

Preliminaries

In this week's lab, we'll learn to record, visualize, and annotate (speech) audio using the free speech annotation software [Praat](#)¹. Praat is widely used by speech scientists, phoneticians, and other linguists to annotate speech and analyze its acoustic properties.

Before the lab, you should watch the videos on speech anatomy, articulation, and the structure of the IPA, which are available on [speech.zone](#) under Module 1. If you are keen, there are exercises to help you practice and learn the anatomical terms used in phonetic notation on [Quizlet](#).

As you work through the lab, think about how you can compare various speech sounds using waveforms and spectrograms, and how this relates to articulatory descriptions of speech.

Goals

At the end of this tutorial you should be able to:

- Load sound files into Praat
- Listen to and view sound files
- Toggle the analysis view to show or hide the spectrogram
- Create a TextGrid annotation for a sound file
- Add and delete tiers and boundaries in the TextGrid file
- Label the segments you have created with TextGrid boundaries
- Measure/report basic acoustic information about the speech signal
- Save the TextGrid for later use
- Record new sounds in Praat (and save the sound files)

Resources

As you work through this lab, your tutor can help you with any questions that you have. You may also find it useful to consult the following video resources from Professor Richard Ogden at the University of York (click on the links to open in your web browser):

- [Praat 1: Opening a file](#)
- [Praat 2: Zooming in and out](#)
- [Praat 10: Labeling intervals](#)
- [Praat 9: Saving your work](#)

¹Praat is developed and maintained by Paul Boersma at the University of Amsterdam

Tasks

The tasks for this lab session are as follows.

- Download the following audio files and open them in Praat:

- speechproc_phonlab1_1.wav
- speechproc_phonlab1_2.wav

The first of these is Rebekka Puderbaugh saying “Take a picture, it’ll last longer”. The second recording is the same sentence from a (not very good) text-to-speech system (which we will examine more in Assignment 1).

- Examine both the provided audio using waveform and spectrogram views in the SoundEditor.
- Add TextGrid annotations that will allow you to measure and compare your recording to the one provided.
- **Answer the following questions:**
 1. **Without listening to the sound, can you identify the consonants and vowels in the recording? If so, how are you able to do this? If not, why not?**
 2. **Identify 3 similarities and 3 differences between Rebekka’s recording and the TTS version. What does it mean to be similar or different in this instance? How would you describe these similarities/differences?**
 - What’s different about the way Rebekka says ‘take’ versus the TTS? Why does this make the speech sound weird?
 3. **Locate the three ‘t’ sounds in both the provided audio and your own recording. How do they compare to each other? How do you determine where each instance begins and ends? What do the visual displays of acoustic information tell you about each instance of ‘t’? Add and label intervals that identify each instance of ‘t’ in both recordings. Be sure to save your TextGrid from the Objects window so that you can revisit it later.**
 4. **Bonus: Record yourself saying the sentence. Then close the SoundEditor window and select only the sound Object from the list for your self-recording. Find a classmate and ask them to identify the three ‘t’s *without listening to the audio*. Do the same for your classmate’s recording. What clues are you looking for that tell you where each ‘t’ begins and ends? Do they look the same as your t’s? What about the vowels? Try to locate the vowel in ‘it’ without listening to the audio. What clues are there? Are they different from your classmate’s speech?**

The rest of this document provides guidance on how to do the tasks above. You can walk through the tasks by following the instructions, or figure them out on your own.

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1 Get Praat

Praat is available for free from the Praat website, <http://www.fon.hum.uva.nl/praat/>.

1.1 Download Praat

For your convenience, here are download links for the three most common operating systems (click on the name to go to the download page):

- [Mac](#)
- [Windows](#)
- [Linux](#)

Save Praat in your Applications folder just like any other application.

1.2 Open Praat

Open Praat as you would open any other application on your computer, typically by double-clicking on the Praat icon, or by finding it under the Start menu on Windows. The first time you open it, you may get a warning about running programs you have downloaded from the internet. To the best of my knowledge it is all safe.

Two windows will appear, the Praat Objects window on the left, and the Praat Picture window on the right. For this exercise, you can close the Praat Picture window.

2 Loading sounds into Praat

First we need to get some sound files to work with. There are two ways to do this: open an existing sound file, or a record a new one.

2.1 Open an existing sound file

Note: Praat is capable of handling most sound file formats, including MP3 and other familiar file types. However, it is best practice to use lossless, uncompressed formats such as WAV, AIFF, or FLAC to ensure high quality sound and reliable analyses. For the purposes of the PHON tutorials, we'll be using WAV files exclusively.

2.1.1 Download a sound file

Most of the time when we are doing acoustic analyses, we are using pre-recorded data. For this exercise, the following sound files are available to you: `speechproc_phonlab1_1.wav` and `speechproc_phonlab1_2.wav`

Download these files and save them to a folder where you will be able to find them easily.

2.1.2 Open a sound file

Once you have downloaded the sound file, the next step is to load the audio into Praat with the following steps:

1. Click on 'Open' at the top of the Praat Objects window.
2. Click on 'Read from file...' in the dropdown menu.
3. In the window that opens, browse to the directory where you have previously saved the sound files above.
4. Select one of the sound files and click on 'Open'.

3 Examine the sound

Praat allows you not only to listen to sounds, but also to look at that by creating static images of the sound waves across time, frequency, and amplitude domains.

3.1 Listen to the sound

To hear the sound file that you have loaded, select it by clicking on it and then click on the 'Play' button that will appear on the right hand side of the Objects window.

Notice that if you deselect the sound by clicking away from it in the Objects window, the buttons will disappear. This is because the buttons are *dynamic*, meaning that they change depending on the type of object you have selected. We'll see an example of such changes in section [4.1](#).

3.2 Look at the sound

Praat can create images of sounds from various perspectives, including waveforms, spectra, spectrograms, and combinations of the three. In this section we'll look at the waveform and spectrogram, and learn how to manipulate which part of the sound is visible by selecting, zooming and scrolling through the sound.

3.2.1 View the waveform (and spectrogram)

Make sure the sound is still selected, then click on the 'View and edit' button. A new window will open that shows the waveform and spectrogram of the sound you have loaded. For now, we are only interested in the waveform, so hide the spectrogram and any other analyses by clicking on 'View', then selecting 'Show analyses...'. In the window that pops up, untick any boxes that are ticked, then click 'OK'.

3.2.2 Play around with the Sound editor window controls

The signal editor, which is the window that now displays the waveform, can be manipulated in various ways to investigate different parts of the sound. Play around with the following functionalities:

- Zoom: click on the 'in' and 'out' buttons at the bottom left corner of the window.
- Scroll along backwards and forwards in the sound by using the scroll bar that appears after you zoom in.
- Play the sound: click on the bars at the bottom of the window.
 - The **top bar** will play a section of the sound that is visible in the window, starting or stopping at the point where the bar is split into sections;
 - The **middle bar** ('Visible part') will play whatever is currently visible in the window;
 - The **bottom bar** will play the entire sound from the beginning.
- Measure the timepoint of a certain part of the waveform by clicking on it. A red vertical cursor will appear, with a time value displayed at the top of the line.
- Select a portion of the waveform by clicking and dragging along in the view window. You will be able to see the beginning and ending times of the selection you have chosen, as well as the duration of the selection at the top of the window.
- Zoom in on your selection by clicking 'sel' in the bottom left near the 'in' and 'out' buttons.

Now you know how to use the Sound editor! Zoom all the way out until you can see the entire sound again. Highlight a section, zoom in on it, and play it.

Close the Sound editor window before moving on to the next part of the exercise.

4 Annotate the sound file

In this section you will use a TextGrid to *segment* the sound file into delimited intervals of speech, and *label* the segments according to the sound that appears there.

First you need to create a TextGrid. Then, you can add time-aligned intervals and add labels to identify the speech occurring within the interval.

4.1 Create a TextGrid

Select the sound from the Objects list again, and then click on ‘Annotate’. Click on ‘To TextGrid...’ in the dropdown menu. A window will pop up with fields labeled ‘All tier names’ and ‘Which of these are point tiers?’

1. Delete any text that is in these fields.
2. In the ‘All tier names’ field, enter the word *segments*.
3. Leave the field about point tiers blank.
4. Click OK.

You should now see a new object in the Objects lists. This is a TextGrid with the same name as the sound file. The TextGrid object is a text file that is time-aligned to a particular audio file. Select the TextGrid, and notice how the buttons in the dynamic window are different from those available when you selected the Sound file.

In order to do anything useful with a TextGrid, we need to open it along with the Sound it was made for. To do this, select **both** the Sound and the TextGrid by clicking and dragging, then click on ‘View and Edit’ from the buttons that appear. You should now see a new window with the waveform on top, and the TextGrid on the bottom. If you’ve followed the instructions correctly, the TextGrid should have just one tier, labeled *segments* on the righthand side.

4.2 Segment the sound file

To segment the speech, you need to insert boundary markers in the TextGrid.

For the first and last speech sounds in the file, you will also need to insert a boundary on either side to show where the sound starts (for the first sound) or ends (for the last sound).

- **To insert a boundary** click on the place in waveform where you would like to place a boundary. Then click on the circle that appears at the top of the gray vertical bar in the TextGrid.

- **To delete a boundary**, select it by clicking on it (it will turn red), then type Alt+Backspace.
- **To label the interval** you have created, click between the boundaries to highlight that interval, then type in the label.

Don't worry if you're not sure where to place a boundary or what label to give the segments you have created. We will return to this question later.

4.3 Save the TextGrid

A TextGrid is just a plain text file with some information that aligns the text with particular time points in the waveform. You can open a TextGrid file in any text editor to see how it is structured. However, you need to use the `.TextGrid` extension in order for Praat to interpret it properly.

When you are done adding annotations to your TextGrid, save it by clicking on 'File' in the Sound editor window, then click on 'Save TextGrid as text file...' in the dropdown menu. Save the TextGrid with the same name as the `.wav` file it corresponds to, with the file extension `.TextGrid`.

4.4 Record a new sound file

If you're just starting out you might not have any sound files readily available to work with, so you will need to record your own. You could do this with any kind of recording software and equipment, but Praat also provides this functionality.

4.4.1 Record the sound file

1. At the top of the Praat Objects window, click on 'New'.
2. Select 'Record mono Sound...' from the drop down menu that appears.
3. A new SoundRecorder window will appear with a white window labeled 'Meter' at the center and a few options for you to select. By default, the following options should be preselected:
 - (a) Channels: Mono
 - (b) Input source: Built-in Microph[one]
 - (c) Sampling frequency: 44100 Hz

In the bottom right corner of the SoundRecorder, there is also a field labeled 'Name:' where you can input a name for the sound. This name will appear in the Praat Objects window after you have saved your recording.

4. The Meter window should show a message that reads 'Not recording.' Click on 'Record'. Now the Meter window in the center of the SoundRecorder should be monitoring the sound coming from your microphone. Clap your hands a few times to watch the levels spike and turn red. This is an indication that the sound you have

recorded was too loud and will be distorted or clipped. Try to keep your recordings in the green or yellow range. Click on ‘**Stop**’ to stop recording.

5. Now record yourself saying ‘Hello, world!’ (or anything else you’d like to say, such as the provided phrase) and save the recording to the Praat Objects list.
 - (a) Type a name into the ‘**Name:**’ field. (NB: your own name is a good choice here, because it will make it easier to compare your own speech to that of other people. But it’s up to you.)
 - (b) Click on ‘**Record**’
 - (c) Wait for the Meter to register sound from your microphone
 - (d) Say ‘Take a picture, it’ll last longer.’
 - (e) Click on ‘**Stop**’
 - (f) Click on ‘**Save to list**’ (which should be highlighted in blue).

You should now see a new item in the Objects list with the name of the sound that you recorded.

TIP: If you forgot to name your item, it will be called ‘**untitled**’ in the Objects list. You can rename it by selecting the item and then click on ‘**Rename...**’ at the bottom of the list.

If you would like to revisit this file later, be sure to save it from the Objects window as follows:

- (a) Select the sound file in the Objects list.
- (b) Click on ‘**Save**’, then ‘**Save as WAV file...**’
- (c) Rename and save your file wherever you’d like.

4.4.2 Save the sound file

To save the sound file for later use, first select it from the Objects list. Then click on **Save** and select **Save as WAV file...** from the list of file options. Name the file something sensible, like `sp-lab1-myaudio.wav` or similar, and save it somewhere you’ll be able to find it easily. One way to do this is to set up a folder for this course, with a subfolder for labs or for each module.

Acknowledgments

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