

Lab Assignment #07**Analyzing fricatives**

Due **W Oct 15** at 2:30pm on Canvas (Assignments)

25 points total

Lab session: Part of class on **F Oct 10** is a lab session for this assignment. You will have an opportunity to collaborate with classmates, get help with Praat, and ask questions.

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 place of articulation for voiceless fricatives
- Work with TextGrids: combine sounds, add a text tier, extract sounds
- Learn how to measure centroid frequency and dispersion in the fricative spectrum

Task

1. Prepare the fricatives for analysis (and answer numbered questions in Canvas)

- 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` (labiodental)

`essen.wav` (alveolar)

`schoen.wav` (postalveolar)

`oesterreich.wav` (palatal, in word-final position)

`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) On the right-side menu, click `Combine > Concatenate recoverably`

(c) Highlight the new `Sound chain` and `TextGrid chain` and click `View & Edit`

- 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. Try making this number a little **smaller** to help remove background noise, as follows: Click on `Spectrogram > Spectrogram settings`, click `Standards` to restore all the default settings, and experiment by changing the `Dynamic range` value until the background noise is less visible but the fricatives still look dark.

- (1) What setting did you choose for “Dynamic range”? (There is no specific correct answer!) [2 points]
- 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 new tier is optional but useful (perhaps “fricatives”)
 - Place boundaries at the beginning and end of each fricative (use the final fricative in *Österreich*), and label the fricative intervals on the new text tier. This might be easier if you first select each word (shortcut: click on the “labels” tier) and zoom in.
 - (a) Click on the new tier; it should become highlighted
 - (b) To place a boundary, click on the waveform or spectrogram to create a boundary at a certain timepoint on the tier, then hit the `Enter` key or click on the little circle to make the boundary permanent (you can also remove boundaries; use `Alt+Backspace` on Windows, 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) Zoom out with the all button. Then take a **screenshot** of this TextGrid window and upload it on Canvas as a **PDF or doc/docx** file. (Please remember to include your **name** in the filename or in the document.) [5 points]
- Extract your labeled fricatives as separate Objects in the Objects window.
 - (a) In the Objects list, highlight `Sound chain` and `TextGrid chain` again
 - (b) Click on `Extract > Extract non-empty intervals` and choose tier 2 (the “fricatives” tier that you created)
 - (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 on Canvas as a **PDF or doc/docx** file. (Please remember to include your **name** in the filename or in the document.) [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 and click `OK`)
- (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
- Perform a spectral analysis (using `f` as an example).
 - (a) Select the `Spectrum f_smooth`
 - (b) Click on `Query > Get center of gravity` (keep the `Power` at 2.0) and `OK`
 - This is the **centroid** or “first spectral moment”
 - (c) Click on `Query > Get standard deviation` (keep the `Power` at 2.0)
 - This reflects the **dispersion** or “second spectral moment”
 - (d) As you can see, there are menu options for the other spectral moments also (see the optional Hoole handout below for more information).
- (4) Enter the **centroid** and **dispersion** values that you have measured for **each** of the five fricatives (labiodental, alveolar, postalveolar, palatal, and velar). [10 points]
- (5) Discuss: Is there any relationship between the centroid values of these German fricatives and their place of articulation (location of the constriction in the vocal tract)? Does this relate to any predictions of the source/filter model? [2 points]
- (6) 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? [4 points]

Criteria for success

This lab assignment is worth a total of 25 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.

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 2025.10.10 at

[http://www.phonetik.uni-muenchen.de/~hoole/kurse/akustik_ba/fricative_uebung_kurz_anleitung.pdf].