Linguistics 201A
Phonological Theory I

Winter 2023
B. Hayes

Class 9, 2/7/23: Type Variation II; Phonotactic Analysis

1. Current assignments

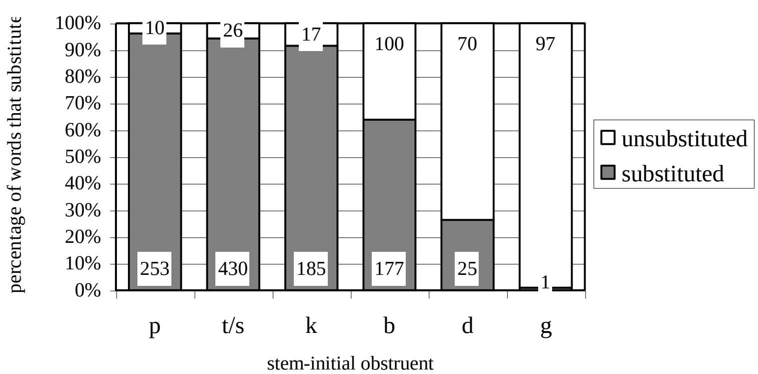
- BH hand back Hebrew homework
- Read Becker, Michael, Andrew Nevins, and Jonathan Levine. "Asymmetries in generalizing alternations to and from initial syllables." Language (2012): 231-268.
  - On web site
  - No summary required
- New homework on Phonotacics is due Thurs. Feb. 16.

2. Today

- Go over Hebrew homework
- Finish type variation
- Orientation on phonotactics
- Orientation to the phonotactics homework

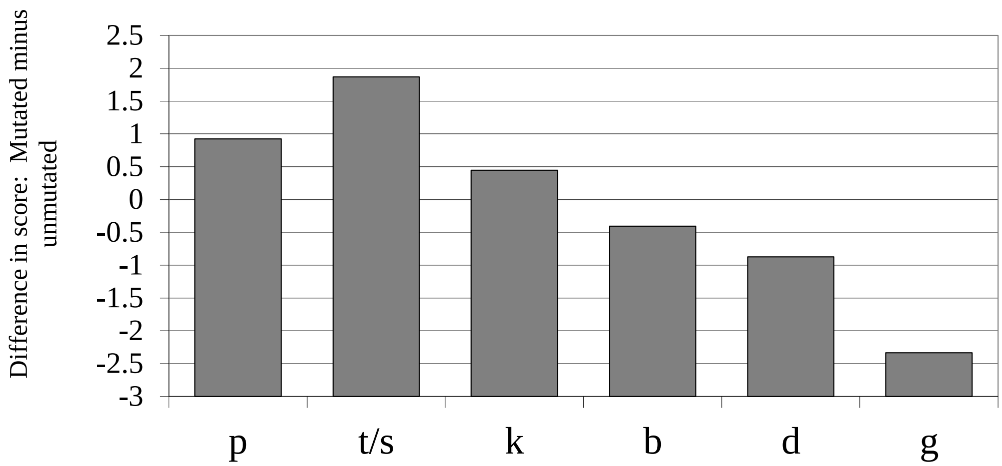
TYPE VARIATION II

3. Zuraw's study: Frequency of Tagalog Nasal Substitution varies in the lexicon according to the stem-initial consonant



4. Native speakers are tacitly aware of this pattern

- Again Zuraw, a "wug" test (following Berko 1958). Preference for the nasally-mutated form (difference between both options, each rated on 1-10 scale)



5. The Law of Frequency Matching

- Hayes, Zuraw et al. (2009) go for broke in their rhetoric:

Speakers of languages with variable lexical patterns respond stochastically when tested on such patterns. Their responses aggregately match the lexical frequencies.

- Some other phonological experiments whose results support this law are reported in Eddington (1996, 1998, 2004), Berkley (2000), Coleman and Pierrehumbert (1997), Zuraw (2000), Bailey and Hahn (2001), Frisch and Zawaydeh (2001), Albright (2002), Albright and Hayes (2003), Pierrehumbert (2006), and Jun and Lee (2007), Moore-Cantwell (2021).
- Sociolinguistic study demonstrates frequency matching by children during real-life phonological acquisition (Labov 1994, Ch. 20).

6. The Law in (much) broader perspective

- Frequency-matching is known to be a common ability in animals (Gallistel 1990, ch. 11); and in humans for nonlinguistic tasks (Hasher and Zacks 1984).

MODELING TYPE VARIATION

7. Zuraw's theory (2000, 2010): the dual listing/generation model

- Words are memorized—even inflected ones—as they are heard.
- Psycholinguistic work has strongly supported a **huge capacity for word memorization** in humans (contra early generative phonology, which emphasized data compression)
  - Baayen, Harald, Robert Schreuder, Nivja De Jong, and Andrea Krott "Dutch inflection: The rules that prove the exception," in Sieb Nooteboom, Frank Wijnen and Fred Weerman (eds.), *Storage and computation in the language faculty* (2002, Kluwer)
  - See Baayen's web site for further work

- Basic argument: recognition-ease or speed of fully-inflected forms is dependent on the frequency of the form itself, not its morphological base or paradigm as a whole.

- Back to Zuraw: claims that there is hard analytic work as well as memorization: a stochastic grammar is created from the data — treating them *as if* they were free variation data.
- I.e.: memorize, but be ready to project.
- If you *have* a listed form, you generally use it: USE LISTED

8. Zuraw describes a near-optimal human

- Memorization is just great for producing irregulars accurately.
- Children's memorization capacity is strong but not unlimited.
- So grammar-based back-up is sensible too.
- … and a grammar is essential for production and understanding[1] of novel forms.

9. An alternative: constraint cloning theory

- When you hit a ranking contradiction, make a copy of the relevant Faithfulness constraint, indexing it to the words that are lexically allowed to be more marked.
- Hence the grammar encodes the exceptionality directly.
- … and is non-stochastic
- New forms must be projected — somehow — from the populations of existing forms that violate the various Faithfulness constraints.
- References:
  - Pater, Joe. 2000. Nonuniformity in English stress: the role of ranked and lexically specific constraints. *Phonology* 17:2. 237-274.
  - Pater, Joe. 2009. Morpheme-Specific Phonology: Constraint Indexation and Inconsistency Resolution. In Steve Parker, (ed.) *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox.
  - Becker, Michael 2008. *Phonological trends in the lexicon: the role of constraints*. http://becker.phonologist.org/papers/becker_dissertation.pdf

10. Exceptions to the Law of Frequency Matching

- Here, there is a formula for research:
  - Establish *nonveridical learning* — deviations from Frequency Matching
  - Find the causes — why learn nonveridically?
  - Ideally, form a learning model that learns nonveridically just like people.

11. The sources of nonveridical learning

- Simplicity bias — prefer simpler, more general constraints
  - Hayes and White (2015, *LI*)

[1] When I first heard [mɪdˈwɪfəɹi] for *midwifery*, I was extremely surprised but knew exactly what was meant, since it is the output of Trisyllabic Shortening (cf. *divine* ~ *divinity*).

  - Jennifer Kuo (2020) UCLA M.A. xxx fill in
- Naturalness bias — prefer outcomes that obey Markedness principles
  - (2009) Bruce Hayes, Kie Zuraw, Peter Siptar, and Zsuzsa Londe. Natural and unnatural constraints in Hungarian vowel harmony. *Language* 85: 822-863.
- Paradigm uniformity bias — prefer outcomes that reduce alternation
  - Wilson, Colin (2006) Learning phonology with substantive bias: An experimental and computational study of velar palatalization. *Cognitive Science* 30 (5), 945-982— the ur-work on bias, with MaxEnt analysis
  - White, James. "Accounting for the learnability of saltation in phonological theory: A maximum entropy model with a P-map bias." Language 93, no. 1 (2017): 1-36.
- Other
  - See Becker et al, readings on Initial Syllable Faithfulness

12. You can do learning simulations with MaxEnt that incorporate bias

- Wilson (2006) is the pioneering work; see also work of White and Kuo
- The math is simple — a penalty in the objective function for deviating from natural weights.

13. The key interest in studying nonveridical learning

- Are we getting at UG? How else do we explain the observed effects?

A SUBSET OF THE LITERATURE ON NON-VERIDICAL LEARNING

14. The ur-reference, I believe

-
- His UG principle is the **P-map** (Steriade, Zuraw, more later on): avoid alternation when it is phonetically salient.
- ki ~ tʃi is less phonetically salient than ke ~ tʃe
- Artificial grammar experiment: train on ke ~ tʃe, generalizes to ki ~ tʃi, but not the other way around.
- A later critique: see Elliott Moreton (2008) “Analytic bias and phonological typology”; *Phonology* 2008

PHONOTACTICS

15. This is an ancient topic.

- B. L. Whorf published a formula for the English monosyllable in 1940 in *Technology Review*, the MIT alumni magazine:

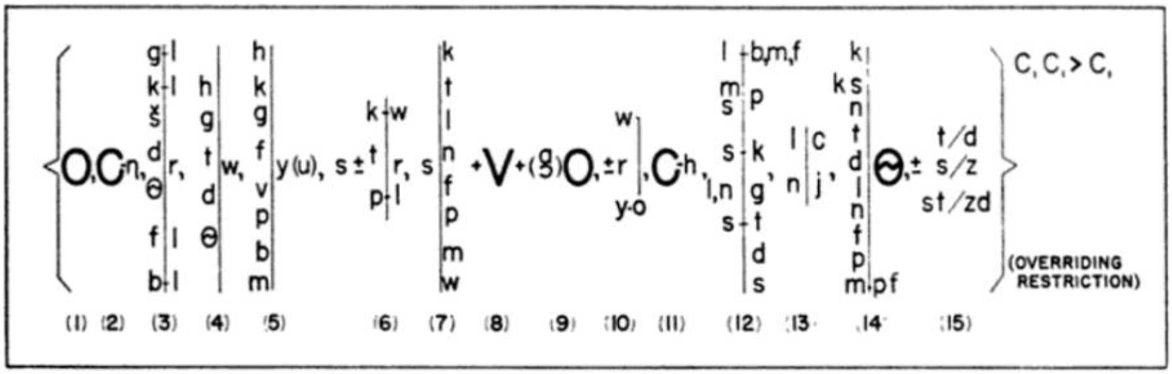


Figure 12. Structural formula of the monosyllabic word in English (standard mid-western American). The formula can be simplified by special symbols for certain groups of letters, but this simplification would make it harder to explain. The simplest possible formula for a monosyllabic word is C + V, and some languages actually conform to this. Polynesian has the next most simple formula, O, C + V. Contrast this with the intricacy of English word structure, as shown above.

16. Phonotactics in OT

- Classical Rich Base theory (Prince and Smolensky 1993)
  - ➢ The ranking of the universal constraint inventory defines a (non-probabilistic) filter through which the forms of the Rich Base must pass.
  - ➢ This is a tough theory to probabilitize, since stochastic repair predicts free variation! /pɔɪk/ → [pɔɪk] or [paɪk] (or whatever)
- Maxent-over-GEN theory
  - ➢ I suspect the first to propose this was: Hayes, Bruce & Colin Wilson. 2008. A maximum entropy model of phonotactics and phonotactic learning. *Linguistic Inquiry* 39.379–440.
  - ➢ Simply let the grammar assign a probability to every form in GEN
  - ➢ This theory may also have problems: how to get special/general relations in allophony? See:
  - ➢ Wilson, Colin, and Gillian Gallagher. "Accidental gaps and surface-based phonotactic learning: A case study of South Bolivian Quechua." Linguistic Inquiry 49, no. 3 (2018): 610-623.
  - ➢ We'll try it anyway.

17. Can gradient phonotactics be made more rigorous?

- Advantages, perhaps, of maxent-over-GEN model
  - ➢ good frequency matching ability (if the constraints are good)
  - ➢ ability to disentangle effects of overlapping constraints (see below)
  - ➢ statistical testing of hypotheses

18. How to employ maxent-over-GEN: two ways

- Difficult and thorough: the "UCLA Phonotactic Learner", written by Wilson for Hayes and Wilson (2008). Available at https://linguistics.ucla.edu/people/hayes/Phonotactics/index.htm
    - It uses a finite-state machine, following principles developed by Jason Eisner, to explore a vast space of whole-word candidates in feasible time.
- Simple and contingent: Find a subset of the phonotactics, hoping it is somewhat isolated from the rest of the system.
    - E.g., medial clusters, V … V sequences
    - With some patience, this can be done entirely with conventional office software.

DEMO: VOWEL PHONOTACTICS OF TURKISH IN MAXENT-OVER-GEN

19. Turkish vowels

i	y	u	ɯ
e	ø	o	a

20. The famous rules of Turkish vowel harmony

- Backness Harmony: a suffix must agree with the preceding vowel in backness.
- Rounding Harmony:
    - A high voweled suffix must agree with the preceding vowel in rounding.
    - A low voweled suffix is unrounded

21. Examples

```
'rope' 'girl'  'face'  'stamp' 'hand' 'stalk' 'village' 'end'
ip-in  kız-ın  jüz-ün  pul-un  el-in  sap-ın   køj-yn   son-un  (gen.sg.)
ip-ler kız-lar jyz-ler pul-lar el-ler sap-lar  køj-ler  son-lar (nom.pl.)
```

- There are many suffixes like -In, many like -lAr

22. Does Vowel Harmony govern stems?

- Not clear, because numerous exceptions have been introduced in loanwords.
- This ref.:
    - Clements, G. and E. Sezer (1982) "Vowel and Consonant Disharmony in Turkish," in H. van der Hulst and N. Smith, eds., The Structure of Phonological Representations (Part II), Foris, Dordrecht.

  says "no".
- With stochastic phonology and significance testing, we can check more carefully.

23. Turn to Homework Assignment