

ACOUSTIC PHONETICS

Overview

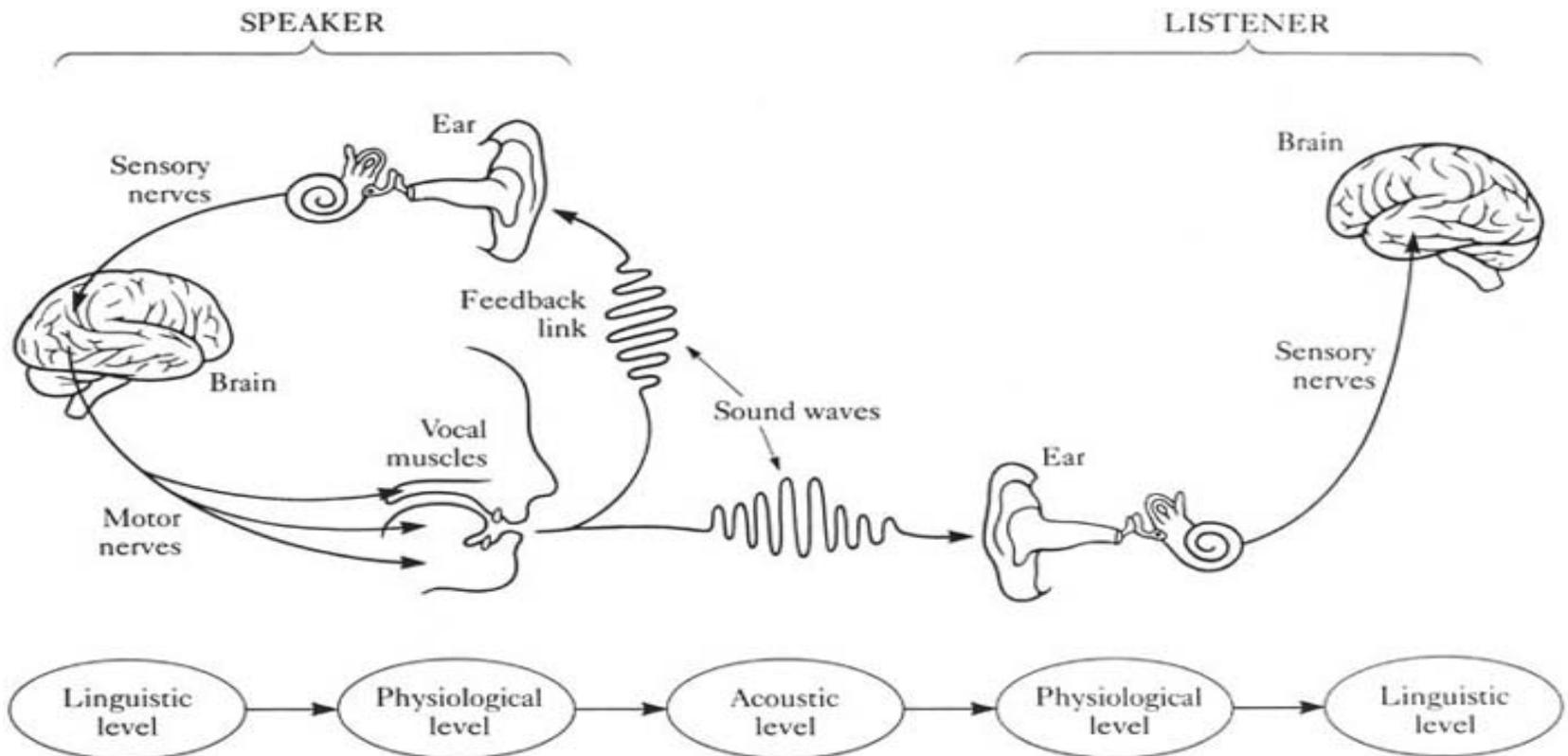
- What is acoustic phonetics?
- Introduction to PRAAT
 - Spectrogram
 - Oscillogram
- Spectrum
- Summary
- Correlation between acoustic phonetics and auditory phonetics

What is acoustic phonetics?

- branch of phonetics dealing with
 - physical characteristics of sound waves which carry speech sounds between mouth and ear (transmission of sound)

Acoustic phonetics in context of phonetics and phonology

- **Phonetics** refers to the physiological and acoustic parts of the following diagram, while **phonology** resides in the brain

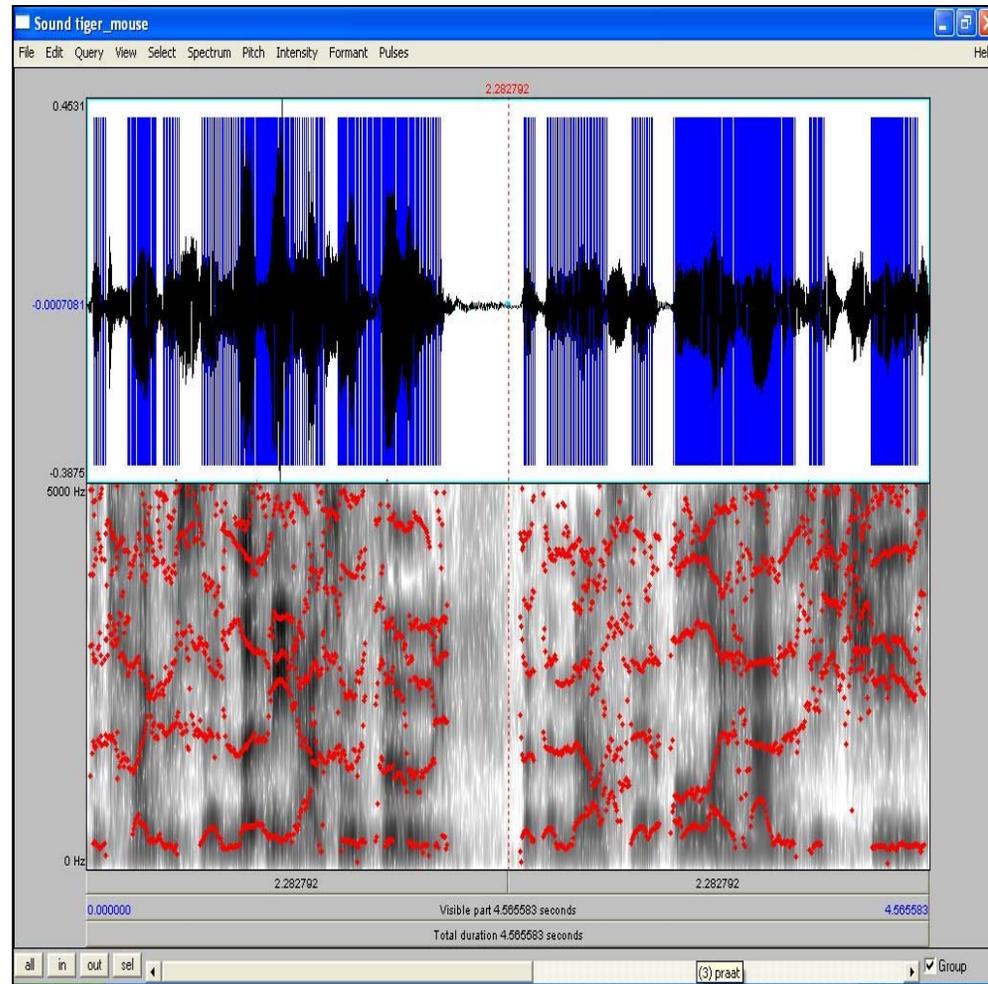


(URL: http://www.ling.upenn.edu/courses/Spring_2001/ling001/phonology.html)

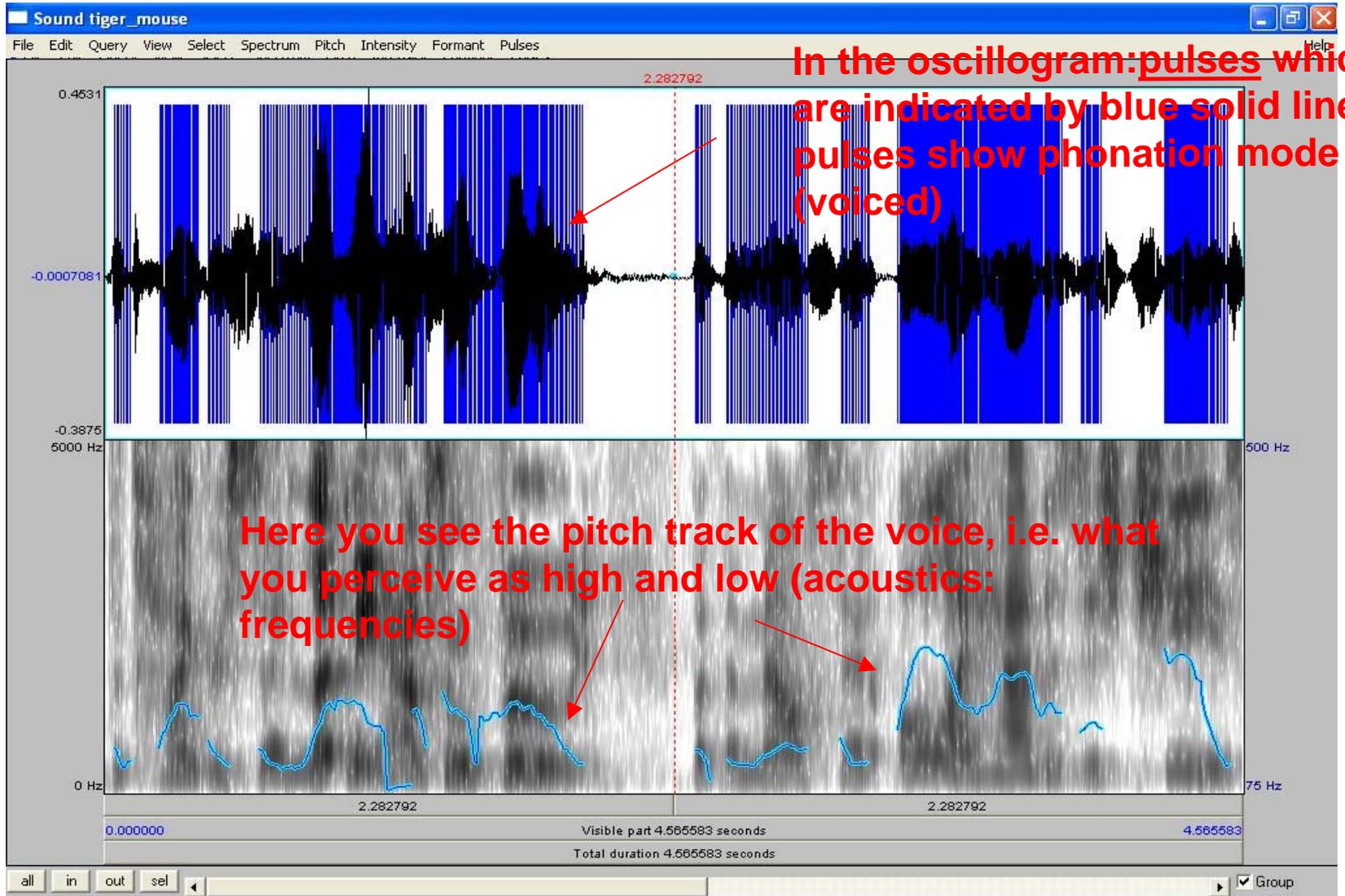
-Acoustic phonetics and PRAAT- What is PRAAT?

- speech sound waves can be analysed in terms of its acoustic properties →

PRAAT: computer program
→ enables visualizing,
playing, annotating, and
analyzing of sound object
in terms of its acoustic
properties (e.g. frequency,
pitch, etc.)

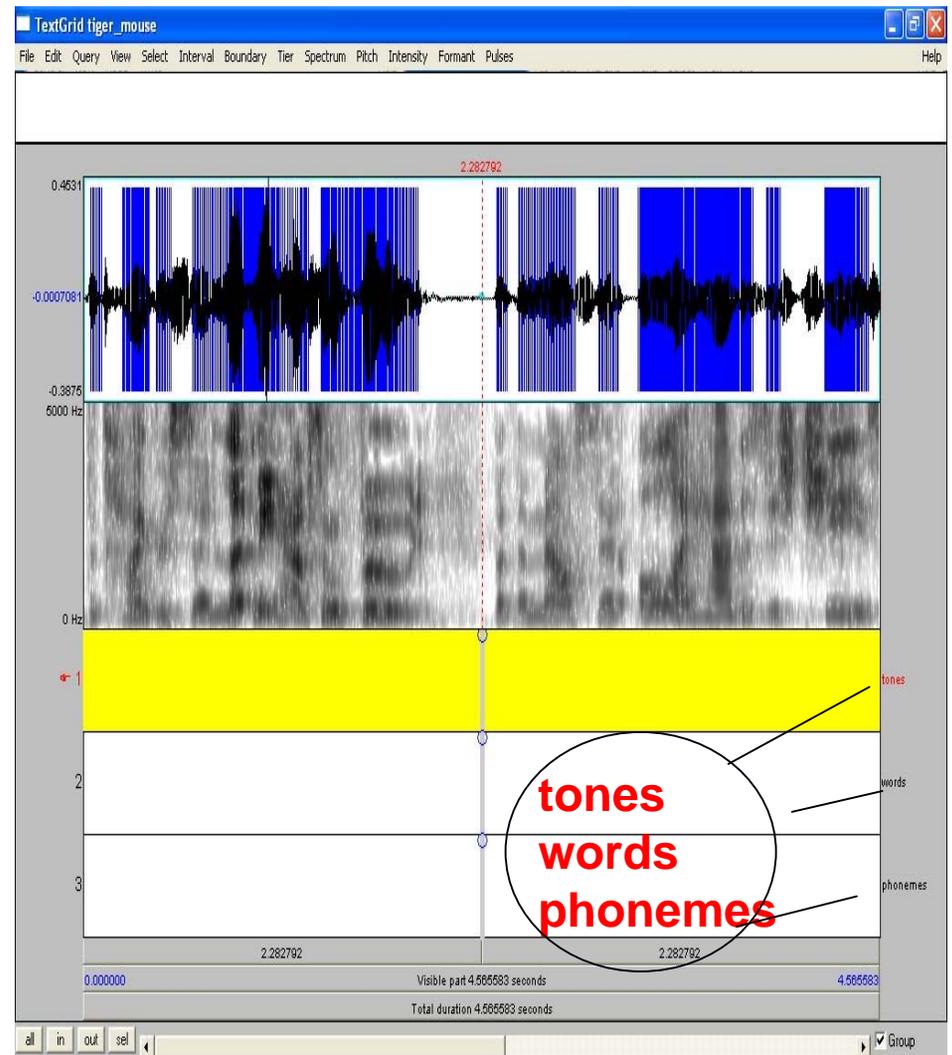


Pulses and pitch



PRAAT-tiers (layers/levels)-

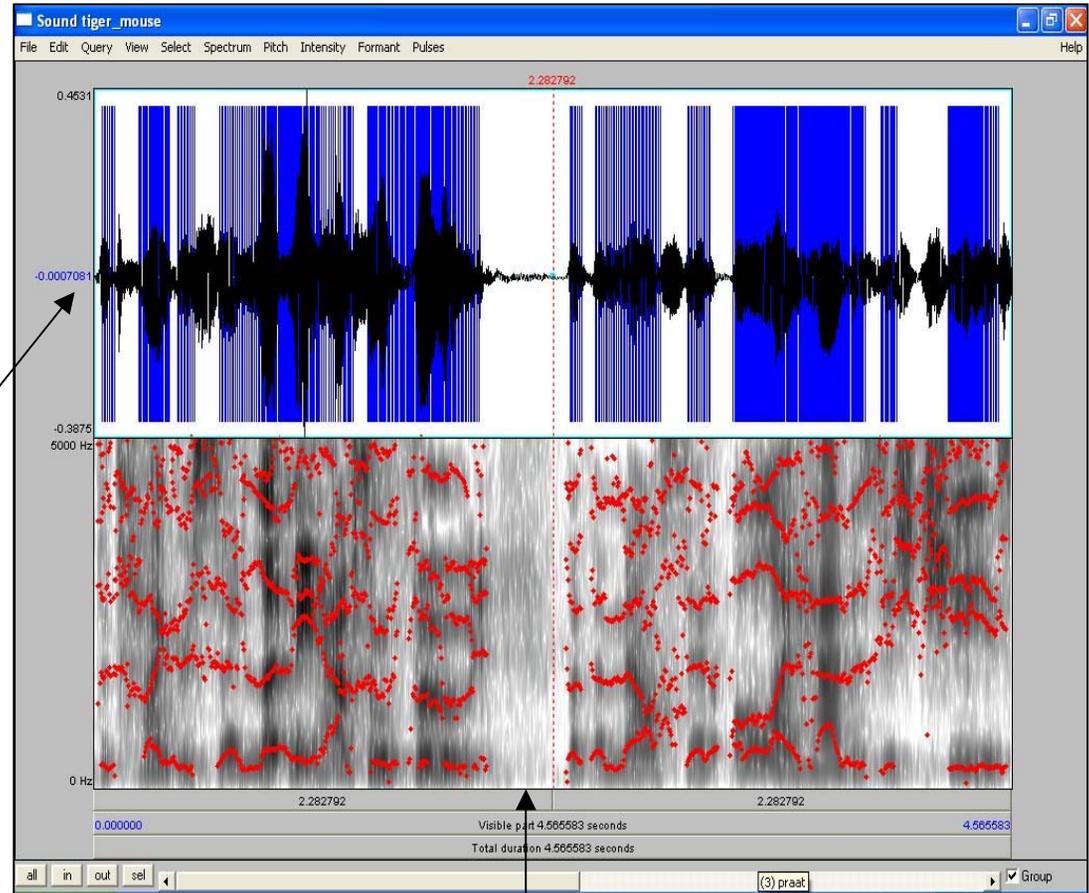
- tiers are used to segment a speech waveform and attach labels for each segment for further processing



What does PRAAT show?

- Speech acoustic analysis can be realized by using:
→ spectrogram & oscillogram

oscillogram



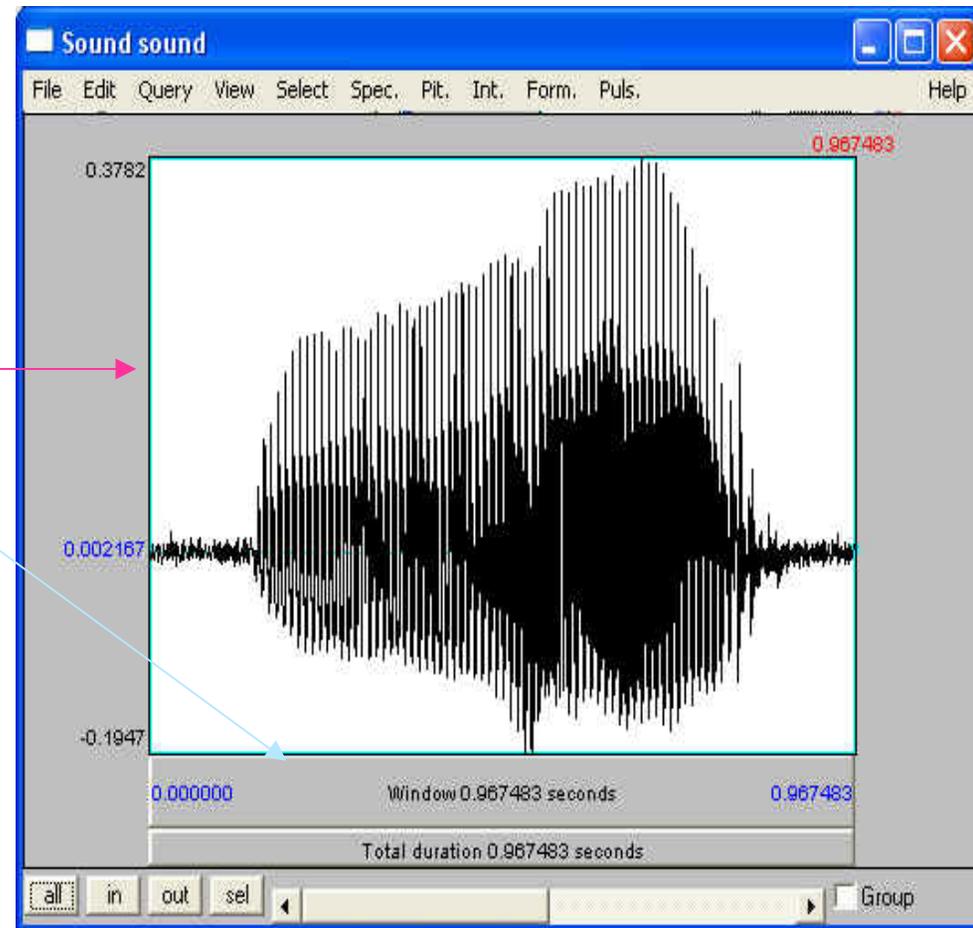
spectrogram

What is an oscillogram?

- represents speech signals

→ vertical axis: amplitude

→ horizontal axis: time
(total duration)



Spectrogram

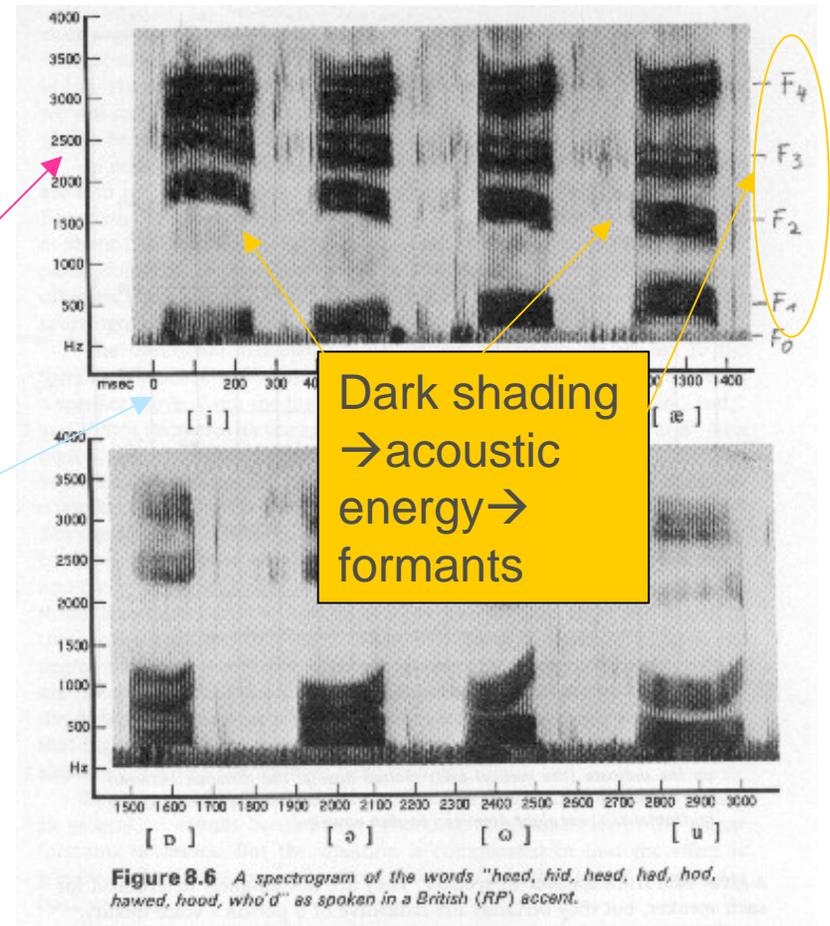
- graphic representation of sounds in terms of their component frequencies

Three dimensions:

→ vertical axis: frequency

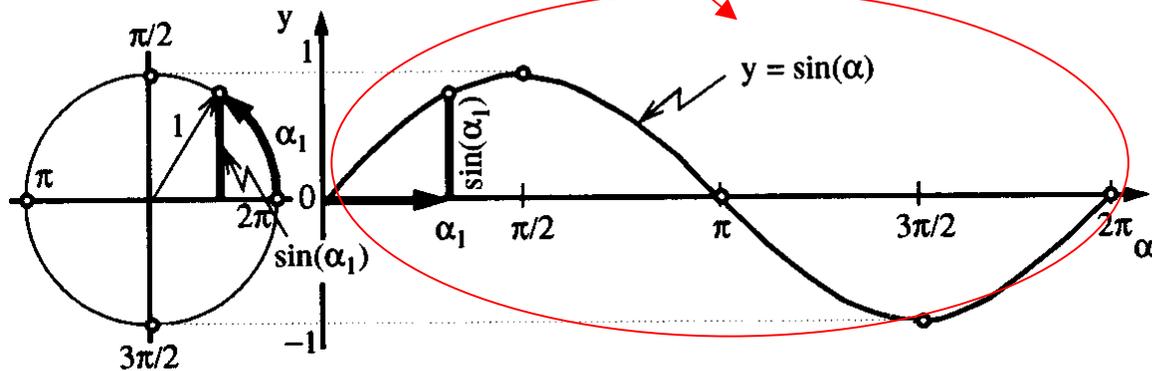
→ horizontal axis: time

→ dark shading (third dimension): acoustic energy (formants F1, F2, F3)



What is frequency?

- number of cycles completed per second; measured in Hertz (Hz)
- when the cycle meets the axis for the second time, one cycle is completed: one cycle

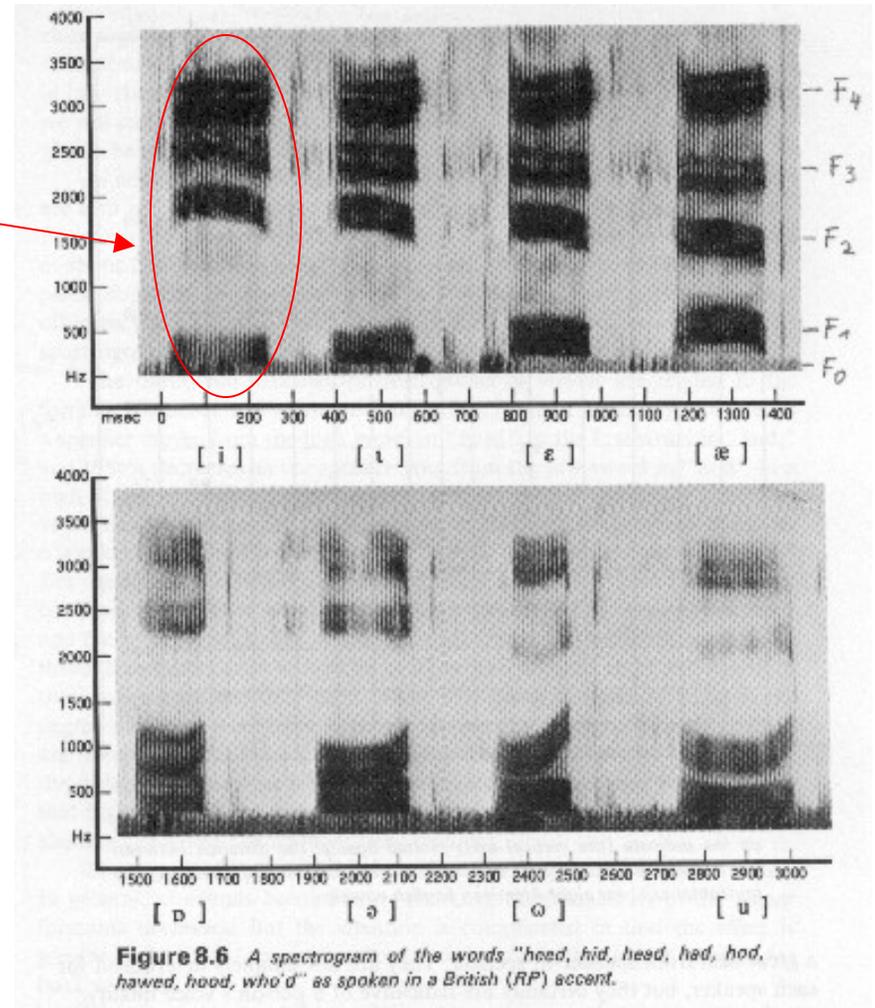


Sine wave: simplest kind of periodic wave → made by an ideal tuning fork

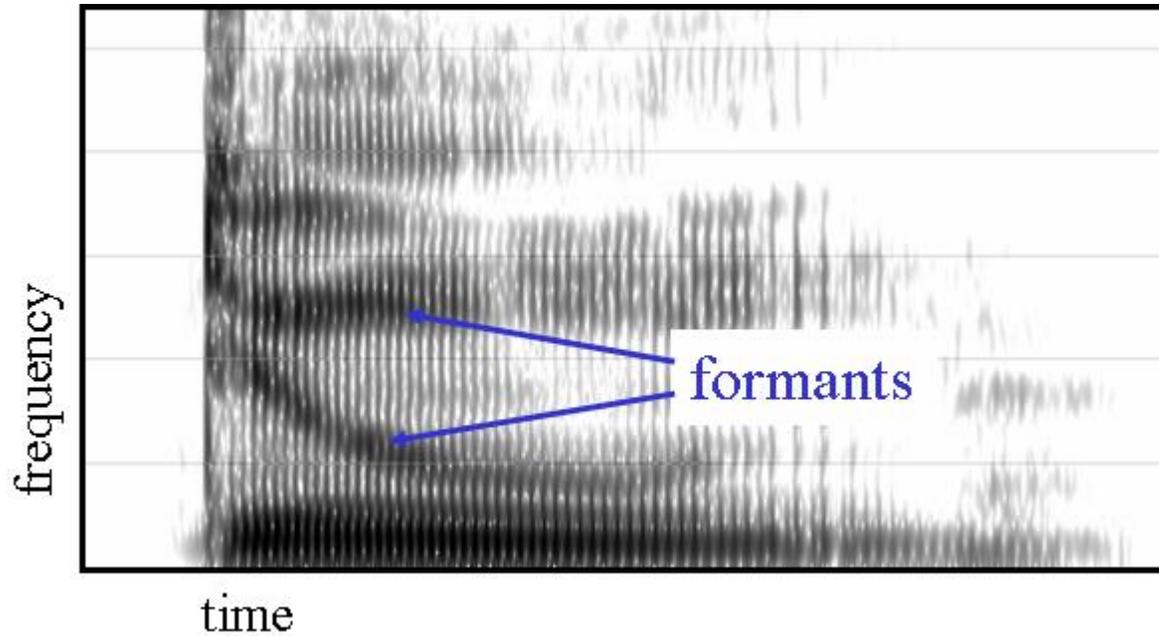
Lowest frequency sine wave component → fundamental frequency (f_0)

What are formants?

- Spectrogram also shows formants
- concentration of acoustic energy
- group of overtones corresponding to a resonating frequency of the air in the vocal tract
- vowels are characterized by three formants (F1, F2, F3)

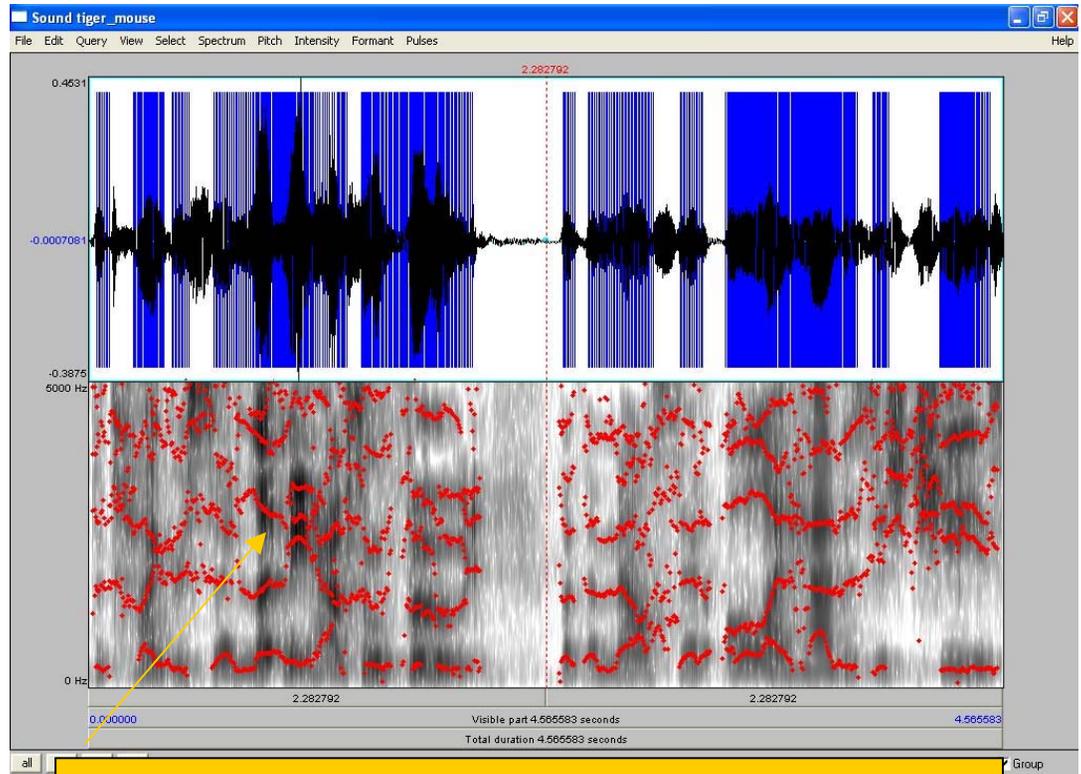


Formants



Formants in PRAAT

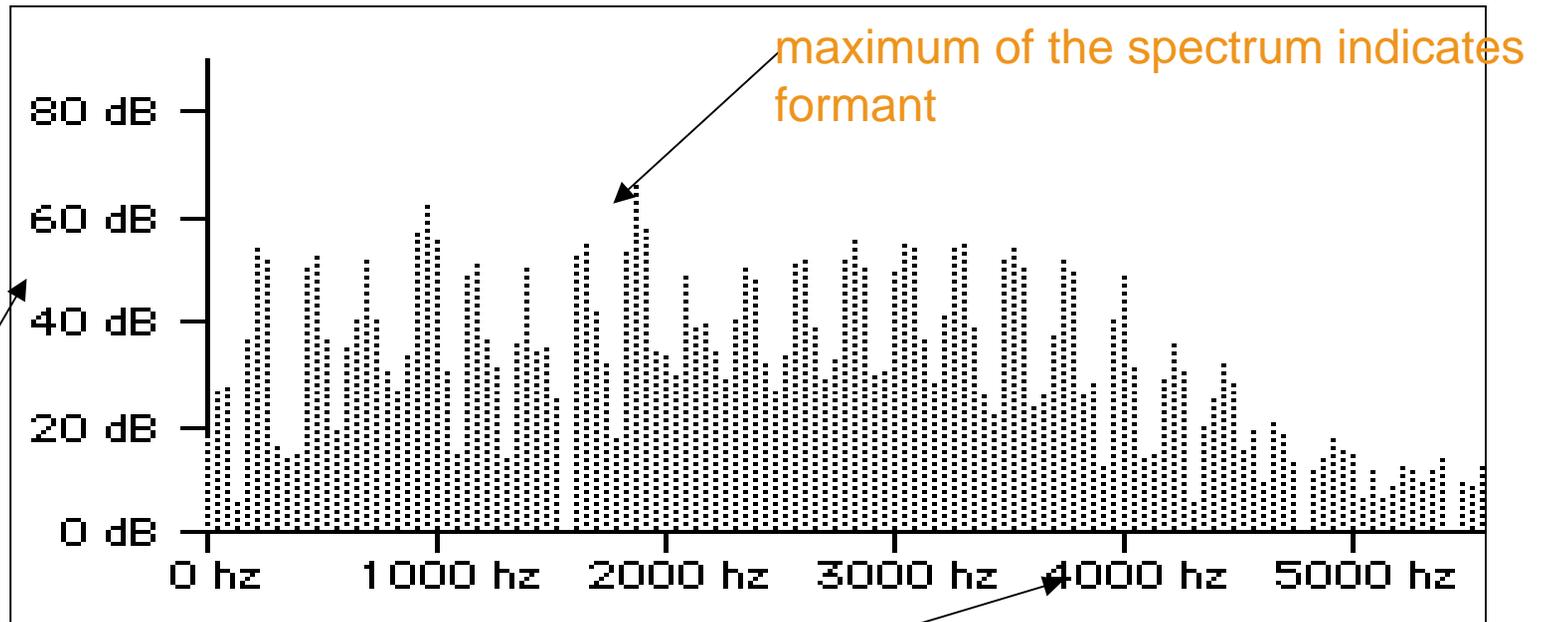
- formants in PRAAT are also shown by 'red dotted lines' in the spectrogram



The 'red dotted lines' and especially dark shadings show the formants

Spectrum

- spectrum: only shows frequency and amplitude → no relation to time

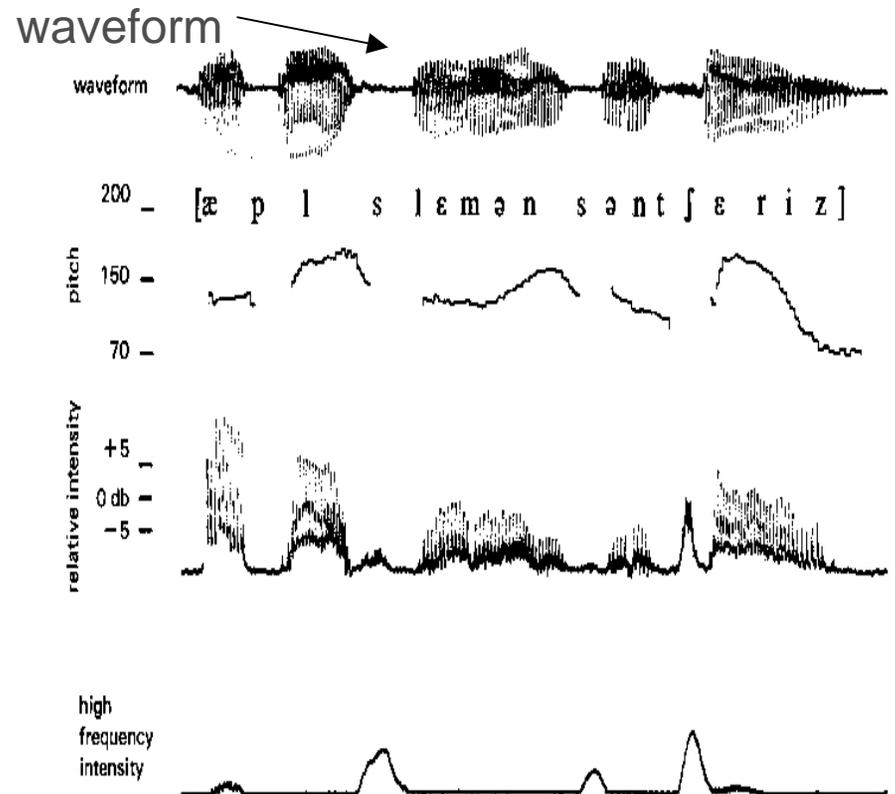


vertical position shows amplitude

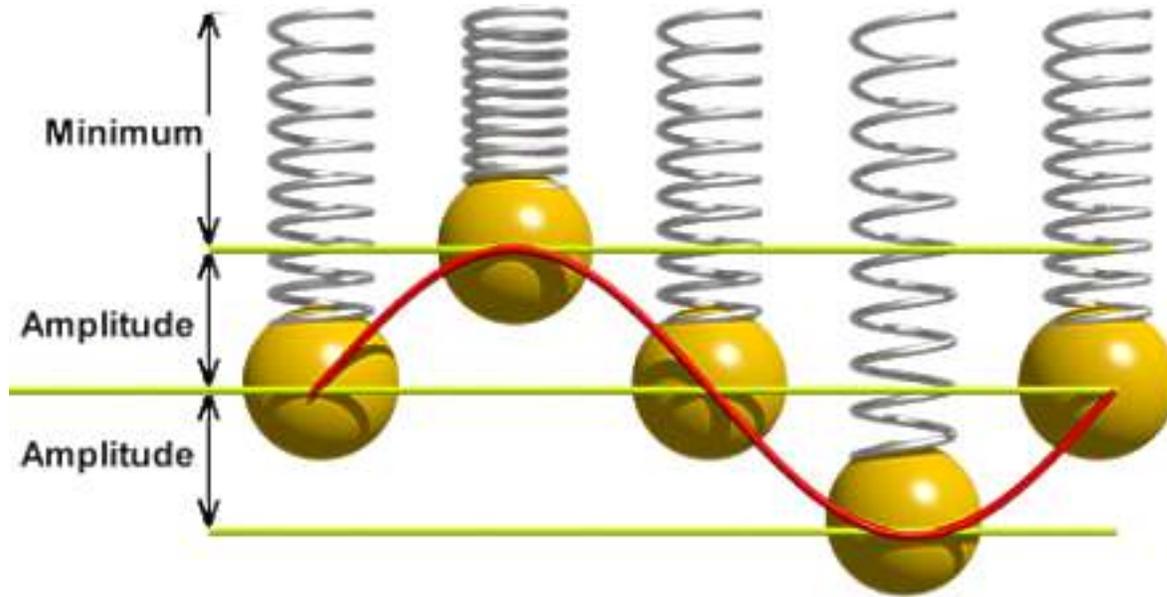
horizontal position shows frequency

What is amplitude?

- given in an oscillogram
- displacement of the vibrating medium from its rest position (example: tuning fork)
- measured in relation to time, measured in dB



Amplitude



Summary

spectrogram

(representation in PRAAT)

y-axis: frequency (Hz)

x-axis: time (sec)

third dimension: dark shading (intensity → formants; dB)

oscillogram

(representation in PRAAT)

y-axis: amplitude

x-axis: time

spectrum

(no representation in PRAAT)

y-axis: amplitude

x-axis: frequency

Correlation between acoustic phonetics and auditory phonetics

Acoustic phonetics

frequency

(measured in Hz)

amplitude

(measured in dB)

duration

(measured in time)

Auditory phonetics

perceived as pitch

perceived as loudness

perceived as speech

tempo