LING 151 Lab: Formants and the Vowel Space

October 29th, 2008

- We saw in class today that there is a correlation between the first two formants of a vowel and its height and backness.
  - Higher F1 → lower vowel
  - Higher F2 → fronter vowel
- Today, we will use F1 and F2 to examine the vowel spaces of different varieties of English.

Data

- There is a large database of recordings of different varieties of English at `http://www.soundcomparisons.com`.
- The varieties of English in the database are listed in a frame at the lower left of the screen. The dialects are grouped into seven categories; today, we are interested in dialects from five of them: England and Wales, North England, Scotland and Ireland, North America, and Rest of the World.
- For each dialect, the site contains recordings of 110 words being spoken by a speaker of that variety. Click on a dialect to see a page with the recordings and narrow phonetic transcriptions of them.

Instructions: Taking Measurements

- Working in groups of two or three, choose a dialect to investigate. Let me know which dialect you choose – I'd like to have a representative set of dialects across all the groups.
- For each recorded word for your dialect, download the sound file and open it in Praat.

  ⇒ The sound files are in mp3 format, which Praat can read (but not write). To save a file, right-click on the transcription and choose `Save link as...` or `Save target as...`. You will probably want to create a new folder to hold all of the sound files.

- For each vowel that is indicated in the narrow transcription, find that vowel in the spectrogram and measure its F1 and F2. If possible, try to measure the formants near the center of the vowel (away from the influence of neighboring consonants). In some cases, it may be difficult to tell where the boundaries of the vowel actually are; this is normal!

  ⇒ If the vowel in question is a diphthong, take two measurements, one from near the beginning and one from near the end. Record the measurements as two separate vowels with the symbols used in the narrow transcriptions.

- Record your measurements in a text file. Since you will later read this text file back into Praat, it must be in a particular format. Figure 1 shows the first few lines of the file I created with measurements of Standard Scottish.

  – Use tabs to separate columns.
  – The first row should have the names of the two columns, `F1` and `F2`, appropriately aligned.
  – Each following row should record the measurements of a single vowel token. This means that each vowel quality will have several entries in your table, each time with different measurements.
  – Ideally, the first element of each row would be the IPA symbol for the relevant vowel. Unfortunately, many of the IPA symbols are not ASCII characters and are therefore difficult to work with. Instead, today we will use the X-SAMPA system for translating IPA symbols into ASCII characters. Figure 2 shows the IPA vowel symbols, and figure 3 shows the corresponding X-SAMPA symbols.

- You may not have time to measure all 110 recordings. Just measure as many as you can.

Figure 1: Beginning of a text file recording the formants of vowels in Standard Scottish

```
        F1      F2
A       583     1128
I       381     2436
O       444     843
a       906     1394
a       801     1247
...
```

Figure 2: IPA vowels

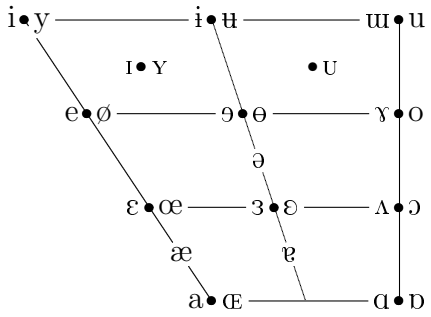
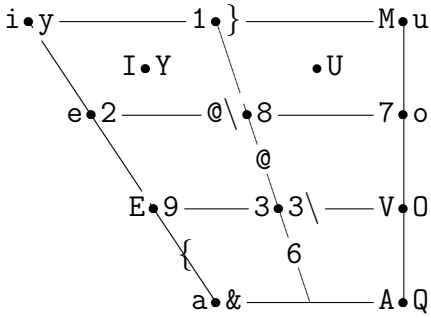


Figure 3: X-SAMPA vowels



Instructions: Plotting the Vowel Space

- Once you're finished measuring and recording formants, read the data into Praat by going to `Read` → `Read Table from tab-separated file...` and opening the text file with your measurements.
- You can click the `Edit` button on the right to make sure the table was read properly.
- Recall that F1 is *inversely* correlated with vowel height, and F2 is *inversely* correlated with vowel backness. Since we want the plot to have the same orientation as the vowel spaces we're used to looking at, we want to multiply all of the formants by -1.

  ⇒ Click the `Modify -` button on the right and choose `Formula (column range)...`. Fill in `F1` in the box labelled `From column label` and `F2` in the box labelled `To column label`. In the formula box at the bottom, fill in `self * -1`. This will multiply all of the values in the F1 and F2 columns by -1.

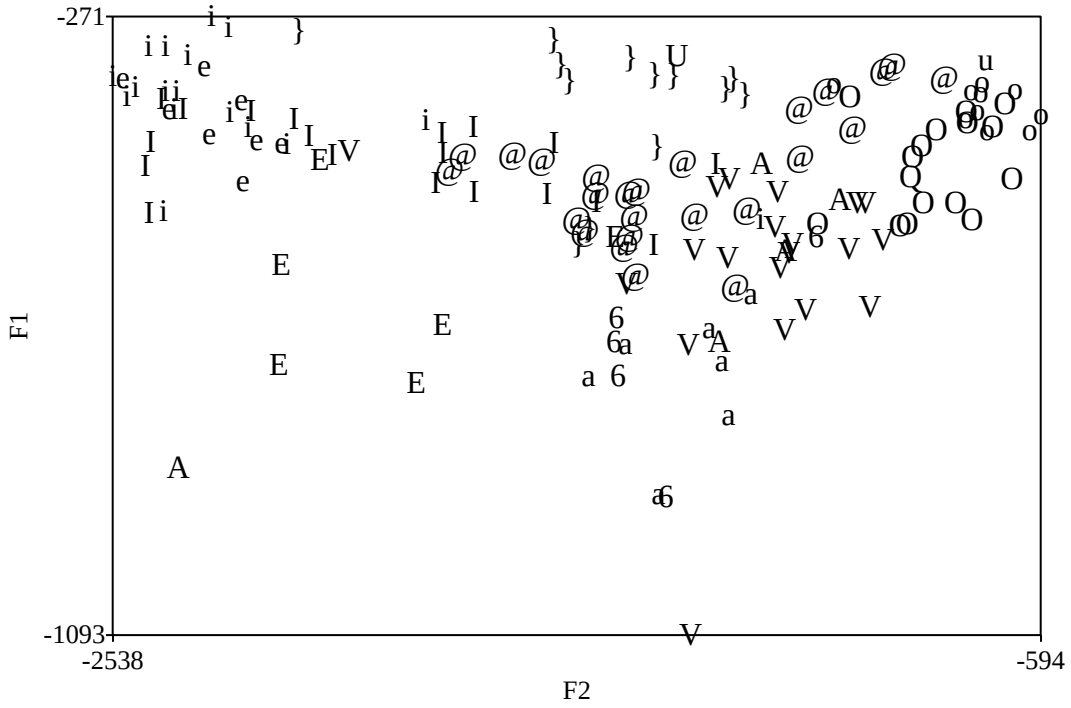
- To plot the vowels in your table, click the `Draw -` button on the right and choose

`Scatter plot...`. Fill in `F2` in the box labelled `Horizontal column` and `F1` in the box labelled `Vertical column`. Click `OK`. A scatter plot should appear in the Praat picture window, with each vowel labelled with the appropriate symbol. Figure 4 shows a scatterplot of the measurements I did on Standard Scottish.

⇒ The pink box in the Praat picture window shows what part of the window you've selected. If the picture that Praat creates is too small, try selecting a larger portion of the window before you draw the scatterplot. You can erase things that are already in the picture window by going to `Edit` → `Erase all...`

- Save the scatterplot by going to `File` → `Write to EPS file...`. Email the file to me at `kaplanas@gmail.com` so we can look at everyone's results at the end of the lab period.

Figure 4: Scatterplot of F1 and F2 values of vowels in Standard Scottish



Questions to Ask about Your Dialect's Vowel Space

1. Which vowels are the most spread out in the vowel space? Which vowels are the least spread out? Why do you think this might be?

2. How much overlap is there between different vowels? Is this surprising? Why or why not?

3. Does the position of any of the vowels seem surprising? If so, which one(s), and why?

4. How does the vowel space of your dialect compare to that of other dialects?