KARL-FRANZENS-UNIVERSITÄT GRAZ
UNIVERSITY OF GRAZ

Introduction to Praat

Petra Hödl
petra.hoedl@uni-graz.at

Summer school "Intonation and Word Order – Theoretical and Empirical Approaches"

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Aim of this short tutorial

- To give an **introduction** to Praat
- Tips and recommendations for obtaining **good audio-recordings**
- Demonstration of some **key functions** relevant for acoustic analysis
- Tips for producing and exporting **high-quality pictures** from Praat
- (Demonstration of how to **run a perception experiment** in Praat)

What is Praat?

- *Praat* = a computer program with which you can

  - **visualize**
  - **analyze**
  - **synthesize**
  - **manipulate speech** (or any other acoustic signal)

- Invented and further developed by **Paul Boersma** and **David Weenink** (Institute of Phonetic Sciences, University of Amsterdam) since 1992

The authors

Paul Boersma and David Weenink
Phonetic Sciences, University of Amsterdam
Spuistraat 210
1012VT Amsterdam
The Netherlands

What is Praat?

- **Updated versions are regularly available** for various operating systems (Windows, Macintosh, Linux)
- It is a **free software**
- **Very popular around the world for linguistic and phonetic research** and beyond…(musicology, animal communication, etc.)

Why use Praat?

- It is the **most complete program** for phonetic research available at the moment
- There are **updates and improvements** of the program happening on a regular basis
- It is **very good**, i.e. algorithms are quite exact
- It is **user-friendly** and has a **GUI**. But it is also a **scripting language**!
- There is a **big (and helpful!) user community** as well as a Praat **mailing list**
- There are plenty of **tutorials and scripts freely available** on the internet

Step 1: Download Praat

- Where you can **download** it: http://www.fon.hum.uva.nl/praat/
- Download the version compatible with your operating system (e.g. for Windows: http://www.fon.hum.uva.nl/praat/download_win.html)
- Use the **64-bit edition** if possible (especially with newer computers, this is the one you almost certainly want)
- After downloading, you will see a **zip folder** in your downloads (or wherever you have decided to put it)

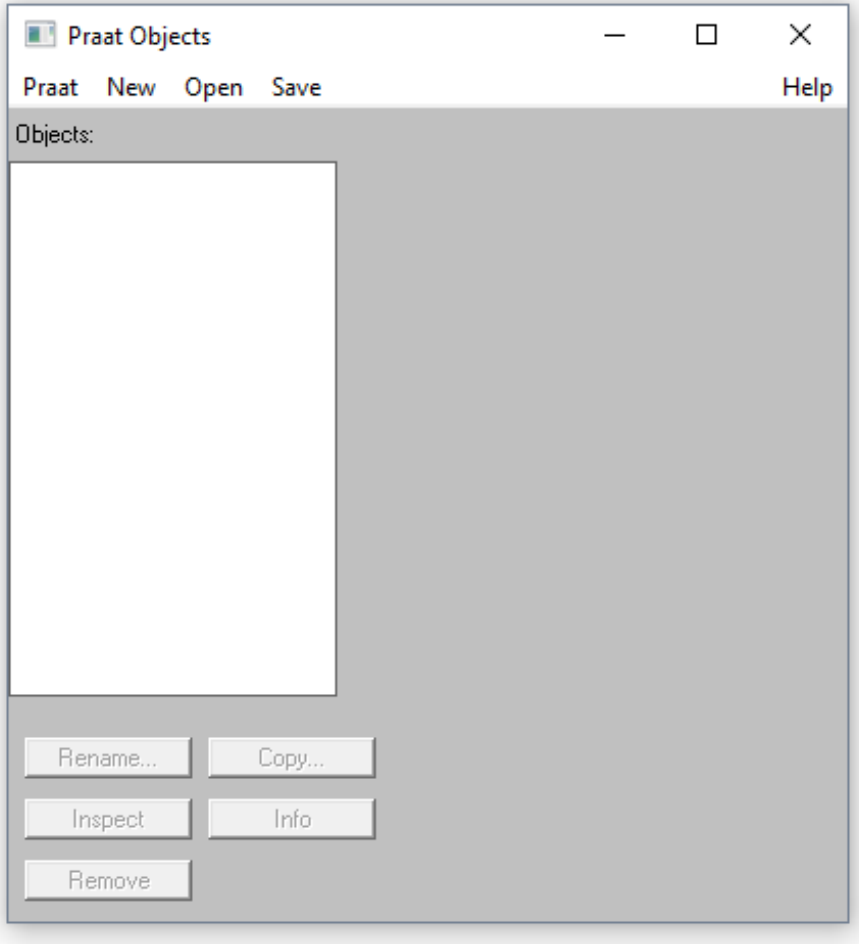
praat6025_win64.zip

- **Double-click on the zip folder** and a file called **Praat** or **Praat.exe** will appear (this is the Praat program). You can use it right now or you can move it out of the zip folder to any location on your computer
- Remark: You are able to use Praat even if your system administrator does not allow you to install programs

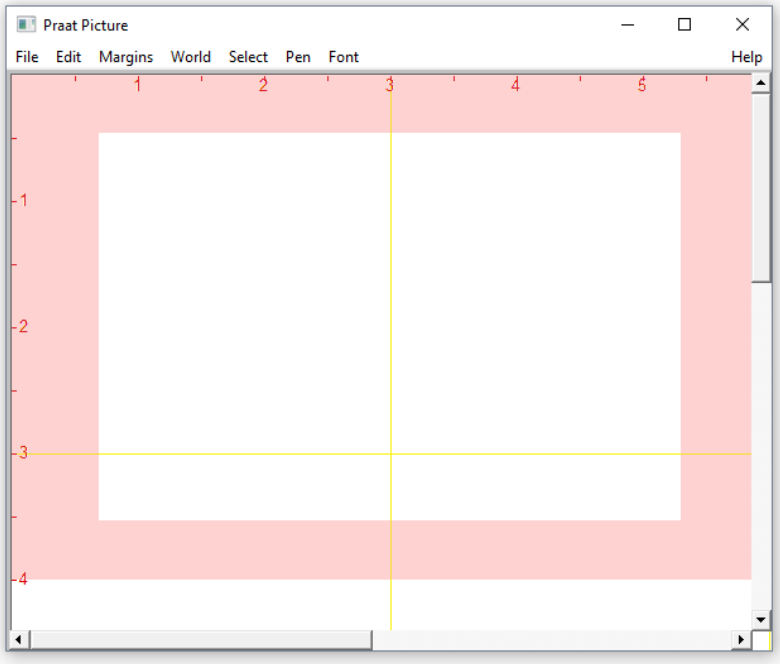
Step 2: Open Praat

- Double-click on the **Praat.exe file** or the **Praat icon**
- Two windows will open up immediately

Praat Objects Window

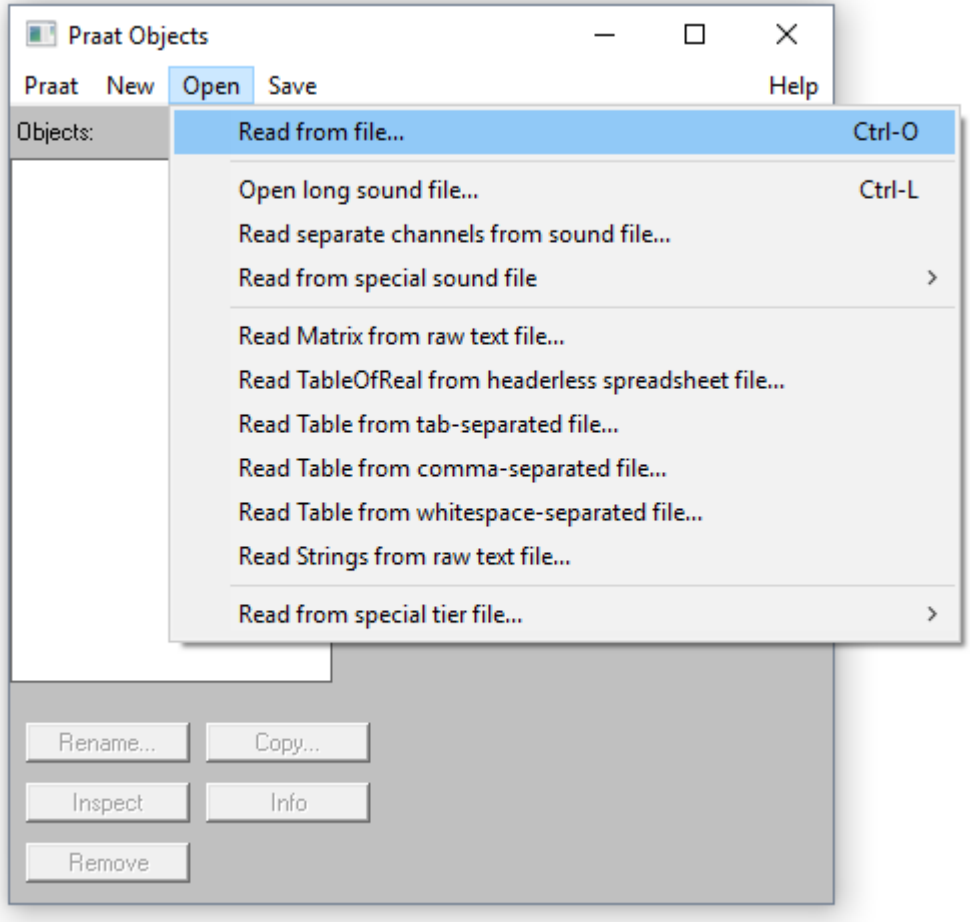


Praat Picture Window



Step 3: Open a sound file or record one

- You need to **import** the sound file(s) you want to work with



- **„Read from file“**
- Use **„Open long sound file“** for files that are too long to read into memory completely (Praat will only read so much of the file as needed to display parts of it)

Step 3: Open a sound file or record one

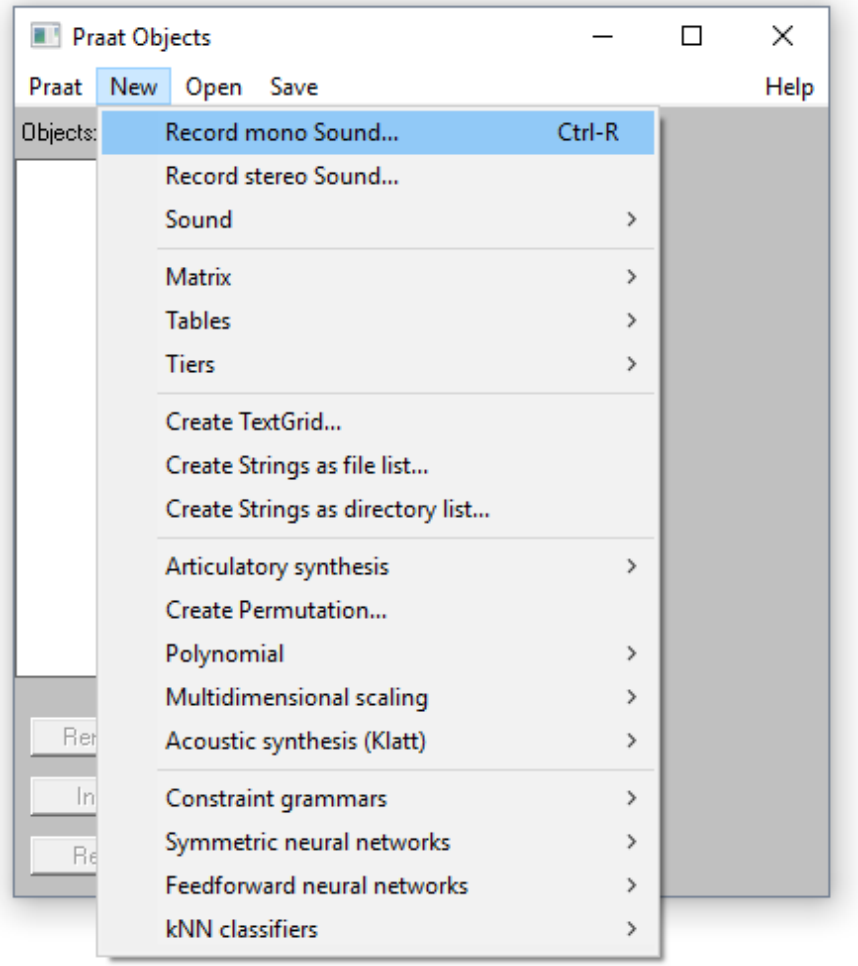
- Praat can handle a number of **standard audio file formats** such as:
  - ✓ WAV (*Waveform Audio File Format*)
  - ✓ AIFF (*Audio Interchange File Format*)
  - ✓ MP3

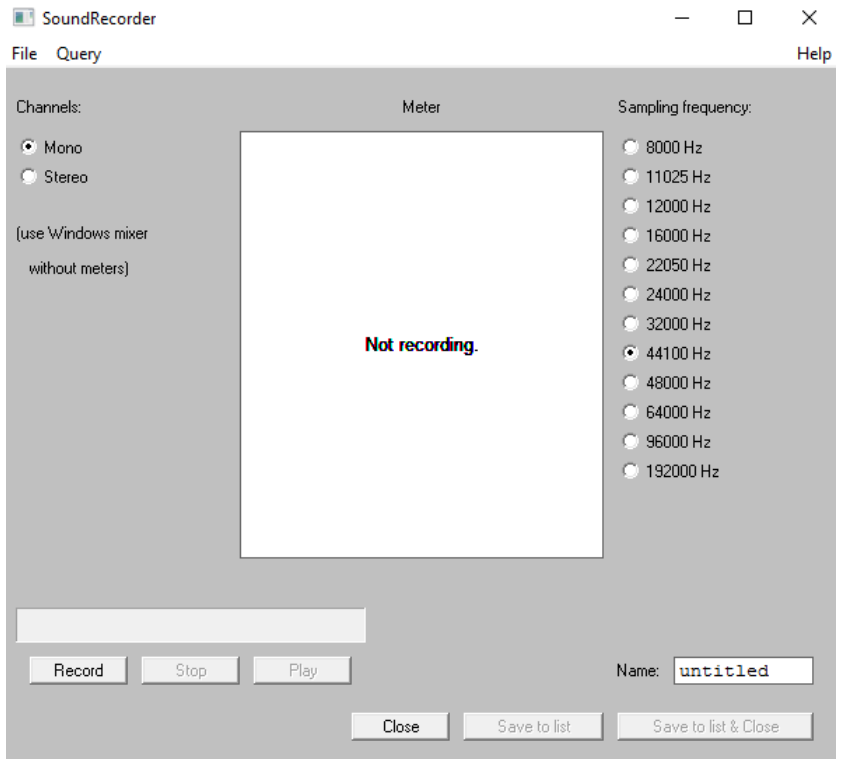
  (and some more)

- Remark: While Praat is able to *read* MP3 files, **I would not recommend saving recorded audio files as MP3 files**, if you want to do phonetic research
- Reason: MP3 uses lossy data compression (It encodes data using inexact approximations and partial discarding of data)

Step 3: Open a sound file or record one

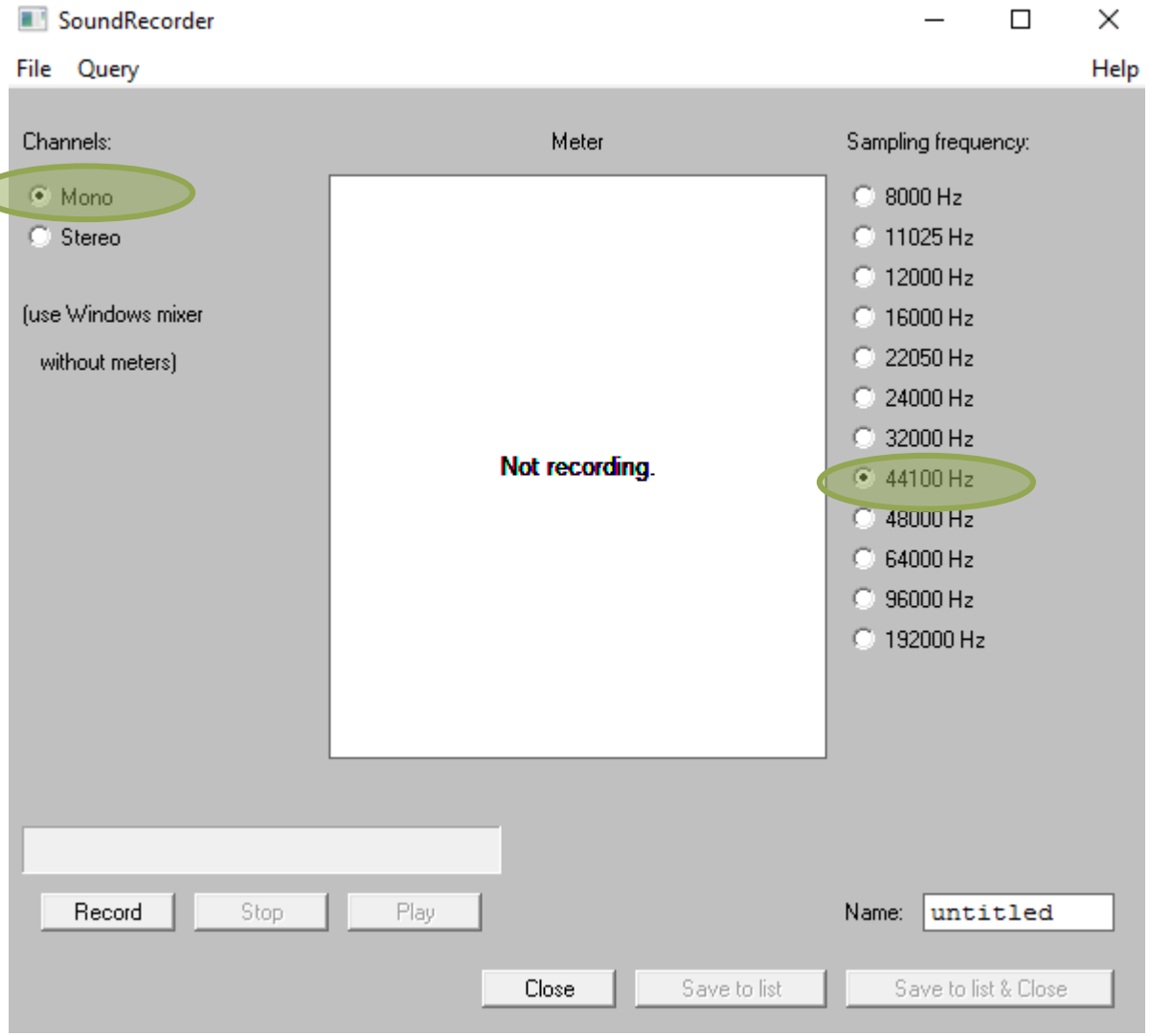
- You can also **directly record speech in Praat** (an input device must be active, i.e. a microphone)





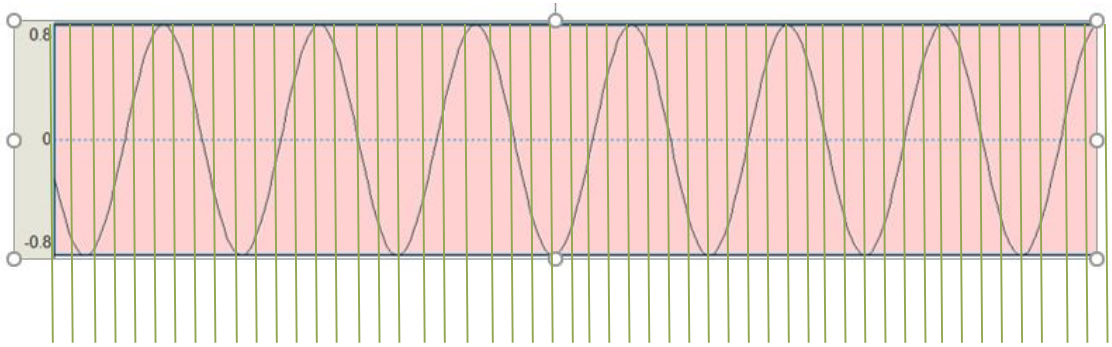
Recording: Settings

- Use **„Mono“**: i.e. you record one channel
- Use **Sampling frequency** of **44100 Hz**
- Watch for the meter to stay in the **green area**

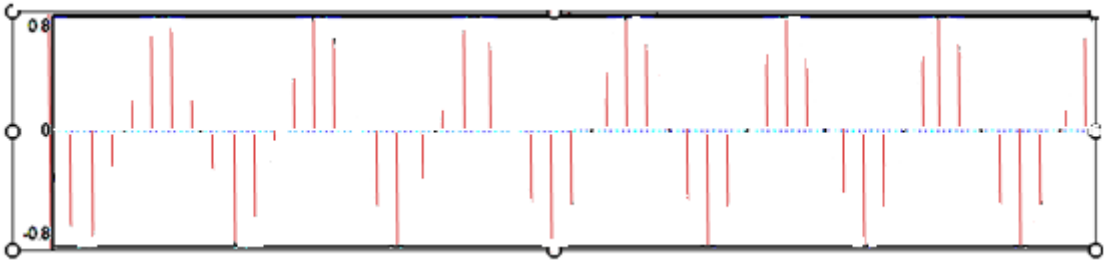


Remarks on sampling frequency

- **How often** do we measure the amplitude?



- This is one second of a pure tone



Let‘s say we are measuring the amplitude 53 times per second

Sampling frequency = 53 Hz

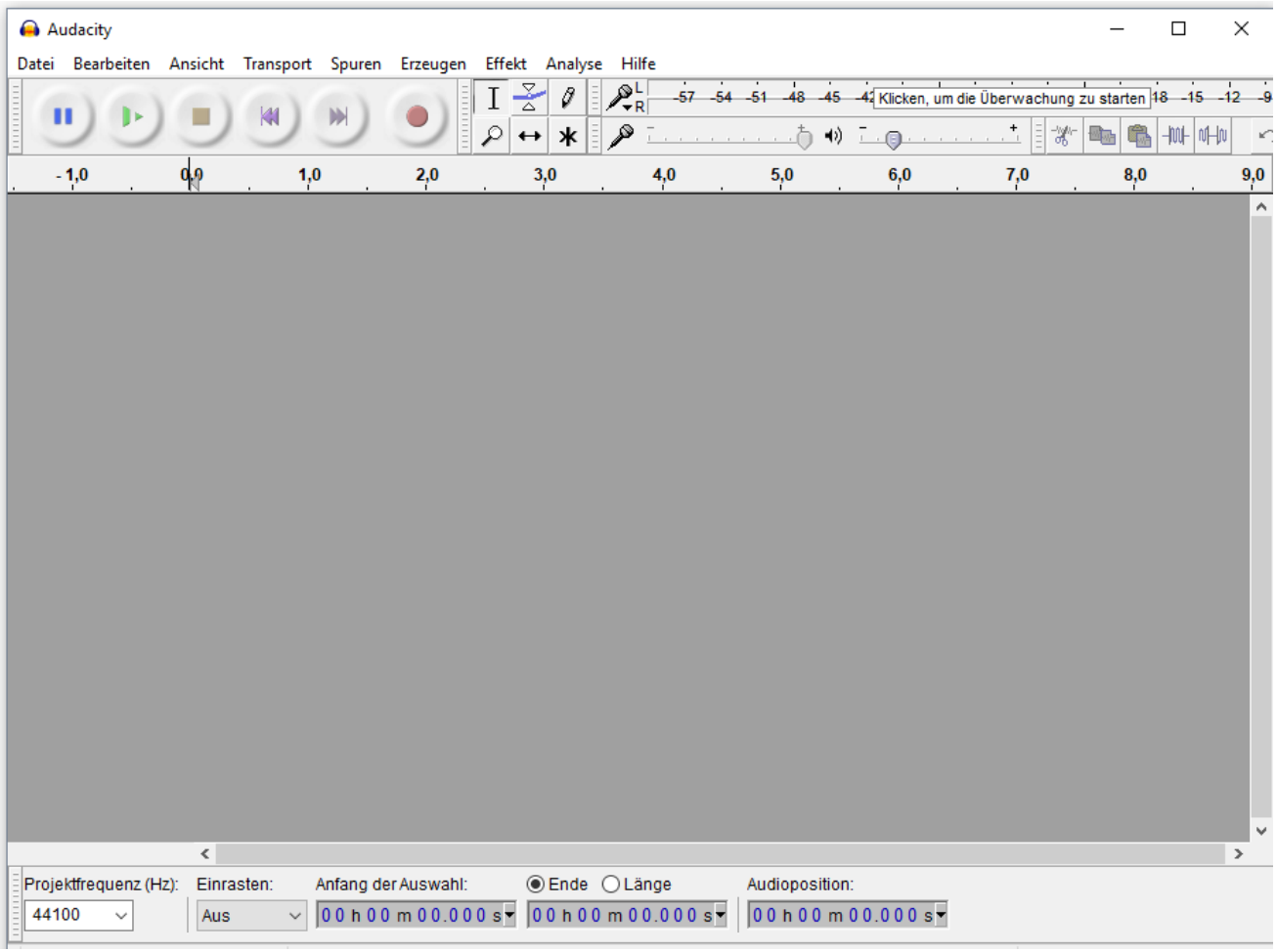
Remarks on sampling frequency

The *sampling frequency* has to be **at least twice the highest frequency** we would like to record

- For speech recordings the standard is a **sampling rate of 44.1 kHz** (i.e. we are looking 44 100 times per second how big the amplitude is = CD-quality)
- So we can record frequencies up to **22.05 kHz**

Recordings

- An alternative free recording software I can recommend: ***Audacity***
- https://www.audacityteam.org/download/



Tips for good recordings

- **Find a suitable environment:** a quiet room, small, with lots of soft surfaces (curtains, carpets, cushins etc.)
- **Reduce background noise** (close the windows, switch off the clock or any other noise-emitting device, get rid of creaky chairs, clinking jewelery etc.)
- **Instruct your participant** (and remind them if necessary) **to not touch their faces while recording**
- If you are using a **external microphone** (recommended for phonetic research!): **Do not hold it directly in front of your mouth** (keep a distance of approx. 20 cm). **Also don‘t be too far away**

ALWAYS MAKE TEST RECORDINGS!

Tips for good recordings

- Always ask for your participant‘s **consent**!
- Ask for **meta data** (depending on your reseach question) such as age, gender, native language, highest eduction, etc.
- **Give your recordings sensible names**
- Use **participant codes** (no full names!)
- Make the participant feel **comfortable**
- **Explain the task exactly** and **let them ask questions** for clarification
- Task ought to be suitable for your participants and your research question
- In general: Aim for **short recording sessions** (and have **breaks** in between!)

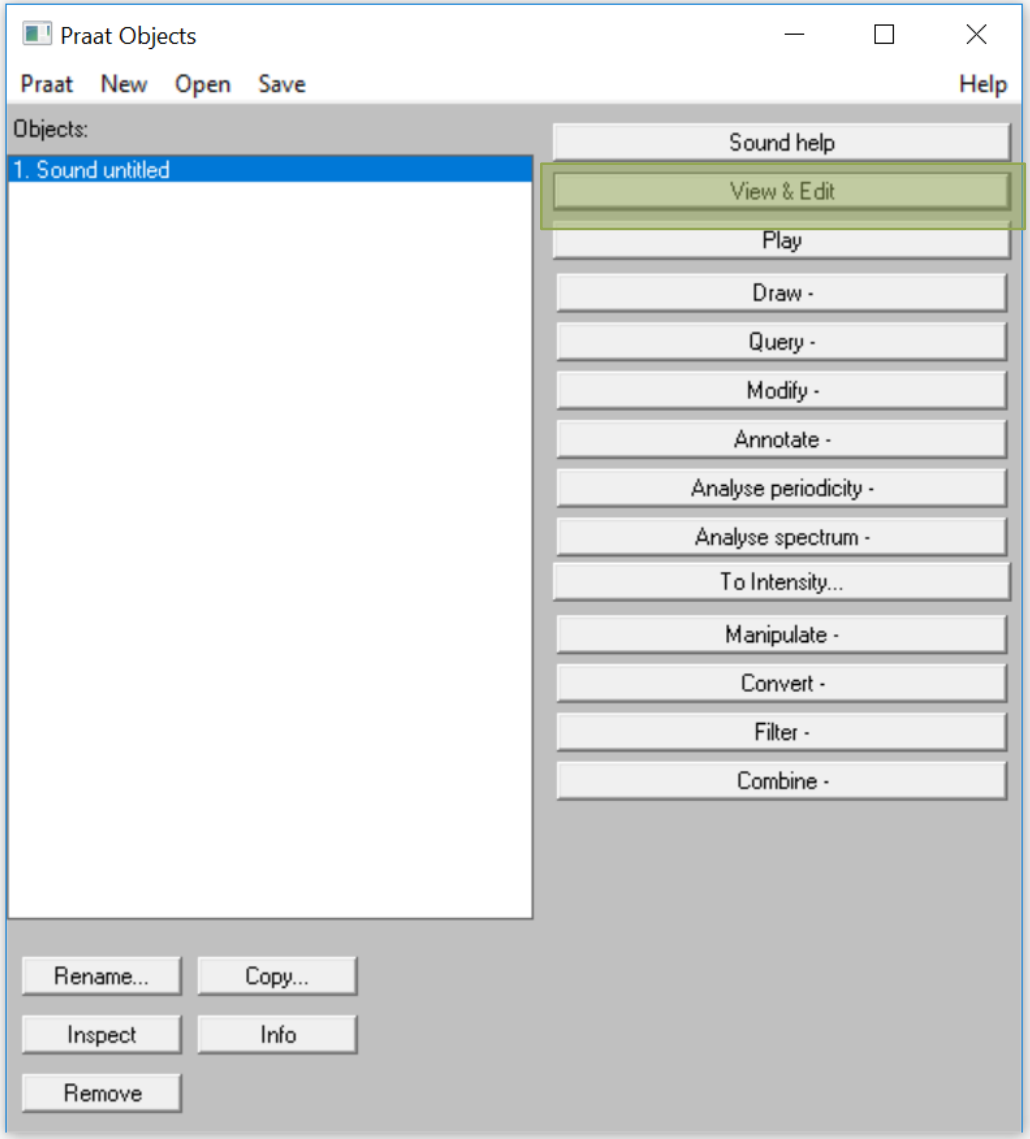
Summary: settings for recordings

For speech recordings suitable for phonetic analysis:

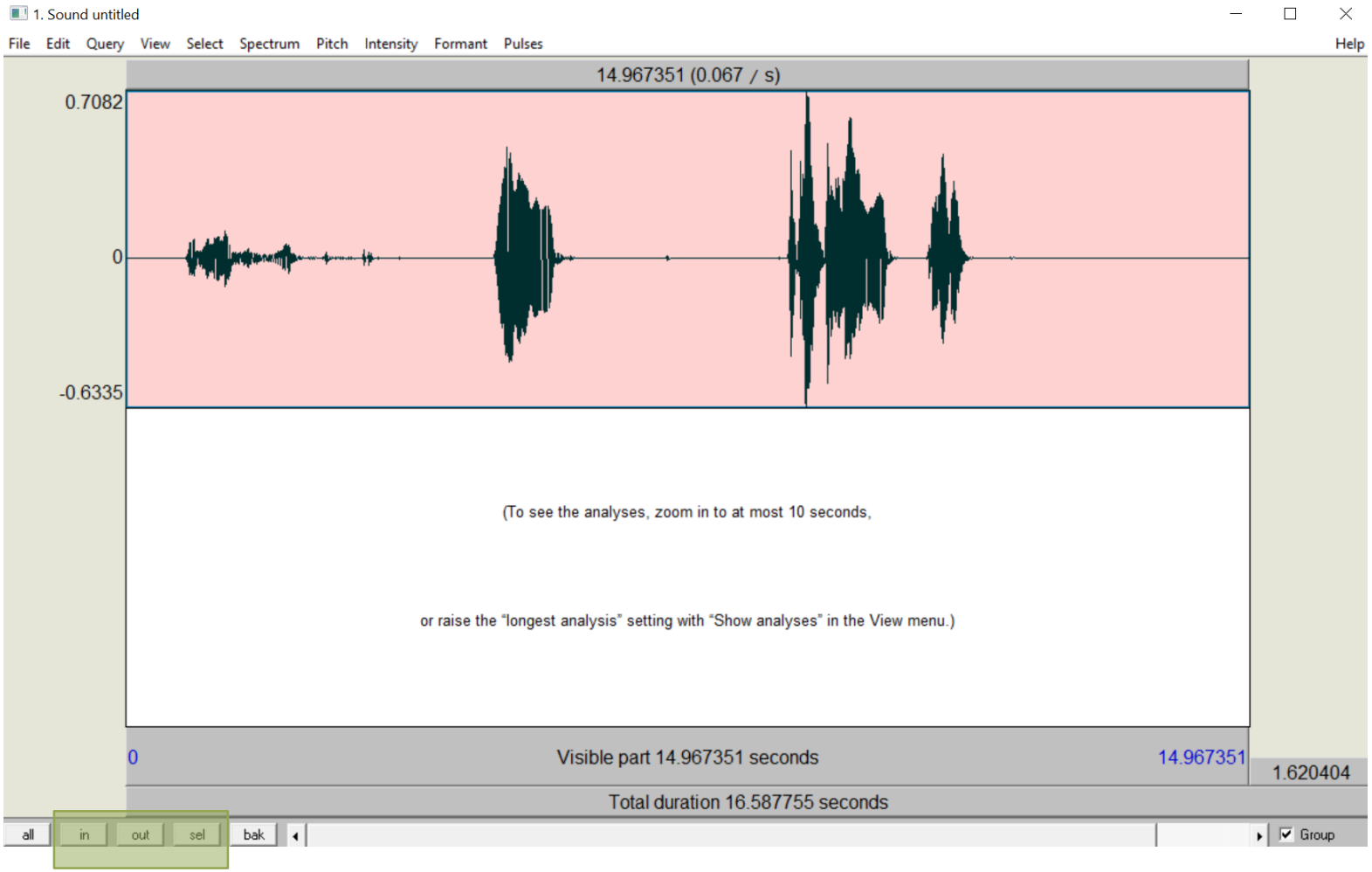
- 1 audio channel: Mono
- Sampling frequency: 44 100 Hz
- Bit: 16-bit
- Wav.file

Step 4: Visualize and analyze your sound file

- Once you have a sound file opened up in Praat, you can start inspecting it
- *"View & Edit"*

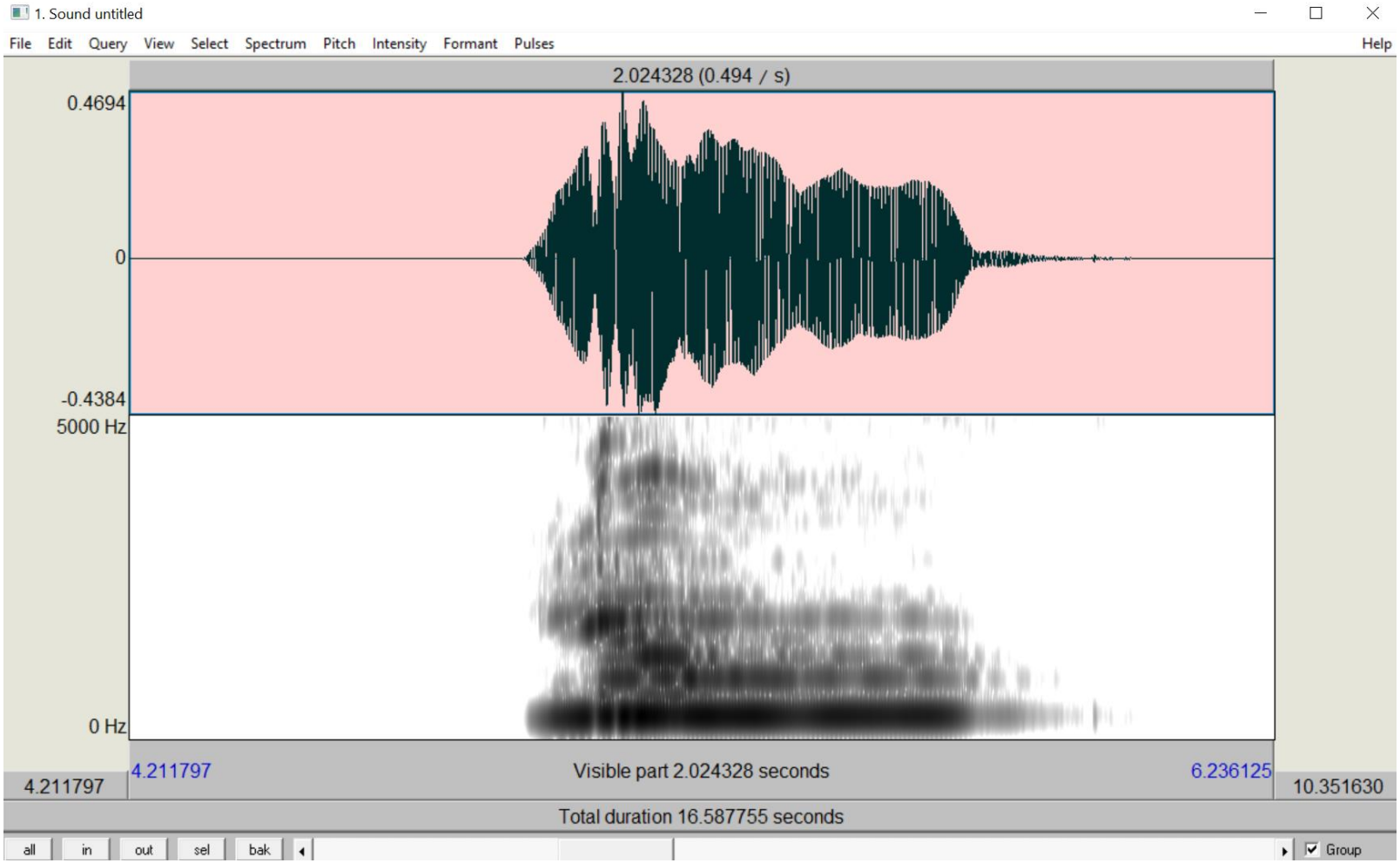


Step 4: Visualize and analyze your sound file



- **Zoom in** to see the spetrogram as well

Step 4: Visualize and analyze your sound file

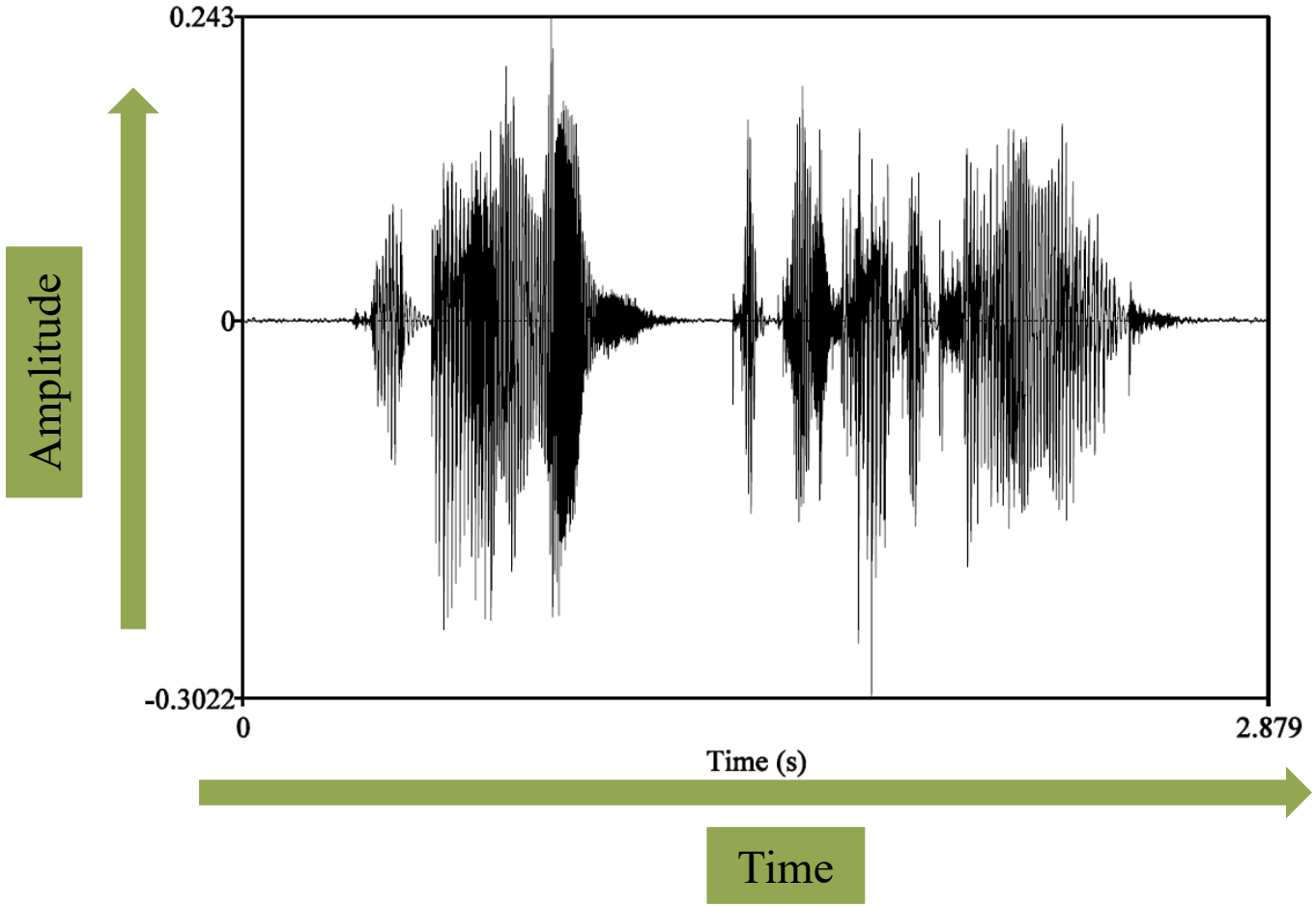


Step 4: Visualize and analyze your sound file

- The upper half of the window shows you the **wave form** of the sounds
- The lower half of the window shows you the **spectrogram**
- You can adjust the settings of the spectrogram in the menu (*Spectrum > Spectrogram Settings*)

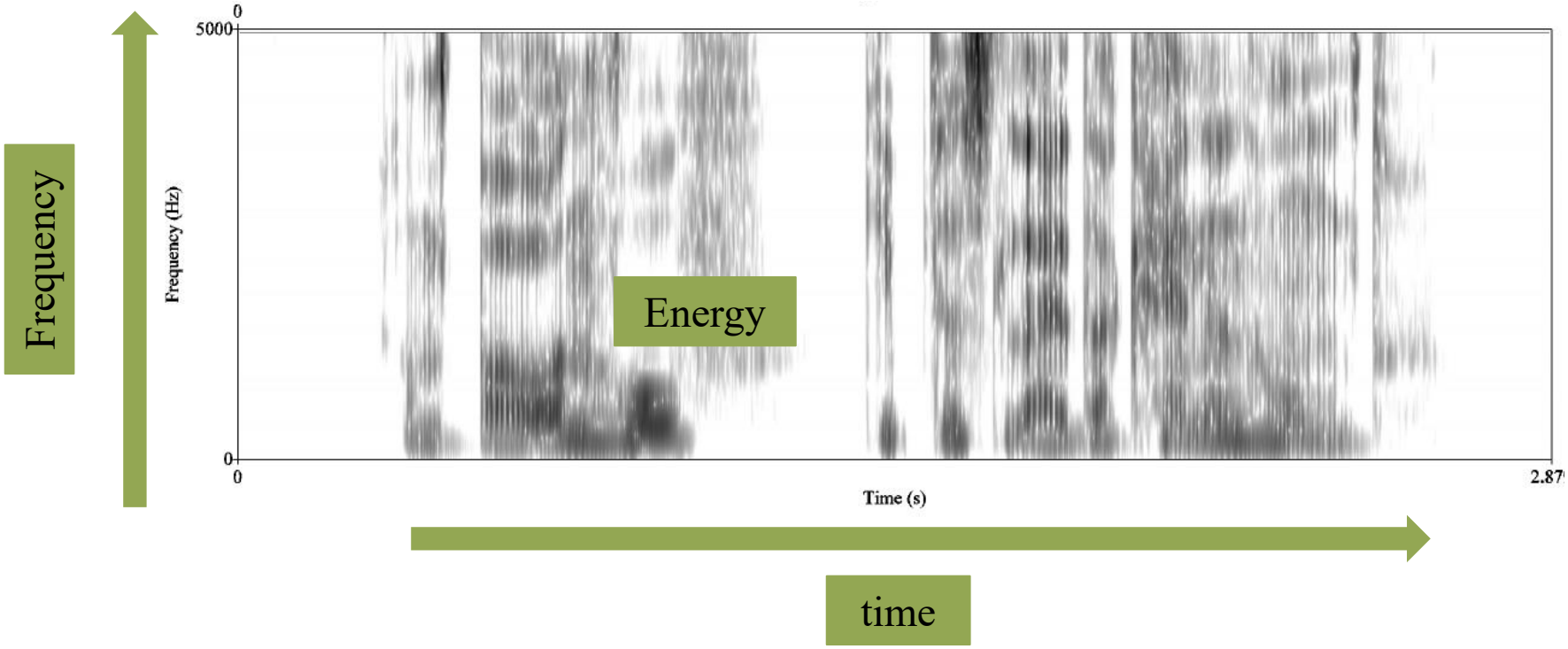
Visualization of sounds

- **Wave form**: amplitude-time diagram



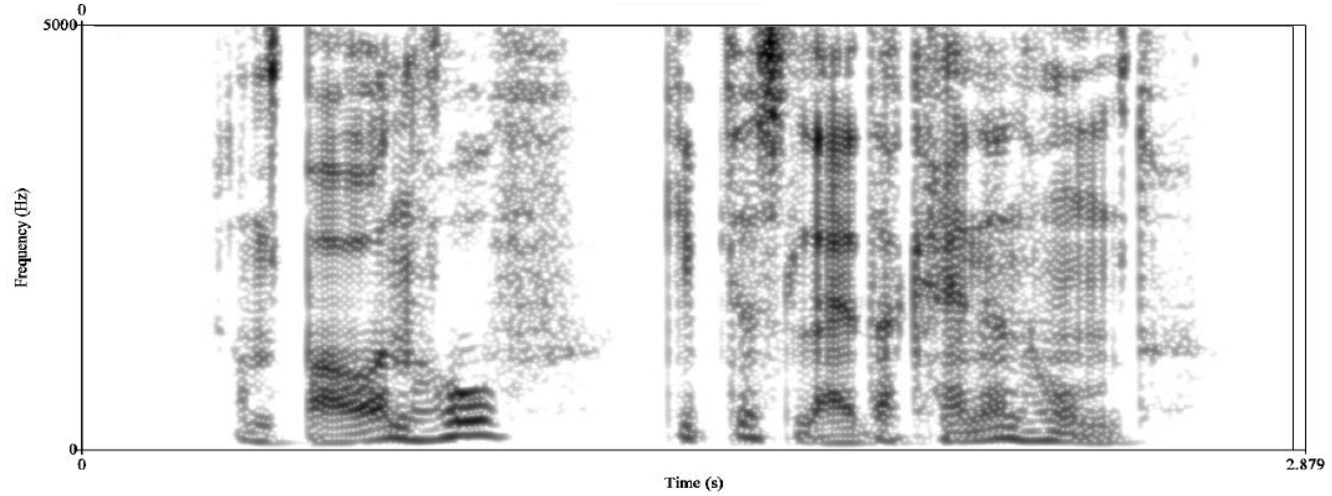
Visualization of sounds

- **Spectrogram**: frequency-time diagram plus energy by means of the colouring: the darker the more energy

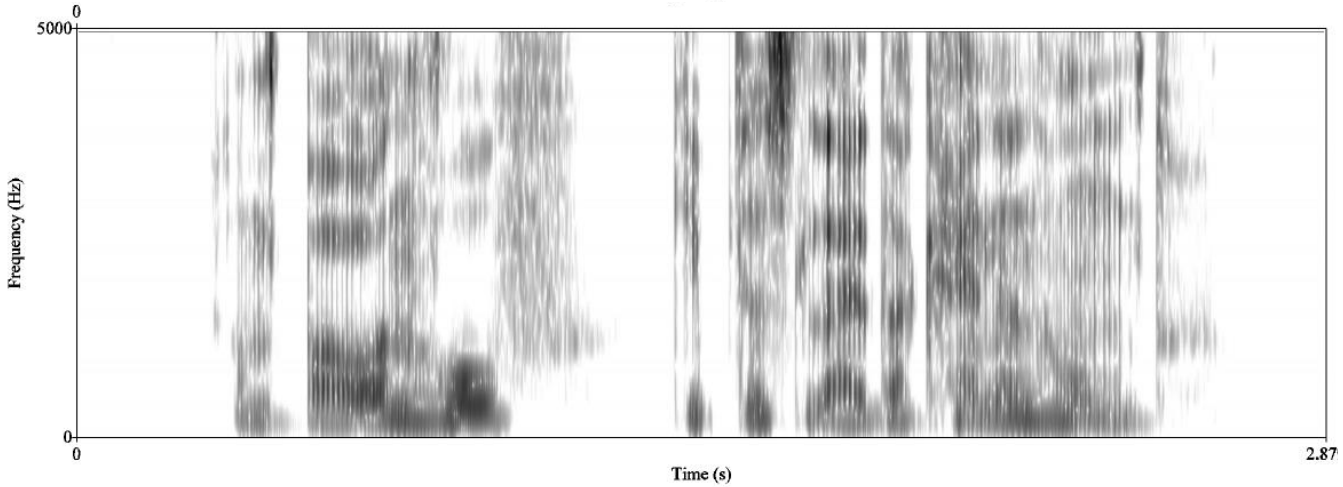


Visualization of sounds

- There are 2 types of spectrograms (can be changed by means of the window length in the spectrogram settings)



Narrow band (window length: 30 msec)

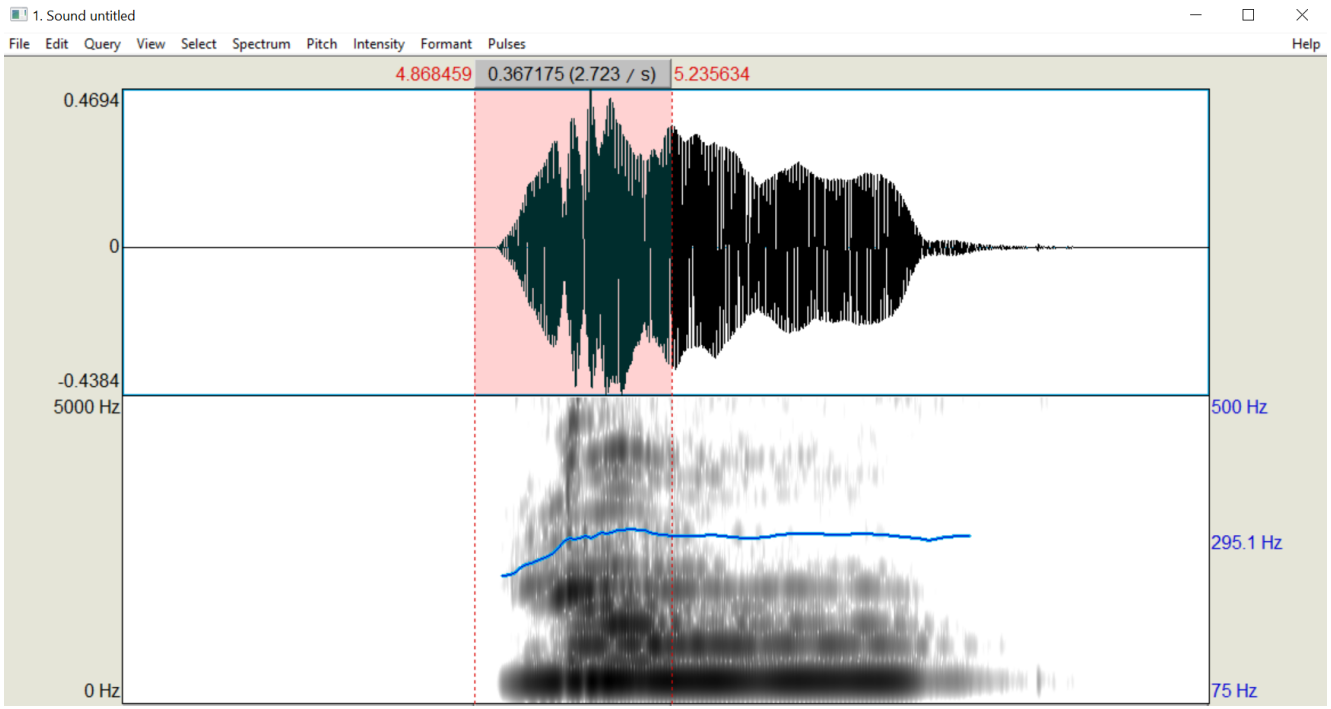


Broad band (window length: 5 msec)

Step 4: Visualize and analyze your sound file

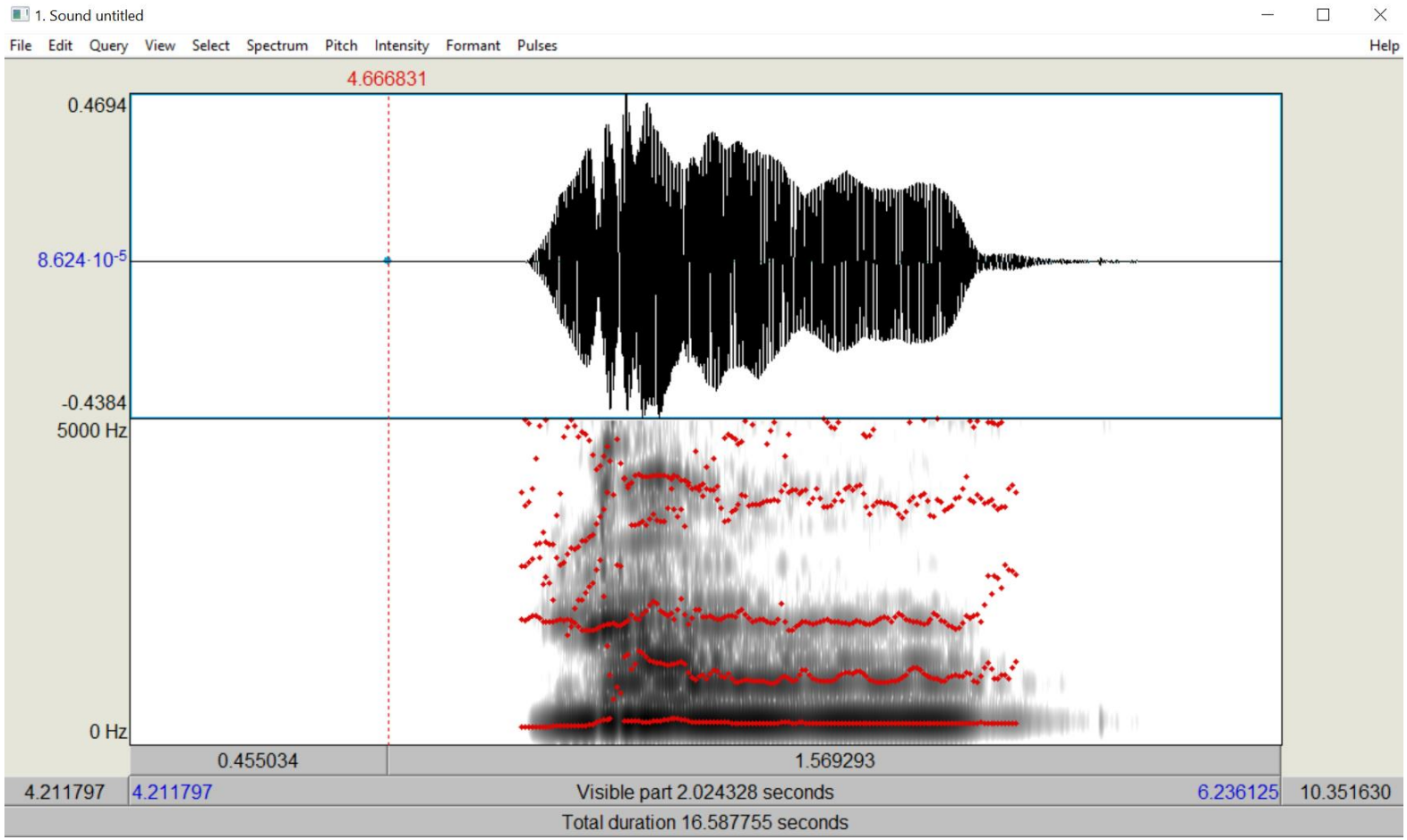
- You can analyze certain acoustic features of your recordings:

+ You can measure **duration**: How long are certain parts of your recordings?
+ You can look at the **pitch contour** (*Pitch* > *Show pitch*): A blue line visualizing the F0 contour will appear in the spectrogram



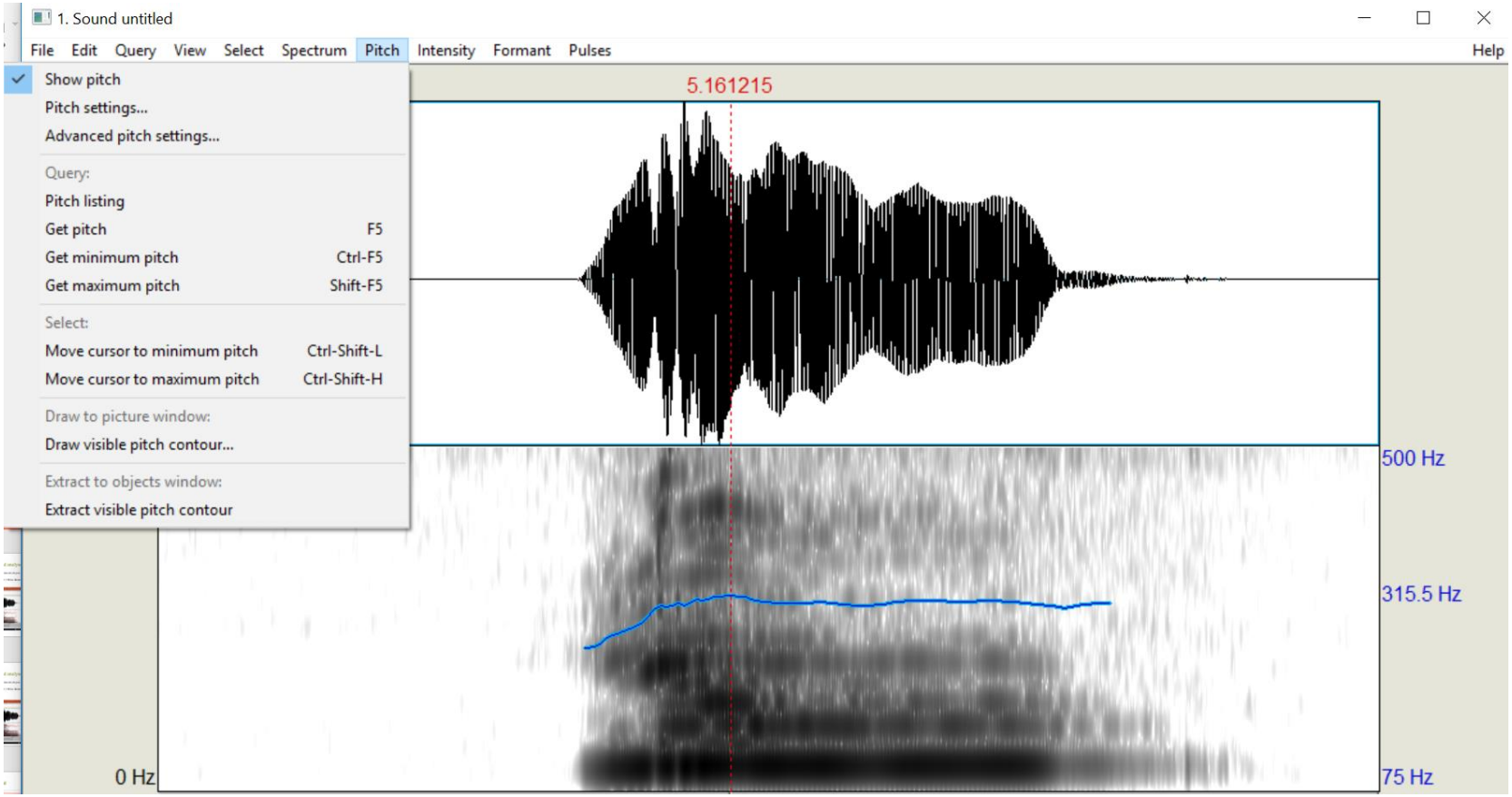
Step 4: Visualize and analyze your sound file

+ You can look at formants (*Formant* > *Show fomants*)



Step 4: Visualize and analyze your sound file

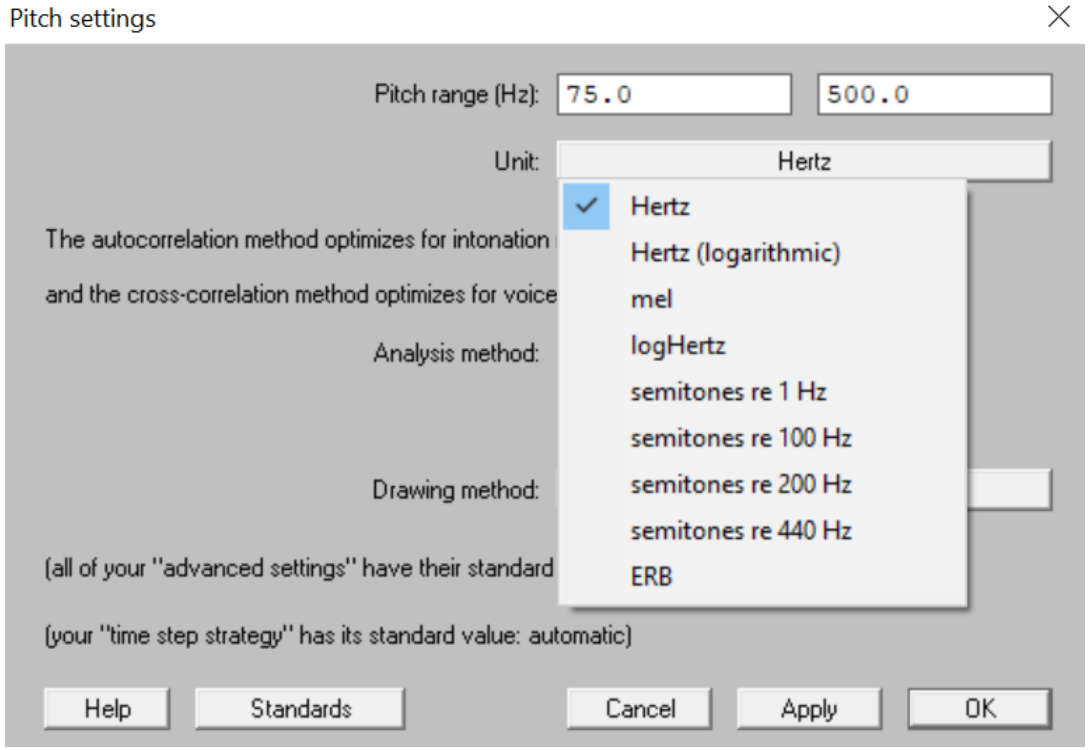
- You can get the **average pitch in your selection**, you can **get minimum/maximum pitch**, you can **move the cursor** to the minimum/maximum pitch etc.



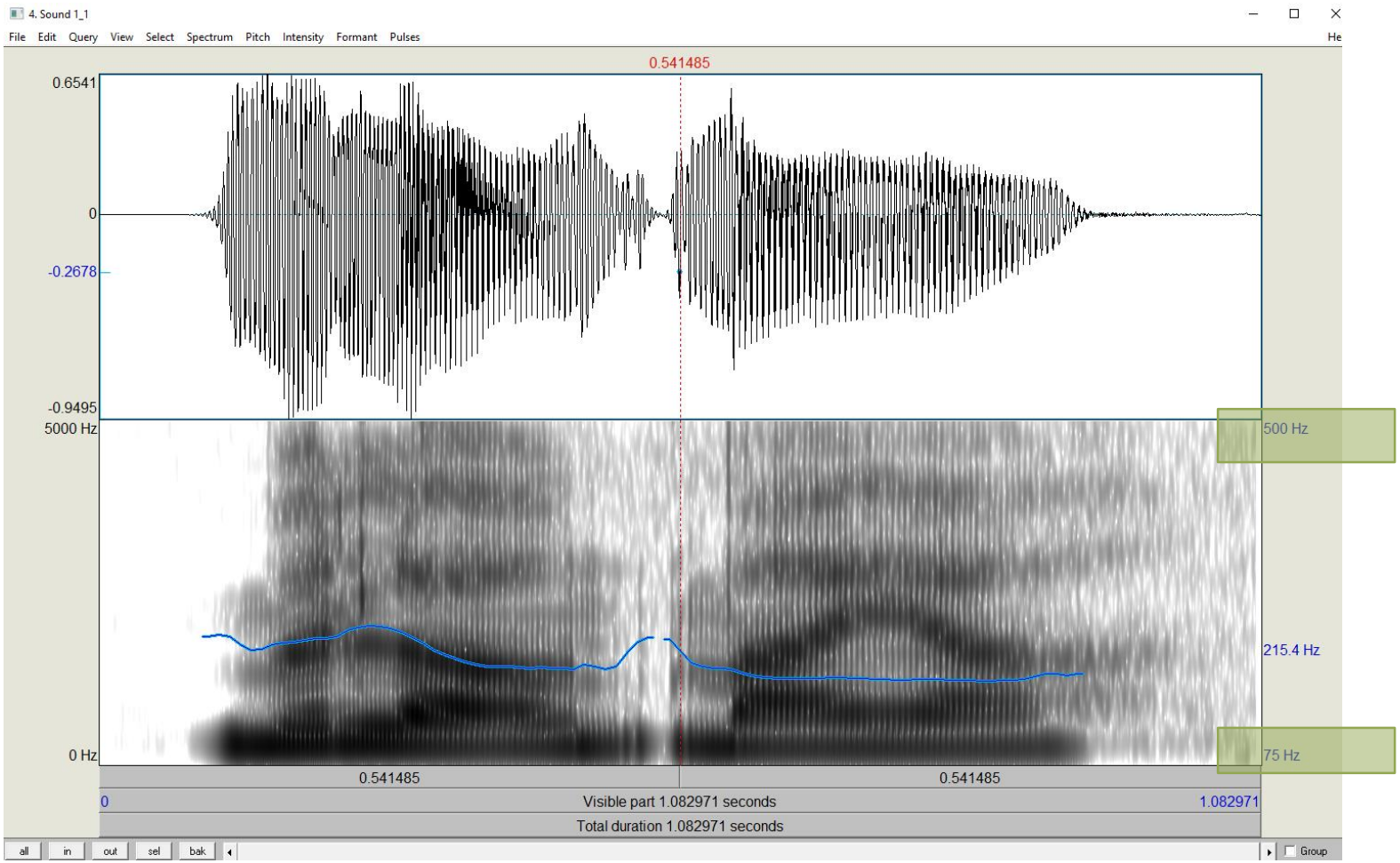
Step 4: Visualize and analyse your sound file

- Pitch settings: You can **adjust the pitch range**
- For a female speaker you can use a range of 100-500 Hz
- For a male speaker use 75-300 Hz

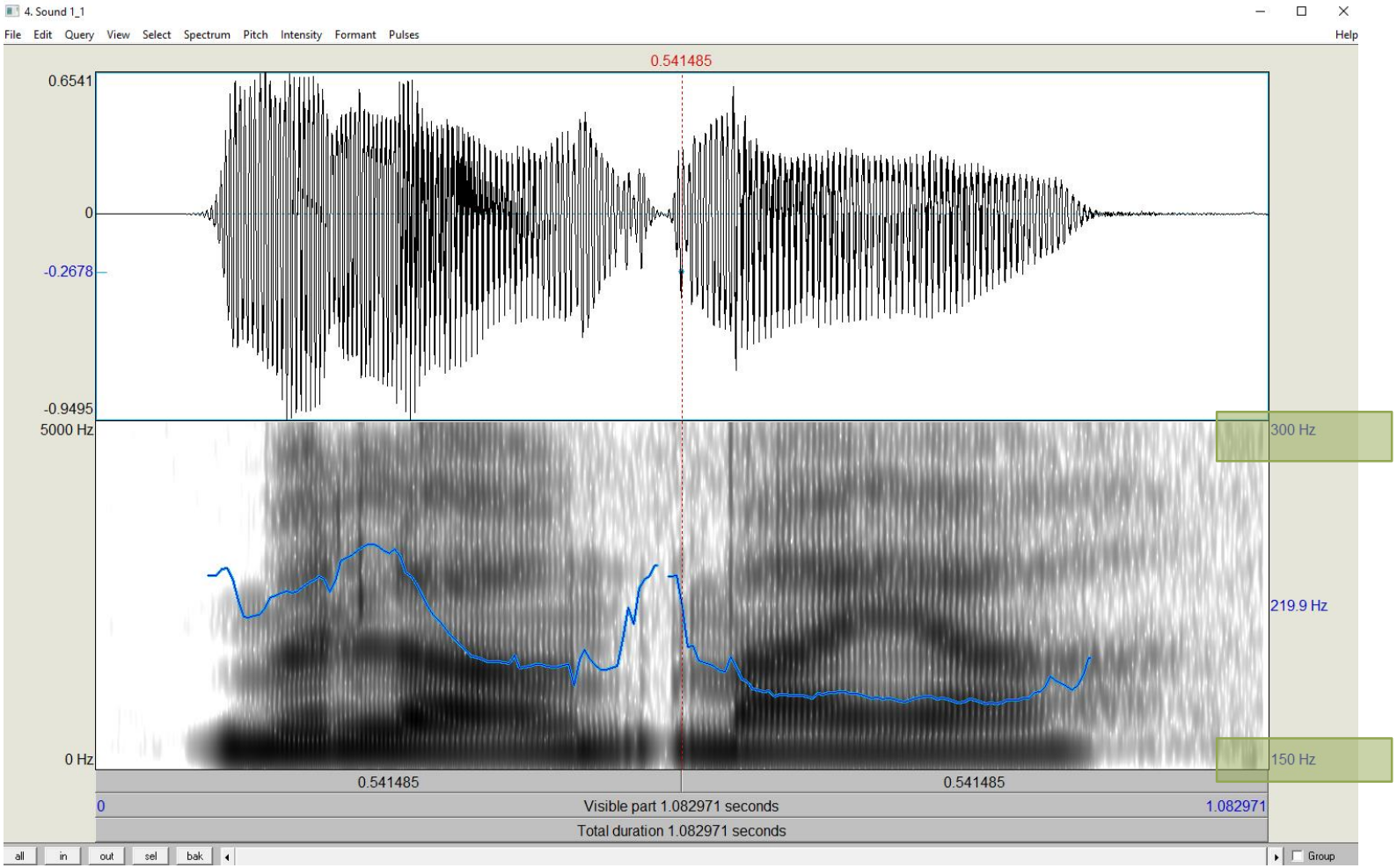
- The default unit is **Hertz** but you can change it to semitones etc. if you like



Effect of pitch range change

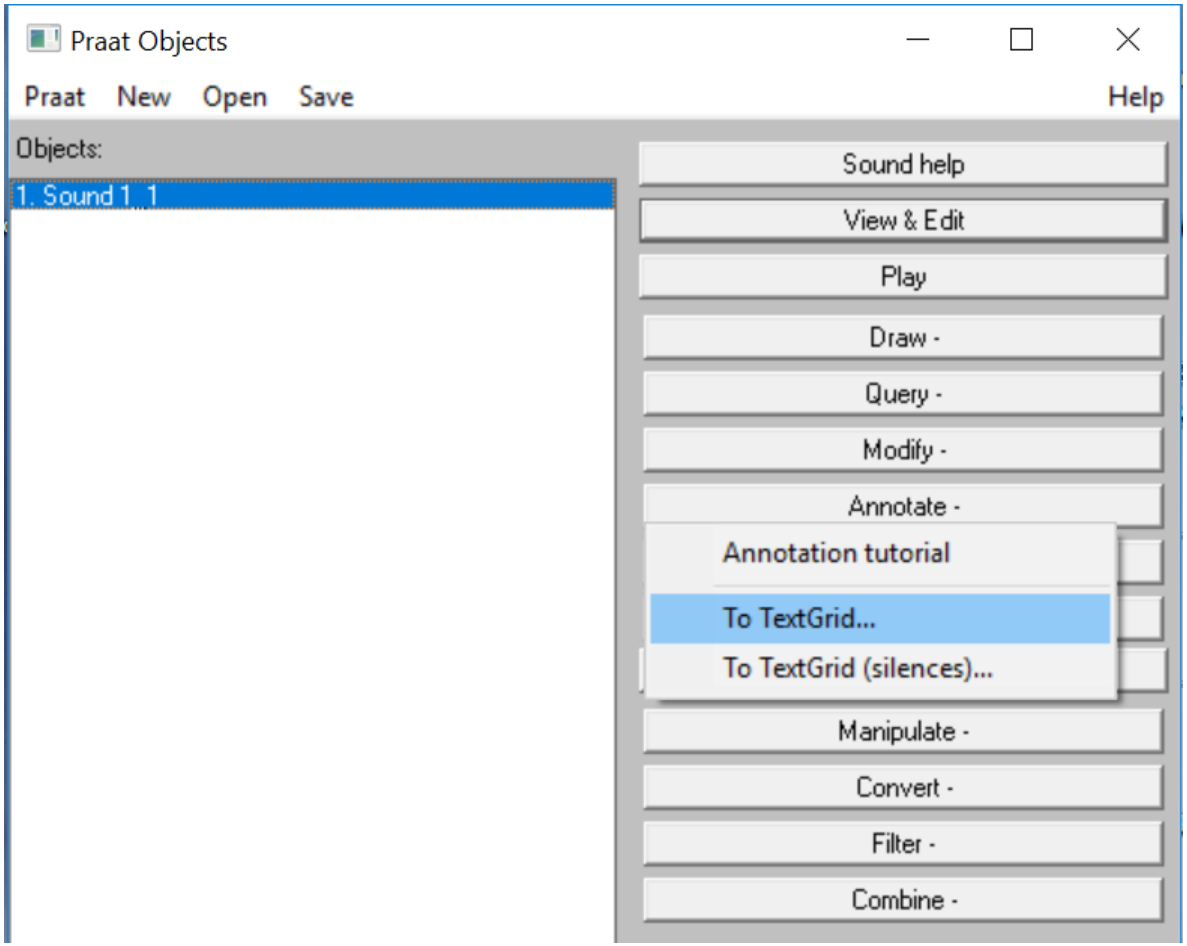


Effect of pitch range change



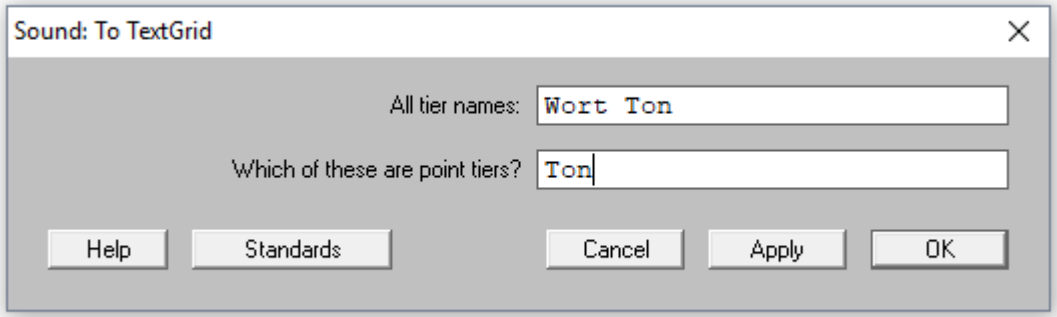
Step 5: Annotate your recordings

- You can add one or more **annotation grids** to your sound file:



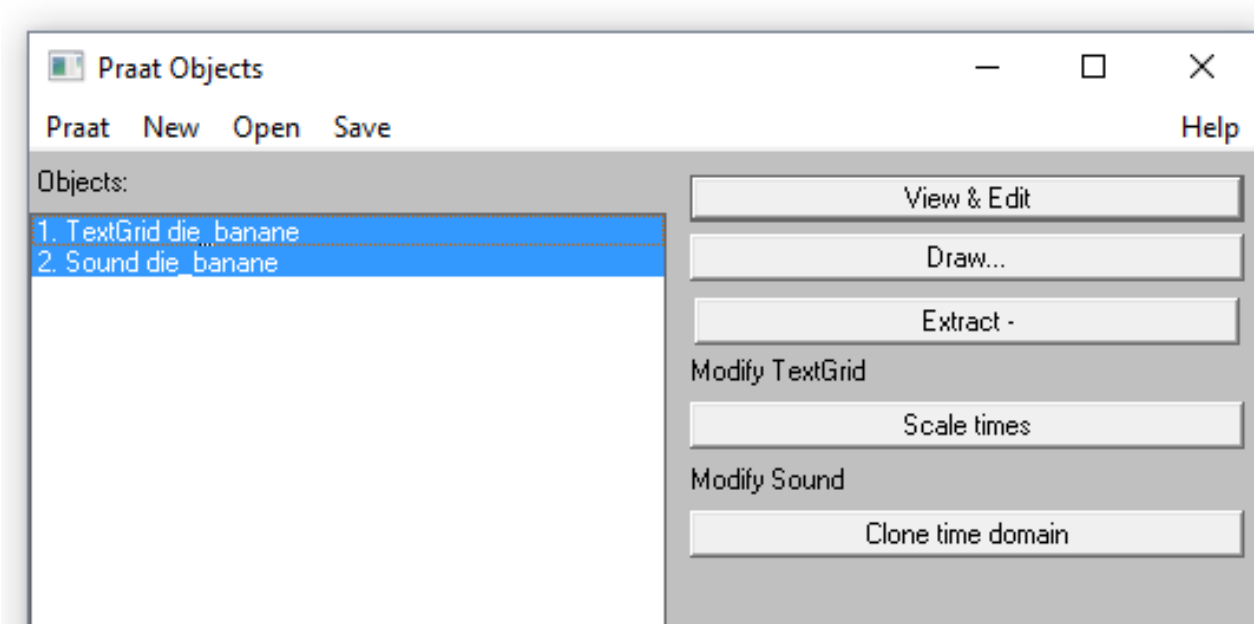
Step 5: Annotate your recordings

- **Interval tiers:** for marking elements with a distinct span, e.g. words, sentences, phonemes, syllables etc.
- **Point tiers:** for marking single points, e.g. location of a high tone, peak in an intensity curve, turn change in a conversation etc.

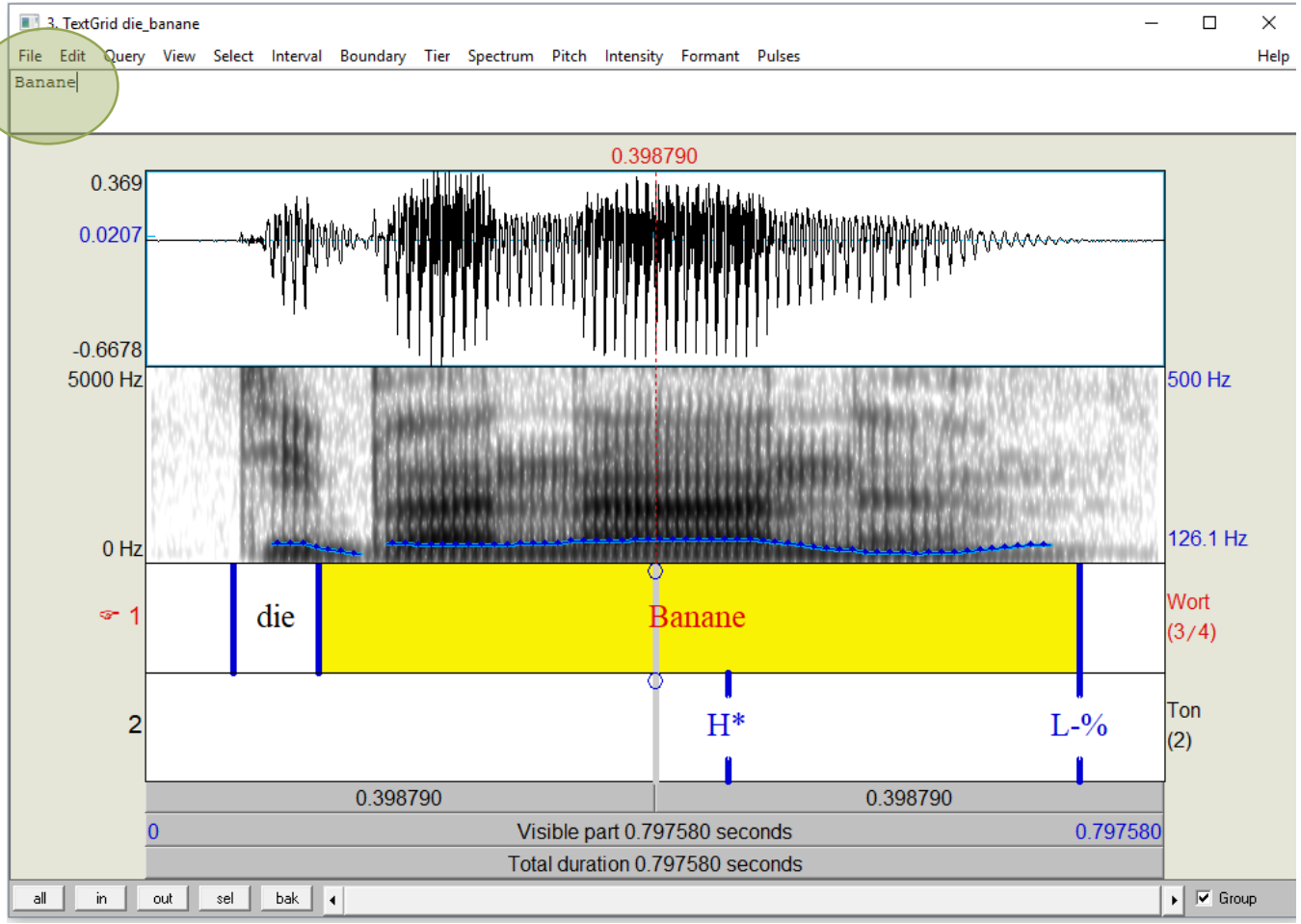


Step 5: Annotate your recordings

- Choose your **sound and your textgrid together** (ctrl/Strg + click on both) and go to *View & Edit*:



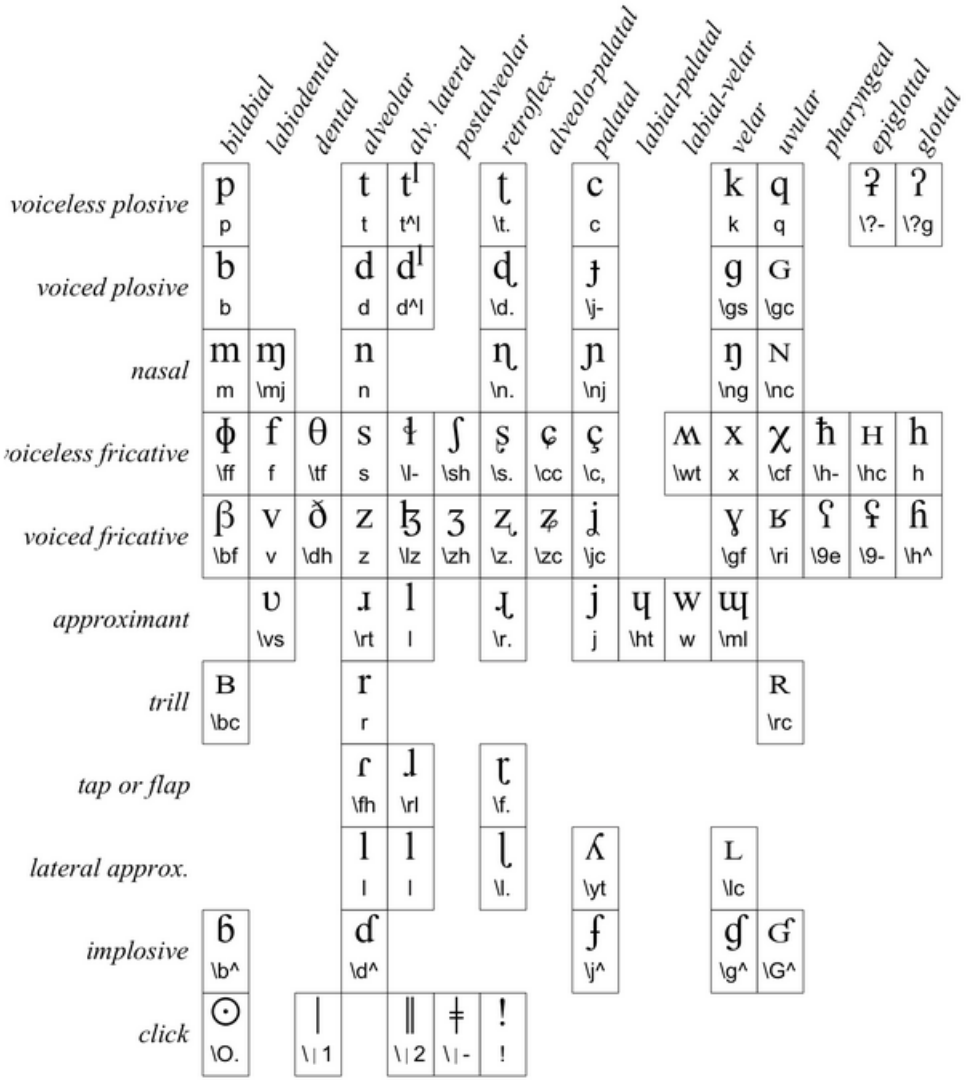
Step 5: Annotate your recordings



Step 5: Annotate your recordings

- You can also use **IPA symbols** in your annotation
- Install the fonts **Charis SIL** and **Doulos SIL** (from www.sil.org or from www.praat.org)
- Either type the symbols directly (if your computer has an input method for them), or use backslash sequences
- There are tables for vowels, consonants and diacritics: (http://www.fon.hum.uva.nl/praat/manual/Phonetic_symbols.html)

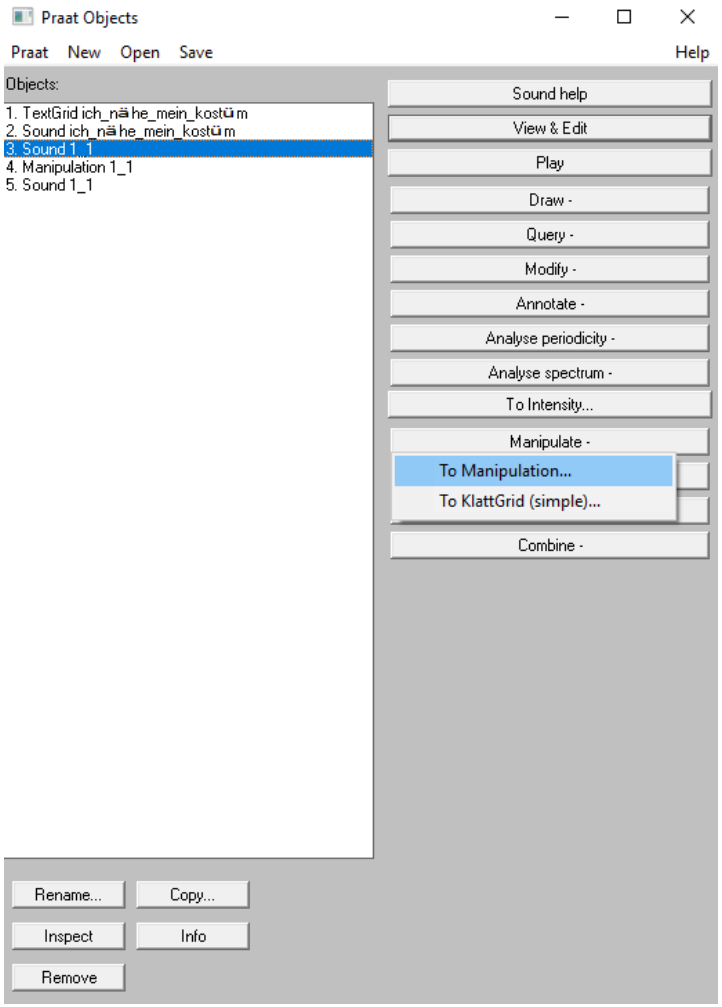
Step 5: Annotate your recordings

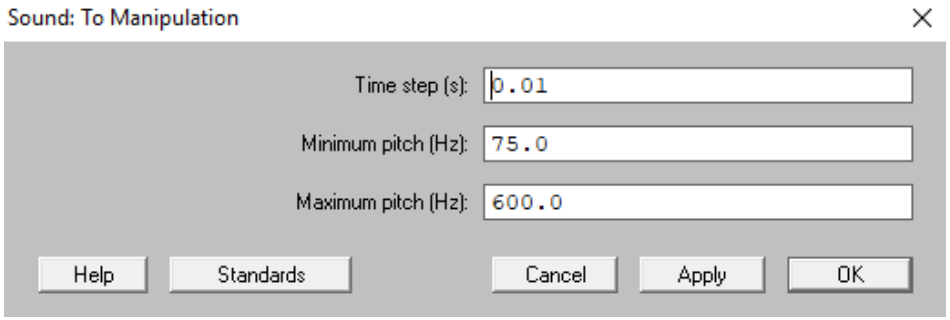


- Example: backslash sequences for consonant symbols

Step 6: Manipulate

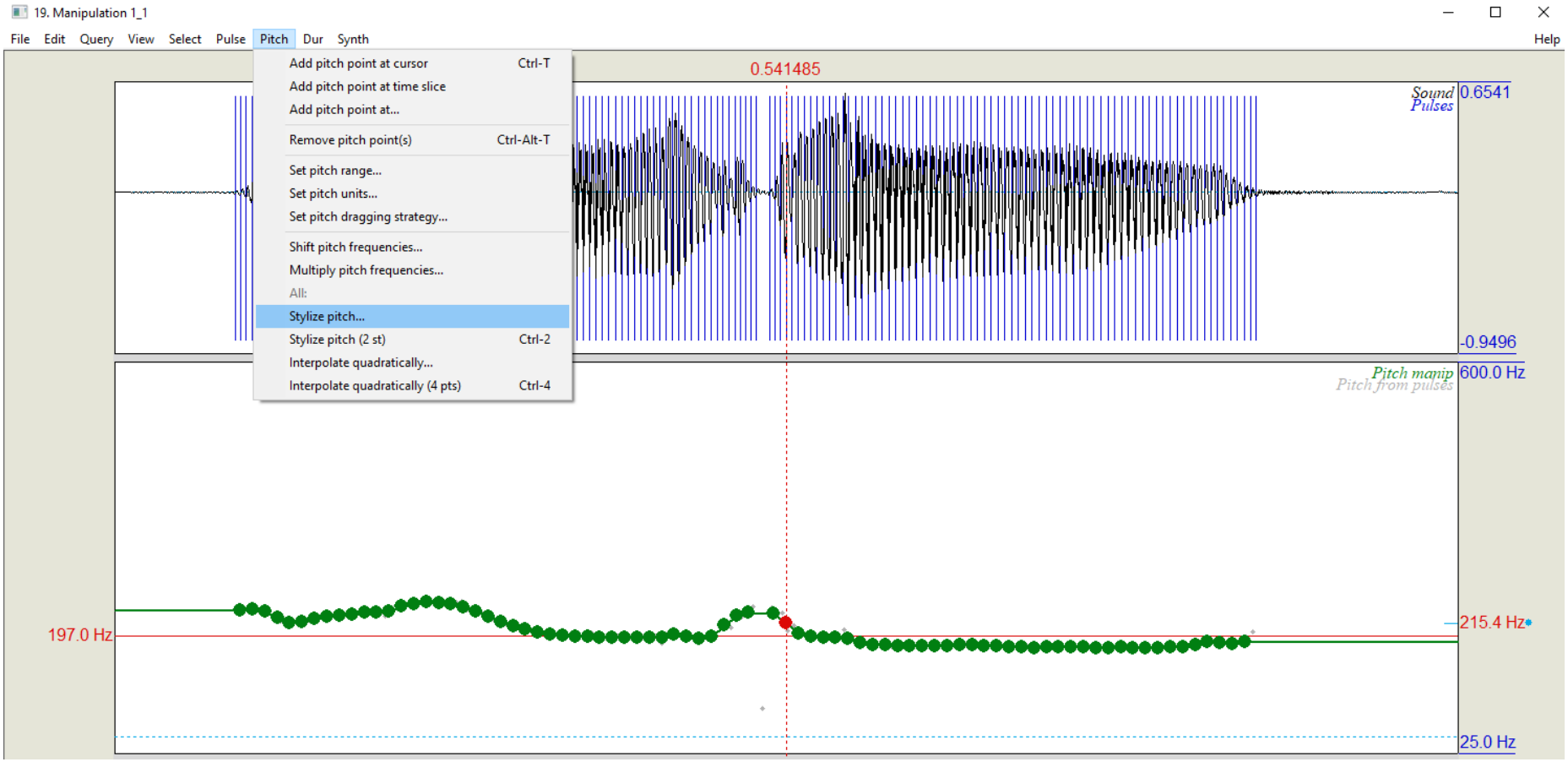
- Praat can also be used to **manipulate sounds** (e.g. for experimental purposes)
- Example: Pitch modification:





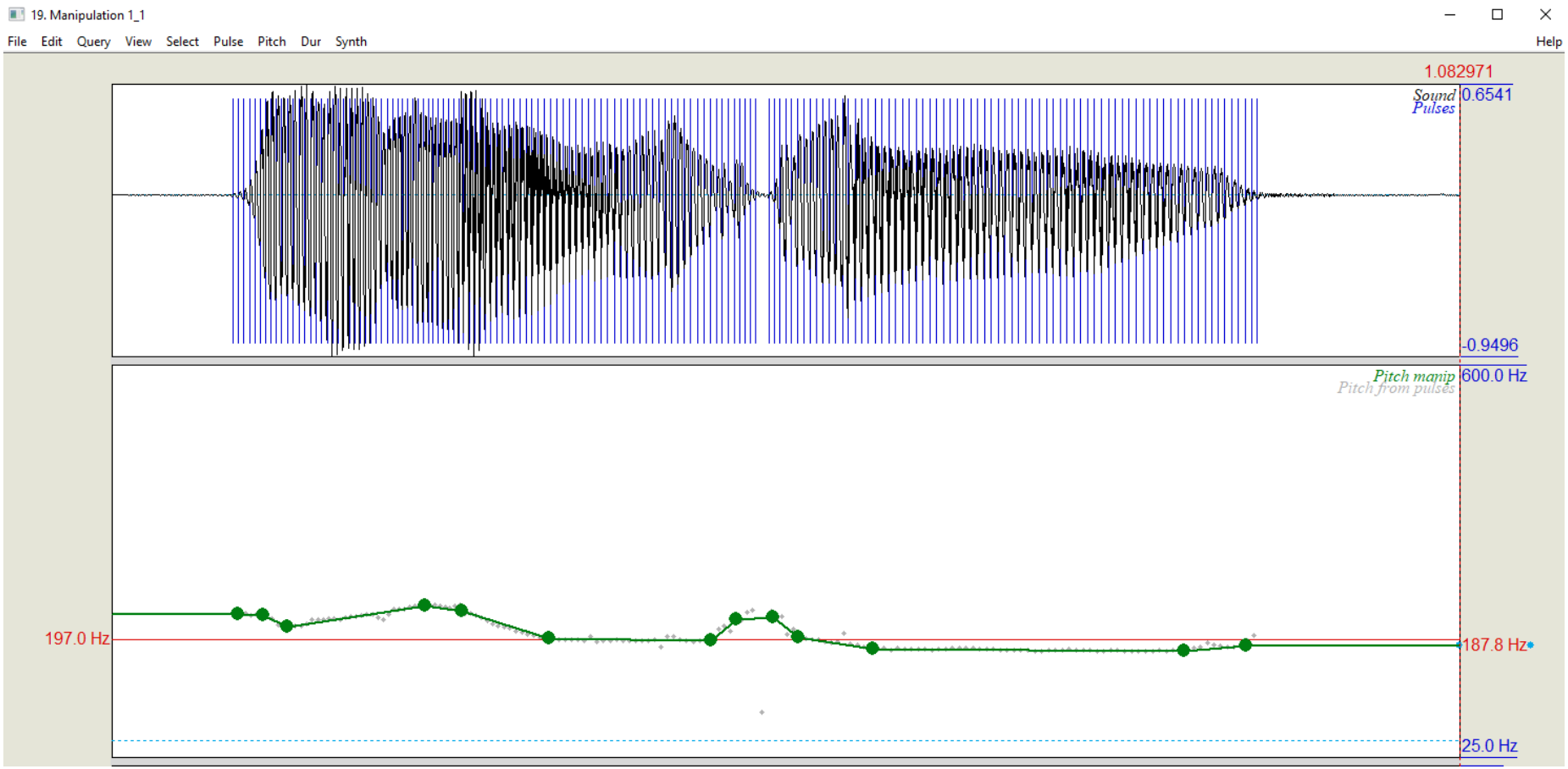
Step 6: Manipulate

- Select the Manipulation object in the object window and click *View & Edit*
- *Pitch > Stylize pitch*



Step 6: Manipulate

- Now you can move the green dots around to change the pitch contour



Step 6: Manipulate

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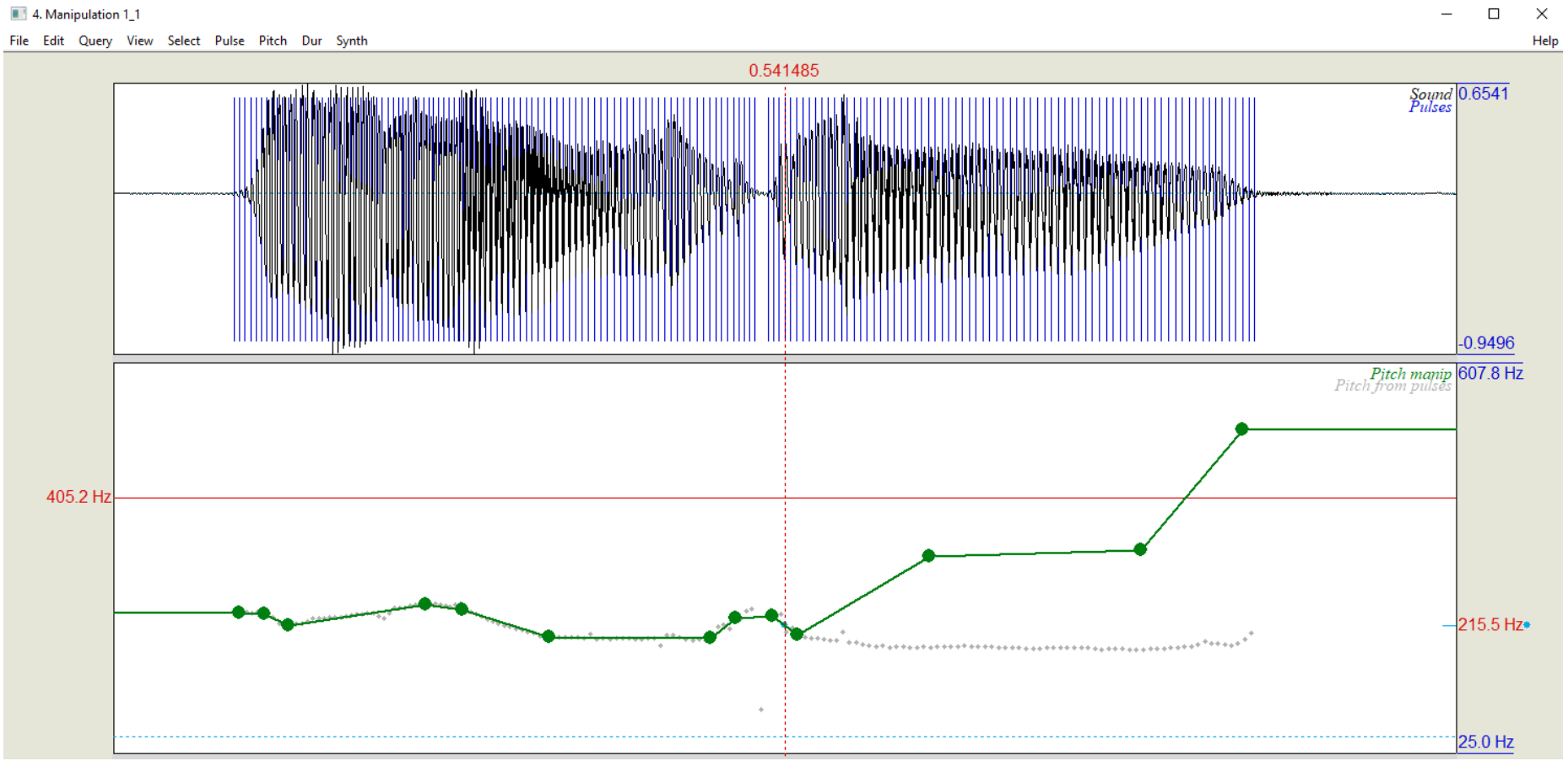
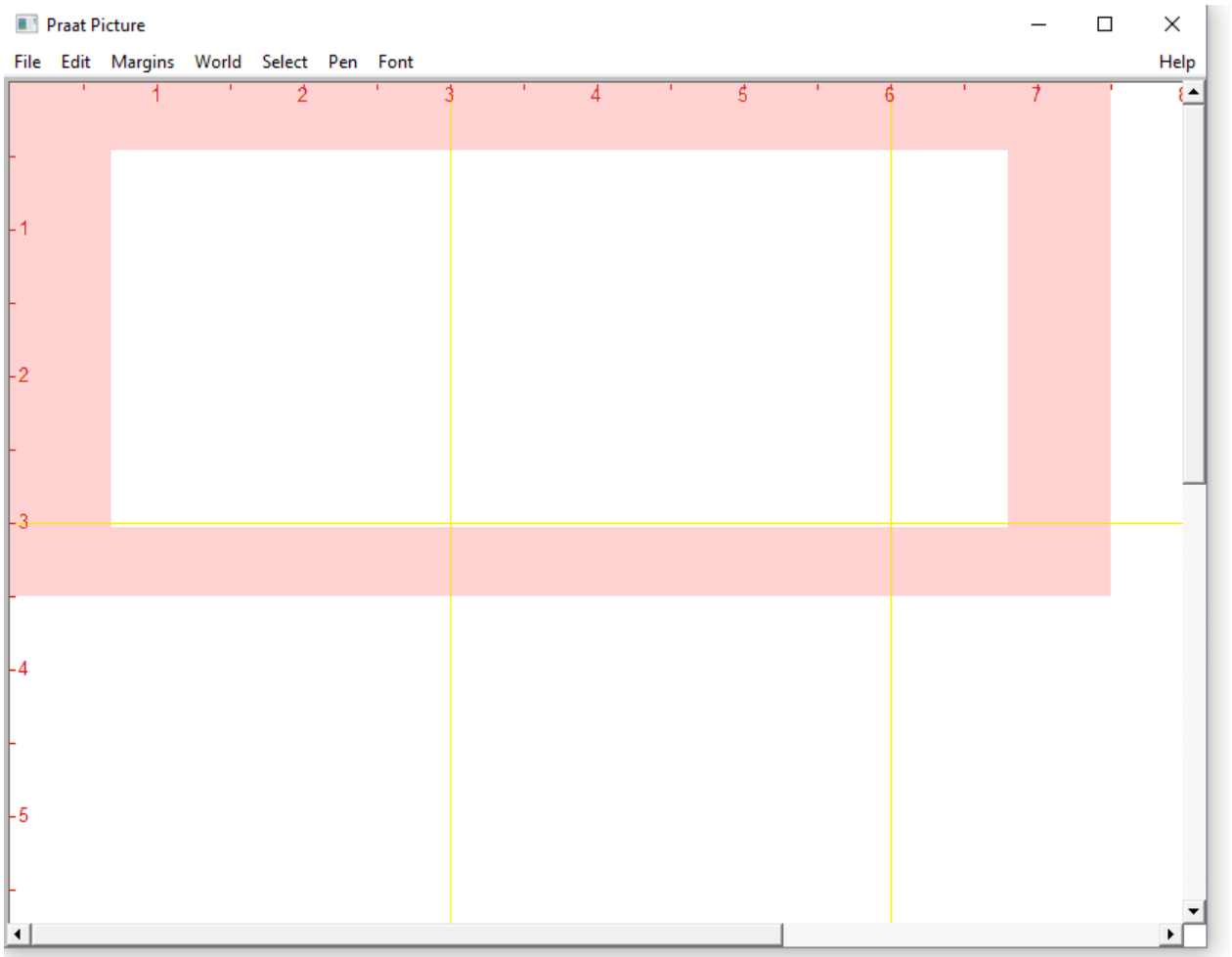


Step 7: Produce and export pictures

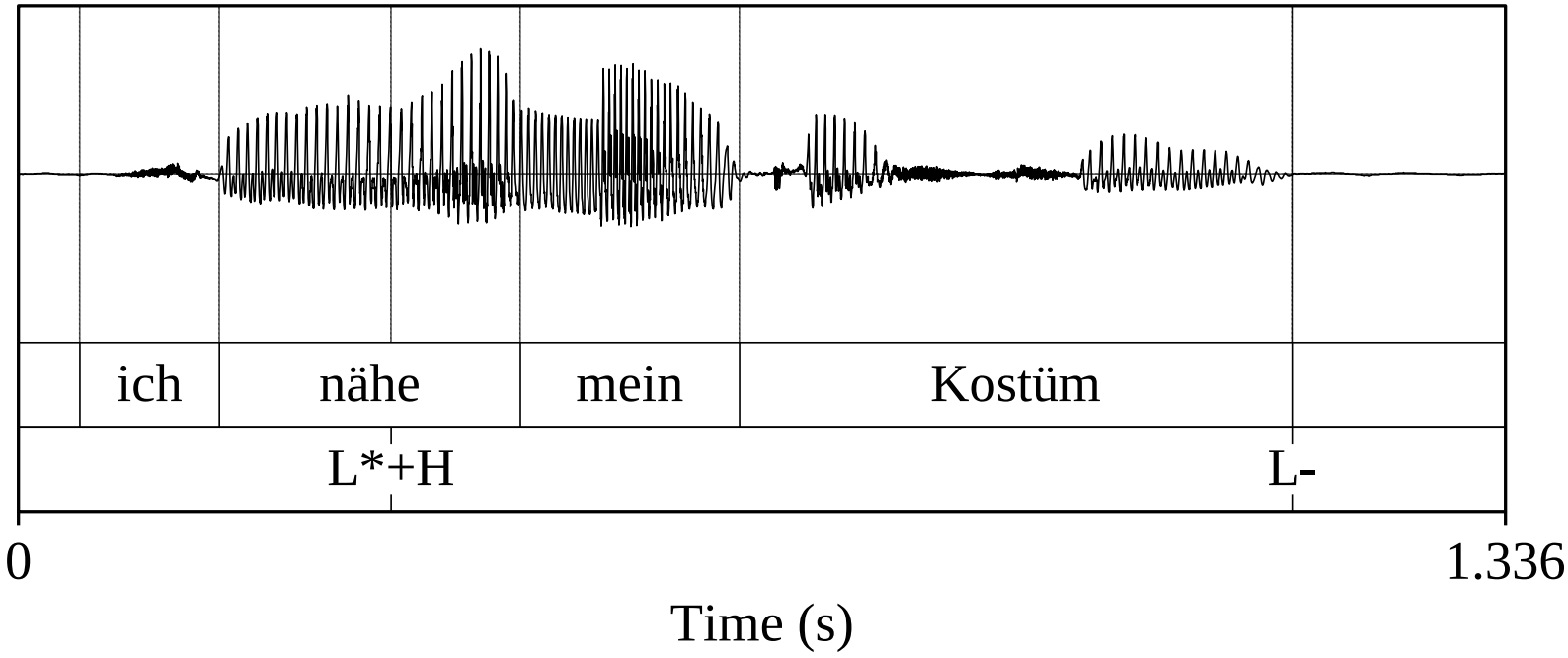
- You can produce **high quality pictures** of the speech signal in Praat
- Now we need the **Praat Picture Window**

➢ With the pink margins you decide where your picture will be located



Step 7: Produce and export pictures

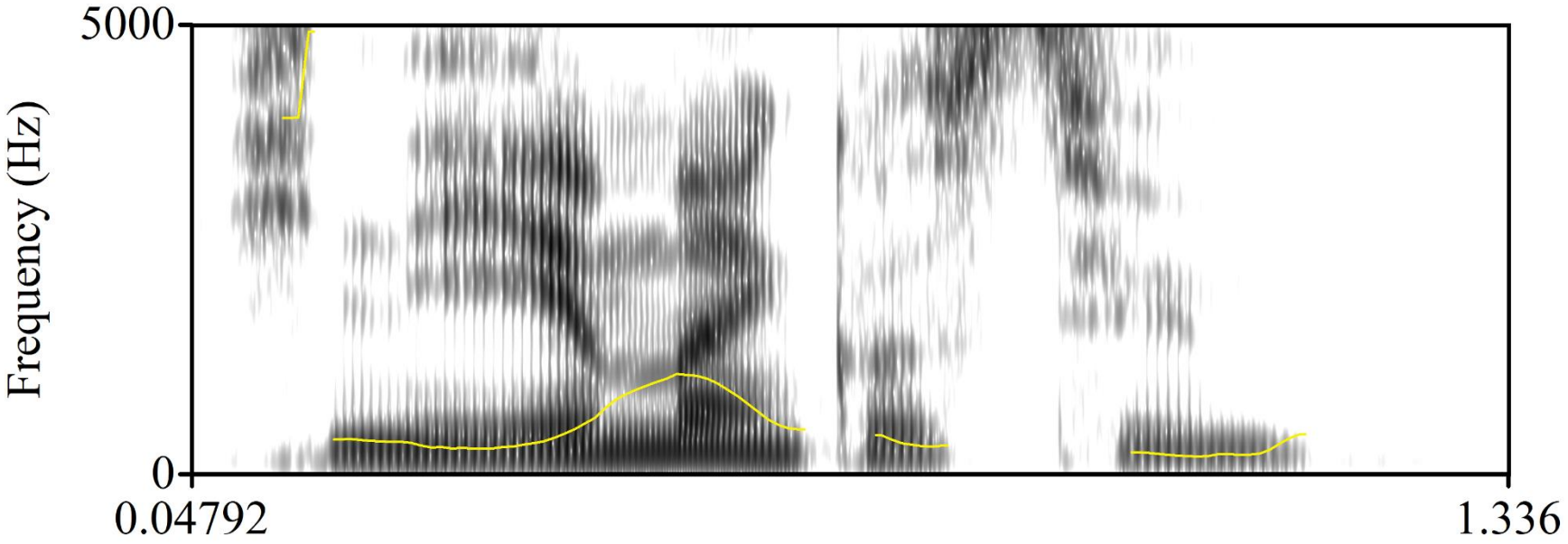
- Example: Sound wave with text grid



Select sound and textgrid in the object window together and click *Draw*

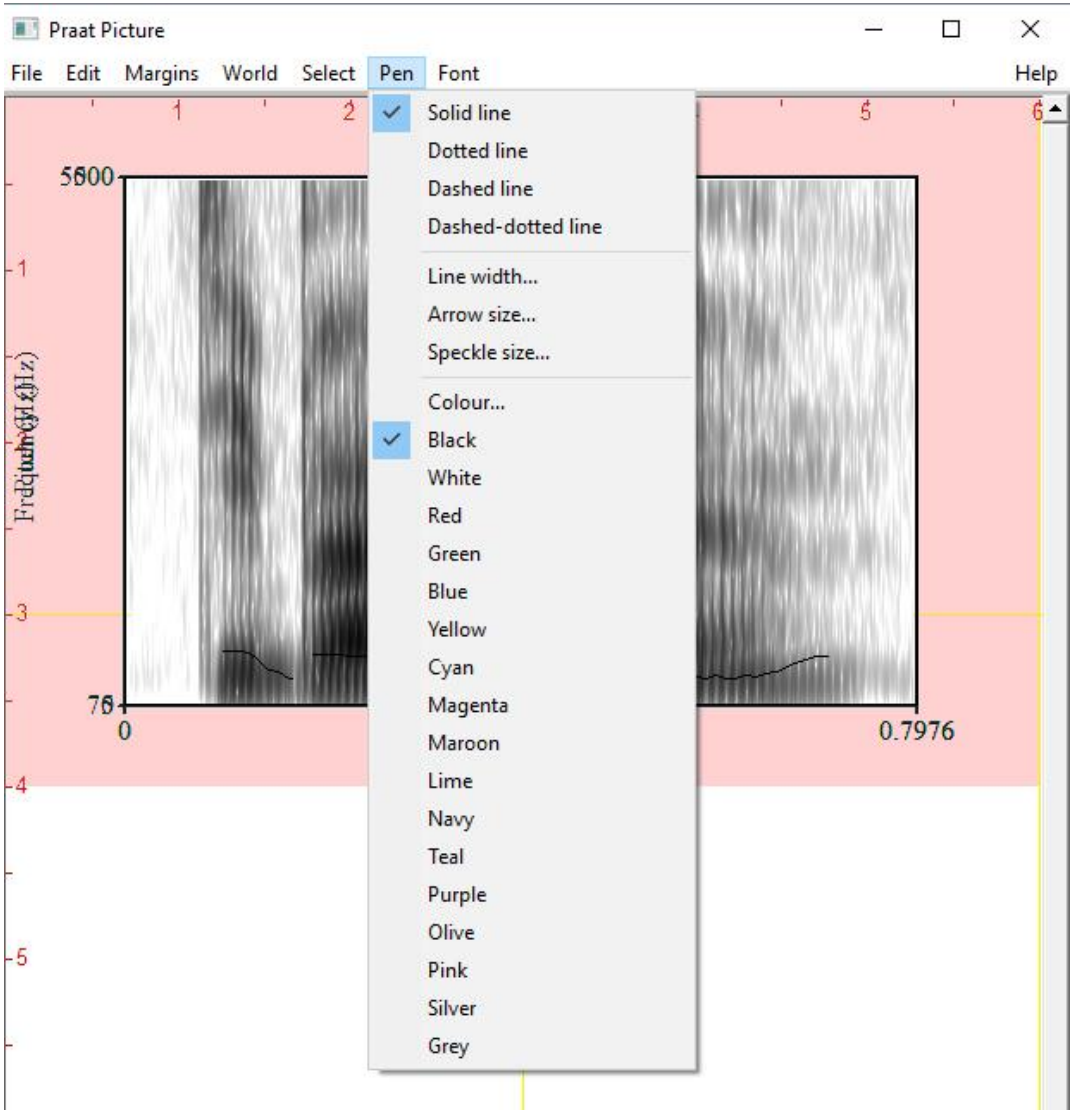
Step 7: Produce and export pictures

- Example: Spectrogram with f0 contour



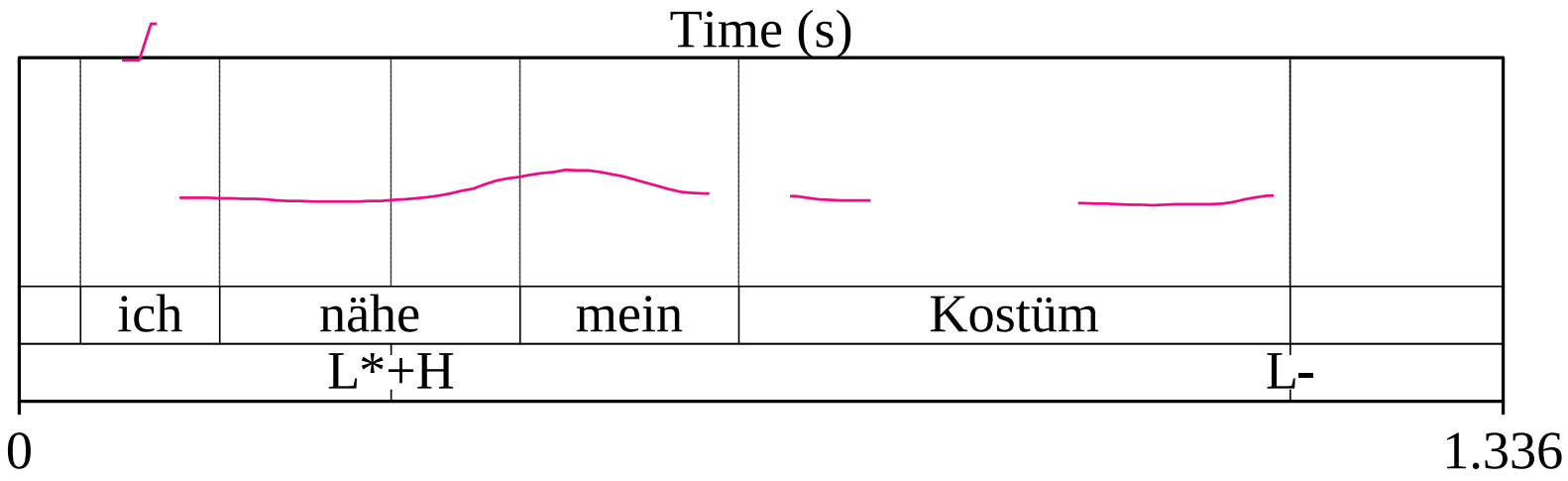
Spectrum > *Paint visible spectrogram* and *Pitch* > *Draw visible pitch contour*
The colour can be changed in the picture window (*Pen*) **before** you do the drawing

Step 7: Produce and export pictures



Step 7: Produce and export pictures

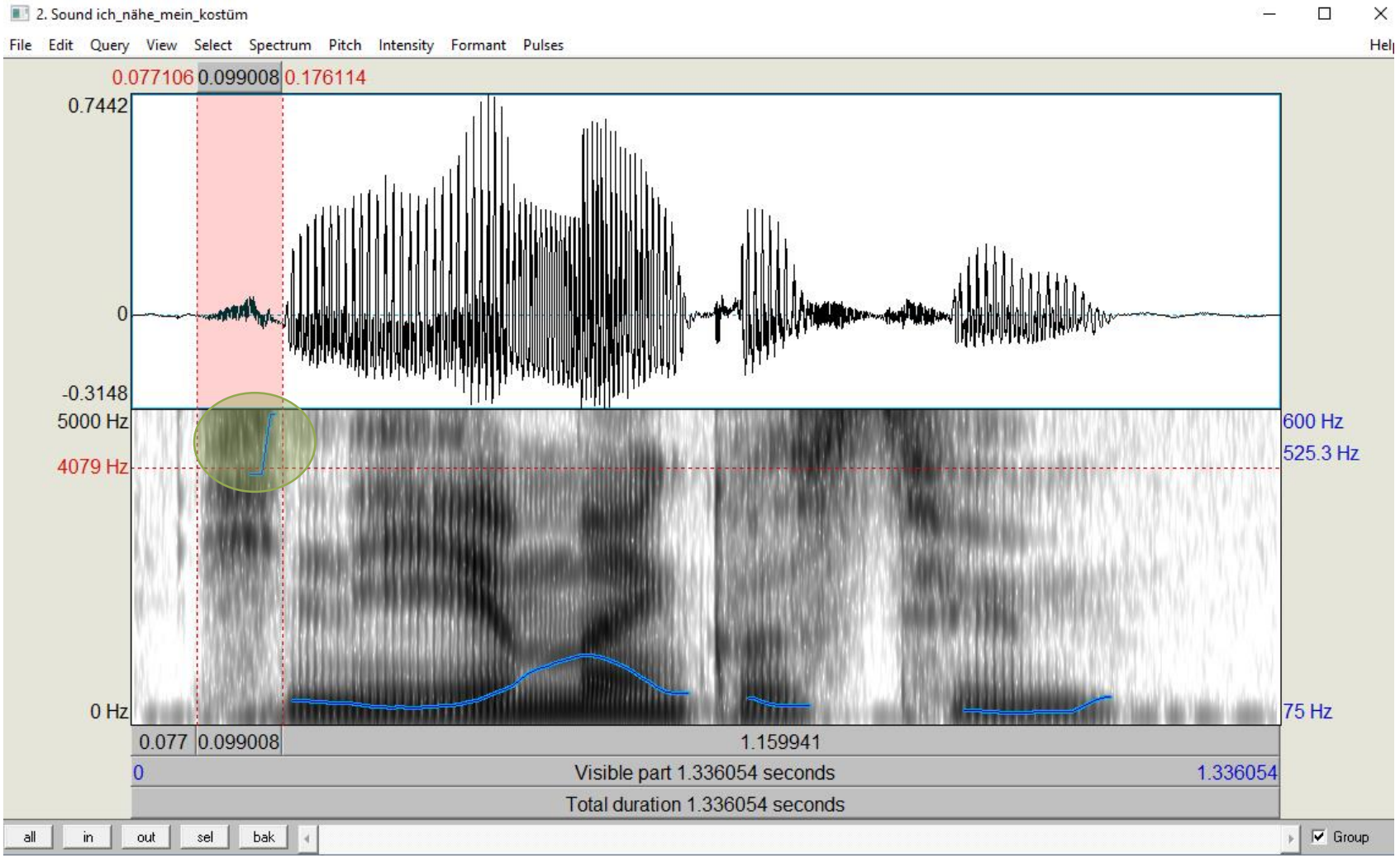
- Example: Text grid with f0 contour



Pitch > Extract visible pitch contour
Select the pitch contour and the text grid in the Praat object window and click *Draw*

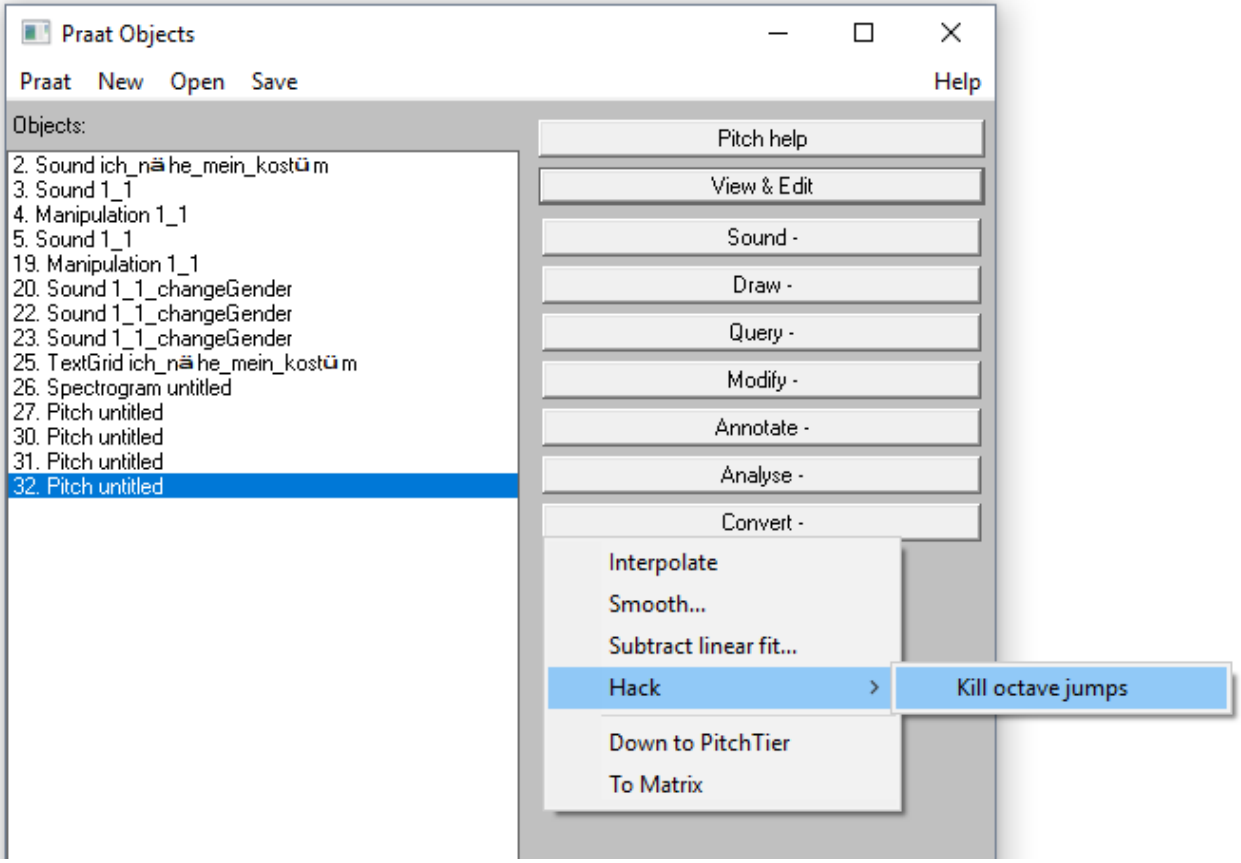
Convert pitch contour

- Tip: How to get rid of “crazy” intonation curves

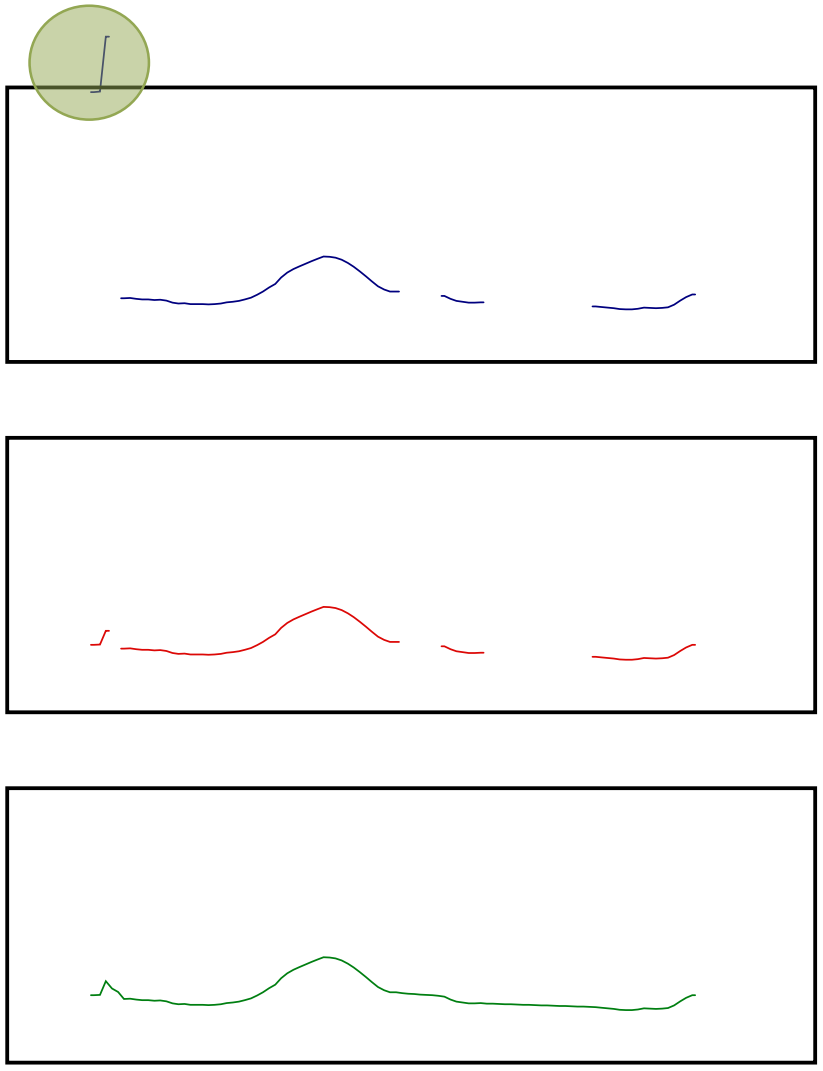


Convert pitch contour

- *Pitch > Extract visible pitch contour*
- *Convert > Hack > Kill octave jumps*



Convert pitch contour



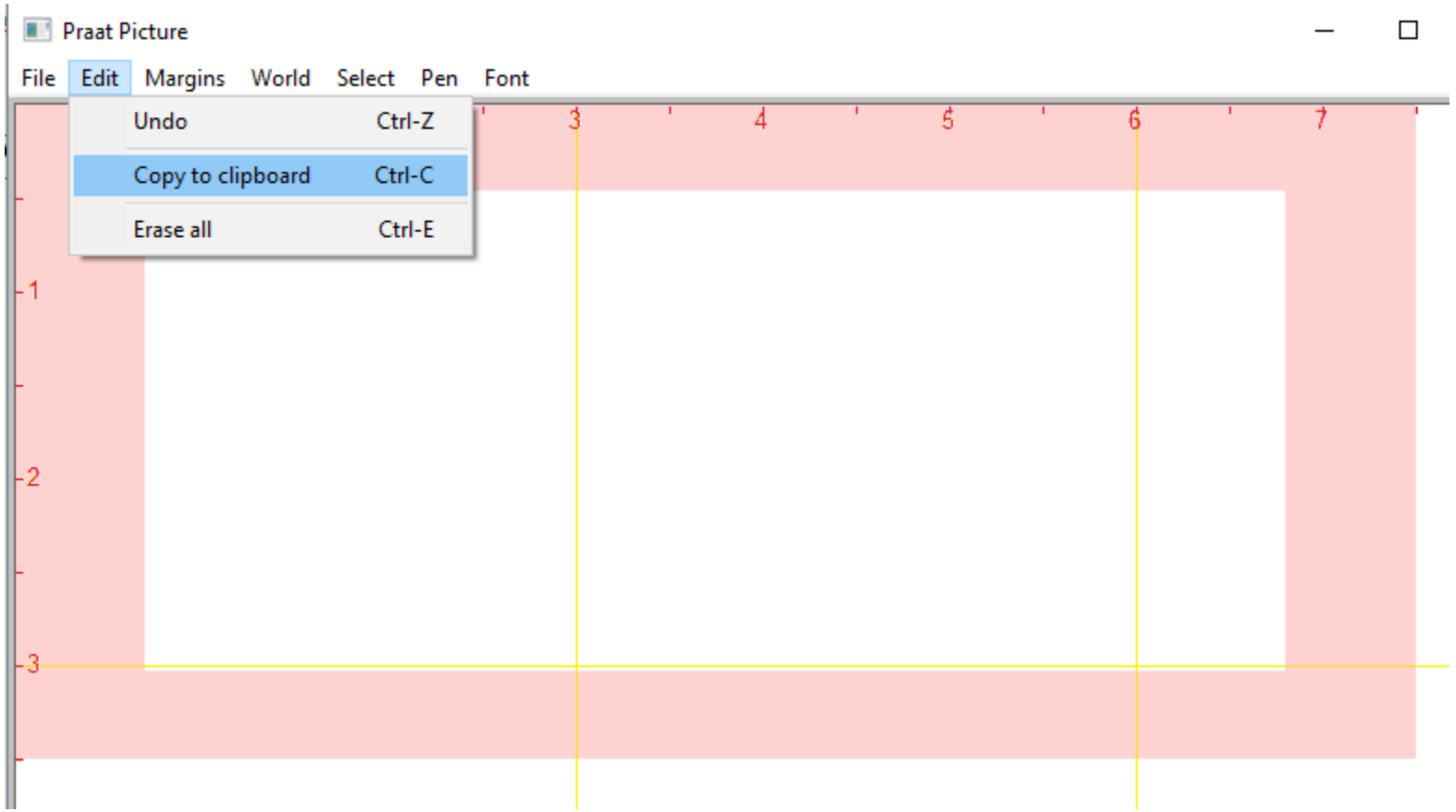
original

with octave jump removed

Interpolate (Praat will connect the pitch contour so that it does not get interrupted by voiceless parts)

Step 7: Export pictures

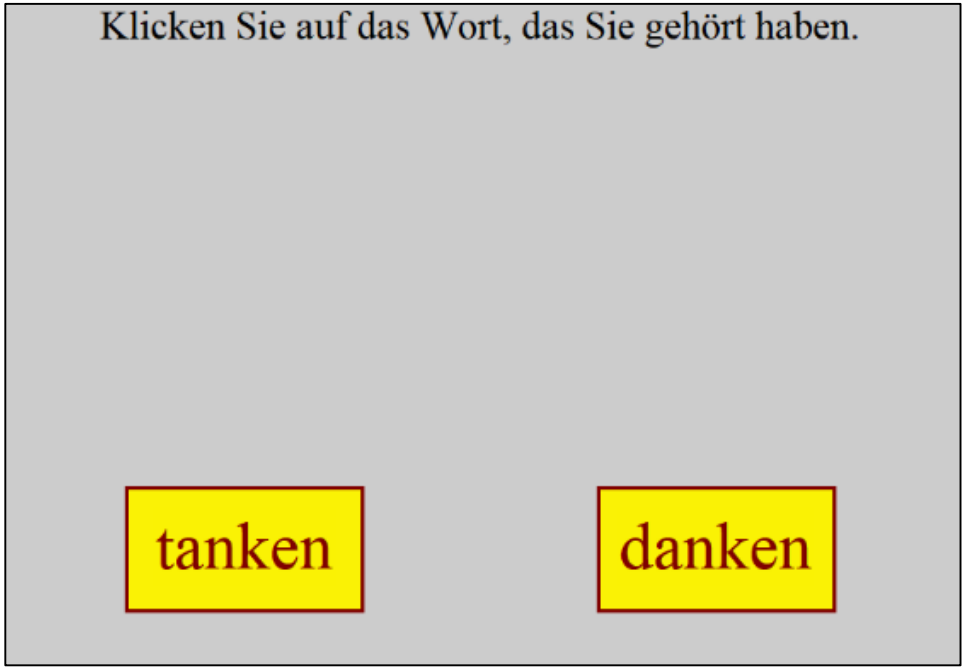
- I would recommend *"Edit > Copy to clipboard"* or *"File > Save as 600-dpi PNG file"* for high quality



Praat: Experiment MFC

- You can also run simple **perception experiments** in Praat
- Identification and discrimination tests are possible

➢ Example: 2AFC identification tests



Praat: Experiment MFC

- You need a simple text file with a certain structure http://www.fon.hum.uva.nl/praat/manual/ExperimentMFC_2_1__The_experiment_file.html
- **The first two lines have to stay the same**, the rest depends on your stimuli, on the response categories and on the way the experiment is presented to the listener
- The order of the lines in the file cannot be changed and nothing can be skipped

Praat: Experiment MFC

```
"ooTextFile"
"ExperimentMFC 7"
blankWhilePlaying? <no>
stimuliAreSounds? <yes>
stimulusFileNameHead = ""
stimulusFileNameTail = ".wav"
stimulusCarrierBefore = ""
stimulusCarrierAfter = ""
stimulusInitialSilenceDuration = 0.5 seconds
stimulusMedialSilenceDuration = 0
stimulusFinalSilenceDuration = 0.5 seconds
numberOfDifferentStimuli = 4
    "heed" ""
    "hid" ""
    "hood" ""
    "hud" ""
numberOfReplicationsPerStimulus = 3
breakAfterEvery = 0
randomize = <PermuteBalancedNoDoublets>
startText = "This is a listening experiment.
After hearing a sound, choose the vowel that is most similar to what you heard.

Click to start."
```

Don‘t change these two lines!

Here, you can define the duration of silence before, within (for discrimination tests) and after a stimulus

Write the file names of you wav-Files (they have to be in the same folder as the textfile)

Indicate how often a stimulus should be presented in the experiment and after how many trials there should be a break

This text will appear on the screen at the beginning of the experiment

Praat: Experiment MFC

```
runText = "Choose the vowel that you heard."
pauseText = "You can have a short break if you like. Click to proceed."
endText = "The experiment has finished."
```

This text will appear during the experiment, during the break and at the end of the experiment

```
maximumNumberOfReplays = 0
replayButton = 0 0 0 0 "" ""
okButton = 0 0 0 0 "" ""
oopsButton = 0 0 0 0 "" ""
```

You can give participants the opportunity to replay a stimulus and also to change their response ("oops button")

```
responsesAreSounds? <no> "" "" "" "" 0 0 0
numberOfDifferentResponses = 5
    0.2 0.3 0.7 0.8 "h I d" 40 "" "i"
    0.3 0.4 0.5 0.6 "h E d" 40 "" "e"
    0.4 0.5 0.3 0.4 "h A d" 40 "" "a"
    0.5 0.6 0.5 0.6 "h O d" 40 "" "o"
    0.6 0.7 0.7 0.8 "h U d" 40 "" "u"
```

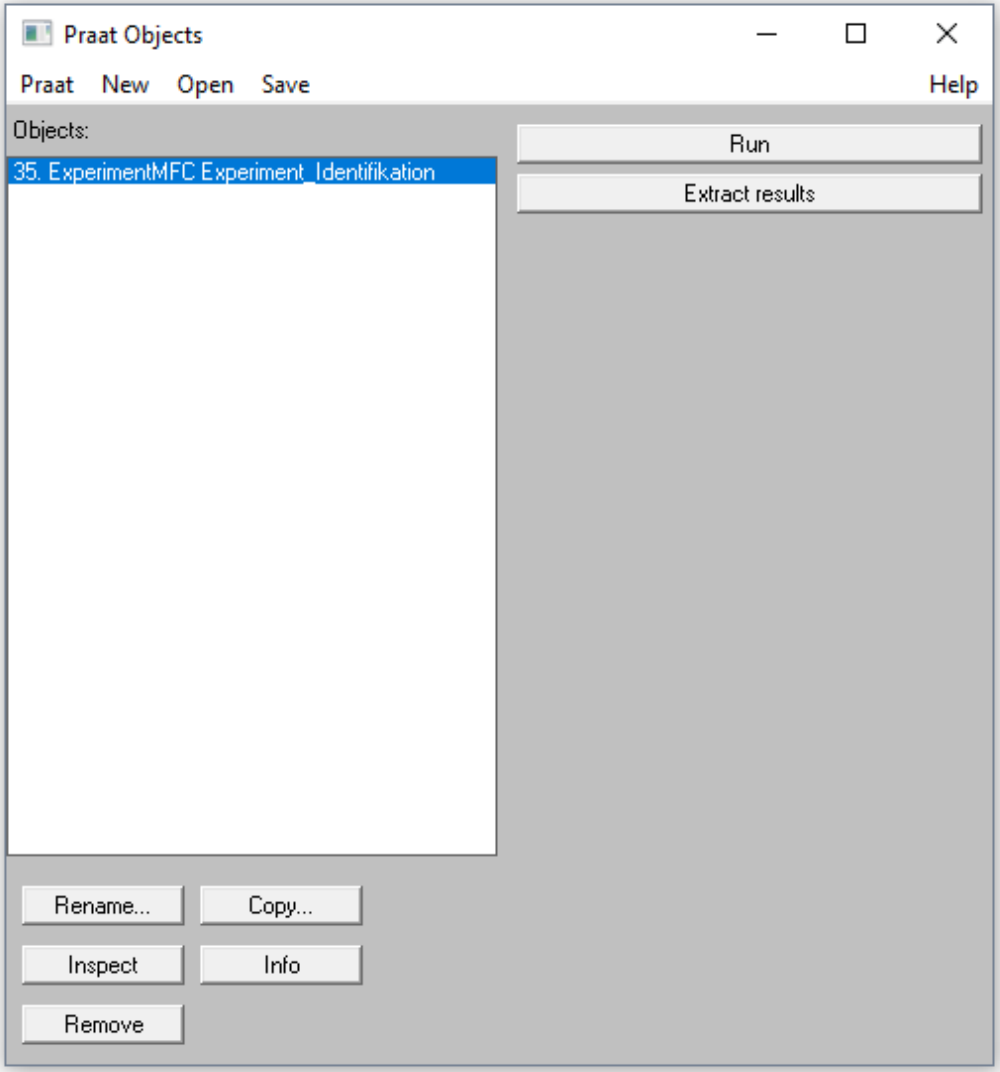
These are the response options displayed on the screen

```
numberOfGoodnessCategories = 5
    0.25 0.35 0.10 0.20 "1 (poor)" 24 ""
    0.35 0.45 0.10 0.20 "2" 24 ""
    0.45 0.55 0.10 0.20 "3" 24 ""
    0.55 0.65 0.10 0.20 "4" 24 ""
    0.65 0.75 0.10 0.20 "5 (good)" 24 ""
```

You can also add a goodness rating (i.e. participants are asked to tell how "good" they think a stimulus was/or how "certain" they were about their response)

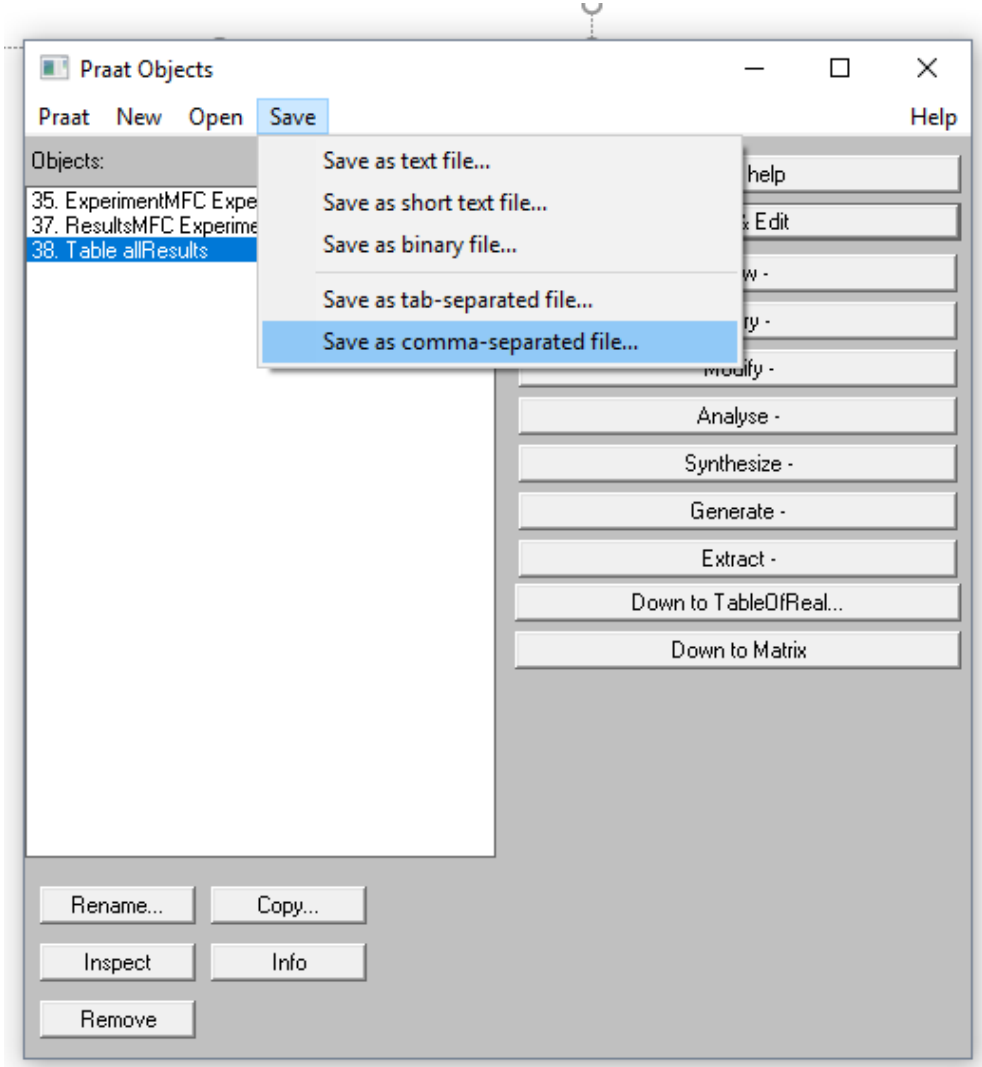
Praat: Experiment MFC

- Open the text file (*Open > read from file*)
- Run it
- After the experiment finishes, you choose *Extract results*



Praat: Experiment MFC

- *Collect to Table*
- *Save > Save as comma-separated file* or *Save as tab-separated file*



Praat: Experiment MFC

- **Output**
- The first column contains the names of the *subject* (actually the name of the text file), the second column the *stimulus names*, the third column the *responses*, and the last column the approximate *reaction times* (However, I would recommend different programs than Praat if you are interested in reaction time!). If there are *goodness ratings* as well, they will be displayed in the fourth column
- Open the texfile in Excel, SPSS, R etc. and do statistical analysis

subject	stimulus	response	goodness	reactionTime
SUBJ_01	heed	i	5	1.424453409781563
SUBJ_01	hood	u	5	0.3100557906436734
SUBJ_01	heed	e	5	1.0524721151014091
SUBJ_01	hid	i	5	1.787820853991434
SUBJ_01	hud	u	5	1.0343763243145077
SUBJ_01	heed	i	4	1.1687852420873241
SUBJ_01	hud	e	3	1.0476764482300496

Thank you for your attention!

Links and useful literature

- Will Styles: *Using Praat for Linguistic Research* https://phonetique.uqam.ca/upload/files/LIN2623/Styler_2013_2.pdf (handbook about Praat for linguists; highly recommendable!)

- Jörg Mayer: *Die Praatpfanne* http://praatpfanne.lingphon.net/ (handbook, scripts and other resources about Praat in German; also highly recommendable!)

- Tutorials on Praat scripting:

Antje Schweitzer:
http://www.ims.uni-stuttgart.de/institut/arbeitsgruppen/phonetik/helps/praat-scripting/praat.tutorial.pdf

Ingmar Steiner:
http://www.coli.uni-saarland.de/~steiner/teaching/2007/winter/praat/praat_lecturenotes.pdf