Class 6, 3/18/2018: Knobs II

1. Assignments

- Read for next time:
  - Lise Menn (1983) Development of articulatory, phonetic, and phonological capabilities. In Brian Butterworth, *Language Production* vol. 2. Academic Press.
  - I will mail it out; web site still down.
- Homework on bias due in class Monday April 23.

COMMENTS ON MEDIAL CLUSTER HOMEWORK

2. Looks good

- Everyone is with the program, and various imaginative things popped up.

3. Integrating more traditional phonology

- The traditional story is define onsets, define codas, concatenate, add a few trans-syllabic constraints.
- This would imply including the initial and final clusters in the spreadsheet, trying general constraints that penalize e.g. both CC and C#.
- Then, we have the problem of syllabification; is [b] in [abra] an onset or coda?
  - The problem of **hidden structure**, to be covered later.

4. Repaired violations

- Sometimes a trans-syllabic constraint is actively repaired, so the constraint you posit interact with Faithfulness.

5. The Syllable Contact Law

- Useless. Every single language.

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6. A reference source on modeling I couldn't find earlier

- Burnham, Kenneth P., Anderson, David R. (2002) *Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach*. Springer. Pricey.
  - Fisheries bit was: Colorado Cooperative Fish and Wildlife Research Unit.
- Coetzee and Pater cite an article by this helpful pair of statisticians.

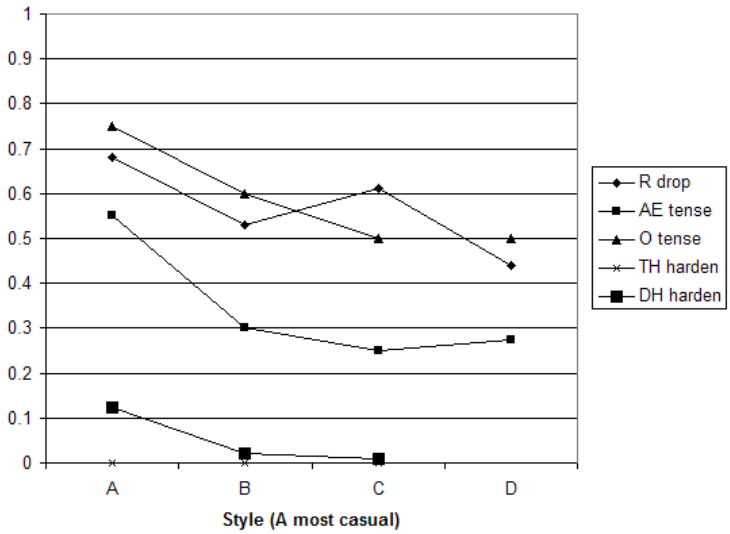
MORE ON KNOBS

7. What have we got so far?

- Four conjectured "knobs":
  - style
  - emphasis
  - rate
  - lexical frequency
- A fifth knob made dubious by acquisition issues:
  - identity, depending on exposure to enough learning data in childhood[1]
- Classical methods of measuring the effect of style: Labov's interviews and observations
- Lockstep: New Yorkers lockstep their application of:
  - ɹ → ∅ in codas
  - /æ/ → [ɪə] before certain consonants
  - /ɔ/ → [ʊɔ]
  - /θ,ð/ → [t͡θ, d͡ð] or [t̪, d̪]
- We were about to examine some lockstepped Lower East Siders

8. Phonological free variation in the speech of Miriam

- Miriam is 35 years old, graduated Hunter College and St. John's law school, works as lawyer.



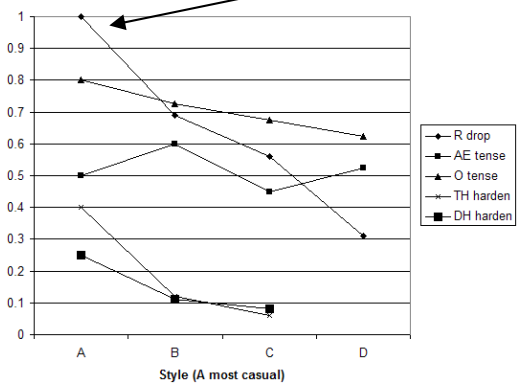
- The phenomenon that an upstate-raised General American speaker (BH) finds eeriest is theta-hardening, where Miriam is at zero in all styles.

[1] I may have paid this short shrift: while I cannot *talk like* a New Yorker or British person, their accents are easily intelligible to me, unlike (say) obscure rural Irish dialects. I clearly have learned something for purposes of perception, perhaps even post-critical period. See later on breaking competence into production vs. perception components.

- *thin* [t̪ɪn] who ever says this?
- *this* [d̪ɪs], *sad* [sɪəd], *law* [lʊə], *car* [kɑː] how charming, how quaint

9. Variation in the speech of Doris

- Doris is 39, homemaker, African-American.
- She doesn't have perfect lockstep
- Labov thinks that for Doris, and others, r-dropping is more sensitive to style than other processes.



10. Why is Doris not lockstepped? A conjecture

- Perhaps she is bidialectal in African-American Vernacular English?
- Conceivably she is switching dialects as well as styles?

11. Is there more available somewhere?

- Sociolinguistics seems to be is shifting its emphasis away from phonology …
- But the older sort of data — careful tracking of application rates of multiple processes across style-controlled elicitation — seems our best hope for studying the style knob.

12. Another way to check lockstep: two processes in the same word

- *Tantalus* /ˈtæntələs/. Rare, (see below), which encourages non-Tapping.
- Eligible processes:
  - NT Tapping: $\{nt\} \rightarrow \tilde{r} \,/\, V \_\_\_ \begin{bmatrix} V \\ -stress \end{bmatrix}$
  - /æ/ Tensing: $æ \rightarrow ɪə \,/\, \_\_\_ \{m,n\}$
- Candidate pronunciations:
  - [ˈtæ̃ntələs]
  - [ˈtĩ̃ntələs]
  - ?[ˈtæ̃r̃ələs]

- [ˈtĩə̃ɾələs]

- Socrates: what is going on here?

13. Here is another example

- *mountain* /ˈmaʊntən/.
- Eligible processes:
  - NT Tapping: $\{nt\} \rightarrow \tilde{r} / V \_\_\_ \begin{bmatrix} V \\ -stress \end{bmatrix}$
  - Syllabic Nasal Formation: ən → n̩ / {t,d}___
- Candidate pronunciations:
  - [ˈmaʊntən]
  - *[ˈmaʊr̃n̩] impossible, Tapping requires a right-side vowel
  - ?[ˈmaʊr̃ən] I don't like this, but others can say it.[2]
  - [ˈmaʊntn̩]

14. Term paper topic?

- Formalize the Coetzee/Pater knob below and make correct predictions about such cases, sometimes known as "register conflict".

15. Free variation in society is structured as well

- Fig. 4.2 from William Labov (1972) *Sociolinguistic Patterns*

[2] My evidence is a recording by the folk singer Pete Seeger, listened to by me on disk in childhood and cassette in parenthood: "She'll be comin' round the [ˈmaʊr̃ən] when she comes".

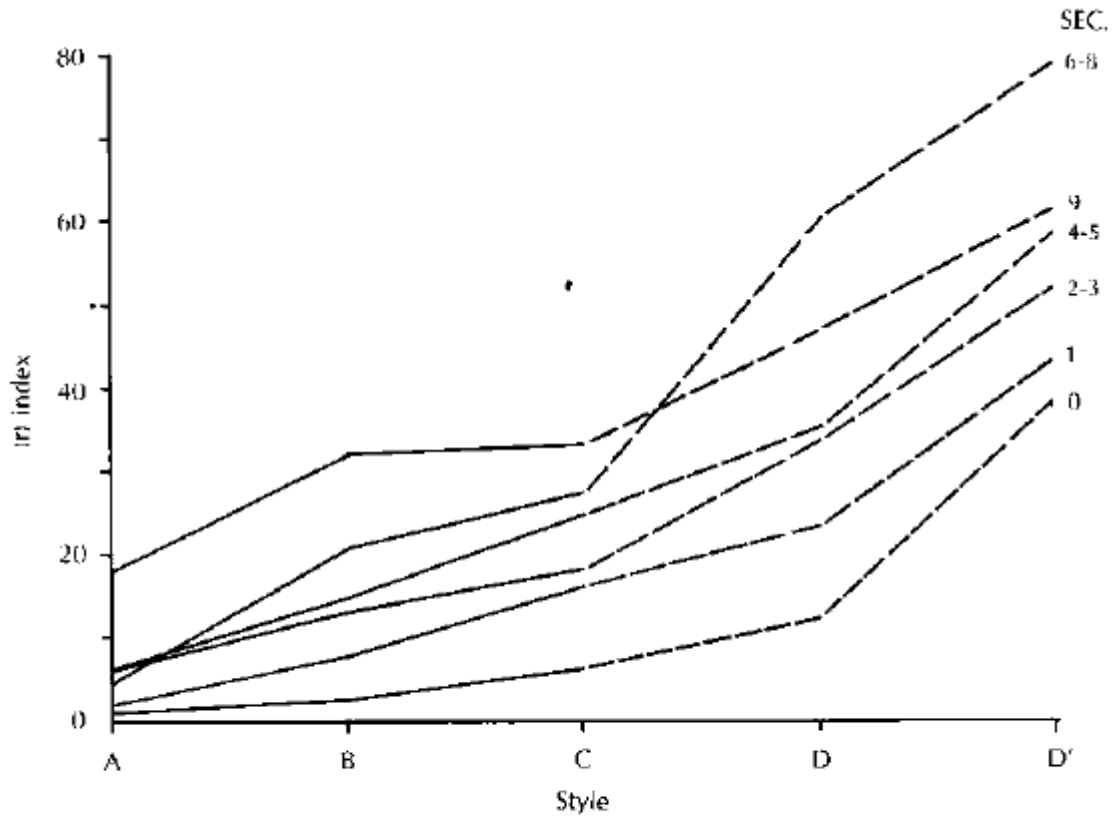


Fig. 4.2. Class stratification of a linguistic variable in process of change: (r) in *guard, car, bear, beard, board,* etc. SEC (Socio-economic class) scale: 0–1, lower class; 2–4, working class; 5–6, 7–8, lower middle class; 9, upper middle class. A, casual speech; B, careful speech; C, reading style; D, word lists; D', minimal pairs.

- from 81 native speakers of New York City English
- Vertical axis: what percentage of underlying /ɹ/ are retained in the output?
- An independent investigation sorted the speakers into their social classes.
- The "leaping up" of the lower-middle-class speakers in the formal styles is found in other studies, and is claimed to reflect a social insecurity independently diagnosed by other tests.[3]
- Perhaps these speakers have similar grammars but habitually set their style knobs differently?
    - Again, the "who listens to whom during acquisition" issue arises; lawyer Miriam may have never met Bennie, Labov's truck driver.

16. The research challenge

- Do knobs exist as entities, so that multiple processes really do vary in lockstep?
- If so, how can we implement knobs in a formal phonological grammar?

[3] For example: series of questions: "how do you say this word? … how should this word be said?", total cases of difference.

- Can Harmonic Grammar/maxent help?
- In empirical work, are there rigorous ways for us to track how knobs are set?

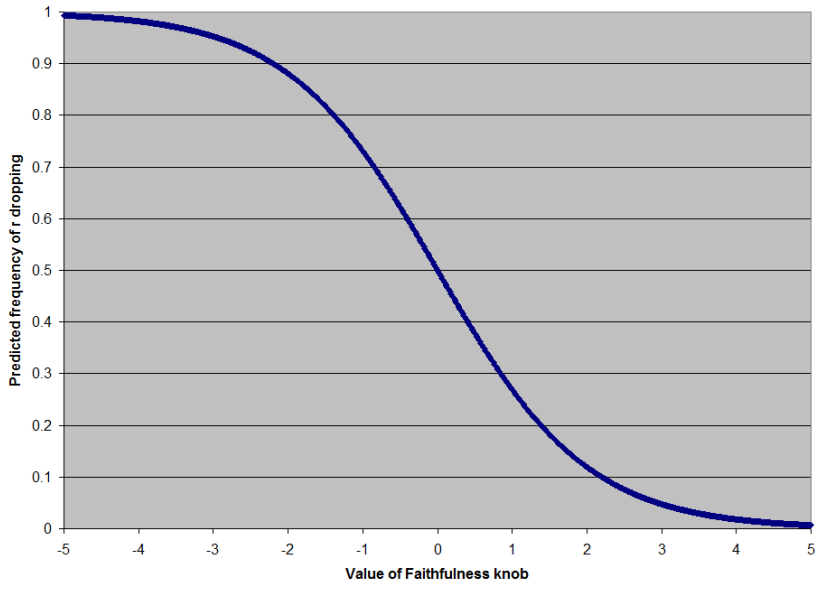
A HALLMARK OF KNOBS IN MAXENT: SIGMOID CURVES

17. Goal

- Understand the qualitative predictions a theory makes, so we know what to look for.

18. Scenario

- We set in conflict a Markedness constraint and a Faithfulness constraint, for R Dropping:
  - *CODA r
  - MAX(r)
- We follow Coetzee and Kawahara, below, in assigning our knob to the Faithfulness constraints.
- Under this scheme, MAX(r) gets an augment or decrement, based on setting of some knob.
  - Call it K.
- Harmony of /kɑr/ → [kɑ]: weight of MAX(r) + K
- Harmony of /kɑr/ → [kɑr]: weight of *CODA(r)
- Let's do a little spreadsheet, checking every value of K from −5 to +5.



- This is the beautiful **logistic curve**, a common output pattern of maxent.
- It is centered at K = 0, with the varying slope that reflects the barriers to certainty near 1 and 0.
- The math is presented in full detail in the Supplementary Materials to:

  - Laura McPherson and Bruce Hayes (2016) Relating application frequency to morphological structure: the case of Tommo So vowel harmony. *Phonology* 33: 125–16
- I suspect that Noisy Harmonic Grammar (below) would behave the same but I'm not sure.

19. A consequences of maxent for knob theory

- If the knob is a simple number (harmony adjustment), it should have
  - small consequences for processes that are at extremes: near-impossible, near-obligatory
  - large consequences for processes that apply with close to 50/50 probability.
- We might try to read confirmation/disconfirmation off of Labov's diagrams for Miriam, Doris, etc. [term paper topic?]
- Or compare near-obligatory regular Tapping with the less-likely-to-apply NT Tapping, seen in *center* [ˈsɛ̃ɾ̃ɚ].

EFFECTS OF FREQUENCY IN PHONOLOGY: NOT ALL OF THEM NECESSARILY GRAMMAR

20. Acquisition effects

- The rare is hard to memorize.
- Hence irregular forms tend to get regularized when frequency goes down.
- See readings p. 81: Bybee showed that old irregular pasts, like *chide ~ chid,* got regularized in this way.[4]

21. Nativization effects

- A foreign word becomes more common in usage.
- It starts to feel ever more strange to give it its faithful foreign rendition.
- Thus, regularization.
  - Partly removing marked, foreign configurations
  - Partly just making more faithful to the orthography
- In my lifetime, I suspect, these have been accommodated:
  - *croissant* [kʁwasɑ̃] → [kɹəˈsɑnt]
  - *cappuccino* [kɑpuˈtʃinoʊ] → [kæpəˈtʃinoʊ]
  - *gazpacho* [ˌgɑsˈpatʃoʊ] → [gəsˈpɑtʃoʊ]
- I believe that the second example in the readings is of this kind; Japanese speakers getting used to foreign words with [bb], [dd], etc.
- Is there a "perceived foreignness" knob?

[4] Bybee, Joan (1985) *Morphology: a study of the relation between meaning and form.* Philadelphia: Benjamins.

22. Online production effects of frequency (focus here)

- Psycholinguistics has shown that the listener knows the frequencies of words, and weights their probabilities in perception.
  - ➢ This is probably one of the best-established results in the field.
- Greater Faithfulness in speaking gives your hearer a better chance on rarer words — this accords with my commonsense experience.

23. Example: let us experience our Sprachgefühl for Tapping

- This is from my little utility; words from CMU Dictionary; frequencies from CELEX:[5]
- Obviously-affixed words excluded.

little	21886	*gratis*	5
water	8418	*natter*	5
matter	6622	*bonito*	4
society	6066	*carotid*	4
city	4867	*catacomb*	4
letter	3706	*Catalonia*	4
total	2520	*catamaran*	4
committee	2503	*clematis*	4
quality	2369	*cuticle*	4
daughter	2305	*betel*	3
hospital	2300	*philately*	2
attitude	2246	*poinsettia*	2
pattern	2213	*vibrato*	2
bottle	2181	*yeti*	2
pretty	2125	*lotto*	1

COETZEE AND KAWAHARA

24. Coetzee and Kawahara's hypothesis: the Frequency knob is implemented by Faithfulness variability

$$\mathsf{H}(cand) = \sum_{i=1}^{n} (w_i + nz_i) M_i(cand) + \sum_{j=1}^{m} (w_j + nz_j + sf) F_j(cand)$$

- This is the Harmony formula, which they then plug into the Noisy Harmonic Grammar framework, similar in results to maxent.
- The formula sums up Markedness and Faithfulness.
- Since it's NHG, we have noise (***nz*$_i$**), added into every constraint weight.
- The scaling factor ***sf*** (my K) is the same for all Faithfulness constraints (lockstep), and its value comes from another equation relating it to frequency.

[5] Actually, *Britain* and *British* are way up there; I removed them as unlikely to be super-frequent for non-Brits.

25. The first stage of the math: computing the scaling factor from frequency

- Find the value at which this function (called the beta distribution) achieves its maximum:

$$f(x, \alpha, \beta, \rho) = \rho \frac{x^{\alpha-1}(1-x)^{\beta-1}}{\int_0^1 x^{\alpha-1}(1-x)dx}$$

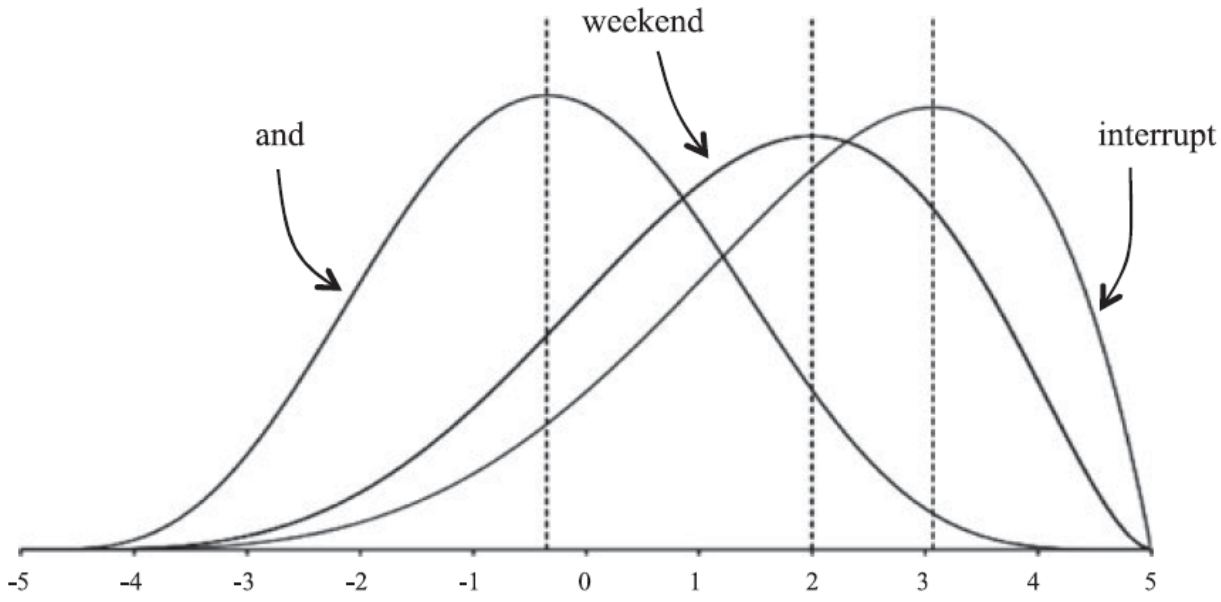
where

- rho = general amount of oomph the factor provides; C+K obtained a value by fitting to their data
- α = log of "reference frequency"; the median frequency of the corpus sorted by tokens
- β = log of frequency of the word you are dealing with

26. Understanding this formula

- I am at a loss for why they chose it.
- The rough qualitative pattern is certainly appropriate:
  - when a word is frequent, the scaling factor is negative (Faithfulness weights goes down)
  - when a word is infrequent, scaling factor is positive (Faithfulness weights go up).

27. Graph showing this



28. Interpreting the scaling factor

- Noisy Harmonic Grammar: Gaussian distribution for the constraint weight moves sideways by whatever the factor is.
- This changes probabilities of output candidates, in a way that could be solved analytically, I guess, but I will not try here.
- *If* we did it in maxent, our earlier theorem applies: log odds of Unfaithful candidate to Faithful candidate shift by the scaling factor.
- But since this is a two-stage process, we do not have some straightforward equation relating lexical frequency to rule application frequency.

29. First empirical study: /t/ deletion

- Buckeye Corpus
- Markedness and Faithfulness constraints are straightforward:
- Constraints used:

*CT]$_{\text{Word}}$

Assign one violation mark for every word that ends in the sequence [-Ct] or [-Cd].

MAX

Assign one violation mark for every input segment lacking an output correspondent.

MAX-PRE-V

Assign one violation mark for each segment that appears in pre-vocalic context in the input, and that does not have a correspondent in the output.

MAX-PRE-PAUSE

Assign one violation mark for each segment that appears in pre-pausal context in the input, and that does not have a correspondent in the output.

30. Knob

- All three Faithfulness constraints get the same knob-based boost/decrement.
- Note that since there is Faithfulness overlap there will be a *double* boost/decrement.

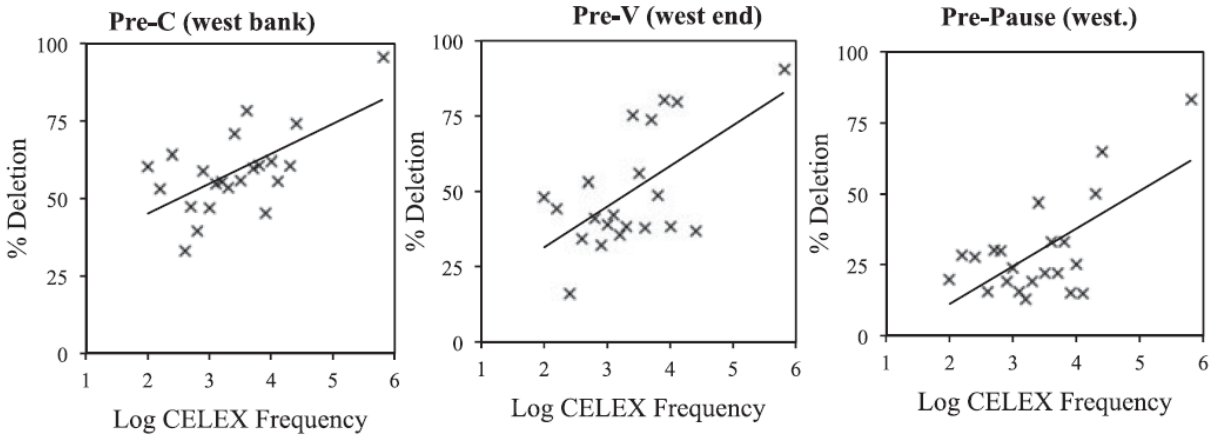
31. Incorporating frequency improves model performance

- They use the "AIC" (Akaike Information Criterion) and it unambiguously shows an improvement, properly taking into account the increase of 1 in parameter count.

32. Commentary I: choice of data

- The word *and* is extremely frequent and is an outlier in the distribution.

- Indeed, the raw distributions are narwhal-shaped.[6]



- So to what degree is the model performing as well as it is because of *and*?

33. Commentary II: testing the model

- I would see the "acid test" to be taking on some "lockstep" data, as above. Perhaps one phenomenon at a time is too easy?

GENERAL PREDICTIONS OF THE MODEL

34. Prediction (p. 78): no frequency reversals in different Markedness contexts

- If deletion word-finally is more common than deletion pre-consonantally for some lexical frequencies, it must be so for all lexical frequencies.
- Same, I suppose, for other knobs.

35. Prediction (p. 80): Markedness conflicts do not respect word frequency differences

- Stress patterns are often expressed with a set of conflicting Markedness constraints.
- There *is* attested free variation in stress patterns; e.g. penult/preantepenult in LLLL words of Egyptian Radio Arabic.
- So these should not be sensitive to lexical frequency.

36. Restating the prediction

- The standard treatment of allophones in OT is ranking of Markedness constraints only.
- The very fact that they are allophones means that the lexicon has no influence.
- Hence Faithfulness excluded.
- This excludes all instances of allophony from word-frequency effects — a bold move!

[6] Thanks, Beth and Connor, for this outstandingly useful term! I suggest defining it as "blob, plus outlier creating a good correlation".

- This ought to be checkable against the research literature in phonetics.

37. Can we hand-check the role of frequency in an allophonic process?

- Let's try my (and perhaps your?) English, with diphthongization of /æ/ to [ɪə] before [m] and [n].
- Frequencies from CELEX:

andiron	1	*and*	514946
annular	1	*can*	71194
anode	1	*man*	29731
banditry	1	*hand*	14241
pantaloon	1	*stand*	8954
aggrandize	1	*answer*	5435
manioc	2	*plan*	5429
Tantalus	2	*land*	5152
galvanic	2	*animal*	4658
polyandrous	2	*demand*	3584
aniline	2	*chance*	3221
		plant	2707

- I think I diphthongize the common words more.
  - It sound pretentious to me to say the common words as [æ], perfectly natural to say the rare words as [æ].
- But this actually be the style knob: the rare words are suited to learned and vernacular styles in any event.
- This might at least show that the style knob must manipulate Markedness as well as Faithfulness — allophonic processes are style-markers par excellence.

38. What about fortition?

- Do we not take advantage of "clear speech" allophones when we convey a rare or novel words?
- "Hello, my name is Fred [ˈtʰælfəs]" (*Talfus*) with strong aspiration of /t/, really low [æ]?
- Like Faithfulness, this too helps the listener by providing salient, dispersed allophones.

39. Prediction: cases violating multiple overlapping Faithfulness constraints should be more frequency-sensitive

- Scenario: optional vowel reduction of unstressed [i, e] is less common for non-high vowels, word-final vowels
  - /ˈpalipu/ → [ˈpaləpu] 80%
  - /ˈpalepu/ → [ˈpaləpu] 60%
  - /ˈpapuli/ → [ˈpapulə] 40%
  - /ˈpapule/ → [ˈpapulə] 30%

- Faithfulness constraints:
  - IDENT(vowel quality) / in non high vowels
  - IDENT(vowel quality) / ___]
- Prediction:
  - /papule/ → [papulə] should be more as sensitive to lexical frequency
  - (or to other knobs should one wish to extend the theory)
  - Why? It gets two copies of the Faithfulness knob value entered into its harmony computation.