

Class 8, 11/19/20: Segmental Phonology

1. Assignments

- Readings:
 - *SPE* Chapter 4, pp. 178-192.
 - I've included up to p. 200, covering the amazing vowel [ju:]; read this if you are writing a dissertation about English.

2. Today

- A bit of close reading of *SPE* on English segmental phonology.
- A corpus study of English segmental alternations.
- Using it to address the single surface base hypothesis.

3. Looking ahead

- Theories of irregular phonology and English
- Testing English phonology with an on line experiment.

ENGLISH SEGMENTAL PHONOLOGY: WHAT ARE THE PRIMARY ALTERNATIONS?

4. The main source: vowel reduction

- English has many fully-stressless syllables, with a schwa or schwa-like vowel:
 - Weak within their foot: *scallop*
 - Metrically unparsed: *pe'tunia*, perhaps *'Canada*, *Medite'ranean*
- How the vowels of these syllables surface.
 - Usually schwa
 - Sometimes [ɪ] or [i] (dialectal variation)
 - Prevocally, finally: [i] or [ou] survive without being reduced.
- Why they reduce:
 - Often, if they were stressed, they would form a subminimal foot:
 - *atom* ~ *atomic*: cyclic stress gives *[æ][ˈtami:k], so instead ə[ˈtami:k];
 - *phonetic* ~ *phonetician*: cyclic stress gives *[fou][ˈni:tʃən], so instead *[founə][ˈti:fən]
- Vowel Reduction seems fully productive, e.g. it forms part of English-accented foreign pronunciation.
 - [gwaðalaˈxara] → [ˌgwadələˈhɑ:ə]

- [tʃa'batta] → [tʃə'barə], likewise [əs'pɪəsou], [kæpə'tʃinou]
- [ka'put] → [kə'put], [ka'pɛlmaɪstək] → [kə'pɛlmaɪstə]
- [haragʊ^βtʃi] → [hɑɪə'gutʃi]
- [səna] → [sə'na] (?)
- [meg^ha] → ['meɪgə]
- It affects with great force the stressless short vowels in open syllables; but also secondarily the long vowels or vowels in closed syllables: [fou'tagɪəfi] or [fou'tagɪəfi], [ɛk'stærɪk] or [ək'stærɪk]
- Later in this class we will look at Vowel Reduction from the viewpoint of the Albrightian Single Surface Base Hypothesis.

5. Length alternations

- These are native in origin, dating from the Middle Ages.
- But the shortness of English roots mean they are seen primarily in the Latinate stratum.¹
- The most important one is **Trisyllabic Shortening**: *divine* ~ *divinity*, *serene* ~ *serenity*, *profane* ~ *profanity*, *cone* ~ *conical*
 - Mnemonic: at least three from end, followed by stressless
- Less prominent, and slightly elusive, is **Managerial Lengthening**: *harmonic* ~ *harmonious*, *manager* ~ *managerial*.
 - Basic environment is a stressless [iə] sequence in the next two syllables.
- Major historical developments in the English vowel system have made these alternations bizarre and challenging — and a temptation to recapitulationist formal analysis.

6. Consonant alternations

- These are far less prominent, but various forms of Palatalization are quite frequent: *grade* ~ *gradual*, *logic* ~ *logician*, *impress* ~ *impression*.

7. Trisyllabic Shortening

[aɪ] ~ [ɪ]	divine ~ divinity, satire ~ satirical, derive ~ derivative, line ~ linear, delineate
[i:] ~ [ɛ]	meter ~ metrical, appeal ~ appellative, delicious ~ delicacy
[eɪ] ~ [æ]	compare ~ comparative, explain ~ explanatory, grateful ~ gratitude

- As they say: “and so on”
 - We will evaluate this later on.

¹ A spectacular exception, unknown to many native speakers, is [mɪd'wɪfəri] ‘the practice or profession of a midwife’.

8. Managerial Lengthening

- Managerial Lengthening is named (not in *SPE*) after a particular example.
- The environment is, basically, [iə] in the next syllable; several affixes of English provide this in environment: *-ial*, *-ian*, *-ious*, *-iuous*, etc.
- Examples:

[ə] (said to be /ɛ/) ~ [i:] funeral [ə] ~ funereal, manager [ə] ~ managerial, Abel [ə] ~ Abelian, Canada ~ Canadian

[ə] (said to be /æ/) ~ [eɪ] marginal [ə] ~ marginalia [eɪ] (also marginality, revealing the [æ],
algebra [ə] ~ algebraic [eɪ]

[ə] (treated as to be /ð/

- Hey, why aren't these examples simple and clean? More on this later.
- N.B. the vowel alternation [ɪ] ~ [aɪ] does *not* occur for Managerial Lengthening.
 - In fact, in the environment of this rule, the *preferred* outcome is [ɪ]: *Palestine* [aɪ] ~ *Palestinian* [ɪ].
 - So *-ial*, *-ian*, *-ious*, *-iuous*, etc. are triggers of both Managerial Lengthening and Trisyllabic Shortening, depending on the target vowel.

9. The missing alternation is found in occasional Prevocalic Lengthening

- We've seen this before in stress assignment: [ɪ] is *tensed* before another vowel, and is normally skipped across by the stress rule: *various* [ˈverɪəs].
- But (at least in a few examples), prevocalic [ɪ] actually receives the (antepenultimate) stress, and shows up as [aɪ].

[ɪ] (said to be [ɪ]) ~ [aɪ] various [i] ~ variety [aɪ], impios [i] ~ impiety [aɪ]

10. ☞ Exercises

- What kind of alternation is seen in *parasitical*?
- What would we have to say about cases like *parasitic* or *conic*?
- What kind of alternation is *felonious*? What can we infer about the assumed base?
- If *felonical* were a word, how the analysis anticipate that it would be pronounced, and why?
- Explain the (putative) alternation in the stem-final vowel in following cases:

<i>Ghana</i>	<i>Ghanaian</i>
<i>algebra</i>	<i>algebraic</i>
<i>formula</i>	<i>formulaic</i>

- Comment on the above in light of:

<i>parabola</i>	<i>parabolic</i>
<i>Canada</i>	<i>Canadian</i>
<i>Argentina</i>	<i>Argentinian</i>

and

<i>Hebrew</i>	<i>Hebraic</i> [hə.'bɪɪ.ɪk]
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g. Comment on these alternations

<i>keep</i>	<i>kept</i>
<i>deal</i>	<i>dealt</i>
<i>berieve</i>	<i>bereft</i>
<i>redeem</i>	<i>redemption</i>
<i>prescribe</i>	<i>prescriptive</i>
<i>wide</i>	<i>width</i>

[What other cases should we try to think of?]

h. Comment on this alternation

<i>retain</i>	<i>retention</i>
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AN OVERVIEW OF *SPE*'S ANALYSIS OF ENGLISH VOCALIC PHONOLOGY

11. Don't have rules that are really complicated — what Chomsky and Halle say about Trisyllabic Shortening

The rule would have the form:

$$(14) \quad \left\{ \begin{array}{l} \bar{a}y \rightarrow i \\ i\bar{y} \rightarrow e \\ \bar{e}y \rightarrow \text{æ} \end{array} \right\} \text{ in certain contexts}$$

If we replace the informal notations of (14) by their precise representations in terms of features, we find that the rule is quite complex, expressing no underlying generalization. This suggests that the operation of the rule be subdivided into several stages, each of which can perhaps be expressed in some fairly general form.

12. Adding in Managerial Lengthening to the complexity

If, as in (14), we take the phonological composition of [I], [E], [A] to be essentially the same as the phonetic composition, then (16) becomes:

$$(17) \quad \begin{cases} i \rightarrow \bar{a}y \\ e \rightarrow iy \\ \text{æ} \rightarrow \bar{e}y \end{cases} \text{ in certain contexts}$$

As we have noted above in connection with (14), this is an extremely complex rule.

13. The rest of the argument

For a grammar to contain a rule of the complexity of (14) or a rule of the complexity of (17) is implausible enough. For it to contain both of these rules is quite intolerable, not only because of the doubling of complexity, but, more importantly, because it is clear that such a grammar is missing a significant generalization.

14. So how could this be reduced to simplicity?

Here is the underlying front vowel system, derived per SPE. We will also include one back vowel, looking ahead:

i:	i	Underlying forms	
e:	e		
æ:	ɔ:		
æ:	ɔ:	æ	ɔ

example words:

<i>divine</i>		<i>divinity</i>	
<i>obscene</i>		<i>obscenity</i>	
<i>profane</i>	<i>cone</i>	<i>profanity</i>	<i>conical</i>

[At this stage, Trisyllabic Shortening and Managerial Lengthening apply. They are simple rules that change only [long].²]

i:j	i	Diphthongization: insert glide agreeing in backness	
e:j	e		
æ:j	ɔ:w		
æ:j	ɔ:w	æ	ɔ

e:j	i	Vowel Shift I: swap the feature [high] in nonlow vowels.	
i:j	e		
æ:j	ɔ:w		
æ:j	ɔ:w	æ	ɔ

² SPE used the feature [tense] instead of [long]; it doesn't matter.

æ:j		i		Vowel Shift II: swap the feature [low] in nonhigh vowels.
i:j		e		
e:j	o:w	æ	ɔ	

æj		i		Cleanup I: remove redundant length
ij		e		
ej	ow	æ	ɔ	

ɑj		i		Cleanup II: swap backness in low diphthongs
ij		e		
ej	ow	æ	ɔ	

ɑj		ɪ		Cleanup III: short vowels are lax ³
ij		ɛ		
ej	ow	æ	ɔ	

ɑj		ɪ		Cleanup IV (American): low short back vowels are unrounded
ij		ɛ		
ej	ow	æ	ɑ	

<i>divine</i>		<i>divinity</i>	
<i>obscene</i>		<i>obscenity</i>	
<i>profane</i>	<i>cone</i>	<i>profanity</i>	<i>conical</i>

15. Vowel Shift stated formally

$$(34) \quad \left[\begin{array}{c} + \text{tense} \\ \mathbf{v} \end{array} \right] \rightarrow \left\{ \begin{array}{l} \left[\begin{array}{c} -\alpha \text{high} \\ \hline \alpha \text{high} \\ -\text{low} \end{array} \right] \quad (a) \\ \left[\begin{array}{c} -\beta \text{low} \\ \hline \beta \text{low} \\ -\text{high} \end{array} \right] \quad (b) \end{array} \right.$$

16. Much of the rest of Chapter 3: dog wagging tail (?)

- Given that we want Vowel Shift to be a general rule, then all of the other vowels need to have UR's that, when filtered through Vowel Shift, yield the right surface form.

17. [æw]

- It is the “partner” phonetically of [aj] and receives a parallel derivation.

³ Not in SPE, but included here to make the transcriptions more phonetic/familiar.

i:	u:	i	u	Underlying forms
e:		e		
æ:	ɔ:	æ	ɔ	
i:j	u:w	i	u	Diphthongization: insert glide agreeing in backness
e:j		e		
æ:j	ɔ:w	æ	ɔ	
e:j	o:w	i	u	Vowel Shift I: swap the feature [high] in nonlow vowels.
i:j		e		
æ:j	ɔ:w	æ	ɔ	
æ:j	ɔ:w	i	u	Vowel Shift II: swap the feature [low] in nonhigh vowels.
i:j		e		
e:j	o:w	æ	ɔ	
æj	ɔw	i	u	Cleanup I: remove redundant length
ij		e		
ej	ow	æ	ɔ	
æj	ɔw	i	u	Special Cleanup: remove rounding on nucleus of [ɔw]
ij		e		
ej	ow	æ	ɔ	
ɑj	æw	i	u	Cleanup II: swap backness in low diphthongs
ij		e		
ej	ow	æ	ɔ	
ɑj	æw	i	ʊ	Cleanup III: short vowels are lax ⁴
ij		e		
ej	ow	æ	ɔ	
—				Cleanup IV (American): low short back vowels are unrounded.

[🗨 So, what sort of alternations should we find?]

⁴ Not in SPE, but included here to make the transcriptions more phonetic/familiar.

18. Filling out the set of Trisyllabic Shortening alternations

- The single pair I know of is:

[æw] ~ [ʌ] *profound* ~ *profundity*

- SPE* offers a really ambitious account of the vowels spelled with *u*. ([u:], [ju:], [ʊ], [ʌ])
- Basically, [ʊ] and [ʌ] are allophones, with environments for both, but of course a bit of lexical listing (diacritics) as well.
- So the expected [ʊ] in *profundity* can appear as [ʌ].

19. And so on

- Chapter 4 continues with biographies of particular vowels, assigning them interesting underlying forms that let them ‘ride the rules’ to their appropriate surface form.
- Thus, [ɔɪ]:

/æ:/ Underlying form

æ:j Diphthongization: insert glide agreeing in backness and rounding

— Vowel Shift only affect “peripheral” vowels, with same backness and rounding

æj Cleanup I: remove redundant length

ɔj Cleanup II: swap backness in low diphthongs

- Thus, [a:], for dialects in which *father* is [ˈfɑ:ðə] and *bother* is [ˈfɑ:ðə]:

father *bother*

/ɑ:/ /ɔ/ UR

aw — Diphthongization

— — Vowel Shift blocked — backness-rounding mismatch

— ɑ Cleanup IV (American): unround short ɔ

ɑ:ʌ — Same lowering that applies to /ʊ/!

etc. various phonetic adjustments

REACTIONS TO SPE

20. Some early reactions

- James McCawley wrote a superb long review, asking about all sorts of interesting things
 - What theory of morphology is used here?
 - Does non-productivity and non-transparency threaten the analysis?
 - Are the patterns internalized by native speakers, or do they just memorize the words.

- McCawley, James D. "Review of *The sound pattern of English*." *Essays on the Sound Pattern of English* 1 (1975).
- Joan Bybee, then a UCLA grad student, took issue with the extreme abstractness of the UR's (recall *giraffe* [giɹæffe]) and went the opposite way, with a super-concretist theory of phonology.
- Paul Kiparsky took an intermediate course, using data from historical change to motivate a non-trivial but far less abstract approach, probably the dominant one today.
- John Ohala launched experimental phonology with a series of experiments meant to show that none of the patterns of *SPE* have psychological reality.
 - This set back progress (by affiliating experimentation with theory-hatred), but finally the pendulum has swung back, and nowadays we can ponder *SPE* with friendly/helpful/curious skepticism instead.
 - My own work with Albright on past tense alternations (Cognition 2003)
 - The work by Moore-Cantwell covered here.

SOME OTHER REACTIONS, WITH ISSUES STILL ALIVE TODAY

21. Who says the rules are simple?

- See the ferocious rhetoric ((13)) directed against the alternative of a complicated Vowel Shift rule — “quite intolerable”.
- A favorite form of rhetoric is to cite the Main Stress Rule of *SPE*

$$\begin{aligned}
 (15) \quad & \text{MAIN STRESS} \\
 & V \rightarrow [l \text{ stress}] / \left[X \text{---} C_0 \left(\begin{bmatrix} -\text{tense} \\ \gamma\text{stress} \\ V \end{bmatrix} C_0^1 \left(\begin{bmatrix} \alpha\text{voc} \\ \alpha\text{cons} \\ -\text{ant} \end{bmatrix} \right) \right) \right. \\
 & \left. / \text{---} \left\langle \left(\begin{bmatrix} (fik)At \\ [+D]C_0 \end{bmatrix} \right) \left\{ \begin{array}{l} \langle_1 + C_0 \rangle_1 \begin{bmatrix} -\text{stress} \\ -\text{tense} \\ -\text{cons} \end{bmatrix} [+cons]_0 \\ \langle_1 \begin{bmatrix} -\text{seg} \\ \langle_2 -FB \rangle_2 \end{bmatrix} \rangle_1 C_0 [\beta\text{stress}] C_0 \langle_2 V_0 C_0 \rangle_2 \end{array} \right\} \right\rangle \right]_{\langle NBP \langle_1 VA \rangle_1 \rangle} \\
 & \text{Conditions: } \beta = \begin{Bmatrix} 2 \\ 1 \end{Bmatrix} \\
 & \quad \gamma \leq 2 \\
 & \quad X \text{ contains no internal } \#
 \end{aligned}$$

- Nowadays, the idea that there is a *simplicity bias* in learning plays a major role in theorizing.
- Back to *SPE*: I sense that at least in the segmental phonology, all the rules are *natural*.
- Not surprising in that the analysis constantly recapitulates diachrony.

22. Anecdotalism

- We are constantly invited to imagine that all patterns are uncontroversially well exemplified, but this is often not true.
- We saw this already in (10g), elsewhere.
- We can see gaps more generally if we look at the complete set of underlying forms for the “basic six” vowels.

i:	u:	i	u
e:	o:	e	o
æ:	ɔ:	æ	ɔ

These surface, normally, as:

aɪ	aʊ	ɪ	ʊ/ʌ/ju:
i:	u:	ɛ	ʌ
eɪ	oʊ	e	ɑ

But I know of no alternations that relate [u:] (*not* with preceding [j]) and ʌ.

pergoom ~ pergumption

- So this relates to the modern wish to use digital resources to deal with the whole language at once, getting around the problems of anecdotality and representativeness.
- These resources are digital corpora and machine-assisted, statistically tested probabilistic grammars.

INVESTIGATING ENGLISH SEGMENTAL PHONOLOGY: A POSSIBLE METHOD

23. A possible way of finding all the alternations

- English orthography is “deep”, reflecting the pronunciations of several hundred years ago.
- So, it’s very good for morphology.
- Most of the alternations are suffix-triggered.
- So we can:
 - Use the orthography to find the bulk of the alternating stems.
 - Use the phonology of the alternating stems, aligned left-to-right, to find the alternating segments.

24. A bunch of suffixes

-an, -ation, -acy, -ary, -eous, -ial, -ian, -ic, ical, -id, -ify, -ion,
ious, -ity, -ive, -ory, -ous, tion, ure, -y

- Chosen mostly by curiosity/whim, but
- All are Level I.
- They include both “palatalizers” like -ial and “non-palatalizers” like -ory

25. A rough approximation for related -pair finding

- Try all the words, and for each, add every suffix.
- If the result is word, you have a good candidate for morphological relatedness.

atom + ic = atomic, which is a word

26. Hand trimback of accidents is needed

- This can be amusing, at least to me ...

cur ~ curious
Ted ~ tedious
pan ~ panic
can ~ canary

27. You can get more by searching “modified” stems

- Deduct “silent e”, you can get *allege* ~ *allegation*
- Deduct the suffix spelled -y, you can get *hierarchy* ~ *hierarchical*
- Deduct the quasi-morpheme -a, you can get *Canada* ~ *Canadian*.
- Change *ai* to *a*, you can get *vain* ~ *van-ity*

- Some quick numbers on this method: alternations found

do nothing	782	
remove e	930	
remove y	233	
remove a	20	
ai/a	13	
ai/e	7	
ou/u	2	[ɤ for example?]

28. Morphological related pairs can be searched left-to-right, segment by segment

academic
academician

- Pronunciations are from the same Bruce-edited Carnegie-Mellon Dictionary mentioned before.

AE2	K	AH0	D	EH1	M	IH0	K		
AE2	K	AH0	D	AH0	M	IH1	SH	AH0	N

29. Occasionally, but only occasionally, alignment fails

baptism ~ baptismal

B	AE1	P	T	IH0	Z	AH0	M		
B	AE2	P	T	IH1	Z	M	AH0	L	

WHAT IS THE SCOPE OF THE CLASSICAL SPE GENERALIZATIONS?

30. Up front: funny environments

- ic shortens just like its partner -ical, despite lack of enough syllables: *conic*
- ious shortens even when its [i] have been historically lost: *vicious*
- Prefixes with long vowels can shorten as well: *declare* [i] ~ *declaration* [ɛ]. Not counted here, but there are quite a few.

31. Trisyllabic Shortening

- 27 [aɪ] ~ [ɪ]

opine	opinion
bible	biblical
bile	bilious

divine	divinity
excise	excision
conspire	conspiracy
line	lineal
mime	mimic
saline	salinity
type	typify
type	typical
vile	vilify
expedite	expedition
expedite	expeditious
extradite	extradition
erudite	erudition
hermaphrodit	
e	hermaphroditic
palestine	palestinian
parasite	parasitic
reptile	reptilian
recondite	recondition
sacrifice	sacrificial
semitic	semitic
senile	senility
circumcise	circumcision
supervise	supervision
televise	television

7 more with “lost” trisyllabic environment:

ignite	ignition
incise	incision
contrite	contrition
christ	christian
precise	precision
revise	revision
vice	vicious

- 9 [eɪ] ~ [æ]

chaste	chastity
deprave	depravity
grave	gravity
humane	humanity
insane	insanity
nature	natural
nation	national
profane	profanity
sane	sanity

- 20 [i:] to [ɛ]

aesthete	aesthetic
repute	reputable
deprave	depravation
prepare	preparation
reform	reformation
recant	recantation
repute	reputation
obscene	obscenity
extreme	extremity
supreme	supremacy
serene	serenity
secret	secretary
athlete	athletic
atmosphere	atmospheric
zeal	zealous
austere	austerity
sphere	spherical
sincere	sincerity
severe	severity
discrete	discretion

- 7 [ou] ~ [ɑ]

mediocre	mediocrity
episode	episodic
gyroscope	gyroscopic
microscope	microscopic
pedagogy	pedagogical
telescope	telescopic
cone	conic

- 1 [au] ~ [ʌ] (*profound* ~ *profundity*)
- Upshot: these are not equally well attested; would the difference in data strength be reflected in differences of productivity?

32. Managerial Lengthening

- The real surprise is that “ordinary” alternations like:

Amazon ~ Amazonian

[ɑ] [ou]

study ~ studious

[ʌ] [u:]

are virtually nonexistent — these are the only two I know.

- Yet there are many cases where a reduced vowel alternates with a long vowel, as Managerial Lengthening says it should

with [eɪ]

advantage	advantageous
appropriate	appropriation
arab	arabian
desolate	desolation
fallacy	fallacious
episcopal	episcopalian
jordan	jordanian
canada	canadian
courage	courageous
corporate	corporation
private	privation
certificate	certification
algebra	algebraic
formula	formulaic

with [i:]

comedy	comedian	
minister	ministerial	
remedy	remedial	
elizabeth	Elizabethan	not Managerial
strategy	strategic	not Managerial

with [ou]

felony	felonious	
harmony	harmonious	
colloquy	colloquial	
colony	colonial	
custody	custodial	
melody	melodious	
newton	newtonian	
theology	theologian	note again a “lost” environment

We noted that Managerial Lengthening does not affect [ɪ], and indeed [ɪ] is what we get when schwa (orthographic i) gets stressed under suffixation:

province	provincial
prejudice	prejudicial
vestige	vestigial

dictator	dictatorial
equator	equatorial
obstetric	obstetrician
optic	optician
academic	academician
egypt	egyptian
electric	electrician
geriatric	geriatrician
corinth	corinthian
logic	logician
magic	magician
music	musician
niger	nigerian
rhetoric	rhetorician
civil	civilian
sicily	sicilian
statistic	statistician
tactic	tactician
technic	technician

COBBLING AND REDUCED VOWEL RESTORATION

33. English and Sediiq (Jennifer Kuo's work in progress)

- Both languages have stress assigned from the right edge of the word.
- Both languages have Vowel Reduction (English to [ə], Sediiq to [u]).
- Both have paradigms with suffixation.
- Hence both require you to “cobble” classical UR's.

34. Cobbling in English: *atom*

- /æ/ from the base form ['æɾəm]
- /ɑ/ from the suffixed form *atomic* [ə'tam-ɪk]
- Hence /ætam/

35. The Albrightian single-surface base hypothesis

- Research oeuvre of Adam Albright, MIT.
- Language learners pick a single member of the paradigm as the source of information for UR's (or more generally, for phonological new creations).
- The one they pick is the most informative.

- Languages gradually restructure as learners replace the old lexically-listed, unpredictable forms with new ones derivable by the best stochastic grammar from the single surface base.
- This theory is more or less the opposite of cobbling theory.
- See Albright's work — and Kuo's — for support of this approach.

36. Cobbling has never been controversial in English phonology — should it be?

37. A paper by me that called English cobbling into question fairly early

- Hayes (1995) "On What To Teach the Undergraduates: Some Changing Orthodoxies in Phonological Theory." Published 1995 in Ik-Hwan Lee, ed., *Linguistics in the Morning Calm* 3, Hanshin, Seoul, pp. 59-77.

Here is an alternative: we set up the underlying form of *metal* as /mɛtəl/, similar to the isolation form. In the derived form /mɛtəl+ɪk/, stress is assigned to the penult by the lexical stress rules, then a rule of Full Vowel Restoration converts a stressed schwa into a short full vowel in the derived form.

(8) Full Vowel Restoration

$$\begin{bmatrix} \text{ə} \\ +\text{stress} \end{bmatrix} \rightarrow \begin{bmatrix} \text{V} \\ -\text{long} \end{bmatrix}$$

The quality of the vowel created by Full Vowel Restoration (here [æ]) need not be specified in the rule, since the output form is itself a lexical entry. Since Full Vowel Restoration serves only to relate listed lexical items, it can be expressed indeterminately

that the Vowel Reduction would also be retained in the grammar, to derive the initial reduced vowel in *metallic* [mɛtəɪlɪk] and similar forms.

Note

38. My anecdotal argument

A bit of evidence supporting Full Vowel Restoration is the widespread pronunciation by linguists of the feature name *consonantal* as [kənsənɛntəl], in spite of its spelling. It is extremely unusual for orthographic *a* in English to have the phonemic value /ɛ/. The pronunciation nonetheless seems to follow a clear pattern of English phonology: when [ə] occurring in the environment / ____ nt is assigned stress upon suffixation, the vowel that emerges is [ɛ]; cf. *environmental*, *accidental*, *momentous*, *residential*, *penitentiary*, etc. We hypothesize that alongside the generally indeterminate rule of Full Vowel Restoration, we also have a determinate subcase:

(9) /ε/ Restoration

$$\left[\begin{array}{c} \text{ə} \\ +\text{stress} \end{array} \right] \rightarrow \varepsilon / \text{ ______ nt}$$

39. The English-Sediiq parallel

- Confused language learners (literate adults!) have reshaped the lexicon (here, by one word) in ways predicted by the single surface base hypothesis.

40. Debt

- That that base is indeed the isolation form, not the suffixed form.
- Hayes suggested this is always so, but later work suggests this might not be true.

41. So, could there be a grammar that “restores” schwas according to their context?

The data are very substantial.

Since we are not killing trees, let us just list them for now.

I omit schwas restored as long vowels by Managerial Lengthening.

Restoration of ER as AO R	professor	professorial
Restoration of ER as EH R	familiar	familiarity
Restoration of ER as EH R	homer	homeric
Restoration of ER as EH R	irregular	irregularity
Restoration of ER as EH R	insular	insularity
Restoration of ER as EH R	ovary	ovarian
Restoration of ER as EH R	popular	popularity
Restoration of ER as EH R	parliamentary	parliamentarian
Restoration of ER as EH R	peculiar	peculiarity
Restoration of ER as EH R	polar	polarity
Restoration of ER as EH R	prosper	prosperity
Restoration of ER as EH R	regular	regularity
Restoration of ER as EH R	similar	similarity
Restoration of ER as EH R	vulgar	vulgarity
Restoration of IY as AY prevocalically	maniac	maniacal
Restoration of schwa as AA	ontology	ontological
Restoration of schwa as AA	archaeology	archaeological
Restoration of schwa as AA	anarchy	anarchical
Restoration of schwa as AA	anarchy	anarchic
Restoration of schwa as AA	anatomy	anatomical
Restoration of schwa as AA	anthropology	anthropological
Restoration of schwa as AA	astrology	astrological
Restoration of schwa as AA	astronomy	astronomical
Restoration of schwa as AA	atom	atomic
Restoration of schwa as AA	ornithology	ornithological
Restoration of schwa as AA	ion	ionic
Restoration of schwa as AA	ideology	ideological
Restoration of schwa as AA	irony	ironic
Restoration of schwa as AA	irony	ironical
Restoration of schwa as AA	biology	biological
Restoration of schwa as AA	diocese	diocesan
Restoration of schwa as AA	demon	demonic

Restoration of schwa as AA	demonstrate	demonstrative
Restoration of schwa as AA	despot	despotic
Restoration of schwa as AA	ecology	ecological
Restoration of schwa as AA	economy	economic
Restoration of schwa as AA	economy	economical
Restoration of schwa as AA	etymology	etymological
Restoration of schwa as AA	photograph	photography
Restoration of schwa as AA	philanthropy	philanthropic
Restoration of schwa as AA	philosophy	philosophic
Restoration of schwa as AA	philosophy	philosophical
Restoration of schwa as AA	physiology	physiological
Restoration of schwa as AA	gastronomy	gastronomic
Restoration of schwa as AA	harmony	harmonic
Restoration of schwa as AA	equal	equality
Restoration of schwa as AA	interrogate	interrogatory
Restoration of schwa as AA	idiot	idiotic
Restoration of schwa as AA	geology	geological
Restoration of schwa as AA	compare	comparable
Restoration of schwa as AA	catastrophe	catastrophic
Restoration of schwa as AA	canon	canonical
Restoration of schwa as AA	causal	causality
Restoration of schwa as AA	chronology	chronological
Restoration of schwa as AA	lithograph	lithography
Restoration of schwa as AA	lethargy	lethargic
Restoration of schwa as AA	melody	melodic
Restoration of schwa as AA	mason	masonic
Restoration of schwa as AA	method	methodical
Restoration of schwa as AA	morphology	morphological
Restoration of schwa as AA	methodology	methodological
Restoration of schwa as AA	mythology	mythological
Restoration of schwa as AA	meteorology	meteorological
Restoration of schwa as AA	napoleon	napoleonic
Restoration of schwa as AA	polyphony	polyphonic
Restoration of schwa as AA	pathology	pathological
Restoration of schwa as AA	person	personify
Restoration of schwa as AA	parabola	parabolic
Restoration of schwa as AA	patriot	patriotic
Restoration of schwa as AA	period	periodic
Restoration of schwa as AA	period	periodical
Restoration of schwa as AA	synonym	synonymous
Restoration of schwa as AA	psychology	psychological
Restoration of schwa as AA	symbol	symbolic
Restoration of schwa as AA	symphony	symphonic
Restoration of schwa as AA	sociology	sociological
Restoration of schwa as AA	technology	technological
Restoration of schwa as AA	theology	theological
Restoration of schwa as AA	vitriol	vitriolic
Restoration of schwa as AA	objective	objectivity
Restoration of schwa as AA	obstetric	obstetrician
Restoration of schwa as AA	observe	observation
Restoration of schwa as AA	improvise	improvisation
Restoration of schwa as AA	commend	commendation
Restoration of schwa as AA	compile	compilation
Restoration of schwa as AA	compute	computation
Restoration of schwa as AA	connote	connotation
Restoration of schwa as AA	condemn	condemnation
Restoration of schwa as AA	condense	condensation
Restoration of schwa as AA	conductive	conductivity
Restoration of schwa as AA	confirm	confirmation
Restoration of schwa as AA	confront	confrontation

Restoration of schwa as AA	consult	consultation
Restoration of schwa as AA	conserve	conservation
Restoration of schwa as AA	continue	continuity
Restoration of schwa as AA	contribute	contribution
Restoration of schwa as AA	chronology	chronological
Restoration of schwa as AA	meteorology	meteorological
Restoration of schwa as AA	polyphony	polyphonic
Restoration of schwa as AE	octagon	octagonal
Restoration of schwa as AE	abnormal	abnormality
Restoration of schwa as AE	original	originality
Restoration of schwa as AE	eventual	eventuality
Restoration of schwa as AE	organ	organic
Restoration of schwa as AE	autobiography	autobiographical
Restoration of schwa as AE	iceland	icelandic
Restoration of schwa as AE	italy	italic
Restoration of schwa as AE	botany	botanical
Restoration of schwa as AE	biography	biographical
Restoration of schwa as AE	bestial	bestiality
Restoration of schwa as AE	brutal	brutality
Restoration of schwa as AE	dynasty	dynastic
Restoration of schwa as AE	demography	demographic
Restoration of schwa as AE	fatal	fatality
Restoration of schwa as AE	formal	formality
Restoration of schwa as AE	final	finality
Restoration of schwa as AE	photography	photographic
Restoration of schwa as AE	frugal	frugality
Restoration of schwa as AE	hexagon	hexagonal
Restoration of schwa as AE	herald	heraldic
Restoration of schwa as AE	human	humanity
Restoration of schwa as AE	irrational	irrationality
Restoration of schwa as AE	italy	italian
Restoration of schwa as AE	illegal	illegality
Restoration of schwa as AE	immoral	immorality
Restoration of schwa as AE	immortal	immortality
Restoration of schwa as AE	informal	informality
Restoration of schwa as AE	instrumental	instrumentality
Restoration of schwa as AE	gelatin	gelatinous
Restoration of schwa as AE	german	germanic
Restoration of schwa as AE	germany	germanic
Restoration of schwa as AE	general	generality
Restoration of schwa as AE	gymnast	gymnastic
Restoration of schwa as AE	geography	geographical
Restoration of schwa as AE	genial	geniality
Restoration of schwa as AE	climate	climatic
Restoration of schwa as AE	liberal	liberality
Restoration of schwa as AE	lithography	lithographic
Restoration of schwa as AE	legal	legality
Restoration of schwa as AE	local	locality
Restoration of schwa as AE	modal	modality
Restoration of schwa as AE	moral	morality
Restoration of schwa as AE	mortal	mortality
Restoration of schwa as AE	mental	mentality
Restoration of schwa as AE	national	nationality
Restoration of schwa as AE	normal	normality
Restoration of schwa as AE	neutral	neutrality
Restoration of schwa as AE	particular	particularity
Restoration of schwa as AE	punctual	punctuality
Restoration of schwa as AE	personal	personality
Restoration of schwa as AE	pornography	pornographic
Restoration of schwa as AE	plural	plurality

Restoration of schwa as AE	practical	practicality
Restoration of schwa as AE	principal	principality
Restoration of schwa as AE	puritan	puritanical
Restoration of schwa as AE	rational	rationality
Restoration of schwa as AE	satan	satanic
Restoration of schwa as AE	psychiatry	psychiatric
Restoration of schwa as AE	sexual	sexuality
Restoration of schwa as AE	sentimental	sentimentality
Restoration of schwa as AE	tyranny	tyrannical
Restoration of schwa as AE	typography	typographical
Restoration of schwa as AE	titan	titanic
Restoration of schwa as AE	technical	technicality
Restoration of schwa as AE	tonal	tonality
Restoration of schwa as AE	total	totality
Restoration of schwa as AE	trivial	triviality
Restoration of schwa as AE	theatre	theatrical
Restoration of schwa as AE	vital	vitality
Restoration of schwa as AE	venal	venality
Restoration of schwa as AE	adapt	adaptation
Restoration of schwa as AE	adore	adoration
Restoration of schwa as AE	affirm	affirmation
Restoration of schwa as AE	affect	affectation
Restoration of schwa as AE	academy	academic
Restoration of schwa as AE	accuse	accusation
Restoration of schwa as AE	allege	allegation
Restoration of schwa as AE	anatomy	anatomical
Restoration of schwa as AE	appellate	appellation
Restoration of schwa as AE	aspire	aspiration
Restoration of schwa as AE	astrology	astrological
Restoration of schwa as AE	astronomy	astronomical
Restoration of schwa as AE	ferment	fermentation
Restoration of schwa as AE	catastrophe	catastrophic
Restoration of schwa as AE	mature	maturation
Restoration of schwa as AE	machine	machination
Restoration of schwa as AE	pathology	pathological
Restoration of schwa as AE	perspire	perspiration
Restoration of schwa as AE	perturb	perturbation
Restoration of schwa as AE	certificate	certification
Restoration of schwa as AE	statistic	statistician
Restoration of schwa as AH	autumn	autumnal
Restoration of schwa as AH	illustrate	illustrative
Restoration of schwa as AH	industry	industrial
Restoration of schwa as AH	industry	industrious
Restoration of schwa as EH	academy	academic
Restoration of schwa as EH	accident	accidental
Restoration of schwa as EH	angel	angelic
Restoration of schwa as EH	orchestra	orchestral
Restoration of schwa as EH	ornament	ornamental
Restoration of schwa as EH	detriment	detrimental
Restoration of schwa as EH	department	departmental
Restoration of schwa as EH	different	differential
Restoration of schwa as EH	existent	existential
Restoration of schwa as EH	exponent	exponential
Restoration of schwa as EH	element	elemental
Restoration of schwa as EH	element	elementary
Restoration of schwa as EH	asymmetry	asymmetrical
Restoration of schwa as EH	heretic	heretical
Restoration of schwa as EH	execute	executive
Restoration of schwa as EH	experiment	experimental
Restoration of schwa as EH	electromagnet	electromagnetic

Restoration of schwa as EH	environment	environmental
Restoration of schwa as EH	imperfect	imperfection
Restoration of schwa as EH	incident	incidental
Restoration of schwa as EH	instrument	instrumental
Restoration of schwa as EH	geometry	geometric
Restoration of schwa as EH	geometry	geometrical
Restoration of schwa as EH	complement	complementary
Restoration of schwa as EH	confident	confidential
Restoration of schwa as EH	consequent	consequential
Restoration of schwa as EH	continent	continental
Restoration of schwa as EH	compensate	compensatory
Restoration of schwa as EH	contemplate	contemplative
Restoration of schwa as EH	coincident	coincidental
Restoration of schwa as EH	monument	monumental
Restoration of schwa as EH	magnet	magnetic
Restoration of schwa as EH	majesty	majestic
Restoration of schwa as EH	moment	momentous
Restoration of schwa as EH	negate	negative
Restoration of schwa as EH	parliament	parliamentary
Restoration of schwa as EH	parent	parental
Restoration of schwa as EH	poet	poetic
Restoration of schwa as EH	provident	providential
Restoration of schwa as EH	prophet	prophetic
Restoration of schwa as EH	prefer	preferable
Restoration of schwa as EH	prudent	prudential
Restoration of schwa as EH	relate	relative
Restoration of schwa as EH	regiment	regimental
Restoration of schwa as EH	reverent	reverential
Restoration of schwa as EH	resident	residential
Restoration of schwa as EH	sacrilege	sacrilegious
Restoration of schwa as EH	sequent	sequential
Restoration of schwa as EH	solemn	solemnity
Restoration of schwa as EH	symmetry	symmetrical
Restoration of schwa as EH	supplement	supplementary
Restoration of schwa as EH	sedate	sedative
Restoration of schwa as EH	sediment	sedimentary
Restoration of schwa as EH	sentiment	sentimental
Restoration of schwa as EH	system	systemic
Restoration of schwa as EH	tangent	tangential
Restoration of schwa as EH	torrent	torrential
Restoration of schwa as EH	temperament	temperamental
Restoration of schwa as EH	testament	testamentary
Restoration of schwa as EH	transcendent	transcendental
Restoration of schwa as EH	argument	argumentation
Restoration of schwa as EH	ornament	ornamentation
Restoration of schwa as EH	defame	defamation
Restoration of schwa as EH	degrade	degradation
Restoration of schwa as EH	declare	declaration
Restoration of schwa as EH	demography	demographic
Restoration of schwa as EH	design	designation
Restoration of schwa as EH	exhort	exhortation
Restoration of schwa as EH	ecology	ecological
Restoration of schwa as EH	economy	economic
Restoration of schwa as EH	economy	economical
Restoration of schwa as EH	exasperate	exasperation
Restoration of schwa as EH	exhibit	exhibition
Restoration of schwa as EH	eccentric	eccentricity
Restoration of schwa as EH	expire	expiration
Restoration of schwa as EH	expire	expiry
Restoration of schwa as EH	expect	expectation

Restoration of schwa as EH	explore	exploration
Restoration of schwa as EH	elizabeth	elizabethan
Restoration of schwa as EH	enclose	enclosure
Restoration of schwa as EH	government	governmental
Restoration of schwa as EH	implement	implementation
Restoration of schwa as EH	instrument	instrumentation
Restoration of schwa as EH	parabola	parabolic
Restoration of schwa as EH	preserve	preservation
Restoration of schwa as EH	refute	refutation
Restoration of schwa as EH	regiment	regimentation
Restoration of schwa as EH	recite	recitation
Restoration of schwa as EH	restore	restoration
Restoration of schwa as EH	reserve	reservation
Restoration of schwa as EH	resign	resignation
Restoration of schwa as EH	specific	specificity
Restoration of schwa as EH	specific	specification
Restoration of schwa as IH	origin	original
Restoration of schwa as IH	medicine	medicinal
Restoration of schwa as IH	politic	political
Restoration of schwa as IH	residue	residual
Restoration of schwa as IH	dominic	dominican
Restoration of schwa as IH	dispense	dispensation
Restoration of schwa as IH	divine	divination
Restoration of schwa as IH	deport	deportation
Restoration of schwa as IH	import	importation
Restoration of schwa as IH	inform	information
Restoration of schwa as IH	incline	inclination
Restoration of schwa as IH	inspire	inspiration
Restoration of schwa as IH	install	installation
Restoration of schwa as IH	invite	invitation
Restoration of schwa as IH	relax	relaxation
Restoration of schwa as IH	artifice	artificial
Restoration of schwa as IH	artery	arterial
Restoration of schwa as IH	office	official
Restoration of schwa as IH	family	familial
Restoration of schwa as IH	manager	managerial
Restoration of schwa as IH	province	provincial
Restoration of schwa as IH	prejudice	prejudicial
Restoration of schwa as IH	vestige	vestigial
Restoration of schwa as IH	dictator	dictatorial
Restoration of schwa as IH	equator	equatorial
Restoration of schwa as IH	obstetric	obstetrician
Restoration of schwa as IH	optic	optician
Restoration of schwa as IH	academic	academician
Restoration of schwa as IH	egypt	egyptian
Restoration of schwa as IH	electric	electrician
Restoration of schwa as IH	geriatric	geriatrician
Restoration of schwa as IH	corinth	corinthian
Restoration of schwa as IH	logic	logician
Restoration of schwa as IH	magic	magician
Restoration of schwa as IH	music	musician
Restoration of schwa as IH	niger	nigerian
Restoration of schwa as IH	rhetoric	rhetorician
Restoration of schwa as IH	civil	civilian
Restoration of schwa as IH	sicily	sicilian
Restoration of schwa as IH	statistic	statistician
Restoration of schwa as IH	tactic	tactician
Restoration of schwa as IH	technic	technician
Restoration of schwa as IH	optimist	optimistic
Restoration of schwa as IH	artist	artistic

Restoration of schwa as IH	antagonist	antagonistic
Restoration of schwa as IH	acid	acidic
Restoration of schwa as IH	idyll	idyllic
Restoration of schwa as IH	chauvinist	chauvinistic
Restoration of schwa as IH	atheist	atheistic
Restoration of schwa as IH	fatalist	fatalistic
Restoration of schwa as IH	futurist	futuristic
Restoration of schwa as IH	horrify	horrific
Restoration of schwa as IH	humanist	humanistic
Restoration of schwa as IH	imperialist	imperialistic
Restoration of schwa as IH	impressionist	impressionistic
Restoration of schwa as IH	individualist	individualistic
Restoration of schwa as IH	journalist	journalistic
Restoration of schwa as IH	capitalist	capitalistic
Restoration of schwa as IH	linguist	linguistic
Restoration of schwa as IH	monopolist	monopolistic
Restoration of schwa as IH	materialist	materialistic
Restoration of schwa as IH	moralist	moralistic
Restoration of schwa as IH	narcissist	narcissistic
Restoration of schwa as IH	naturalist	naturalistic
Restoration of schwa as IH	nationalist	nationalistic
Restoration of schwa as IH	pacify	pacific
Restoration of schwa as IH	pessimist	pessimistic
Restoration of schwa as IH	pugilist	pugilistic
Restoration of schwa as IH	sadist	sadistic
Restoration of schwa as IH	philanthropy	philanthropic
Restoration of schwa as IH	philosophy	philosophic
Restoration of schwa as IH	individualist	individualistic
Restoration of schwa as IH	lithography	lithographic
Restoration of schwa as IH	egotist	egotistical
Restoration of schwa as IH	philosophy	philosophical
Restoration of schwa as IH	mythology	mythological
Restoration of schwa as IH	acid	acidify
Restoration of schwa as IH	solid	solidify
Restoration of schwa as IH	opposite	opposition
Restoration of schwa as IH	edit	edition
Restoration of schwa as IH	definite	definition
Restoration of schwa as IH	exhibit	exhibition
Restoration of schwa as IH	inhibit	inhibition
Restoration of schwa as IH	intuit	intuition
Restoration of schwa as IH	posit	position
Restoration of schwa as IH	requisite	requisition
Restoration of schwa as IH	transit	transition
Restoration of schwa as IH	distribute	distribution
Restoration of schwa as IH	imperfect	imperfection
Restoration of schwa as IH	impersonate	impersonation
Restoration of schwa as IH	infiltrate	infiltration
Restoration of schwa as IH	inhibit	inhibition
Restoration of schwa as IH	intuit	intuition
Restoration of schwa as IH	elongate	elongation
Restoration of schwa as IH	malice	malicious
Restoration of schwa as IH	mystery	mysterious
Restoration of schwa as IH	prodigy	prodigious
Restoration of schwa as IH	objective	objectivity
Restoration of schwa as IH	active	activity
Restoration of schwa as IH	agile	agility
Restoration of schwa as IH	acid	acidity
Restoration of schwa as IH	authentic	authenticity
Restoration of schwa as IH	docile	docility
Restoration of schwa as IH	domestic	domesticity

Restoration of schwa as IH	eccentric	eccentricity
Restoration of schwa as IH	fertile	fertility
Restoration of schwa as IH	facile	facility
Restoration of schwa as IH	feminine	femininity
Restoration of schwa as IH	festive	festivity
Restoration of schwa as IH	fluid	fluidity
Restoration of schwa as IH	fragile	fragility
Restoration of schwa as IH	futile	futility
Restoration of schwa as IH	hostile	hostility
Restoration of schwa as IH	humid	humidity
Restoration of schwa as IH	electric	electricity
Restoration of schwa as IH	inactive	inactivity
Restoration of schwa as IH	insensitive	insensitivity
Restoration of schwa as IH	immobile	immobility
Restoration of schwa as IH	infertile	infertility
Restoration of schwa as IH	elastic	elasticity
Restoration of schwa as IH	conductive	conductivity
Restoration of schwa as IH	captive	captivity
Restoration of schwa as IH	creative	creativity
Restoration of schwa as IH	liquid	liquidity
Restoration of schwa as IH	lucid	lucidity
Restoration of schwa as IH	masculine	masculinity
Restoration of schwa as IH	morbid	morbidity
Restoration of schwa as IH	mobile	mobility
Restoration of schwa as IH	native	nativity
Restoration of schwa as IH	public	publicity
Restoration of schwa as IH	passive	passivity
Restoration of schwa as IH	rapid	rapidity
Restoration of schwa as IH	relative	relativity
Restoration of schwa as IH	rigid	rigidity
Restoration of schwa as IH	subjective	subjectivity
Restoration of schwa as IH	solid	solidity
Restoration of schwa as IH	civil	civility
Restoration of schwa as IH	sensitive	sensitivity
Restoration of schwa as IH	selective	selectivity
Restoration of schwa as IH	specific	specificity
Restoration of schwa as IH	sterile	sterility
Restoration of schwa as IH	stupid	stupidity
Restoration of schwa as IH	toxic	toxicity
Restoration of schwa as IH	timid	timidity
Restoration of schwa as IH	volatile	volatility
Restoration of schwa as IH	valid	validity
Restoration of schwa as IH	virile	virility
Restoration of schwa as IH	virgin	virginity
Restoration of schwa as IH	versatile	versatility
Restoration of schwa as IH	illegal	illegality
Restoration of schwa as IH	immoral	immorality
Restoration of schwa as IH	immortal	immortality
Restoration of schwa as IH	immobile	immobility
Restoration of schwa as IH	informal	informality
Restoration of schwa as IH	infertile	infertility
Restoration of schwa as IH	inferior	inferiority
Restoration of schwa as IH	elastic	elasticity
Restoration of schwa as IH	definite	definitive
Restoration of schwa as IH	indicate	indicative
Restoration of schwa as IH	obligate	obligatory
Restoration of schwa as IH	confiscate	confiscatory
Restoration of schwa as IH	carnivore	carnivorous
Restoration of schwa as IH	conifer	coniferous
Restoration of schwa as IH	ridicule	ridiculous

Restoration of schwa as IH
 Restoration of schwa as OW
 Restoration of schwa as OW

infinite	infinity
domestic	domesticity
photography	photographic

42. Where we might head with this

- With Kuo, see how well a true single-base grammar can perform.

43. Some islands of hope

- Managerial Lengthening, applicable really only reduced vowels, is a huge argument for Albrightianism, I think: only by regarding it as a *rule of reduced vowel restoration* can we capture the generalization that it affects only vowels that surface (in the base form) as stressless.
- This emerges from several non-undergoers I have found:
 - rebellious
 - repression
 - and others, out of time ...
- This could be wug tested.
- ['pɪəsən] ~ Xian [pɪə's__niən]
- ['pɪən] ~ Xian ['pɪ__niən]
- My corpus fully confirms the goodness of the Hayes /nt/ generalization.

44. Some islands of non-hope

- All English speakers who know these words are literate.
- English is a massively normative language.
- So it is pretty unlikely that speakers can get away very often with “errors” like *conson[ɛ]ntal*.

45. For next time

- Some tentative results in creating a Kuovian grammar for vowel quality restoration in English.