LING 151 Lab: Perceptual Maps

November 19th, 2008

1 Perception of Nasal Murmurs

1.1 Confusion Matrices

- Today in class, we did an experiment in which we tried to identify the place of articulation of various nasal murmurs.
- The results of this experiment can be represented as a *confusion matrix*:

Figure 1: Our class's confusion matrix for nasal murmurs

	[m]	[n]	[ŋ]	[ɴ]
[m]				
[n]				
[ŋ]				
[ɴ]				

- Every cell records how many times someone identified the nasal corresponding to the row label as the nasal corresponding to the column label.

  ⇒ For example, on ?? occasions, someone identified [m] as [ŋ].

- If everyone had performed perfectly during the experiment, all of the cells would be zero except the ones on the diagonal.
- But since we *didn't* perform perfectly, we can use the confusion matrix to measure how similar the different nasal murmurs are.

  ⇒ Intuitively, the more often nasal X is misidentified as nasal Y (and vice versa), the more similar the two nasals are.

1.2 Multidimensional Scaling and Perceptual Maps

- You can find a text file containing the confusion matrix from our in-class experiment, `nasal_murmur_confusions.txt`, at `http://people.ucsc.edu/~kaplanas/labs`. Download this file.
- The file is formatted so that Praat can read it as a `Confusion` object – in other words, as a confusion matrix. Read the file into Praat.
  - Go to `Read` → `Read from file...`.
  - Choose `nasal_murmur_confusions.txt`.
- One thing Praat can do with a confusion matrix is convert it to a perceptual map. Essentially, a perceptual map is a visual representation of the similarity (or lack thereof) of various sounds. The more similar two sounds are, the closer they are to each other on the map. The technique Praat uses to create a perceptual map is known as multidimensional scaling (MDS).
- Create a perceptual map from the confusion matrix for nasal murmurs.
  - Go to `To Proximity -` → `To Dissimilarity (pdf)...` and click `OK`. This will create a new `Dissimilarity` object in the Praat objects list.
  - Select the new `Dissimilarity` object and go to `To Configuration -` → `To Configuration (monotone mds)...` and click `OK`. This will create a new `Configuration` object in the Praat objects list.
  - Select the new `Configuration` object. Go to `Draw -` → `Draw...`. Make sure the box called `Label` is clear and click the button that says `Use row labels`. Click `OK`.
- Questions to think about:
  1. According to the perceptual map, which nasals are most similar? Which are least similar? Does this correspond to your intuitions?
  2. The two axes of the graph are arbitrarily labelled "dimension 1" and "dimension 2". Do these dimensions seem to correspond to any traditional linguistic properties of these sounds?

2 Perception of Nasal-Stop Sequences

2.1 Perception and Position

- Three other files contain the results of a perceptual experiment involving six nonsense words: [ana], [anta], [anda], [an], [ant], and [and], as follows:

  - `nt_confusions_medial.txt`: confusion matrix for [ana], [anta], and [anda]
  - `nt_confusions_final.txt`: confusion matrix for [an], [ant], and [and]
  - `nt_confusions_all.txt`: confusion matrix for all six stimuli

- Make a perceptual map for the first file. Of the words [ana], [anta], and [anda], which (if any) seem to be most similar?
- Make a perceptual map for the second file. Of the words [an], [ant], and [and], which (if any) seem to be most similar?
- What do these results tell you about how position in the word affects the perception of sequences like [n], [nt], and [nd]?
- Make a perceptual map for the third file. What property of the words (if any) does dimension 1 correspond to? Dimension 2?

2.2 Perception and Symmetry

- Look at the third confusion matrix (the one for all six words).
  - Select the `Confusion` object.
  - Clear the Praat picture window. Go to `Draw -` → `Draw as numbers...` and click `OK`.
- Look at the confusions between [and] and [an]. How many times was [and] misperceived as [an], and how many times was [an] misperceived as [and]?
- What does this tell you about the limitations of representing perceptual distance in a form like the perceptual map?