Impersonal passives and the Unaccusative Hypothesis. *BLS* 4: 157–190.

Postal, Paul M. 1968. *Aspects of phonological theory*. New York: Harper and Row.

Pound, Louise. 1914. *Blends—their relation to English word formation*. Heidelberg: Anglistische Forschungen.

Prince, Alan, & Paul Smolensky. 2004. *Optimality Theory: Constraint interaction in generative grammar.* Cambridge: Wiley Blackwell.

Renner, Vincent, François Maniez, & Pierre J. L. Arnaud. 2012. *Cross-disciplinary perspectives on lexical blending*. Berlin: Mouton de Gruyter.

Revithiadou, Anthi. 1999. *Headmost accent wins: Head dominance and ideal prosodic form in lexical accent systems*. PhD diss., Leiden.

Ross, J. R. 1972. Endstation Hauptwort: The category squish. *CLS* 8: 316–339.

Sereno, Joan A., & Allard Jongman. 1990. Phonological and form class relations in the lexicon. *J Psycholing Res* 19: 387–404.

Sezer, Engin. 1981. On non-final stress in Turkish. *Journal of Turkish Studies* 5: 61–69.

Shaw, Katherine E. 2013. Head faithfulness in lexical blends: A positional approach to blend formation. MA thesis, UNC.

Shaw, Katherine E., Andrew M. White, Elliott Moreton, & Fabian Monrose. 2014. Emergent faithfulness to morphological and semantic heads in lexical blends. In John Kingston, Claire Moore-Cantwell, Joe Pater, & Robert Staubs (eds.), *Proceedings of the 2013 Meeting on Phonology*. Washington, DC: LSA.

Shiraishi, Hidetoshi. 2004. Base-Identity and the noun-verb asymmetry in Nivkh. In Dicky Gilbers, Maartje Schreuder, & Nienke Knevel (eds.), *On the boundaries of phonology and phonetics,* 159–182. Groningen: U.niversity of Groningen.

Silverstein, Michael. 1976. Hierarchy of features and ergativity. In R.M.W. Dixon (ed.), *Grammatical categories in Australian languages*, 112–171. Canberra: Australian Institute of Aboriginal Studies.

Smith, Jennifer L. 1997. Noun faithfulness: On the privileged behavior of nouns in phonology. [http://users.castle.unc.edu/~jlsmith/home/pdf/nfaith97.pdf].

Smith, Jennifer L. 2001. Lexical category and phonological contrast. In Robert Kirchner, Joe Pater & Wolf Wikely (eds.), *Papers in Experimental and Theoretical Linguistics 6: Workshop on the Lexicon in Phonetics and Phonology*. 61–72. Edmonton: University of Alberta.

Smith, Jennifer L. 2005. *Phonological augmentation in prominent positions*. New York: Routledge.

Smith, Jennifer L. 2011. Category-specific effects. In Marc van Oostendorp et al. (eds.), *The Blackwell Companion to Phonology*, 2439–2463. Malden, MA: Wiley-Blackwell.

Smith, Jennifer L. 2014a. Prosody vs. segments in laboratory learning of category-specific phonology. LAGB 2014; Oxford University, September 5. [http://users.castle.unc.edu/~jlsmith/home/pdf/smith2014_LAGB2014_poster.pdf]

Smith, Jennifer L. 2014b. Prototypical predicates have unmarked phonology. In John Kingston, Claire Moore-Cantwell, Joe Pater, & Robert Staubs (eds.), *Supplemental Proceedings of the 2013 Meeting on Phonology*, article #37. Washington, DC: LSA.

Smith, Jennifer L. 2016. Segmental noun/verb phonotactic differences are productive too. In Patrick Farrell (ed.), *Proceedings of the Linguistic Society of America*, vol. 1, article #3717. Washington, DC: LSA. [http://journals.linguisticsociety.org/proceedings/index.php/PLSA/article/view/3717]

Steriade, Donca. 1995. Positional neutralization. Ms., UCLA.

Sugawara, Ayaka. 2012. Japanese accent is largely predictable: Evidence from given names. *Proceedings of the 144th Meeting of the Linguistic Society of Japan*.

Trubetzkoy, Nikolai S. 1939. *Grundzüge der Phonologie* [Principles of Phonology]. Travaux du Cercle Linguistique de Prague 7. Translated by Christiane A.M. Baltaxe. Berkeley: UC Press, 1969.

Walker, Rachel. 1998. *Nasalization, neutral segments, and opacity effects*. PhD dissertation, UC Santa Cruz.

Wentworth, Harold. 1934. *Blend-words in English*. PhD dissertation, Cornell University.

Zhang, Hang. 2013. *The acquisition of Mandarin Chinese tones by English, Japanese, and Korean speakers.* PhD dissertation, UNC.

Zoll, Cheryl. 2004. Positional asymmetries and licensing. In John McCarthy (ed.), *Optimality theory in phonology: A reader*, 365–378. Oxford: Blackwell.