Linguistics 201A | Winter 2023
Phonological Theory I | B. Hayes

Class 16, 3/1/23: Phonetics in phonology IV; Tone I

1. Bureaucratic

- Feel free to make an appointment with me to discuss your term paper research (even if stymied!).

2. Current assignments

- The UCLA course Web site is still down: please visit instead:
  - https://www.palisadessymphony.org/temp/index.htm
- Read for next time:
  - Extract on tone, from Michael Kenstowicz (1994) *Phonology in Generative Grammar*
  - Posted on the site listed above
  - No summary required

GENERATIVE PHONETICS

3. Usage

- Caution: the use of this term is **entirely non-standard**, and reflects a point of view.

4. One possible answer

- A **generative phonetics** would be the portion of a generative grammar that models the phonetic capacities of people.
- It would take the form of a formalized grammar.
- Like other grammars, it is intend to make predictions about future-gathered data.

5. What a phonetic grammar should predict

- Given a surface phonological representation and other factors (like speaking style, speaking rate, word frequency), what is the contour that the speaker will create for:
  - F0
  - formants
  - tongue body coordinates
  - … and durational pattern for all of the above
- I.e. generate a "movie of the mouth", or a waveform.
- The grammar is the algorithm for speaking

6. Four influential early works from the rule-based era in generative phonetics

- *From text to speech; The MITalk system* (1987) Jonathan Allen, M. Sharon Hunnicutt and Dennis Klatt (with Robert C. Armstrong and David Pisoni): Cambridge University Press, Cambridge.
- Pierrehumbert, Janet (1980) The phonology and phonetics of English intonation, MIT diss.
- Liberman, Mark and Janet Pierrehumbert (1984) Intonational invariance under changes in pitch range and length. In Aronoff and Oehrle, *Language sound structure*, MIT Press.
- Pierrehumbert, Janet, and Mary Beckman (1988) *Japanese tone structure*, MIT Press.

7. Key idea in this work

- The structural elements of surface phonology can be translated into *targets* defined in time and space (both physical and acoustic).
- The quantitative values assigned to targets obey simple arithmetical regularities.

8. Example: the Liberman-Pierrehumbert "berry" sentences

- The authors and colleagues at Bell Labs recite sentences consisting of lists of berries, using downstepping intonation: "Blueberries, bayberries, raspberries, mulberries, and brambleberries"

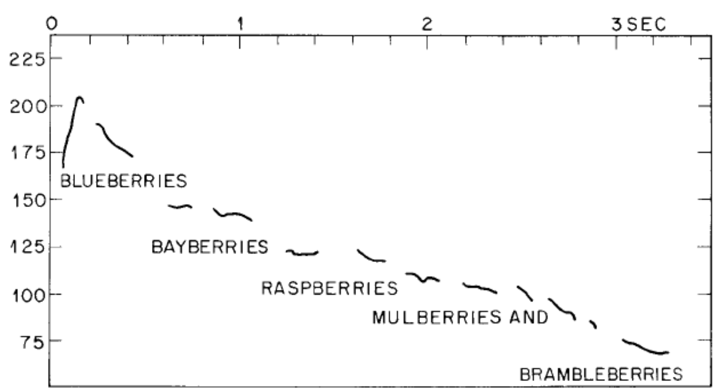


Figure 13
An F0 contour for the berry list *Blueberries, bayberries, raspberries, mulberries, and brambleberries*, produced with a sequence of step accents. Each step is smaller than the one before, so that the step levels appear to trace out an exponential decay.

9. Full dataset for one speaker

- The lists may consist of 2-5 berries.
- They did three pitch ranges (of which we will consider just one).

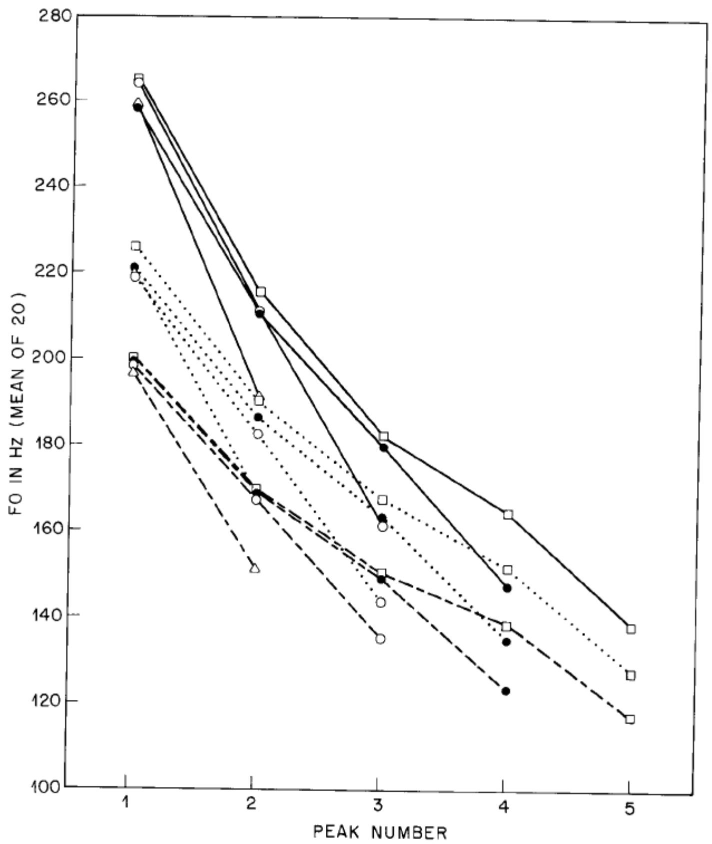


Figure 19
Downstep data (3 pitch ranges, 4 lengths) for subject DWS

10. The key ideas of the analysis

- There is a bottom line, as low as the speaker is willing to go.
- For any degree of emphasis, you can define a pitch scale — Pierrehumbert (1980) jokingly calls this "Amanas".
- On the Amana scale, each pitch accent is a constant multiple of the preceding one.
- … except that the last accent gets further multiplied by a Final Lowering constant.

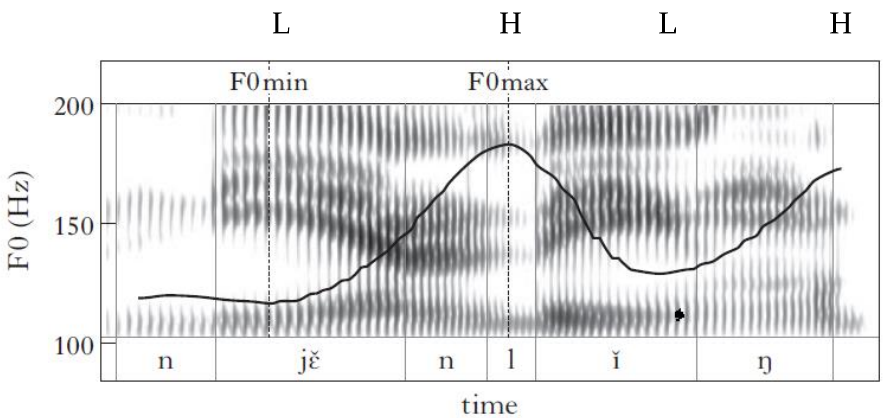
AccentTarget = c × Preceding Target (in Amanas)

11. What was special about the early work on F0?

- It mostly involved *uncrowded targets* — each target is actually achieved.

12. Moving to the present time: what is needed to treat *crowded* targets?

- Example: a Mandarin rising tone after a high. I've drawn a dot where the L target might be.
  - ➢ Source: Flemming, Edward, and Hyesun Cho. "The phonetic specification of contour tones: Evidence from the Mandarin rising tone." *Phonology* 34, no. 1 (2017): 1-40.



Pitch tracks and spectrogram: of [njĕnlĭŋ] 'age'.

13. A standard view in the phonetics literature

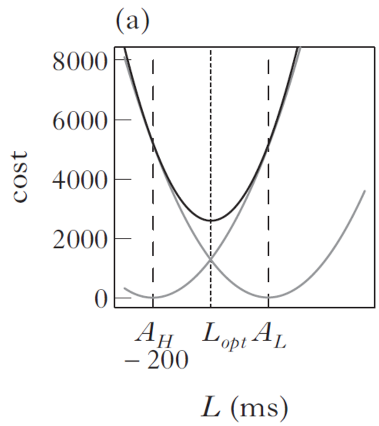
- Phonetic realization is filled with *compromises* between conflicting ends.
- The classic is F2 at the release of a stop — compromising between a consonant target and a vowel target.

14. How to obtain compromise in Harmonic Grammar?

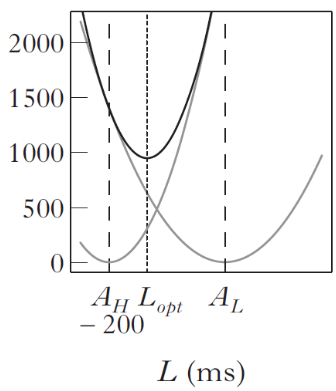
- Key idea appeared in Flemming (200)
  - ➢ Flemming, Edward. "Scalar and categorical phenomena in a unified model of phonetics and phonology." Phonology 18, no. 1 (2001): 7-44.
- ➢ You have a consonant, like /t/, and a vowel, like /a/.
  - ➢ /t/ wants F2 to be 1800
  - ➢ /a/ wants F2 to be 1100.
- ➢ "Violations" = number of Hertz deviating from target.
- ➢ The key Flemming uses **squared** penalties
- ➢ Three conflicting constraints
  - ➢ Achieve consonant target
  - ➢ Achieve vowel target
  - ➢ Avoid effortful transition

15. Now we can see why squaring is needed

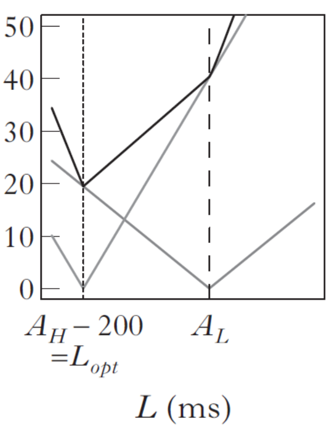
- Vertical axis: Harmony penalty
- Horizontal axis: timing of the left-side L-tone target



16. An unequal compromise: higher-weighted constraint has stronger influence



17. The bad result with power-of-one rather than power-of-two: winner-take-all



18. Summing up so far

- Phonological surface representation is converted to phonetic targets, spaced in time and defined on various physical/psychoacoustic continua.
- A Harmonic grammar, with squared penalties, defines the phonetic surface representations as a winning candidate.

EXAMPLE: PARADIGM UNIFORMITY AND NEAR-NEUTRALIZATION

19. Work of Aaron Braver

- Braver, Aaron (2013) Degrees of incompleteness in neutralization: Paradigm uniformity in a phonetics with weighted constraints. Rutgers Ph.D. dissertation.
- *Phonology* article in readings.
- Experimental collaborations with Shigeto Kawahara.

20. Recalling near neutralization

- German: the "[t]" in the derivation /rad/ → "[rat]" 'wheel'is not quite a real [t], such as would be derived from /rat/ 'advice'.

21. Braver's key idea

- Near-neutralization is not capricious.
- In every case, *it represents a compromise*:
  - Inherent value predicted by pure phonetics
  - Influence of a paradigmatic base — at the phonetic level.

22. Braver's Law of Incomplete Neutralization

- All incomplete neutralizations are compromises between observed values in paradigms.
- Example: there could never be a German′ in which /rad/ surfaces as slightly "more voiceless" than /rat/.

23. The signature case: Japanese vowel length

- Empirical work was in an earlier paper with his adviser Kawahara.
- Example:
  - /CV/ → [CVˑ], not quite as long as underlying /CVː/.
  - /fu/ 'gluten' is [fuˑ] alone, [fu ga] with suffix.
  - /fuː/ 'seal' is [fuː] alone (and I assume, [fuː ga] with a suffix).
- Example:
  - /fu/ alone wants to be bimoraic to satisfy a word-minimum.
  - It wants to be shortish to resemble the base form (seen before a suffix, as in *fu ga*)
  - There is further evidence — from pitch accent — that the suffixed form is the base in Japanese.

24. Another example, showing experimental setup

Sample stimulus set (from Braver & Kawahara 2016)

	condition	*orthography*	
a.	short, with particle	木もなくしたよ。	ki mo nakushita yo tree also lost DISC
b.	short, no particle	木なくしたよ。	ki nakushita yo tree lost DISC
c.	long	キーなくしたよ。	kii nakushita yo key lost DISC

25. The theory in outline

- Derived forms are tied to their bases by weak, weighted constraints that penalize differences in phonetic parameters.
- This is done with Harmonic Grammar, with Flemmingian squared derivations from constraints TARGETDUR=x, OOFAITH(Dur).

26. A schematic version of the Japanese case

		Bimoraic target 158	Base duration 56	
		Markedness: min word duration	OO Faith	
Candidate (vowel duration of /fu/ ‘gluten’, base [fu ga])	weights:	**0.051**	**0.000526**	Harmony
0		24964 = (158 - 0), squared	3136 = 56 - 0 squared	1274.813
2		24336	2916	1242.669
4		23716	2704	1210.938
6		23104	2500	1179.618
8		22500	2304	1148.711
…				
56	faithful candidate	10404	0	530.604
…				
116		1764	3600	91.85683
118		1600	3844	83.62112
120		1444	4096	75.79762
…				
148		100	8464	9.550252
150		64	8836	7.909844
152		36	9216	6.681643
154		16	9604	5.865648
156	**winner**	**4**	**10000**	**5.461859**
158	Least marked candidate	0	10404	5.470277
160		4	10816	5.890901
162		16	11236	6.723731
164		36	11664	7.968767

27. What if we went from Harmonic Grammar all the way to MaxEnt?

- We would then derive probability distributions over outputs, which is probably realistic.
- Two items from UCLA:
  - Hayes, Bruce, and Russell G. Schuh. "Metrical structure and sung rhythm of the Hausa rajaz." Language 95, no. 2 (2019): e253-e299.
  - Lefkowitz, Michael. Maxent harmonic grammars and phonetic duration. Ph.D. dissertation University of California, Los Angeles, 2017.

TONE

1. Where we will be going

- Tone is the classic domain for **autosegmentalism**, an idea worked out with many languages in the pre-OT era.
- We will give the classical arguments for autosegmental tone, keeping our eyes open:
  - Are these argument dependent on the rule-based conception (notably: intermediate stages of derivation, typology of processes not targets)
  - Might more recent development — notably phonetic *Map constraints — better take over the explanatory burden of autosegmental representations?

2. Warmup Exercise: Tonal Stability in Etsako (Kwa, Nigeria)

(West Africa, Baruch Elimelech (1978), *A Tonal Grammar of Etsako*, UC Press.)

[á] = high tone [à] = low tone [â] = falling tone [ǎ] = rising tone
General pattern: in certain morphological constructions, V → ∅ / ___ V
This is optional.

ídzé + élà	→	ídzêlà	'ax-three = three axes'
ówà + ówà	→	ówǒwà	'house-house = every house'
údzé + òkpá	→	údzôkpá	'ax-one = an axe'

3. Tonal Stability

- The preservation of underlying tones, docked onto locations distinct from their original site.

4. Formalizing ówà + ówà → ówǒwà in Autosegmentalism/OT

Tiers: (o_1,w_1,a_1,o_2,w_2,a_2) segments (further decomposition (X, [cor], etc.) ignored)
(H_1, L_1, H_2, L_2) tones

Links: ((o_1,H_1), (a_1,L_1), (o_2,H_2), (a_2,L_2))

5. Autosegmental theory is not correspondence theory

(at least, I think not)

- Autosegmental theory: represents timing within one single level of representation.
- Correspondence theory: represents the pairwise relation between the elements of two levels of representation.

6. Some Candidates

ówǒwà	(winner)
ówàówà	(faithful)
ówǎwà	(incorrect hiatus resolution)
ówówà	(loss of a tone)
ówòwà	(loss of a tone)
ów ` ówà	(floating L. More on this later.)
ôwówà	(bad migration)
ówòwâ	(bad migration)