Lab Assignment #07 — Analyzing fricatives

Due M Oct 10 at 11:15am on Sakai
20 points total

Lab #07 is an individual assignment, but you are welcome to work with your partner group or other classmates on the lab tasks as long as your write-up is done individually.

Purpose

This assignment provides an opportunity to:

- Review fricative acoustics in the source-filter model
- Practice IPA symbols for voiceless fricatives
- Work with TextGrids: combine sounds, add text tier, extract sounds
- Learn how to measure centroid frequency and dispersion in the fricative spectrum

1. Prepare the fricatives for analysis

- Load the following sound files from the German vowels set (Lab #06) into the Praat Objects window, in this order (they contain voiceless fricatives, whose place of articulation is given in parentheses):
  - `offen.wav` (bilabial)
  - `essen.wav` (alveolar)
  - `schoen.wav` (postalveolar)
  - `oesterreich.wav` (palatal)
  - `kuchen.wav` (velar)
- Paste the five sound files together into one Sound object, with a labeled TextGrid:
  - (a) Highlight all five sound files at the same time
  - (b) Click `Combine > Concatenate recoverably`
  - (c) Highlight and open the new `Sound chain` and `TextGrid chain` together
    - Praat's default *dynamic range* for spectrograms is 70 dB: this determines what amplitude range, in terms of how far 'down' below the highest amplitude, the spectrogram will display. You might want to make this number a little ***smaller*** to help weed out relatively quiet background noise. Click on `Spectrogram > Spectrogram settings` and experiment by changing the `Dynamic range` value.

(1) What setting did you choose for "Dynamic range"? (There is no specific correct answer!) [1 point]

- Make a new tier on the TextGrid for segmenting and labeling the fricatives—review Praat handout #4 if needed
  - (a) In the TextGrid (with Sound) editor window, click on `Tier > Add interval tier`
  - (b) You should get a dialog box; keep the position setting as "`2 (= at bottom)`";

naming the tier is useful but optional

- Place boundaries at the beginning and end of each fricative (use the final fricative in *Österrei**ch***), and label the fricative intervals on the new text tier
    (a) Click on the new tier; it should become highlighted
    (b) To place a boundary, click on the waveform or spectrogram to place a boundary on the tier, then hit the Enter key or click on the little circle to make the boundary permanent (you can also remove them; use Alt+Backspace or the Tier menu commands)
        - Try to include as much of the fricative as you can while keeping the selected area (on the spectrogram) fairly uniform
    (c) Click inside each fricative interval on the fricatives tier and type a label (it's convenient to use letters or letter combinations that remind us of the IPA symbols, but use regular letters because these will become Praat Sound object names in a later step)

(2) Take a screenshot of your TextGrid and upload it to Sakai. *PDF files as well as image files in .jpg, .png, or .gif formats are **all** acceptable.* [5 points]

- Extract your fricatives as separate Objects in the Objects window
    (a) In the Objects list, highlight your Sound and TextGrid objects again
    (b) Click on `Extract > Extract non-empty intervals` and choose tier 2
    (c) For fun, we can next recombine the fricatives into a single Sound object and listen: what does it sound like?

(3) Take a screenshot of your Objects window and upload it to Sakai. *PDF files as well as image files in .jpg, .png, or .gif formats are **all** acceptable.* [2 points]

2. Fricative spectral analysis

- Prepare each fricative for spectral analysis (using `f` as an example)
    (a) Select the Sound `f` in the Objects window
    (b) Click on `Analyse spectrum > To spectrum` (keep the `Fast` box checked)
    (c) Select the `f` Spectrum object you have just created
    (d) Click on `Convert > Cepstral smoothing` and set `Bandwidth` to 200 Hz
    (e) Rename the new Spectrum `f_smooth`
    - Then, repeat this process with the other fricatives
- Spectral analysis
    (a) Click on `Query > Get center of gravity` (keep the `Power` at 2.0)
        - This is the **centroid** or "first spectral moment"
    (b) Click on `Query > Get standard deviation` (keep the `Power` at 2.0)
        - This reflects the **dispersion** or "second spectral moment"
    (c) As you can see, there are menu options for the other spectral moments also

(4) On Sakai, enter the centroid and dispersion values that you have measured for each of the five fricatives (bilabial, alveolar, postalveolar, palatal, and velar). [10 points]

(5) Discuss: Are the German fricatives uniquely identifiable from their centroid frequency? Are they uniquely identifiable from their dispersion? What happens if we consider both measures together? [2 points]

Criteria for success

This lab assignment is worth a total of 20 points; points for each question are as specified. Points will be awarded for answers that are accurate and insightful, showing understanding of course material where appropriate. Partially correct answers will receive partial credit. Some of the parts may be automatically graded on Sakai, but I will double-check everything by hand in case of Sakai errors.

References

This exercise is a modification of the following handout. The Praat spectral analysis procedure outlined above follows Hoole's exactly.

Hoole, Phil. 2010. Acoustic analysis of fricatives: Exercise with Praat. Handout from Seminar Akustik. University of Munich. Accessed 2018.11.08 at [http://www.phonetik.uni-muenchen.de/~hoole/kurse/akustik_ba/fricative_uebung_kurz_anleitung.pdf].