What Are Linguistic Sounds Made Of?

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Main idea: Describing linguistic sounds in terms of features does not allow for the fine grained detail necessary to account for human language. It is possible to map phonological features to acoustic/articulatory parameters, though. By doing so, the phonological feature set can be much smaller and more abstract.

Supporting data: Articulatory data of tongue shape for American English vowels (for articulatory parameters), Contrasts in Melpa, Mid-Waghi, Kele, Titan, and Mpi (for why new contrasts are likely to not appear), Danish/English vowels and Kalaḅari/Hausa implosives (for why single scale phonological features can not explain between language variation in phoneme pronunciation)

Paper Summary

Introduction (p. 485)

- Linguistics phonetic parameters are not features.
- Seems to be primarily arguing against the *SPE* view.

> Chomsky and Halle (1968, p. 298): "To summarize, the features have a phonetic function and a classificatory function. In their phonetic function they are scales that admit a fixed number of values, and they relate to independently controllable aspects of the speech event or independent elements of perceptual representations. In their classificatory function they admit only two coefficients, and they fall together with other categories that specify the idiosyncratic properties of lexical items."

- There seem to be three facts that Ladefoged is trying to make sense of:
  1. Sound patterns are best described using phonological features
  2. Phonological features are not sufficient for specifying the actual sounds of a language
  3. Phonological features are not in a one-to-one relationship with the phonetic parameters required for specifying the sounds

Section 1 (pp. 485 – 493)

- Articulatory parameters are based off those used in speech synthesizers.

Articulatory Parameters:

1. Front raising
2. Back raising
3. Tip raising
4. Tip advancing
5. Pharynx width
6. Tongue bunching
7. Tongue narrowing
8. Tongue hollowing
9. Lip height
10. Lip width
11. Lip protrusion
12. Velic opening
13. Larynx lowering
14. Glottal aperture
15. Phonation tension
16. Glottal length
17. Lung volume decrement

- Discusses front raising(/lowering) and back raising(/lowering) and how it can account for American English non-rhotic vowels.
- "[these] two parameters shown (or something very like them) will probably account for more of the variance found in the vowels of the languages of the world than any other two parameters for specifying tongue shapes" (p. 487).
  - How is this different from traditions high/low and front/back features? Those define a single point (the highest point of the tongue) and there is no algorithm for describing the position of the rest of the tongue, given just that information.

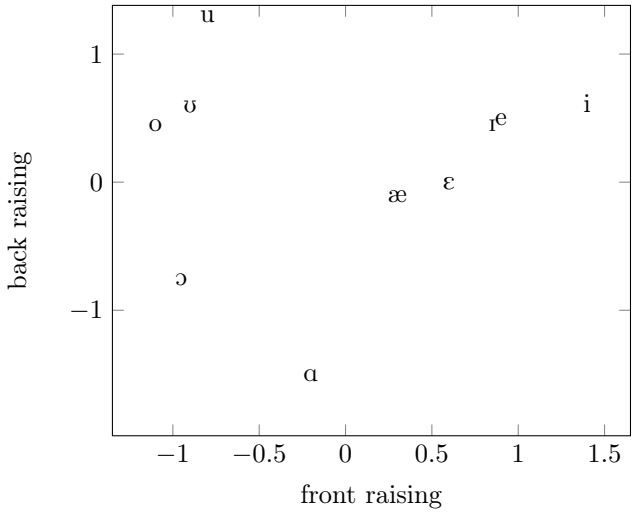
  - Multiple tongue configurations can have the same highest point.

- "It seems more likely that these parameters...describe higher-level cortical control functions. That is, we may think of them as the underlying parameters that determine the synergistic actions which are required for the skilled motor movements that occur in speech" (pp. 499–489).

  - A clear precursor to Articulatory Phonology...

- Do these parameters have any explanatory power when it comes to phonological phenomena?

- Figure 5 replicated below.



- Front raising clearly separates front/back, but back raising, "*considered as a single physical scale*, is not very useful in explaining observed vowel patterns, or in writing phonological rules for alternations of vowels..." (p. 490).

- Moves on to discuss tip advancing and tip raising

- Coronal/alveolar feature can only be described in terms of both of these parameters and therefore cannot be considered a single scale.

- Reiterates that articulatory parameters should not replace traditional phonological features, but instead that his main point is that phonological features do not need to be interpreted as a single scale.

  - He also says phonological features must refer to observable phonetic phenomena, but is not clear about how strong the reference must be. Since he focuses so much on the mappings, it seems that this view of features could fit in nicely with some of the substance free world.

- Remainder of section discusses other parameters, but makes the same general point.

Section 2 (pp. 493 – 495)

- Acoustic parameters are based off of the OVE III Speech Synthesizer (Liljencrants, 1968).

Acoustic Parameters:

1. Voice source frequency
2. Voice source amplitude
3. Frequency of formant 1
4. Frequency of formant 2
5. Frequency of formant 3
6. Bandwidth of formant 1
7. Bandwidth of formant 2
8. Bandwidth of formant 3
9. Amplitude of nasal formant
10. Frequency of nasal formant
11. Amplitude of aspiration
12. Amplitude of fricative source
13. Frequency of lower fricative pole
14. Frequency of upper fricative pole
15. Relative amplitude of fricative poles

- Some phonological features can be interpreted in terms of a single acoustic parameter (F1 and vowel height), but the majority are in a many-to-many relationship with the minimal set of acoustic parameters.

- For most articulatory configurations there is a unique acoustic specification.

- It is possible to use different articulatory configurations to create the same acoustic signal, but Ladefoged is skeptical of its widespread significance. Primarily, it seems, due to changes along one parameter requiring changes to another parameter to keep the same sound.
- If acoustic and articulatory parameters are in a one-to-one relationship then do we need both descriptions?
  - Ladefoged says yes because "languages get to be the way they are because of the interplay between articulatory and acoustic (and other) factors" (p. 495).

Section 3 (pp. 495 – 496)

- "To map features onto articulatory or acoustic parameters, something like a speech-synthesis-by-rule program is needed to provide addition information" (p. 495).
- E.g. $P_i = \alpha f([\mathrm{k^h}]) + \beta f([\text{æ}]) + \gamma f([\text{ʔt}])$
  - P_i is the value for parameter i
  - $f([\sigma])$ is a function of the feature values for the allophone $[\sigma]$
  - α, β, γ are time-varying weighting function corresponding to the degree of co-articulation that occurs in these circumstances
- Features cannot be interpreted on their own and must be interpreted as a group
- These mappings are not psychologically real, but instead are used as a way to relate phonological facts to phonetic facts
  - Also a very clear precursor to Articulatory Phonology...
- This view allows for much more abstract units (as I hinted at earlier in the handout)
- What is phonology then?
  - A description of speakers' behavior?
  - What is going on in the speakers' mind?
- Ladefoged takes the language-as-a-social-institution route and seems skeptical of phonological competence playing a large role in communication.

Section 4 (pp. 496 – 498)

- It's easy to show that the parameters given in the previous sections are necessary for phonetically characterizing linguistic sounds, but it is harder to prove that they are sufficient.
- Will counter-evidence ever appear that requires a new type of contrast?
  - Ladefoged thinks this is unlikely and gives examples from Melpa, Mid-Waghi, Kele, Titan, and Mpi that show that most "new" contrasts are combinations of previously known possibilities rather than totally new phenomena.
- More speech sounds could be contrastive but they are not. So maybe the parameters are sufficient?

Section 5 (pp. 498 – 501)

- General feature theories fail in accurately describing between language variation of the same phoneme
- English /i/ vs. Danish /i/
  - Danish /ɛ/ higher than English /e/
  - See figure 8
- Kalaḅari and Hausa implosives
  - Kalaḅari /ɓ ɗ/ are fully voiced while Hausa /ɓ ɗ/ are preceded by creakiness in the vowel and are at best laryngealized throughout the closure.
  - See figure 9

Section 6 (pp. 501 – 502)

- Features are different than phonetic parameters
- At an abstract level, languages may be organized as features, but the more concrete phonetic descriptions require more parameters