Linguistics 219 Phonological Theory III
B. Hayes Spring 2019

Class 5, 3/16/2018: Model Evaluation II; Knobs

1. Assignments

- Read:
  - Coetzee, Andries and Shigeto Kawahara (2013) Frequency biases in phonological variation. *Natural Language and Linguistic Theory*, 31: 47-89.
- Hand in homework on medial clusters.
- New homework on bias, due in class Monday April 23.

GO OVER THE NEW HOMEWORK

2. Look at homework printouts and explain

MORE ON MODEL EVALUATION; WILSON AND OBDEYN

3. What we have so far: empirical

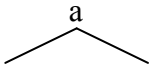
- The basics of consonant occurrence pattern: avoid similars in the same root.
- Defining "similar" is the toughie, and by now there are many approaches.

4. What we have so far: methodological

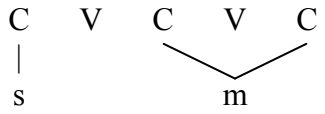
- A strong attack on statistical ad hockery: watch out for intuitively-plausible but mathematically ungrounded methods.
- Wilson Obdeyn concocted data:
  - Maxent fully recovers the "intent of the founders"
  - Observed/Expected introduces a phoney result, namely stricter cooccurrence for noncoronals.

5. Back to the root-cooccurrence data: The curious override to the similarity-avoidance principle

- Arabic is a canonical case of avoiding similar consonants in roots, but it also loves "biliteral" roots with *identical* consonants.
  - /samam/ 'to poison'
  - This was an elegant focus of John McCarthy's 1979 Ph.D. dissertation,[1] where he used autosegmentalism to make such roots genuinely bilateral.



[1] *Formal problems in Semitic morphology and phonology*, https://works.bepress.com/john_j_mccarthy/



- /samam/ is ok because of left-to-right "spreading", */sasam/ would require right-to-left and is not ok.

- Autosegmental morphology is mostly gone, I think, due to contradictions: sometimes you want consonants on a separate tier, sometimes the same.
  - Nowadays we can use straightforward linear represention, Correspondence Theory to describe morphemes, and suppose Semitic languages are special in despising CONTIGUITY.

$/s_1m_2/$, $/a_3/$
$[s_1a_3m_2a_3m_2]$

6. Modern views of the override

- Zuraw (2002) has found that speakers love to interpret roots as *reduplicated* if they can, and exaggerate the degree of resemblance through mispronunciation: [pɑmpɑm] for *pompon*.
  - Zuraw, Kie (2002). Aggressive reduplication. *Phonology* 19. Pp. 395-439.
- So /samam/ looks perhaps like constraint ranking; it's horrible for similarity, great for "be reduplicated".
- Coetzee and Pater (2008) later noted, re. the same sort of override in Muna:
  - "In particular, in many cases the identical consonants do precede identical vowels, suggesting some form of reduplication"

7. A spectacular proposal

- Early version:
  - Frisch, S. A., Broe, M. B., and Pierrehumbert, J. B. (1997). Similarity and phonotactics in Arabic. Bloomington, IN and Evanston, IL: Indiana University and Northwestern University, ROA-223.
- Later:
  - Frisch, S. A., Pierrehumbert, J. B., and Broe, M. (2004). Similarity avoidance and the OCP. *Natural Language & Linguistic Theory*, 22(1):179–228.

- Key idea:
  - There is *one* mechanism for computing similarity in phonology, and you don't even have to do phonetics to access it!
  - You need to make a list of all the natural classes in the language (often about 600, easy to do with computer)
  - Then, for two segments, compute

    (shared natural classes) / ((shared natural classes) + (unshared natural classes))

    - Dissimilarity is then predicted by taking this one single dissimilarity measure as a constraint.
- This amazingly simple and restrictive theory got quite a lot of empirical mileage!
- It got the special status of coronals for free: there are *more coronals* in virtually any language, and so more natural classes involving them, and so in general less similarity between them.
- People like me adopted the similarity metric for other purposes (e.g. Albright and Hayes 2001, *Cognition*).

8. Coetzee and Pater's contributions

- Coetzee, A. W. and Pater, J. (2008). Weighted constraints and gradient restrictions on place co-occurrence in Muna and Arabic. *Natural Language & Linguistic Theory*, 26:289–337.
- Language specificity: What works for Arabic doesn't work for Muna (Western Austronesian)
    - "Arabic shows an overwhelming effect of sonorancy agreement in lowering attestedness, while Muna has a more balanced contribution of voicing, sonorancy and stricture."
- We are in familiar territory: learning phonotactics with multiple constraints, using a data corpus.
- They also advocate a particular measure of phonotactic well-formedness:
    - "We argue for a definition of Harmony-based well-formedness in terms of the difference between the [harmony] score of an Input-Output mapping and the optimal distinct mapping for the same Input."
    - For instance, for [t … s] the best output candidate might be [p … s].
- Constraints: they advocate a *very rich* model, in which constraints target specific combinations of place feature and manner feature.

  "Assign a violation mark to a sequence of nonidentical consonants that both have place of articulation P and agree in specification for S; where
  P is drawn from the set {Pharyngeal; Dorsal; Coronal; Labial}
  S is drawn from the set {Sonorancy; Stricture; Voice; Emphatic; Prenasalization}"

- Summarizing:
    - Discovery of language-specific effects
    - Modeling of languages with inventories of phonotactic constraints and a Harmony-based framework.

MODEL EVALUATION IN WILSON AND OBDEYN

9. The primary method

- Likelihood, as we have been working with.
- This is the metric of *accuracy*.

10. Accuracy is not enough

- Model complexity must also be determined.
- Simple example proving this: a model with these constraints:
  - *p p, *p t, *p k, *t p, *t t, *t k, *k p, *k t, *k k (and so on for all possible pairs)

  cannot but succeed in provide a *perfect match to data*, but is worthless as an explanation.

11. Where they head with the math

- Laplacean approximation, which combines a measure of accuracy with a measure of model restrictiveness.
- I have not seen this used elsewhere but it might be nice if someone comes up with a shareable script for R.

BY THE WAY, WHO WON?

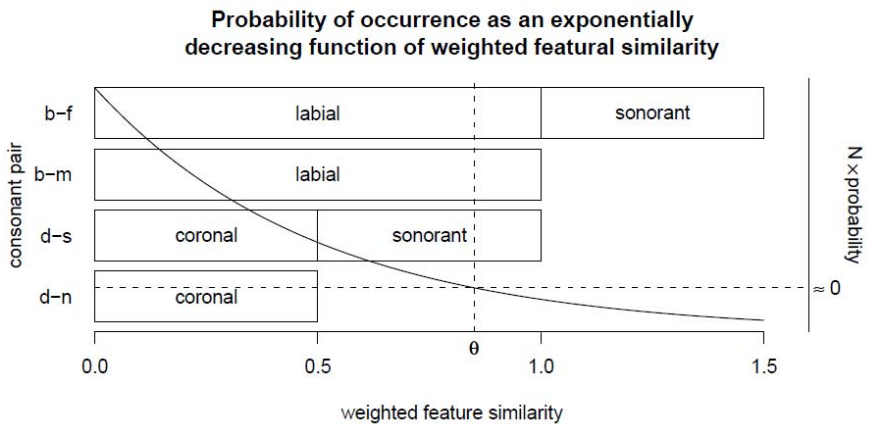
12. The narrow question at hand

- Coetzee and Pater's claim to have improved on Pierrehumbert's team's account is refuted; it's more of a tossup.
- Wilson and Obdeyn's theory:
  - maxent and probabilities, of course
  - Constraints are a simplification of Coetzee and Pater's:

    normal *LAB LAB, *COR COR, etc.
    Role of manner:
    "Don't agree in [voice], [son], etc., *if you agree in place*"
    (so, simpler; not crossing every place and manner feature)
    (the italicized bit perturbs me and I'd like to know how well we can do without it)
- The clear winner by the Laplace approximation criterion is this theory.
- I would love to know what happens if you do something even simpler: just weight all the features, punkt.

13. The explanation for indifference of labials and velars to manner

- It's really trivial, if Wilson/Obdeyn are right:
  - Saturation
  - Weights of OCP-lab and OCP-dorsal are high enough that further nuances from manner don't affect probability much, (remember the purposes of exponentiation in maxent).



KNOBS

14. A primary crime in the study of free variation

- Give up and attribute to randomness what is not random.
- Editorial: Interestingly, the prosecution of this crime is the work of people who themselves are really naïve about the existence of variation! Variationists should be grateful to them.

15. Some possibilities for missing crucial things

- Obviously: **missed phonological contexts** (didn't solve the problem right).
- Genuine **dialect variation**, mixing invariant speakers to produce pseudo-variation imagined to occur in the linguistic competence of a single speaker.[2]
  - I'm really skeptical of this — how do we isolate these "dialects"?
  - Unless the dialects really do *sound* like dialects, Junior is likely to blend the ambient data, learning a free-variation grammar.
  - The other way these "dialects" could arise is if people are bad language-acquirers and leap to different conclusions from the same data.
- Knobs

[2] There's a literature on this, which I'm out of time for hunting down …

16. Knobs

- This term is not part of formal linguistics but perhaps it ought to be.

17. Definition

- A **knob** is a scalar quantity which:
  - Is derived from some non-grammatical, non-lexical property of the world.
  - Is accessed by the grammar and influences quantitative outcomes.
- Feel free to imagine the phonology as a machine with four knobs, and the inner speech-homunculus twisting them back and forth purposefully.

18. The four great knobs[3]

- Speaking **style**
  - the subject of much sociolinguistics
  - who you are talking to, what kind of impression you want to make
- Speaking **rate**
  - See Lefkowitz (2017 UCLA dissertation), Flemming and Cho (*Phonology* 2017)
  - N.B. rate is not style! Subjects in sound booths asked to speak quickly will generally perform heroic efforts to keep the style knob high as the rate knob increases.
- Speaking **emphasis**
  - Liberman and Pierrehumbert, to be covered later, on pitch scaling in English
- **Lexical frequency**
  - readings, and much other work

The idea is that these have on-line varying values and the phonological grammar responds.

19. A connection to Faithfulness?

- Speakers tend to produce more Faithful representations when they speak formally, slowly, emphatically, saying rare words.

20. Phonology and phonetics

- Both plainly participate.
- If there are knobs, they drive the phonetic component at least as much as the phonology.

21. How quickly are the knobs turned?

- Lexical frequency: as fast as we move on to new words as we speak; i.e. fractions of a second.

[3] Are there others?

- Speaking emphasis: perhaps the same? Confounded with a structural notion, focus, which is not a knob but part of the linguistic representation.[4]
- Speaking rate: I'm not sure; probably can go up and down through a sentence.
- Style:
  - I sense it's pretty constant, but virtuosos swoop in and out of the vernacular for effect.

22. Some things that get studied but I suspect not knobs

- Speaker properties:
  - Age
  - Education
  - Ethnicity
- I am inclined to regard these as topics for dialectology/diachronic linguistics.

23. A Negative Example

- Suppose that in Brooklyn, Italian-Americans simplify their final consonant clusters more than people of Eastern European Jewish ancestry.[5]
  - N.B. they are all native speakers of English
- Is there a knob for ethnicity?
- This presupposes that Frank of Brooklyn perfectly knows the deletion pattern of Morris of Brooklyn and vice versa — this I doubt.

24. A positive example: sex of speaker

- In Lakhota, there are formalized, systematic differences between men's and women's speech.[6] Quoting (gaak!) Wikipedia on clitics:
  - *Yeló* (men) *ye* (women) mark mild assertions. *Kštó* (women only according to most sources) marks strong assertion. *Yo* (men) and *ye* (women) mark neutral commands, *yetȟó* (men) and *nitȟó* (women) mark familiar, and *ye* (both men and women) and *na* mark requests.
- Children obviously hear a lot of both men's and women's speech when they are growing up.
- The UCLA Field Methods consultant of yore, though female, used the men's forms as more appropriate to an academic context; there is a literature on this phenomenon.
- Generally: let's avoid miracles; kids acquire what is available to them as they learn to speak.

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[4] An interesting paper discussing the emphasis knob is D. Robert Ladd (1994) "Constraints on the gradient variability of pitch range, or, Pitch level 4 lives!" in *Papers in Laboratory Phonology III*. The same volume has a rather knobby commentary on Ladd's paper by me.

[5] Decades ago, immigration created quite-modestly-distinct native-speaker dialects in NYC based on ethnicity; the same is true in California today.

[6] This goes way back; Edward Sapir wrote of a final-vowel-devoicing rule applied by just one gender in Yana.

25. Style and bidialectalism

- What a can of worms!
- When are we changing our style within a single idiolect, and when are we dialect-switching?
- Perhaps even so, this might help with troublesome cases.

THE STYLE KNOB ON THE LOWER EAST SIDE

26. One source

- William Labov (1972) "The isolation of contextual styles," in his book *Sociolinguistic Patterns.*

27. Labov's earliest research

- He went all over the Lower East Side of New York City, studying people of all social classes and ethnicities.
- He was part of a research team including social scientists, and his subjects were prelocated to represent a great variety of people.
- He did his best to elicit across settings of the style knob.
    - Very high: "please pronounce these minimal pairs"[7]
    - High: "please read these sentences"
    - Less high: "please answer these questions"
    - Less high: "tell me about yourself"
    - Less high: the Danger-of-Death question, the "Were you ever unfairly accused of something you didn't do?" question
    - Also less high: finish the interview, share the offered beer, keep listening.
    - Much lower: consultant leaves the room to take a phone call from kin, forgets linguist is there.

28. Optional phonological processes of New York City English

R Dropping

beard is [biəd], r-less;

beard is [biɹd], r-ful

- Notes:
    - Labov thinks /ɹ/ is underlyingly present, learned from nondeleted tokens in the ambient language
    - i.e. language learners can distinguish "always [sɔ]" from "sometimes [sɔ], sometimes [sɔɹ]" (*saw*/*sore*)
    - This would *not* be true, I suspect, of people like Standard British speakers, who hear no variation in these forms during childhood.[8]

[7] This can be especially effective when the minimal pairs are merged in the consultant's speech!

/æ/ Diphthongization[9]

bad [bɪəd]
bad [bæd]

/ɔ/ Diphthongization

coffee [ˈkʊ͡ɔfi]
coffee [ˈkɔfi]

/θ/ and /ð/ Hardening

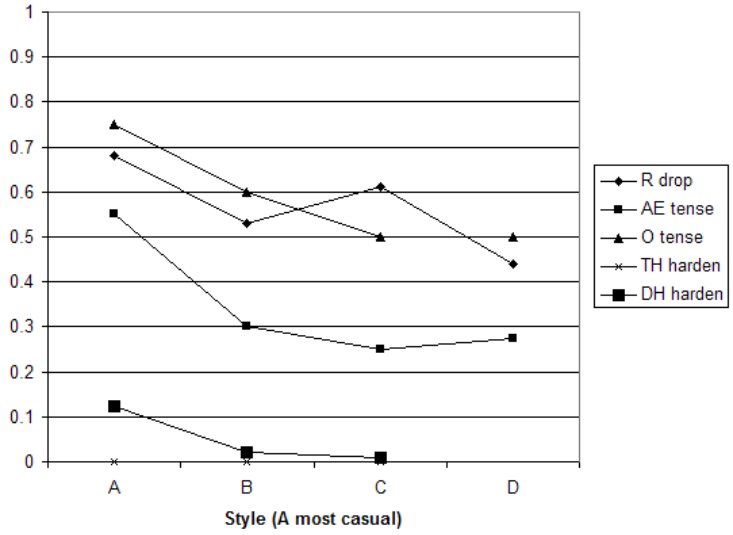
thin	[t̪ɪn]	*this*	[d̪ɪs]
	[t̪͡θɪn]		[d̪͡ðɪs]
	[θɪn]		[ðɪs]

29. Key claim: lockstep

- The above processes vary in lockstep by speaking style, due (I suggest) to the Style knob.
- This emerges from Labov's reporting on individual people (accompanied in the original with rather affectionate verbal portraits of each.)

30. Phonological free variation in the speech of Miriam

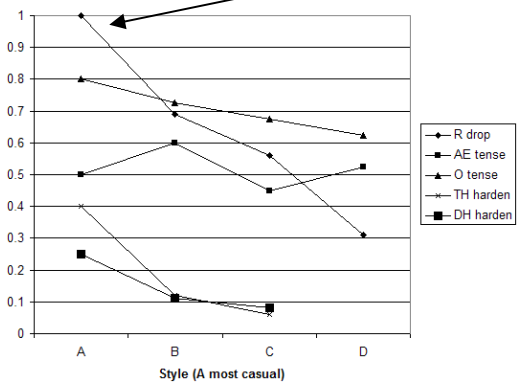
- Miriam is 35 years old, graduated Hunter College and St. John's law school, works as lawyer.



[8] Except perhaps on TV and in movies? Can such input influence acquisition?
[9] Many of us have a similar diphthongization in a more restricted environment, / ___ {m,n}.

31. 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.



32. Why is Doris not lockstepped? A conjecture

- Unlike the others described, she is likely bidialectal (African-American Vernacular English)
- Conceivably she is switching dialects as well as styles when she speaks?

33. Is there more?

- Sociolinguistics gets frustratingly fuzzy for me a lot of the time.
- But this sort of data — careful tracking of application rates of multiple processes across style-controlled eliciation — seems potentially very informative about the systems people internalize.

34. Free variation in society is structured as well

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

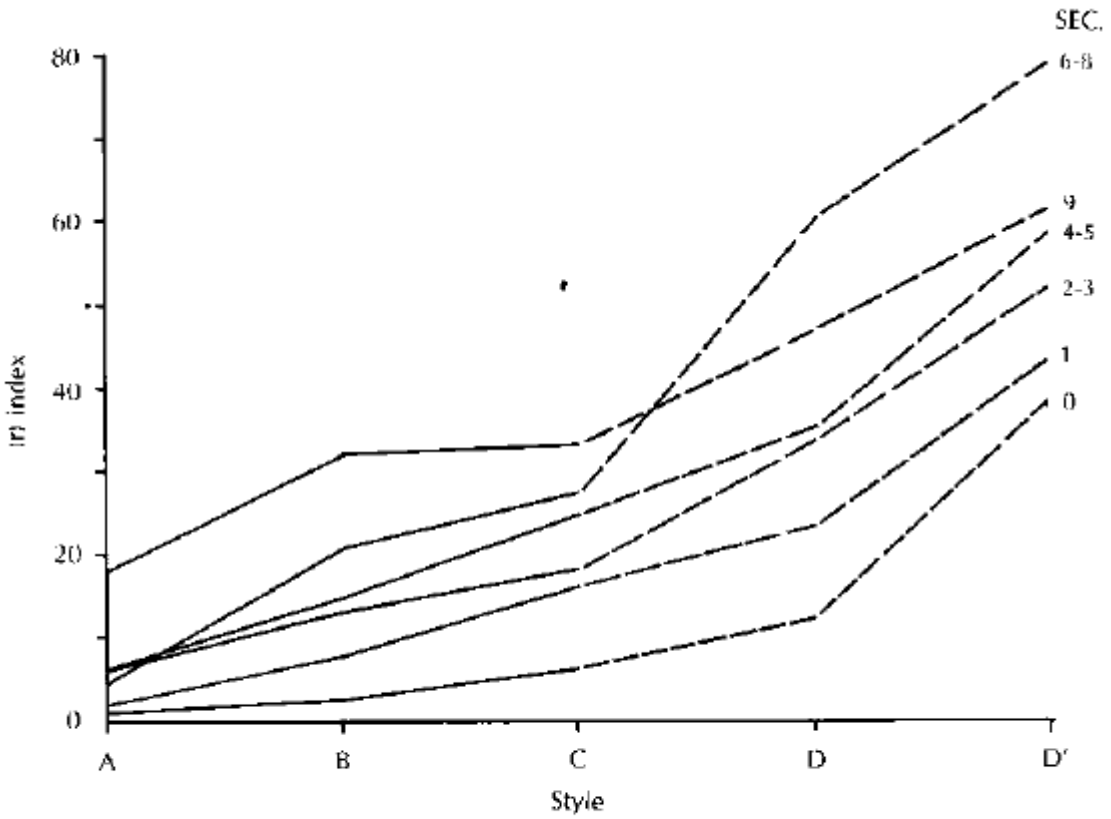


Fig. 4.2. Class stratification of a linguistic variable in process of change: (r) in *guard, car, bear, beard, board*, etc. SEC (Socio-economic class) scale: 0–1, lower class; 2–4, working class; 5–6, 7–8, lower middle class; 9, upper middle class. A, casual speech; B, careful speech; C, reading style; 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.[10]
- As already noted, I think these fascinating patterns are modelable but only diachronically, with a theory of who people talk to and who they pay attention to as they learn their grammars.

35. 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?
  - ➢ Can Harmonic Grammar/maxent help?

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

- In empirical work, are there rigorous ways for us to track how knobs are set?

THE FREQUENCY KNOB

36. Effects of frequency in phonology more generally

- Acquisition effects: the rare is hard to memorize.
  - Hence irregular forms tend to get regularized when frequency goes down.
  - Work of Joan Bybee: old irregular pasts, like *chid* got regularized in this way.[11]
- Nativization effects
  - Foreign word becomes more common in usage.
  - It starts to feel ever more strange to give it its faithful foreign rendition.
  - Thus, regularization.
  - In my lifetime: *croissant, cappuccino, gazpacho*
- Online production effects (focus here)
  - Psycholinguistics has firmly shown that the listener knows the frequencies of words, and weights their probabilities in perception.
  - Greater Faithfulness in speaking gives your hearer a better chance on rarer words.

37. Coetzee and Kawahara's hypothesis: 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, plugged into Noisy Harmonic Grammar.
- We sum up Markedness and Faithfulness
- Since it's NHG, we have noise (nz_i), added into every constraint weight.
- The scaling factor is the same for all Faithfulness constraints (lockstep), and its value comes from another equation relating it to frequency (for next time).

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