

English Phonology

Phonology is a branch of linguistics concerned with the systematic organization of sounds in languages. This project considers the relationship among the words that share the 'ash vowel' based on what consonant ends the word. Each subject (person) says each word three times into a microphone. There are nine words and 24 subjects. The recorded words are parsed by a system called WiSCO developed by Professor Eric Raimy and colleagues in the Department of English. The data are saved into a tab-delimited text with columns for Subject, BD-F1-H, BD-F2-H, BD-F1-T, BD-F2-T, BD-Distance, BD-Rate, BD-Direction, class, place, word, timeA, timeB.

The main focus is on the first and second formants (F1 and F2). Formants are “the spectral peaks of the sound spectrum” (en.wikipedia.org/wiki/Formant). These first two formants are usually plotted with F1 on the vertical axis and F2 on the horizontal axis. The head and tail of the sound are indicated by a and b. That is, there is an arrow starting at head (BD-F2-H, BD-F1-H) going to tail (BD-F2-T, BD-F1-T). [These are in units in vowel space called “bark derived units”, or “bdZ”.] Generally, different sounds plot in different locations on the x-y grid. The duration (difference in msec between beginning and end times, timea and timeb) and distance (in bdZ between head and tail) may both be important. From these, one can also determine rate (distance / duration) and direction of movement (angle from tangent of formant). Note that the final consonant of a word cross-classifies in terms of place of articulation (place) and laryngeal setting (class) used to create the sound according to the following table:

		Laryngeal Setting		
		FORTIS	LENIS	NASAL
place	LABIAL	tap	tab	bam
of	CORONAL	hat	bad	ban
articulation	VELAR	back	bag	bang

Researchers also examine the resultant mean length (R) calculated from the repeated measurements of direction on a word (en.wikipedia.org/wiki/Directional_statistics). Basically, one averages the directions (on a unit sphere). That is $R = |\text{mean}(\cos(a) + i*\sin(a))|$, with $|\cdot|$ being distance in complex space defined as $\text{sqrt}(\cos^2 + \sin^2)$.

Across subjects Raimy is asking whether there are similar patterns in breaking the vowels into groups. For example, ‘ash’ words have the pattern of 3 overlapping groups for local dialects:

- (1) words 'bam', 'ban' and 'bang' are higher (larger F1 values) than the other words (called ‘prenasal raising’),
- (2) words 'bang' and 'bag' move forward and higher (direction between 270 and 360) (called 'G over D' pattern),
- (3) everything else which either doesn't move like (2) or is lower unlike (1).

The ‘G over D’ pattern means 'bag' is higher (larger F1) than 'bad'. The (3) group is generally thought of as the unaffected 'leftovers' of examples that represent an unaffected 'ash' vowel. In addition, the vowel in 'tap', 'hat' and 'back' should be shorter than the other vowels; this is another prominent dialect feature that should appear across everyone modulo native speaker status.

The following questions are of general interest for each subject:

1. How many distinct vowel “phones” are there for the “ash” vowel for these words?
2. What role does the final consonant play in each word in defining these phones?

More broadly, across subjects:

3. How do words separate across subjects?
4. Are all subjects making similar vowel sounds, or can they be divided into distinct groups?

Raimy knows that the 'prenasal raising' should be common across all native speakers of American English so that should be a common feature across all of the subjects. Note that there are some non-native speakers in the data so this generalization may be noisy. The 'G over D' pattern does appear in WI but not for everyone, so there may be different groups in the data set. There is another 'D over G' pattern that is associated with Chicago and possibly southeast WI. There could be some speakers in the data who have that pattern. There is also a 'General American' where all of the non-nasal words (tap, tab, hat, bad, back, bag) form a group under the higher nasal group.

Exciting new finds would be some sort of pattern only affecting 'tab' and 'tap'. We've seen some speakers in WI who 'raise' only these words, which is not any of the patterns we know of (general, G>D or D>G). There could be people with that. Any generalizations about the directions of the vowels would be new information. No one has really done any type of circular statistics on vowels so a simple question as to whether 'all' of the words share the same direction would be useful. If the answer to shared direction is 'no', knowing whether there are multi-modal distributions or just randomness would be useful. Those are questions I have about the data and would love answered. I will eventually get around to getting enough 'approved' data to take a crack at these questions.