

## Class 9, 12/3/20: Experiments and Models

### 1. Assignments

- Readings:
  - Pierrehumbert, Janet B. "The statistical basis of an unnatural alternation." *Laboratory phonology* 8 (2006): 81-107.
  - On course web site
- If four units, think about scheduling your small-audience talk with me.

### 2. Today

- Followup of experiments and models in segmental alternation: what does our stress model say about earlier experiments?
- Followup of experiments and models in stress: what does our stress model say about earlier experiments?
- An overview of the experimental literature on vowel alternations

### 3. Looking ahead

- Theories of irregular phonology and English
- Designing a vowel-restoration experiment.
- Course review and evaluations

## ENGLISH STRESS AND EXPERIMENTS

### 4. What we have from earlier, I: model

- A MaxEnt model attempting to predict position of main (not secondary) stress in English.
- It uses constraints from throughout the literature.
- Information access:
  - Per tradition, three degrees of syllable weight (CVV, CVC, CV)
  - Per tradition, part of speech
  - Specific affixes, identified by their spelling: — like *-ic*, *-ate*, *-ize*, *-ese*.
  - No cyclicity (yet), so no bases. This probably matters fairly little for primary stress (e.g. *per<sup>l</sup>miss-ive* vs. *'genitive*)
- The model is theoretically eclectic:
  - Ternary “feet,” per Liberman and Prince
  - Following Michael Kelly and Kevin Ryan on the modest effect of consonant count in the onset.

- The Moore-Cantwellian “antepenultimate stress when final segment is [i]”
- \*STRESS ON HIATIC VOWEL.
- Constraints traceable from diachrony: “stress penults before [ʃ]”, “stress penults before [sC]”
- The model performs not badly, getting the right answer (on best-guess basis) 88.4% of the time.
- By using so many ingredients, including complex or unnatural ones, the model incurs a big debts in terms of psychological reality.
  - So does *SPE*, but for different reasons, involving very deep underlying forms

## 5. What we have from earlier: experiments

- A survey of four increasingly-sophisticated experiments from the literature, going from Nessly (1977) to Moore-Cantwell (2015).

## 6. A straightforward procedure: submit the wug words to the model

- This means:
  - translate phonetic transcription
  - make up an orthography if you want to encode affixes (this is quite informative!)
  - run the model on them (without letting them influence the constraint weights)
  - aggregate the results

RUNNING THE MODEL ON THE EXPERIMENTS IN MOORE-CANTWELL 2015

## 7. Here are the words from Experiments 3 and 4

- They are meant to
  - assess the extent to which English stress is “analogical” (Expt. 3)
  - assess the strength of the antepenultimate default principle (*SPE* et seq.)
  - assess the psychological reality of the Moore-Cantwellian “antepenultimate stress when final segment is [i]” constraint
- Transcription note:
  - Stress values on vowels are solely for convenience, since the model scrupulously avoids referencing them.

acrathy	AE1 / K R AE1 / TH IY0	acratha	AE1 / K R AE1 / TH AH0
araspy	AE1 / R AE1 / S P IY0	araspā	AE1 / R AE1 / S P AH0
fommovy	F AA1 / M AA1 / V IY0	fommava	F AA1 / M AA1 / V AH0
ladacy	L AE1 / D AE1 / S IY0	ladasa	L AE1 / D AE1 / S AH0
lamacy	L AE1 / M AE1 / S IY0	lamasa	L AE1 / M AE1 / S AH0
mashabee	M AE1 / SH AE1 / B IY0	mashaba	M AE1 / SH AE1 / B AH0
nagacy	N AE1 / G AE1 / S IY0	nagasa	N AE1 / G AE1 / S AH0
nodovy	N AA1 / D AA1 / V IY0	nodava	N AA1 / D AA1 / V AH0
pakary	P AE1 / K AE1 / R IY0	pacara	P AE1 / K AE1 / R AH0

palachy	P AE1 / L AE1 / K IY0	palaca	P AE1 / L AE1 / K AH0
pamady	P AE1 / M AE1 / D IY0	pamada	P AE1 / M AE1 / D AH0
patchaly	P AE1 / CH AE1 / L IY0	patchala	P AE1 / CH AE1 / L AH0
payyani	P AE1 / Y AE1 / N IY0	payyana	P AE1 / Y AE1 / N AH0
podomy	P AA1 / D AA1 / M IY0	podama	P AA1 / D AA1 / M AH0
ramaki	R AE1 / M AE1 / K IY0	ramaka	R AE1 / M AE1 / K AH0
ramany	R AE1 / M AE1 / N IY0	ramana	R AE1 / M AE1 / N AH0
rilicky	R IH1 / L IH1 / K IY0	rilicka	R IH1 / L IH1 / K AH0
riminy	R IH1 / N IH1 / M IY0	rimina	R IH1 / N IH1 / M AH0
rinimy	R IH1 / N IH1 / M IY0	rinima	R IH1 / N IH1 / M AH0
rivicy	R IH1 / V IH1 / S IY0	rivisa	R IH1 / V IH1 / S AH0
sappary	S AE1 / P AE1 / R IY0	sappara	S AE1 / P AE1 / R AH0
seffany	S EH1 / F EH1 / N IY0	seffana	S EH1 / F EH1 / N AH0
selleki	S EH1 / L EH1 / K IY0	selleca	S EH1 / L EH1 / K AH0
tamapi	T AE1 / M AE1 / P IY0	tamapa	T AE1 / M AE1 / P AH0
teppedy	T EH1 / P EH1 / D IY0	teppeda	T EH1 / P EH1 / D AH0
thamary	TH AE1 / M AE1 / R IY0	thamara	TH AE1 / M AE1 / R AH0
thanasy	TH AE1 / N AE1 / Z IY0	thanaza	TH AE1 / N AE1 / Z AH0
viziny	V IH1 / Z IH1 / N IY0	vizina	V IH1 / Z IH1 / N AH0

## 8. Notes on finding an orthography

- I did this just for easy reference but soon realized I had entered a swamp.
- I sense this is accessing deep and understudied native-speaker knowledge.
  - cf. xxx brain guy
- I caught myself looking for spellings that would reinforce the “correct” answer.
- Example: *SPE* points out that -y is used to spell antepenultimate stress in *Lombardy*, -I in *Lombardi*.
- Often a spelling strongly suggests a morphological analysis:
  - My choice of *ck* in *rilicky* implies an -y suffix [ 🤔 why? ]
  - *lamacy*
  - *acrathy* [ 🤔 free-associate here ]
- ... or a source language for loanwords
  - *rivicy* [ 🤔 which? why? ]
  - *mashabee* [ 🤔 which? why? ] This turned out to be a problem that needed fixing.
- Words in English can be unspellable.
  - Albright and Hayes (2003, *Cognition*): [ʃaɪnt]
  - Here: P AE L AE K IY0 ; no neutral solution seems possible.


## 9. An alarming possibility

- Do our highly-literature participants likewise make up orthography in their head for nonce words?

## 10. Running the model yielded a simple result

- The normal outcome, found in almost all cases:

[i] final, antepenult:	0.971	e.g. <i>acrathy</i>
[i] final, penult:	0.028	
[i] final, final	0.001	
[ə] final, antepenult:	0.801	e.g. <i>acratha</i>
[ə] final, penult:	0.199	
[ə] final, final	0.00025	

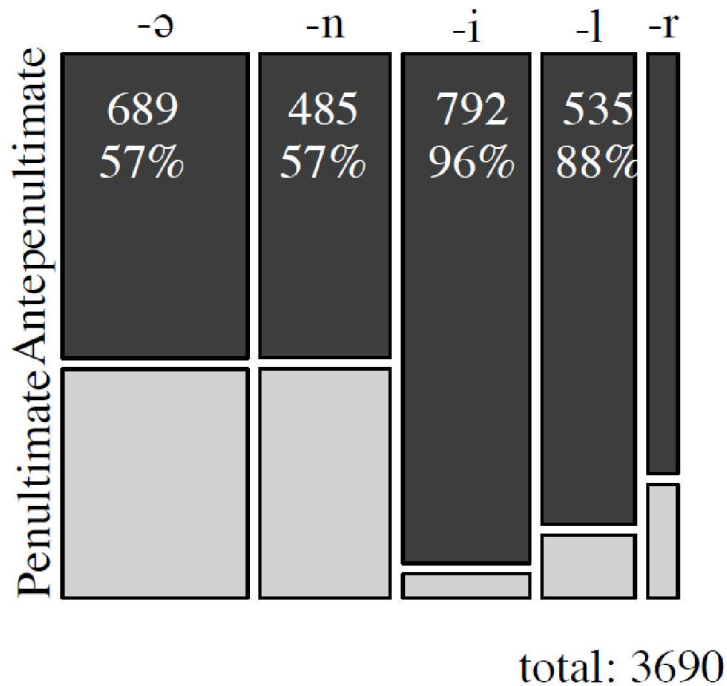
- The probability of final stress emerges as minuscule [  why the difference in final vowel? ].
- My spelling *mashabee* was a mistake; the -ee was read as a suffix, permitting nontrivial probability for final stress: .025. So I fixed it.
- *araspy/araspa* was an outlier:

[i] final, antepenult:	0.971	<i>araspy</i>
[i] final, penult:	0.028	
[i] final, final	0.001	
[ə] final, antepenult:	0.801	<i>araspa</i>
[ə] final, penult:	0.199	
[ə] final, final	0.00025	

- This arose from my “unnatural” constraint, favoring penultimate stress before sC onsets.

# 11. The results skew a little bit more antepenultimately than (Moore-Cantwell's) lexicon

Figure 3.1. Words with light penultimate syllables and the five most common final syllable nuclei, from the CMU pronouncing dictionary (North American English).

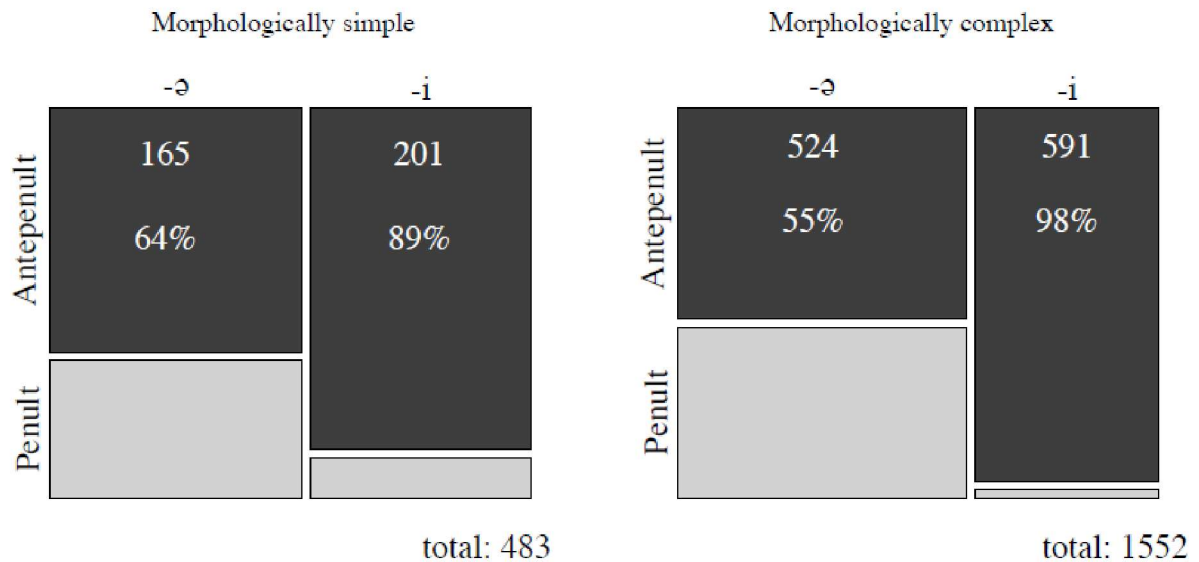


Model (repeated from above):

[i] final, antepenult:	0.971	e.g. <i>acrathy</i>
[i] final, penult:	0.028	
[ə] final, antepenult:	0.801	e.g. <i>acratha</i>
[ə] final, penult:	0.199	

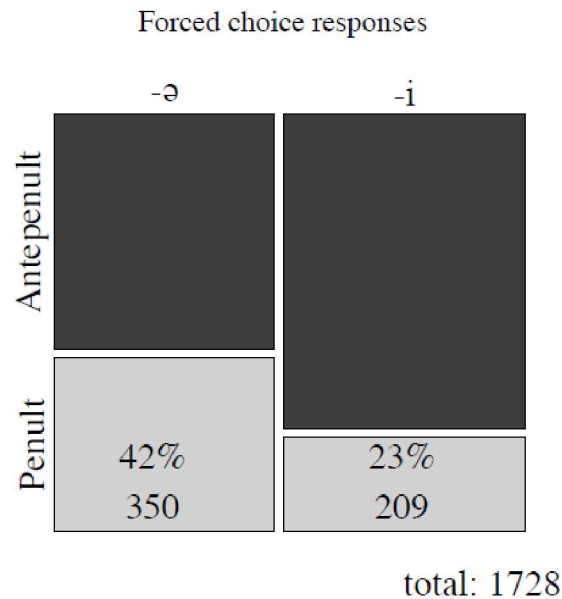
- Conjectured reason: the model includes constraints like “Stress penult if suffix -ic”, which soak up cases that would otherwise make the model favor penultimate stress more.

## 12. The skew is less if we consider just the monomorphemic words



## 13. Reviewing the experimental results: Experiment 3

- This experiment had important other fish to fry: the effect of the analogy from particular existing forms.
  - This is a really important question, sometimes ignored by wug-testers.
  - Moore-Cantwell finds effects of analogy, but not really strong ones.
- Recall the method (Guionian): hear the syllables, concatenate and speak.
- There was also a subtle system to validate the responses by having participants assess their own stress.

**Figure 3.5.** Counts of stress choices for each final vowel in nonwords

- Upshot: the weakening of the effects observed in simple empirical counts emerges as a *greater* weakening, relative to the predictions of a multi-constraint MaxEnt model.

#### 14. Experiment 4

- This demonstrated the strength of constraint-based stochastic models in treating overlapping effects:
  - penultimate heavy
  - final [i] vs. [ə]
- I couldn't find the heavy-penult items in the diss., and didn't see fit to pester the author on very short notice.
- I am curious what the model says ...

#### 15. Upshot for now

- The use of an all-out, aim-for-maximum-accuracy-on-existing words model only raises questions:
  - Are all the elements of the model, including complex or unnatural ones, internalized by native speakers? This would necessitate further testing.
  - If the above is confirmed, then the need to explain the weakness of experimental effects against the lexical patterns that (n.b.) they reflect becomes even stronger.

## 16. The stimuli used

<i>Type 1</i>	<i>Type 2</i>	<i>Type 3</i>	<i>Type 4</i>
CVV CVCC	CV CVCC	CV CVC	CV CVVC
beɪ tɪst	dɛ kɪps	nɪ lɛt	nɪ li:t
tu: kɪps	nɪ gɛpt	dɛ sɪn	dɛ gu:t
tai gɛpt	kɪ mɪnz	sɛ lɪn	bɪ teɪs
poʊ tɪst	sɛ tɪst	bɪ tɛs	bɪ toʊs
gi: kɪps	bɪ bɛkt	sɛ gɛt	kɪ gi:n
poʊ bɛkt	sɛ bɛkt	dɛ lɛt	sɛ lɪt
tu: mɪnz	dɛ mɪnz	nɪ sɪn	nɪ gu:t
tai mɪnz	nɪ kɪps	kɪ gɛt	kɪ teɪs
beɪ bɛkt	kɪ gɛpt	bɪ lɪn	dɛ toʊs
gi: gɛpt	bɪ tɪst	kɪ tɛs	sɛ gi:n

- These were construable as both verbs and nouns, by putting them in frames:

“I’d like a \_\_\_\_.”

“I’d like to \_\_\_\_.”

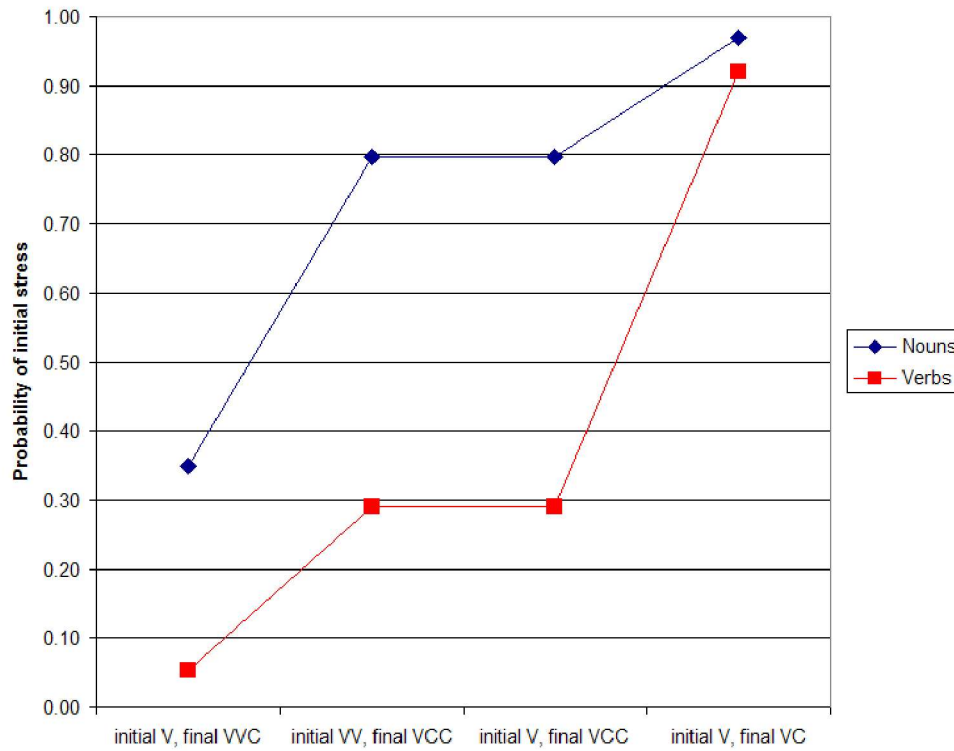
## 17. Post hoc resentment at their design

- The phonological type of initial syllable: CVV vs. CV
- The phonological type of final syllable: CVCC vs. CVC vs. CVVC
- These are not crossed, but sampled (4/6 cases)

## 18. The model’s predictions here are very straightforward

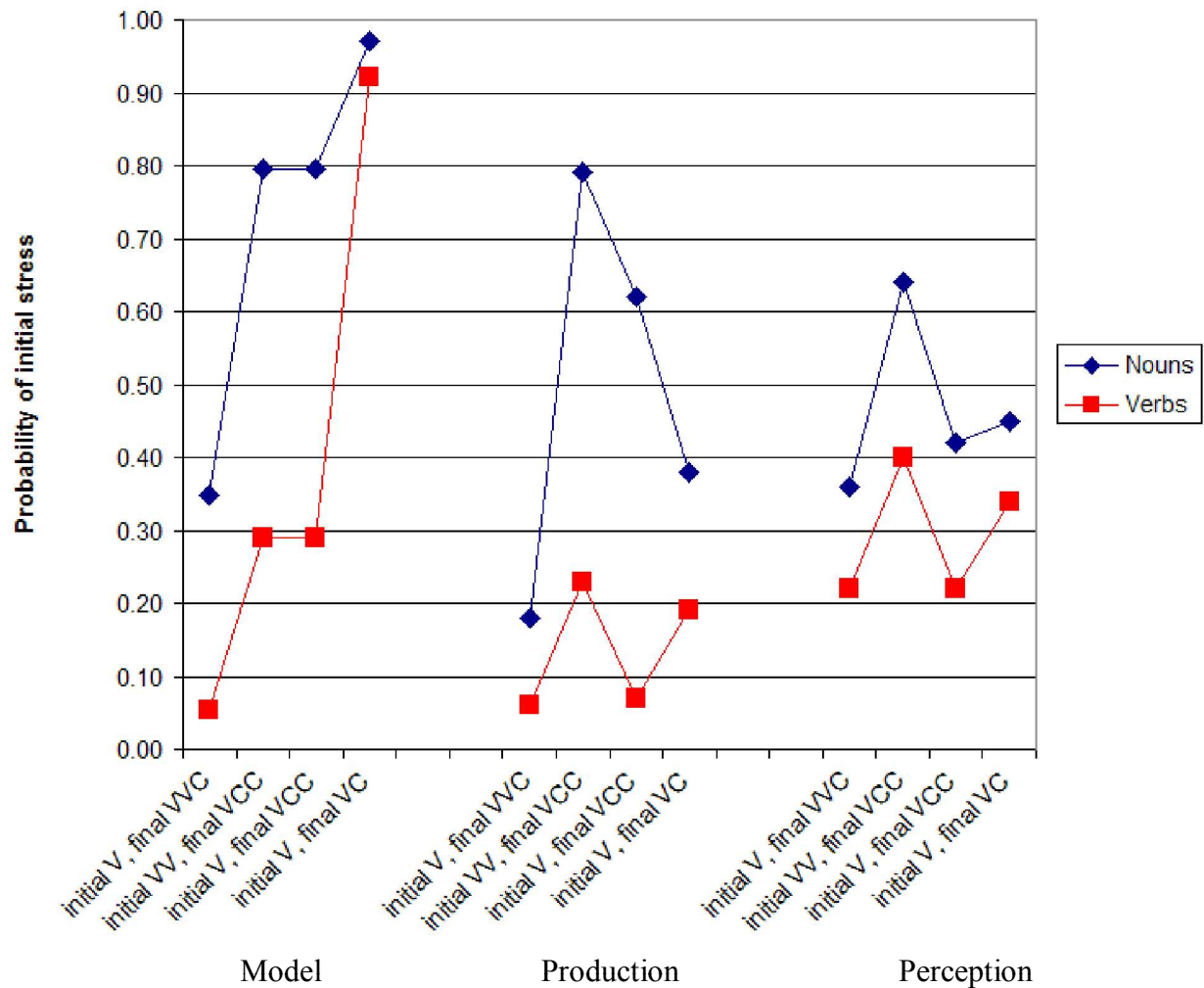
- Every one of the four types gets the same score no matter what particular word is tested.





- Comments:
  - I had tried putting in a constraint on the weight of the initial syllable. It did poorly and I took it out; should try it again.
  - Otherwise, the model reflects the gradient weight of the final syllable, CVVC >> CVCC >> CVC
  - This is a wug-shaped curve (Hayes in progress), with Part of Speech as a perturber.

## 19. The experimental results



- The noun-verb effect is quite solid and we can feel fine about this.
- The quantity effects are significant (different types behave differently), but I am *baffled* by the pattern.
- Biggest weight effect is in *initial* syllable, where the model found very little.

## 20. A conjecture

- The participants did not like perpetrating vowel reduction in their outputs.
- Nor, apparently, did the reader who modeled the forms for the perception experiment.
- Hence, other constraints other than the basic weight-to-stress constraints entered in — specifically FTBIN.

## 21. Saying ['beɪ, bɛkt]

- This is fine, both feet are supraminimal.

- The noun may take initial stress without trouble.
- The verbal rendition [ˌberˈbekt] is fine, too.

## 22. Saying ['bɪbekt]

- This has a subminimal foot in strong position.
- It resembles the very rare existing type in *Semite*. [ˈsɛlˌmɑt]
- In contrast, [bɪˈbekt] represents a normal type, with reduction not-quite to schwa in initial syllable.

## 23. Upshot

- A huge boost for initial stress from initial CVV — for an artifactual reason (cf. model)
- Otherwise, I think we see a very modest effect of final weight when we hold CV constant.
  - (per above, resenting the non-gathering of all six cases)

## 24. General upshot

- I admire the ability of the Guion paradigm to get around the issues involving orthography.
- But now I am quite worried about it introducing a whole other set of issues involving vowel reduction.

# IS ENGLISH A VERSION OF SEDIIQ? PROPECTS FOR A VOWEL-QUALITY RESTORING GRAMMAR

## 25. Setting: the goal of listing all of the English segmental alternations

- This is proceeding bit by bit when I have time.
- A further possible goal is: make sure all the alternations listed in the literature get discovered by machine.
- I.e., do whatever tweaks are needed to discover listed alternation X, then trim back the bad cases by hand.

## 26. A good source

- Myers, Scott. "Vowel shortening in English." *Natural Language & Linguistic Theory* 5, no. 4 (1987): 485-518.
- I think the analysis is perhaps gimmicky? It involves using ambisyllabicity to reduce Trisyllabic Shortening to Closed Syllable Shortening

vem. ɪ . ti → [væn. ɪ . ti]

- But Myers, like elsewhere in his work, was scrupulous in trying to find abundant examples, e.g.

	bleed/bled	breed/bred	feed/fed
	hide/hid	lead/led	light/lit
	meet/met	read/read	slide/slid
	speed/sped		
b.	heal/health	deep/depth	steal/stealth
	wide/width		
c.	perceive/perceptive	receive/receptive	
	deceive/deceptive	describe/descriptive	
	prescribe/prescriptive	produce/productive	
	induce/inductive	deduce/deductive	
	reduce/reductive	seduce/seductive	
	resume/resumptive	consume/consumptive <sup>5</sup>	
d.	intervene/intervention	contravene/contravention	
	convene/convention	redeem/redemption	
	perceive/perception	receive/reception	
	deceive/deception	conceive/conception	
	describe/description	subscribe/subscription	
	inscribe/inscription	transcribe/transcription	
	induce/induction	produce/production	
	deduce/deduction	reduce/reduction	
	seduce/seduction	resume/resumption	
	assume/assumption	presume/presumption	
	detain/detention	abstain/abstention	
	retain/retention <sup>6</sup>		
e.	discreet/discretion	succeed/succession	
	recede/recession	concede/concession	
	proceed/procession	decide/decision	
	precise/precision	circumcise/circumcision	
	elide/elision	collide/collision	
	revise/revision	supervise/supervision	
	divide/division	provide/provision	
	extradite/extradition	expedite/expedition	
	ignite/ignition	erudite/erudition	
	contrite/contrition	recognize/recognition.	

## 27. Discovering *assume* ~ *assumption*

- We need to say that every stem ending orthographically in *me* has an allomorph ending in *mp*.
- We test this allomorph with every suffix, and this discovers four alternating pairs:

assume	assumption
consume	consumption
presume	presumption
resume	resumption

- The result must be hand-studied, however, in order to trim back:

same	sampan
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- The program runs ever slower as affixes and stem-mutations get added.

## 28. Returning to English as Sediig

- Albrightianism suggests that UR's like /ætəm/ for *atom* ~ *atomic* are not psychologically real.
- Assuming that the intuitive base is the phonological base, we must set up /ætəm/ as the base form.
- So, do English speakers have a tendency to reform their lexicon, to increase the projectibility of derived full vowels from the stem?

## 29. Hayes (1995)'s anecdote

- Phonologists pronouncing *consonantal* as [kənsən'nəntəl] despite the orthography.
- This is a pattern: “restressed schwa” becomes [ɛ] roughly / \_\_\_\_ nt

## 30. What we found earlier in this course

- Managerial Lengthening has vastly more examples when it assigns a long vowel quality to restressed schwa
  - Examples like *manager* ~ *managerial* are abundant.

## 31. How could we take on the job of studying vowel restoration in general?

- What is needed (and would serve phonology well...) is a standard, capable **environment finder**.
- This has been worked on, e.g., by Michael Becker and Maria Gouskova.
- I hauled out an old program written by Albright for Albright and Hayes (2003): the Minimal Generalization Learner.

## 32. The idea of Minimal Generalization Learning

- Invented (?) by Pinker and Prince, without any implementation or application, in their famous blast (1988) against connectionism.

## 33. Step I: construe each base-derivative pair as a little rule

(3)  $\emptyset \rightarrow d / [ʃaɪn \_\_\_]_{[+past]}$  = “Insert [d] after the stem [ʃaɪn] to form the past tense.”

(4)  $\emptyset \rightarrow d / [kənsaɪn \_\_\_]_{[+past]}$  *consign~consigned:*

### 34. Step II: compare rules and find the tightest generalization that covers both

(5)	a.	Change	Variable	Shared features	Shared segments	Change location	
	b.	$\emptyset \rightarrow d$	/ [	ʃ	aɪn	—	] <sub>[+past]</sub> ( <i>shine-shined</i> )
	c.	$\emptyset \rightarrow d$	/ [ kən	s	aɪn	—	] <sub>[+past]</sub> ( <i>consign-consigned</i> )
	d.	$\emptyset \rightarrow d$	/ [ X	$\begin{bmatrix} +\text{strident} \\ +\text{continuant} \\ -\text{voice} \end{bmatrix}$	aɪn	—	] <sub>[+past]</sub> (generalized rule)

### 35. Step III: iterate until no further generalization is possible

$$\emptyset \rightarrow d / [X [+voice] \text{ — } ]_{[+past]}$$

$$\emptyset \rightarrow t / [X [-voice] \text{ — } ]_{[+past]}$$

$$\emptyset \rightarrow \text{əd} / [X \begin{bmatrix} +\text{coronal} \\ +\text{anterior} \\ -\text{nasal} \\ -\text{continuant} \end{bmatrix} \text{ — } ]_{[+past]}$$

- and plugging in a little bit of phonology (phonotactics tells us that heterovoicing is bad; alveolar stop clusters are bad), the Ling. 1 outcome:

$$\emptyset \rightarrow d / [X \text{ — } ]_{[+past]}$$

### 36. Rule evaluation

- This involves issues that remain very lively today.
- What matters?
  - scope (number of cases where rule can apply)
  - accuracy (number of cases where it succeeds)
- Albright/Hayes adjured OT (which already existed, even in stochastic form), for it privileges the exceptionless specific over the general, irrespective of scope.
- Nowadays, we await an appropriate theory of biased constraint weighting to solve this problem for us, *within* OT.

### 37. Applying Minimal Generalization to the vowel restoration problem

- How to set up the inputs:
  - make pairs with a dummy vowel in the affixed base, which has to change into the stressed vowel

$$\text{detrəm}^{\text{'}\underline{\text{A}}\text{nt}+\text{'ə}l} \rightarrow \text{detrəm}^{\text{'}\underline{\text{e}}\text{nt}əl}$$

$$\text{ɛləm}^{\text{'}\underline{\text{A}}\text{nt}+\text{'ə}l} \rightarrow \text{ɛləm}^{\text{'}\underline{\text{e}}\text{nt}əl} \text{ etc.}$$

### 38. Running the model three ways

- Use all segments, turn off the capacity to use features — reported here.
- Use just the vowels — unlike Sediiq, there is nothing of interest to report.
- Use all segments, include the use of features — crashed; needs more work.

### 39. Outcome

- Unlike Sediiq, there are no magical rules for vowel restoration in English.
- The best rules simply discover particular suffixes in the base, which of course restore their schwas identically.
- Indeed, Hayes (1995) “nt” generalization represents, mostly, the unproductive affix *-ent*.

### 40. Rules with their statistics

A	B	Pres	P	Q	Qfeat	Qres	scope	hit s	reliabilit y	confidenc e
ə	> a /	X	əl'	_____	jɪkəl		18	18	1.000	0.948
ə	> ɪ /	X	t'	_____	v	Y	13	13	1.000	0.928
ə	> ε /	X	əm'	_____	ntə	Y	12	12	1.000	0.923
ə	> ɪ /	X	əl'	_____	stɪk		11	11	1.000	0.916
ʰə	> a /		k	_____	n	Y	10	10	1.000	0.908
ə	> æ /	X	əgr'	_____	fɪk	Y	8	8	1.000	0.887
ə	> ε /	X	'	_____	ntəl		18	17	0.944	0.877
ʰə	> ε /			_____	ks	Y	7	7	1.000	0.872
ə	> ε /	X	m'	_____	ntə	Y	17	16	0.941	0.870
ə	> ε /	X	'	_____	ntə	Y	24	22	0.917	0.858
ə	> a /	X	əl'	_____	j	Y	21	20	0.952	0.854
ʰə	> ɪ /			_____	m	Y	6	6	1.000	0.852

### 41. Rules with their examples

A	B	Pre s	P	Q	Qre s	Example	form2	This is really just
Λ	> a /	X	əl'	_____	jɪkəl	arkɪəl'Λjɪkəl	arkɪəl'aɪkəl	ological
Λ	> ɪ /	X	t'	_____	v	ækt'Λvəti	ækt'ivəti	ivity

Λ	>	ε	/	X	əm'	___	ntə	Υ	detrəm'antəl	detrəm'entəl	ental
Λ	>	ɪ	/	X	əl'	___	stɪk		kæpɪtəl'astɪk	kæpɪtəl'istɪk	istic
'Λ	>	a	/		k	___	n	Υ	k'andəmn'ɪʃən	kandəmn'ɪʃən	con-
Λ	>	æ	/	X	əgr'	___	fɪk	Υ	deməgr'afɪk	deməgr'æfɪk	ography
Λ	>	ε	/	X	'	___	ntəl		æksəd'antəl	æksəd'entəl	-ent
'Λ	>	ε	/			___	ks	Υ	'akspekt'ɪʃən	ekspekt'ɪʃən	ex-
Λ	>	ε	/	X	m'	___	ntə	Υ	mom'antəs	mom'entəs	-ent
Λ	>	ε	/	X	'	___	ntə	Υ	k'antən'uəti	k'entən'uəti	a bit odd
Λ	>	a	/	X	əl'	___	j	Υ	ænθrəpəl'aʃəkəl	ænθrəpəl'aʃəkəl	
'Λ	>	ɪ	/			___	m	Υ	'ampart'ɪʃən	ɪmpart'ɪʃən	im-

## 42. Full sets of forms justifying rules

arkɪəl'aʃɪkəl, æstrəl'aʃɪkəl, bʏəl'aʃɪkəl, kranəl'aʃɪkəl, ekəl'aʃɪkəl, ʃɪəl'aʃɪkəl, ʏdɪəl'aʃɪkəl, mitɪarəl'aʃɪkəl, mɛθədəl'aʃɪkəl, marfəl'aʃɪkəl, mɪθəl'aʃɪkəl, antəl'aʃɪkəl, pæθəl'aʃɪkəl, fɪzɪəl'aʃɪkəl, sʏkəl'aʃɪkəl, sɒsɪəl'aʃɪkəl, tɛknəl'aʃɪkəl, θɪəl'aʃɪ ækt'ʌvəti, kæpt'ʌvəti, kandʌkt'ʌvəti, kriit'ʌvəti, fɛst'ʌvəti, ɪnækt'ʌvəti, ɪnsɛnsət'ʌvəti, nət'ʌvəti, abʃekt'ʌvəti, relət'ʌvəti, sɪlɛkt'ʌvəti, sɛnsɪt'ʌvəti, səbʃekt'ʌvəti  
detrəm'antəl, eləm'antəl, ɪnstrəm'antəl, manjəm'antəl, arnəm'antəl, rɛʃəm'antəl, sɛntəm'antəl, tɛmprəm'antəl, parləm'antəri, sɛdəm'antəri, sʌpləm'antəri, tɛstəm'antəri  
kæpɪtəl'astɪk, fɪtəl'astɪk, ɪmpɪrɪəl'astɪk, ɪndɪvɪʊəl'astɪk, ʃʌrnəl'astɪk, mətɪrɪəl'astɪk, mənəpəl'astɪk, marəl'astɪk, næʃənəl'astɪk, næçərəl'astɪk, pjuʃəl'astɪk  
k'andəmn'ɪʃən, k'andəns'ɪʃən, k'ʌnfərm'ɪʃən, k'ʌnfrɛnt'ɪʃən, k'ʌnət'ɪʃən, k'ʌnsərɪv'ɪʃən, k'ʌnsɛlt'ɪʃən, k'ʌntrəbj'ʊʃən, k'ʌndʌkt'ɪvəti, k'ʌntən'uəti  
deməgr'afɪk, ɪθəgr'afɪk, fəθəgr'afɪk, pʌrnəgr'afɪk, atəbʏəgr'afɪkəl, bʏəgr'afɪkəl, ʃɪəgr'afɪkəl, tʏpəgr'afɪkəl  
æksəd'antəl, kɒɪnsəd'antəl, kantən'antəl, dɪpartm'antəl, detrəm'antəl, eləm'antəl, ɪnvɪrənəm'antəl, ɪkspɛrɪm'antəl, ɪnsɪd'antəl, ɪnstrəm'antəl, manjəm'antəl, arnəm'antəl, pər'antəl, rɛʃəm'antəl, sɛntəm'antəl, tɛmprəm'antəl, trənsɛnd'antəl  
'akspekt'ɪʃən, 'aksɛpər'ɪʃən, 'aksɛplər'ɪʃən, 'aksæspər'ɪʃən, 'aksəb'ɪʃən, 'aksəntɪr'ɪsəti, 'aksɛp'ɪrɪ  
dɪpartm'antəl, detrəm'antəl, eləm'antəl, ɪnvɪrənəm'antəl, ɪkspɛrɪm'antəl, ɪnstrəm'antəl, manjəm'antəl, arnəm'antəl, rɛʃəm'antəl, sɛntəm'antəl, tɛmprəm'antəl, parləm'antəri, sɛdəm'antəri, sʌpləm'antəri, tɛstəm'antəri, mom'antəs  
æksəd'antəl, kɒɪnsəd'antəl, kantən'antəl, dɪpartm'antəl, detrəm'antəl, eləm'antəl, ɪnvɪrənəm'antəl, ɪkspɛrɪm'antəl, ɪnsɪd'antəl, ɪnstrəm'antəl, i, s  
ænθrəpəl'aʃəkəl, arkɪəl'aʃɪkəl, æstrəl'aʃɪkəl, bʏəl'aʃɪkəl, kranəl'aʃɪkəl, ekəl'aʃɪkəl, ɛtəməl'aʃəkəl, ʃɪəl'aʃɪkəl, ʏdɪəl'aʃɪkəl, mitɪarəl'aʃɪkəl, mɛθədəl'aʃɪkəl, marfəl'aʃɪkəl, mɪθəl'aʃɪkəl, antəl'aʃɪkəl, pæθəl'aʃɪkəl, fɪzɪəl'aʃɪkəl, sʏkəl'aʃɪkəl, sɒsɪəl  
'ampart'ɪʃən, 'ampərɛf'ɛkʃən, 'ampərsən'ɪʃən, 'ʌmɒb'ɪlɪti, 'ʌmər'æɪlɪti, 'ʌmart'æɪlɪti

## 43. General discussion

- We could, with time, use these constraints to form a MaxEnt grammar that carries out vowel restoration.
- Each constraint has some generality.
- The degree to which we could predict the quality of restressed vowels is probably nontrivial.



- But it is unsatisfying that the grammar is simply basing itself on the morphology of the base form.

## EXPERIMENTAL WORK ON VOWEL ALTERNATIONS

### 44. This is not a literature review

... quite a lot I have missed

### 45. My all-time favorite

- Cena, R. M. When is a phonological generalization psychologically real?. Indiana Univ. Linguistics Club, 1978.
  - I love the author's precocious wisdom and enjoyed rereading this.
  - I put it on the course website.
- It is a spin-off from a 1975 dissertation n from the University of Alberta.

### 46. Who is R. W. Cena?

- The author's affiliation on Cena (1978) is listed as University of Hawaii.
- One Google cite says that "R" is "Resty".
- further search (Academia.edu) suggests an unemployed person (?) with substantial research and teaching in Tagalog.

### 47. Another nice collection of work

- *Phonology Yearbook*, (predecessor to *Phonology*) volume 3 (1986), the first half of it, edited by John Ohala.
- There are articles by McCawley, Jeri Jaeger, Bruce Derwing, and other luminaries
- This does have a bit of theory-bashing in it.
- Yet, the authors have benefited from critiques of their earlier work and have raised their game.

### 48. Some bottom lines from my reading

- A properly done wug-test of the classical alternations (like divine-divinity, serene-serenity, vain-vanity, cone-conical) will prove the "psychological reality" of these alternations to almost anyone's satisfaction.
- The effort to find better testing modes has perhaps taught us something about wug-testing.
- Vowel Shift is very tightly bounded to spelling, making it very hard to investigate it as pure phonology.<sup>1</sup>

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<sup>1</sup> Who, indeed, knows tons of Latinate words but cannot read?

#### **49. A hierarchy of strength of wug-tests, from Cena**

- Elicitation
  - The hardest; most likely to give refusals; adherence to paradigm uniformity, weird stuff
- Ratings of alternatives
  - Easier, but perhaps the showing of weird forms (as bad alternatives) to the participants puts them into a weird “anything goes” mental state.
- Training on a pattern
  - See what pattern is most easily/rapidly/accurately internalized by participants as you train them.

## 50. Training stimuli

<u>ay</u> ~ I	<u>subk[ay]pe-subk[I]pity</u>	divine - divinity
ay ~ ε	malp[ay]de-malp[ε]dity	
ay ~ æ	purg[ay]te-purg[æ]tity	
ay ~ ʌ	surf[ay]me-surf[ʌ]mity	
ay ~ ɔ	disr[ay]ne-disr[ɔ]nity	
iy ~ I	surk[iy]te-surk[I]tity	
<u>iy</u> ~ ε	<u>maln[iy]de-maln[ε]dity</u>	serene - serenity
iy ~ æ	disf[iy]me-disf[æ]mity	
iy ~ ʌ	del[iy]ne-del[ʌ]nity	
iy ~ ɔ	ent[iy]pe-ent[ɔ]pity	
ey ~ I	prel[ey]be-prel[I]bity	
ey ~ ε	subn[ey]ze-subn[ε]zity	
<u>ey</u> ~ æ	<u>deb[ey]me-deb[æ]mity</u>	profane - profanity
ey ~ ʌ	surt[ey]ce-surt[ʌ]city	
ey ~ ɔ	disd[ey]pe-disd[ɔ]pity	
aw ~ I	misn[aw]d-misn[I]dity	
aw ~ ε	surs[aw]n-surs[ε]nity	
aw ~ æ	pren[aw]se-pren[æ]sity	
<u>aw</u> ~ ʌ	<u>perc[aw]t-perc[ʌ]tity</u>	profound - profundity
aw ~ ɔ	imp[aw]ze-imp[ɔ]zity	
ow ~ I	end[ow]ne-end[I]nity	
ow ~ ε	emp[ow]be-emp[ε]bity	
ow ~ æ	perh[ow]de-perh[æ]dity	
ow ~ ʌ	disl[ow]pe-disl[ʌ]pity	
<u>ow</u> ~ ɔ	<u>exg[ow]me-exg[ɔ]mity</u>	verbose - verbosity

- [ɔ] is probably correct if the participants were Canadians.
- The great beauty of the system is that *nonalternation* is never given as an option.

## 51. Method

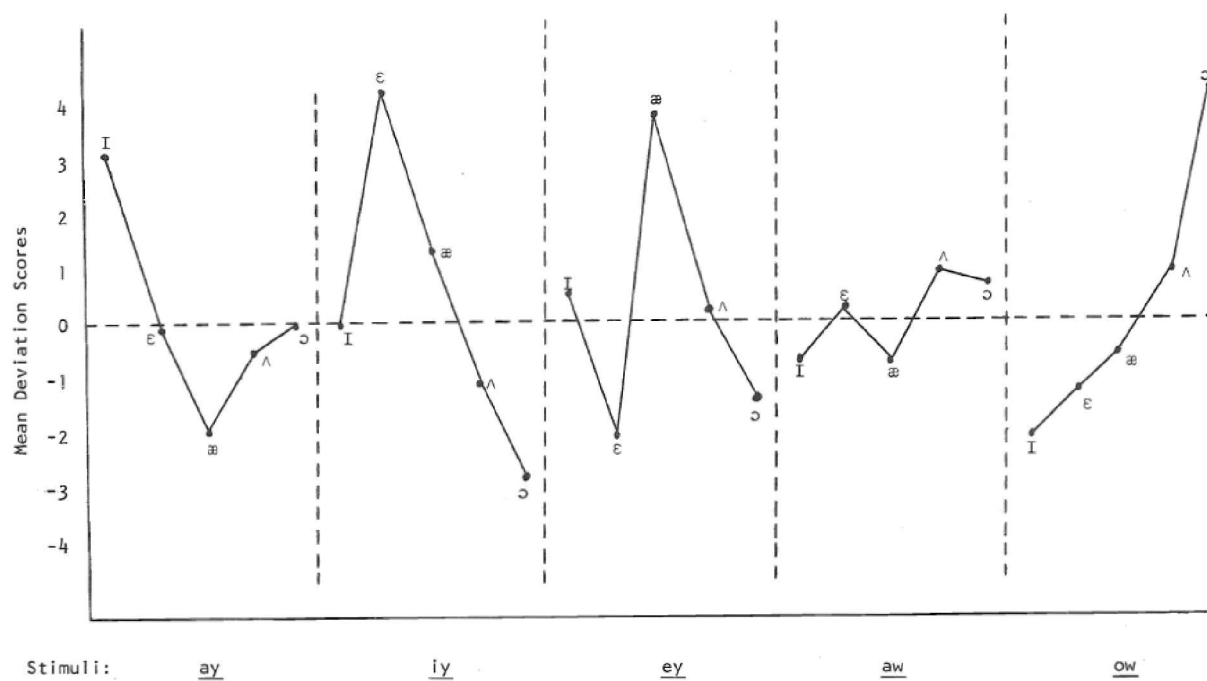
The words were presented to the subject using the study-test procedure. In the study phase, the subject tried to remember the word pairs. The subject heard and repeated both words of each pair, the words separated by a 2-sec gap. All 25 word pairs were heard in a study phase, with a 4-sec interval between word pairs. A short tone signalled the end of a study phase and the start of a test phase. In the test phase, the subject recalled the noun forms. Only the adjective forms were presented, at 5-sec interval. The subject was to give the noun form within the 5-sec gap. A long tone signalled the end of a test phase and the beginning of the next study phase. The order of presentation of word pairs was randomized in each study phase; likewise the order of presentation of the adjective forms was randomized in each test phase. However, since randomization was made during the recording of the materials, there was one fixed ordering for all subjects. The subject was asked to treat the words as uncommon adjective-noun pairs exemplifying the same grammatical relations as the pairs *plausible* - *plausibility*, *possible* - *possibility*, etc. Criterion was set at one error-free trial, or ten trials, whichever was first. Twenty university students who were native speakers of English served as subjects.

## 52. Basic results

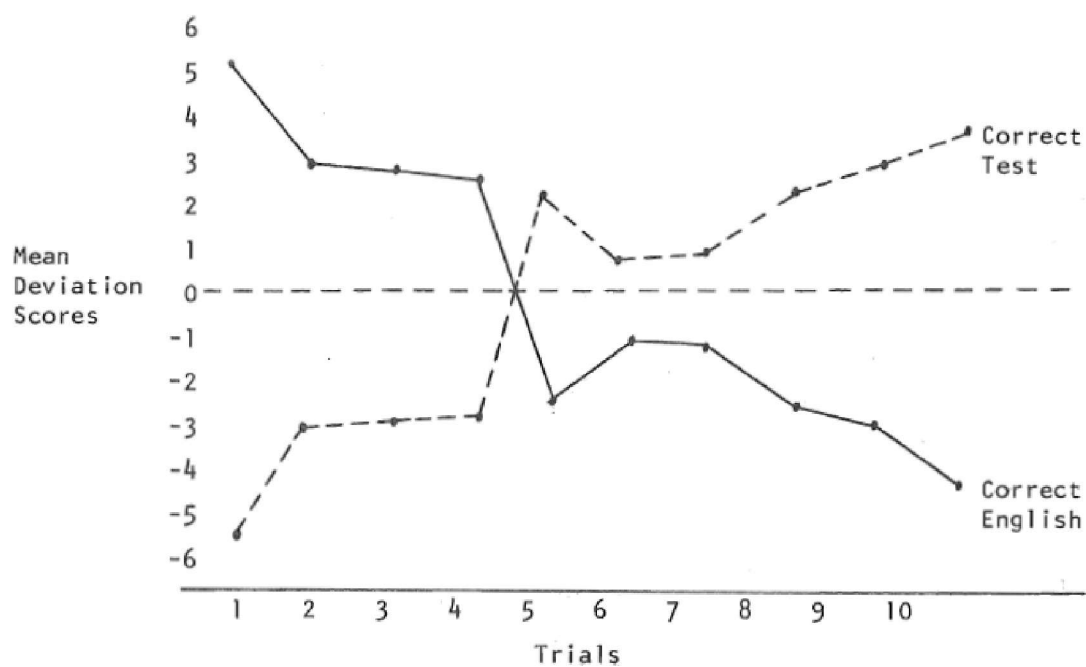
		Required Response				
		<u>I</u>	<u>ɛ</u>	<u>æ</u>	<u>ʌ</u>	<u>ɔ</u>
	<u>ay</u>	<u>154</u>	92	70	83	131
	<u>iy</u>	75	<u>142</u>	113	48	53
<u>Stimulus</u>	<u>ey</u>	99	45	<u>168</u>	92	101
	<u>aw</u>	64	84	77	<u>100</u>	135
	<u>ow</u>	45	54	81	100	<u>185</u>

- Correct wins, except for aw ~ ʌ [☞ why?]

## 53. Same as graph



## 54. Subjects approach correctness gradually when the target is “wrong”



**55. Cena bashes the predecessors**

- Direct elicitation appears to be too insensitive a method to diagnose reality of vowel shift; this is what was done in early work by Steinberg and Krohn and by Ohala.
- He/she emphasizes the *gradiance of productivity*, much as we would do today, and notes that for the productive-but-not-very-productive cases, you need a more sensitive test.

## VOWEL SHIFT AND ORTHOGRAPHY

**56. Why is [aʊ] ~ [ʌ] the outlier?**

- Few cases, just a handful, as we have seen.
- Indeed, Halle, in work pursued after *SPE*, came to believe that the partner of [ʌ] is actually [ju:] (reduce-reduction)

**57. But alas ...**

- The four good pairs are *also* the ones that have mostly uniform orthographic representation.
- [☞ explain this ]

**58. A paper that took this on**

Ohala, John J., H. Samuel Wang, and Bruce L. Derwing. "More on English vowel shift: the back vowel question." *Phonology* 3 (1986): 99-116

**59. Arguments that orthography is involved**

- Narratives from the participants, particularly those who wug-tested well.
  - A particularly articulate one:

'In the first word the vowel sound is long, e.g. e- as in beet. In the second word the vowel sound is short, e.g. e as in let ...

- Details: the alternation with [i:] is the orthographically weakest, since [i:] has other important spellings (<ee>, <ea>).

**60. What might we think 34 years later?**

- We should work at learning whatever we can from earlier wug-testing efforts, even if they
  - addressed unproductive, orthography-contaminated phonology
  - were sometimes theory-hostile
- There is so much other phonology to cover! Out of the swamp and to action!! :=)

