

## Class 20: Phonological evidence

### To do

- Mini-conference on Tuesday (10-1, but we should be done around 12:40) in conference room. Prepare handout for 15-minute presentation, 5 minutes of questions.
- Papers due Friday, March 23 (PDF by e-mail is fine).

**Overview:** How can we find out what generalizations are real to the speaker? How can we find out whether some generalizations are better than others?

### 1 Back to the Chomskyan basics<sup>1</sup>

Let a **grammar** consist of (at least)<sup>2</sup>

- a function that labels any utterance as **grammatical** or **ungrammatical**.
- a function that assigns truth conditions to any utterance

The grammar might be implemented as a lexicon and a list of rules, or a set of constraints, or something else.

Let a **linguistic theory** be a function that, given a (finite) set of utterances (the **learning data**), produces a grammar.<sup>3</sup>

These functions should be accompanied by algorithms for calculating them.

So...

- an observationally adequate grammar labels the utterances that a typical learner would encounter as grammatical (perhaps trivially, e.g. by listing them), and assigns the right truth conditions to them.
- a descriptively adequate grammar captures the psychologically real generalizations
- the real prize, an explanatorily adequate theory, will, given typical learning data, return an descriptively adequate grammar

But how do we figure out what the psychologically real generalizations are?????

### 2 Example: English noun plurals

<i>cat</i>	k <sup>h</sup> æt	k <sup>h</sup> æts	<i>pea</i>	p <sup>h</sup> i	p <sup>h</sup> iz
<i>sack</i>	sæk	sæks	<i>cow</i>	k <sup>h</sup> au	k <sup>h</sup> auz
<i>dog</i>	dæg	dægz	<i>man</i>	mæn	mɛn
<i>grub</i>	gɹʌb	gɹʌbz	<i>foot</i>	fʊt	fɪt
<i>dish</i>	dɪʃ	dɪʃəz	<i>wife</i>	wɑɪf	wɑɪvz
<i>fudge</i>	fʌdʒ	fʌdʒəz	<i>whiff</i>	wɪf	wɪfs
			...		

<sup>1</sup> Mostly Chomsky 1965 pp. 25-27 but an amalgam of various Chomsky works, a simplified and colored by my own views.

<sup>2</sup> We probably want the grammar to do much more. It could, given an utterance, return a gradient “goodness score” rather than a simple binary judgment. Given one utterance and some instruction, it could return some other utterance (e.g., *cat* + PLURAL = *cats*). And there’s a lot more to meaning than truth conditions! (Chomsky also requires a grammar to assign a structural description to an utterance, but I wonder if this is begging the question: the structural description can be used to explain more-observable properties of a sentence like its truth-conditions, but we don’t know *a priori* that it’s necessary.)

<sup>3</sup> Chomsky’s definition of a linguistic theory is weaker: it need only define the set of possible grammars, independent of learning data. This allows Chomsky to define the term **descriptively adequate theory**, which is a theory that includes, as possible grammars, a descriptively adequate grammar for every language—but does not necessarily return that grammar given learning data for that language.

## Examples of observationally adequate grammars for English noun plurals

I. (*just list every word you know*)

k <sup>h</sup> æt	k <sup>h</sup> æts	p <sup>h</sup> i	p <sup>h</sup> iz
sæk	sæks	k <sup>h</sup> au	k <sup>h</sup> auz
dæg	dægz	mæn	mæn
gɪɒb	gɪɒbz	fʊt	fɪt
dɪʃ	dɪʃəz	wɑɪf	wɑɪvz
fʌd̩z̩	fʌd̩z̩əz	wɪf	wɪfs

I.e., the grammar's judgment function accepts utterances containing those items in positions where a plural is required (*I like cats*); its truth-condition-assigning function assigns the appropriate truth-conditions to utterances containing the items in the right column (*I like cats* is true iff I like members of the cat group—it has nothing to do with whether I like members of the dog group).

II. *Add -s to everything, except for these exceptions:*

dæg	dægz	k <sup>h</sup> au	k <sup>h</sup> auz
gɪɒb	gɪɒbz	mæn	mæn
dɪʃ	dɪʃəz	fʊt	fɪt
fʌd̩z̩	fʌd̩z̩əz	wɑɪf	wɑɪvz
p <sup>h</sup> i	p <sup>h</sup> iz	...	...

III. *Add -z to everything, except for these exceptions:*

k <sup>h</sup> æt	k <sup>h</sup> æts	mæn	mæn
sæk	sæks	fʊt	fɪt
dɪʃ	dɪʃəz	wɑɪf	wɑɪvz
fʌd̩z̩	fʌd̩z̩əz	wɪf	wɪfs
		...	...

IV. *Add -əz after “sibilant” sounds, -s after non-sibilant [-voice] sounds, and -z otherwise, except for these exceptions:*

mæn	mɛn
fʊt	fɪt
wɑɪf	wɑɪvz
...	...

IV. *Change final /f/ to [v], and then add -əz after “sibilant” sounds, -s after non-sibilant [-voice] sounds, and -z otherwise, except for these exceptions:*

mæn	mɛn
fʊt	fɪt
wɪf	wɪfs
...	...

*Which generalizations are real? How about a wug test.*

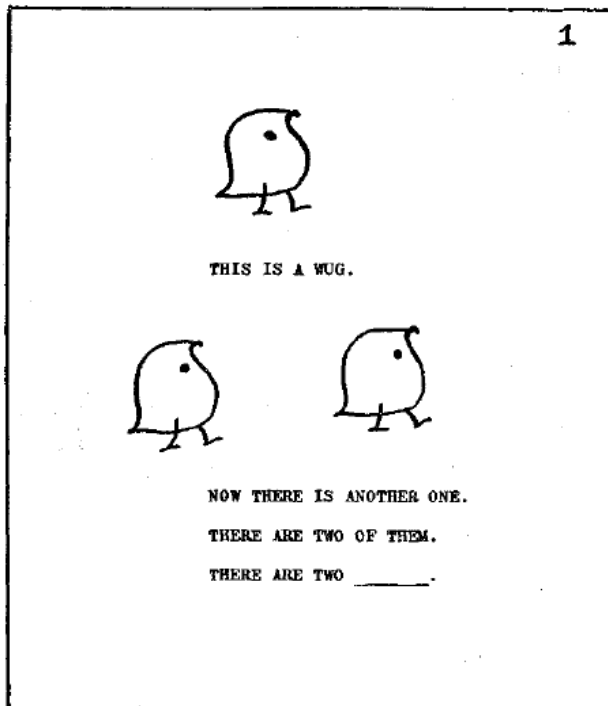


Figure 1. The plural allomorph in /-z/.

(Berko 1958, p. 154)

Berko found that English-speaking adults (all highly educated, in her sample) consistently give the following plurals when presented with invented words (pp. 155-158):

wʌg	wʌgz	lʌn	lʌnz
gʌtʃ	gʌtʃəz	nɪz	nɪzəz
kæʒ	kæʒəz	kɪə	kɪəz
tɔɪ	tɔɪz	tæs	tæsəz

- Which of the grammars above could be descriptively adequate, given these data?
- The adults disagreed about this word—what might we conclude?

heaf            hifs, hivz

**3 Why is it hard to develop a descriptively adequate theory in phonology?**

- Words that the speaker already knows are uninformative! (They don't tell us anything about what generalizations the speaker has learned—she may have simply memorized that word.)
- Constructing novel phonological situations to put speakers in is difficult. Contrast this with syntax, where it's easy to construct sentences that—presumably—the speaker has not encountered before.
- We often can't be sure that these novel situations really test what we want them to test.

#### 4 Novel words from other languages—loan adaptation as a natural *wug*-test

What do speakers do with words imported from other languages (loan adaptation), or when learning other languages (L2 phonology)?

Context is less controlled than in *wug* test: who did they first hear the word from? do they know the spelling in the original language? how well do they speak the foreign language? are there established conventions for borrowing words from this language?

##### *Russian*

Kenstowicz & Kisseberth 1979, p. 46—native words:

<i>dative sg.</i>	<i>nominative pl.</i>	<i>nominative sg.</i>	
xlebu	xleba	xlep	'bread'
gribu	griby	grip	'mushroom'
grobu	groby	grop	'coffin'
čerepu	čerepa	čerep	'kull'
xolopu	xolopy	xolop	'bondman'
trupu	trupy	trup	'corpuse'
sadu	sady	sat	'garden'
prudu	prudy	prut	'pond'
cvetu	cveta	cvet	'color'
zakatu	zakaty	zakat	'sunset'
razu	razy	ras	'time'
zakazu	zakazy	zakas	'order'
lesu	lesa	les	'forest'
usu	usy	us	'whisker'
storožu	storoža	storoš	'guard'
dušu	dušy	duš	'shower'
rogu	roga	rog	'horm'
porogu	porogy	porog	'threshold'
raku	raky	rak	'crayfish'
poroku	poroky	porok	'vice'

K&K report that words borrowed into Russian behave the same way (p. 53):

<i>dative</i>	<i>nominative</i>	
garažu	garaš	'garage'
gazu	gas	'gauze'
klubu	klup	'club'

Moreover, final devoicing can be seen in a typical Russian accent when speaking English (p. 53).

Russian lacks /dz/, /j/, /ɣ/. So what do Russian learners typically do with these sounds? K&K report (p. 337), for speakers who have already mastered /j/ in other environments,

<i>badge</i>	ba[č]
<i>judge</i>	[j]u[č]

Cf. the *Bach* test (What is the plural of [bax]?), proposed by Lise Menn (Halle 1978).

- Let's discuss pros and cons of this approach  
(See Peperkamp 2005 for a model of loan adaptation that requires more than just the normal grammar.)

## 5 Explanatory adequacy

Suppose we could somehow achieve description adequacy for real languages—figure out the significant generalizations in those languages.

To build our linguistic theory, we need to know...

- To build out linguistic theory, we need to know which generalizations people tend to extract from learning data.
  - Are some preferred to others?
  - Are there hard limits on learnability?

*For example*

- Suppose we're convinced by the wug test that English speakers' grammar includes "use the [əz] form of the plural after sibilants".
  - Exposed to the English data, they prefer a grammar with that generalization to one without it.
- But we know nothing about the learnability of "use the [əz] form of the plural after **non**-sibilants". How can we investigate it?

## 6 Typology?

Chomsky & Halle 1968 ("SPE") proceed more or less according to this logic:

- Assume that languages change when members of one generation learn a slightly different grammar from the grammar that generated the data they were exposed to.
  - Further assume that these changes involve learners' constructing a more-preferred grammar than what would be strictly consistent with the learning data.
  - Therefore, if a certain phonological phenomenon is predominant cross-linguistically, it must be because learners prefer it (and therefore have introduced it into many languages).
  - Thus, we can tell what learners prefer by inspecting cross-linguistic tendencies.
- We've seen some problems with this view—let's discuss (see Blevins 2003, Ohala 1992)

## 7 Poverty-of-the-stimulus experiments

(See Wilson 2006, White 2012 for other nice artificial-language cases; Zuraw 2007 for within-lang.)

Kim 2012: Teach people two alternations in an artificial language:

- *map*i + *alop* + *a* → *mapalopa* ('dog's kiwi')
- *nat* + *ipul* + *a* → *natʃipula* ('monkey's watermelon')

In testing phase, sneak in some items like

- *kito* + *ilip* + *a* → ?

- Discuss possible outcomes and what they'd tell us.

## 8 Surfeit-of-the-stimulus experiments

Becker, Ketrez, & Nevins 2011 (we talked about this earlier when discussing Moreton 2008):

- Turkish speakers could have learned various generalizations about whether a final obstruent alternates in voicing under suffixation.
- When tested on new words, they showed evidence of generalizations referring to syllable count, place, and manner.
- But they didn't show evidence of knowing generalizations about preceding vowel quality.

Becker & al.'s conclusion: constraints like \*[V,+hi][C,-voice]V don't exist. But constraints like \*VpV do.

## 9 Processing of native-language rules (Zhang & Lai 2006)

Chinese languages often display a phenomenon known as **tone sandhi**: when two syllables are put together into a word, their tones change:

(2) Mandarin tone sandhi:

a. 213 → 35 / \_\_\_ 213

xaw<sub>213</sub>-təju<sub>213</sub> → xaw<sub>35</sub>-təju<sub>213</sub> 'good wine'

tʂan<sub>213</sub>-lan<sub>213</sub> → tʂan<sub>35</sub>-lan<sub>213</sub> 'exhibit'

b. 213 → 21 / \_\_\_ {55, 35, 51}

xaw<sub>213</sub>-ʂu<sub>55</sub> → xaw<sub>21</sub>-ʂu<sub>55</sub> 'good book'

xaw<sub>213</sub>-tʂən<sub>35</sub> → xaw<sub>21</sub>-tʂən<sub>35</sub> 'good person'

xaw<sub>213</sub>-kʰan<sub>55</sub> → xaw<sub>21</sub>-kʰan<sub>51</sub> 'good-looking'

(Zhang & Lai p. 80)

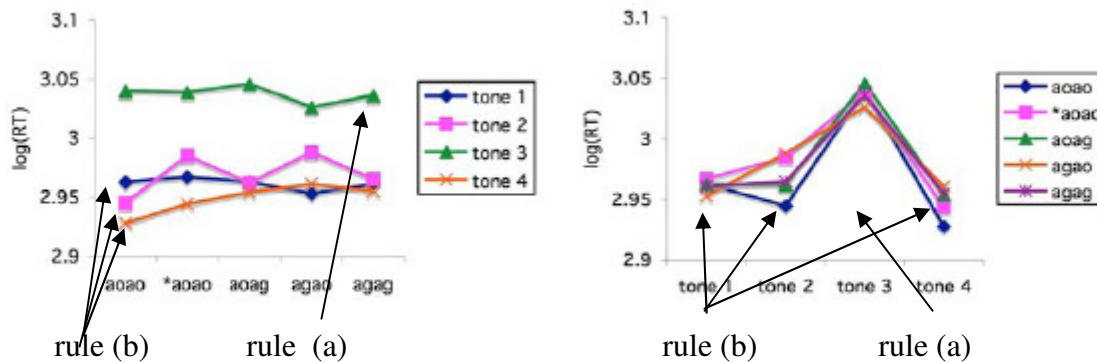
Various reasons to think that rule (b) should be “better” than rule (a):

- Both rules simplify a complex contour, so that it is easier to realize in a shorter time (being nonfinal makes the first word shorter)—see Zhang 2000.
- But (a) also involves raising of pitch, which increases articulatory demands in a short time.
- (b), on the other hand, involves straightforward simplification of the original tone
- (Zhang & Lai discuss other reasons...)

Mandarin speakers use both rules very frequently—but is (b) nevertheless “easier” than (a)?

**Experiment**

Zhang & Lai presented Mandarin speakers with a variety of real and “wug” combinations. Subjects hear the two syllables and had to pronounce them as a single word.



(Zhang & Lai p. 96)

Subjects responded more slowly (higher values) when applying rule (a), for all types of words (real and “wug”). (There are other interesting results concerning how the words were produced.)

Zhang & Lai’s conclusion: Mandarin speakers have learned both rules, but have more difficulty using the “unnatural” one.

**10 If we have time: Literary invention**

Also challenging to interpret, but has advantage of getting speakers out of zone of memorization

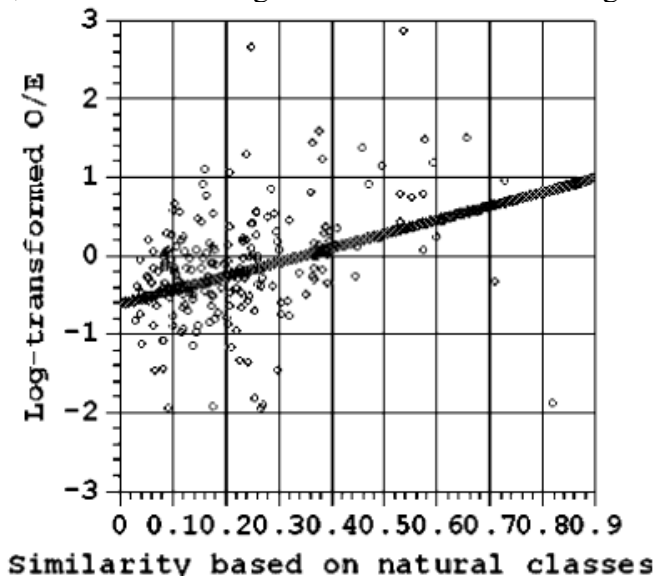
*Imperfect rhyme in Japanese rap lyrics* (Kawahara 2007; see also Steriade 2003 on imperfect rhymes in Romanian translated poetry):

(2) *Mastermind* (DJ HASEBE feat. MUMMY-D & ZEEBRA)

- a. kettobase      kettobase  
kick it            kick it  
'Kick it, kick it'
- b. kettobashita    kashi            de      gettomanee  
funky            lyrics            with    get money  
'With funky lyrics, get money'

(Kawahara p. 115)

Overall, sounds that belong to more natural classes together occur more often in rhymes:



(Kawahara p. 121)

**Cluster splittability**

There is diverse evidence that languages treat *sp, st, sk* as less splittable than other cluster (*bl, kr, ...*).

Fleischhacker 2006: reduplication, loan adaptation, (also puns)

E.g.

Farsi: *esparta* ‘Sparta’ vs. *pelutus* ‘Plutus’

Is there a real preference for grammars that don’t split *s{p,t,k}*, or is it just a matter of mis-hearing or mis-articulation?

Minkova 2003: evidence from alliteration in Middle English. When words that start with 2 or more consonants alliterate, poets allow  $C_1C_2$  to alliterate with just  $C_1$  (*sl...s...*; *dr...d...*; *b...br...*):

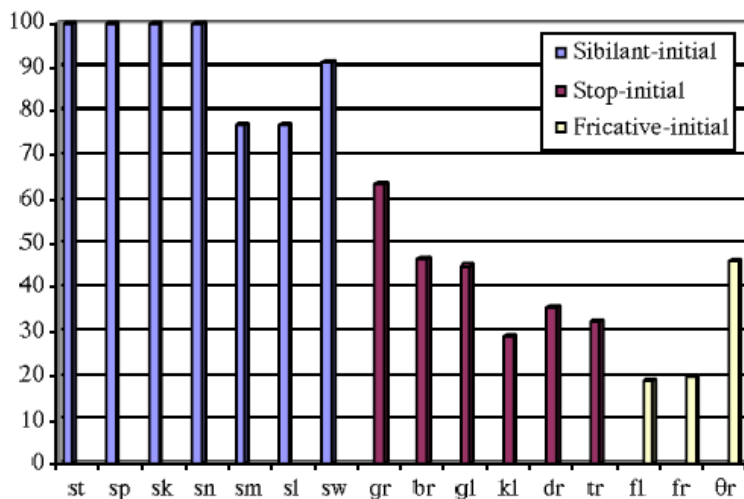
*ðurh slitne niþ / sawle bescufan*<sup>4</sup> *Beo* 184  
*druncen 7 dolhwund. / Næs ða dead þa gyt*<sup>5</sup> *Judith* 107  
*þe þær baldlicost / on þa bricge stop*<sup>6</sup> *Maldon* 78

(Minkova 2001 p. 1)

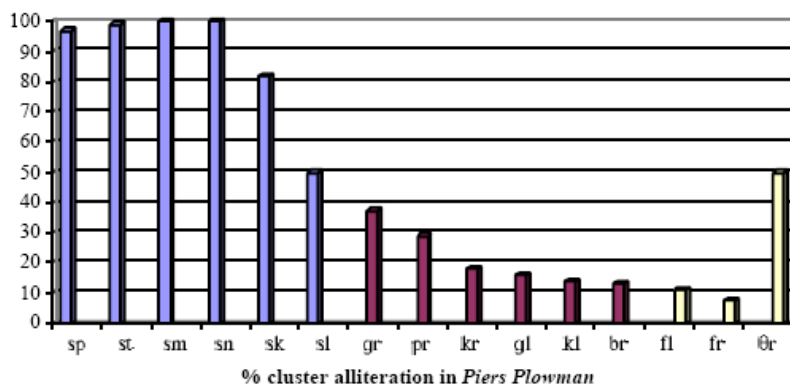
But *s-stop* clusters alliterate in full:

CONTIGUITY in OE (*sp-, st-, sk-*)  
*scaðan scirhame / to scipe foron*<sup>1</sup> *Beo* 1895  
*stopon stymmode, / stercedferhðe*<sup>2</sup> *Judith* 227  
*and þæt spere sprengde, / þæt hit sprang ongean*<sup>3</sup> *Maldon* 137

(Minkova 2001 p. 1)



(Minkova 2001 p. 3)



(Minkova 2001 p. 6)



## 11 Where have we been?

- **Variation** and some tools for handling it throughout the course.
- **Process application:** multiple sites for application, multi-site variation; self-feeding/bleeding
- **Process interaction:** look-ahead vs. myopia; opacity
- **Structure above the segment:** mora, syllable, grid, foot, p-word; prosodic morphology
- **“Downward” interfaces:** phonetic motivation in phonology; phonologization of phonetic effects; autosegmentalism and its relation to articulation
- **“Upward” interfaces:** phonology-morphology interactions; paradigms; Lexical Phonology; syntax-phonology interface, phrasal phonology; prosodic structure above the p-word
- **“Sideways” interfaces:** phonology vs. the lexicon; phonology vs. processing

## 12 Where can you go?

### *Next quarter*

- Intonation (Ling 111 this spring, or 211 next year; Sun-Ah) if you’re interested in higher prosodic structure; interfaces of phonology with syntax, semantics, and information structure.
- Language change (Ling 202; Craig)
- Phonetic theory (Ling 203; Megha)

### *Next year*

- Speech perception (Ling 204C; Megha)
- Morphology (Ling 205; Bruce)
- Intonation (Ling 211; Sun-Ah)
- Research methods (Ling 237; Megha)—you come with an experiment in mind and plan it over the course of the quarter
- Keating proseminar
- Jun/Zuraw proseminar: intonational field methods!
- Hayes/Zuraw proseminar: variation

### *Any time*

- You’re always free to drop by the phonology seminar—you don’t have to commit to the whole quarter.
  - Journal club episodes are a particularly efficient time to visit: learn about 8-10 phonology articles in just 2 hours!

## See you Tuesday.

### References

- Becker, Michael, Nihan Ketrez & Andrew Nevins. 2011. The surfeit of the stimulus: analytic biases filter lexical statistics in Turkish laryngeal alternations. *Language* 87(1). 84–125. (15 March, 2012).
- Berko, Jean. 1958. The child’s learning of English morphology. *Word* 14. 150–177.
- Blevins, Juliette. 2003. *Evolutionary phonology. The emergence of sound patterns..* Cambridge: Cambridge University Press.
- Chomsky, Noam. 1965. *Aspects of the Theory of Syntax..* Cambridge, Mass.: MIT Press.
- Fleischhacker, Heidi. 2006. Similarity in phonology: evidence from reduplication and loan adaptation.. UCLA ph.d. dissertation.
- Halle, Morris. 1978. Knowledge unlearned and untaught: what speakers know about the sounds of their language.. In Morris Halle, Joan Bresnan, & George A Miller (eds.), *Linguistic theory and psychological reality*, 294–303. Cambridge, MA and London: MIT Press.

- Kawahara, Shigeto. 2007. Half rhymes in Japanese rap lyrics and knowledge of similarity. *Journal of East Asian Linguistics* 16(2). 113–144. doi:10.1007/s10831-007-9009-1 (14 February, 2012).
- Kenstowicz, Michael & Charles Kisseberth. 1979. *Generative Phonology: Description and Theory*. New York: Academic Press.
- Kim, Yun Jung. 2012. Do learners prefer transparent rule ordering? An artificial language learning study. Paper presented at the Chicago Linguistic Society.
- Minkova, Donka. 2001. Testing CONTIGUITY in Middle English alliteration.. Handout. Paper presented at the 15th ICHL, Melbourne. [www.english.ucla.edu/faculty/minkova/Handout\\_Melbourne.pdf](http://www.english.ucla.edu/faculty/minkova/Handout_Melbourne.pdf).
- Minkova, Donka. 2003. *Alliteration and Sound Change in Early English*. Cambridge University Press.
- Moreton, Elliott. 2008. Analytic Bias and Phonological Typology. *Phonology* 25(01). 83–127. doi:10.1017/S0952675708001413.
- Ohala, John. 1992. What's cognitive, what's not, in sound change.. In G. Kellerman, M. D Morrissey, G. Kellerman, & M. D Morrissey (eds.), *Diachrony within Synchrony: Language History and Cognition*, 309–355. Frankfurt: Peter Lang Verlag.
- Peperkamp, Sharon. 2005. A psycholinguistic theory of loan adaptations.. In M Ettliger, N Fleischer, & M Park-Doob (eds.), *Proceedings of the 30th Annual Meeting of the Berkeley Linguistics Society*, 341–352. Berkeley, CA: Berkeley Linguistics Society.
- Steriade, Donca. 2003. Knowledge of perceptual similarity and its uses: evidence from half-rhymes.. In M.J. Solé, D Recasens, & J Romero (eds.), *Proceedings of the 15th International Congress of Phonetic Sciences*, 363–366. Barcelona: Futurgraphic.
- White, James. 2012. Evidence for a learning bias against “saltatory” phonological alternations in artificial language learning.. Paper presented at the Linguistic Society of America Annual Meeting, Portland, OR.
- Wilson, Colin. 2006. Learning Phonology with Substantive Bias: An Experimental and Computational Study of Velar Palatalization. *Cognitive Science* 30(5). 945–982.
- Zhang, Jie. 2000. The effects of duration and sonority on contour tone distribution - typological survey and formal analysis.. University of California at Los Angeles.
- Zhang, Jie & Yuwen Lai. 2006. Testing the role of phonetic naturalness in Mandarin tone sandhi. *Kansas Working Papers in Phonetics*(28). 65–126.
- Zuraw, Kie. 2007. The role of phonetic knowledge in phonological patterning: Corpus and survey evidence from Tagalog. *Language* 83. 277–316.