Praat Workshop -Basics-

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Overview of Today

1. Introducing Praat --what is it?
2. Basic workflow to use Praat
3. Hands-on Practice!!
    1. Segmentation Practice with "Taco' 
    2. Learn Main Uses of Praat
        1. Segmentation Rules by Phonemes
        2. Sound Manipulations
        3. Get Graphics
        4. Get Acoustic data
4. Summary - Other cool things you can do with Praat

link

Part 1

Introducing Praat

What is Praat?

- Free software to analyze speech, manipulate speech, and process data of speech

- Standard tool for phoneticians & speech-related scientists

Functionality

The following gives you an idea of the features of the Praat program. The links take you into the web copy of the manual. The same manual is also available from Praat's Help menus, in which case you can do searches.

Speech analysis:

- spectral analysis (spectrograms)
- pitch analysis
- formant analysis
- intensity analysis
- jitter, shimmer, voice breaks
- cochleagram
- excitation pattern

Speech synthesis:

- from pitch, formant, and intensity
- articulatory synthesis
- Klatt acoustic synthesis

Listening experiments:

- identification and discrimination tests

Labelling and segmentation:

- label intervals and time points on multiple tiers
- use phonetic alphabet
- use sound files up to 2 gigabytes (3 hours)

Speech manipulation:

- change pitch and duration contours
- filtering

Learning algorithms:

- feedforward neural networks
- discrete and stochastic Optimality Theory

Statistics:

- multidimensional scaling
- principal component analysis
- discriminant analysis

Graphics:

- high quality for your articles and thesis
- produce PDF, PNG or EPS files
- integrated mathematical and phonetic symbols

Programmability:

- easy programmable scripting language
- communicate with other programs
- (the **sendpraat** source code)
- create hypertext manuals with sound I/O

Portability:

- machine-independent binary files
- read and write many sound and other file types

Configurability:

- grow or shrink menus
- save prefs for fonts, views, sound devices

What can you do with Praat?

Analyze speech

- spectrogram
- formants
- pitch
- intensity
- voice quality
- labelling by
    - phonemes
    - words
    - turns...etc.

Manipulate speech

- copy and paste sounds
- change
    - intensity,
    - pitch
    - duration...etc.
- filtering
- synthesize speech

Speech data processing

- Get a table of acoustic measures
- Get graphics of
    - vowel space
    - spectrum slices
    - LPC slices...etc.
- Stats

Part 2

Basic workflow to use Praat

Common Flow -- 4 steps!

STEP 1: Record or Import a Sound

STEP 2: Make a TextGrid

STEP 3: Analyze the Sound

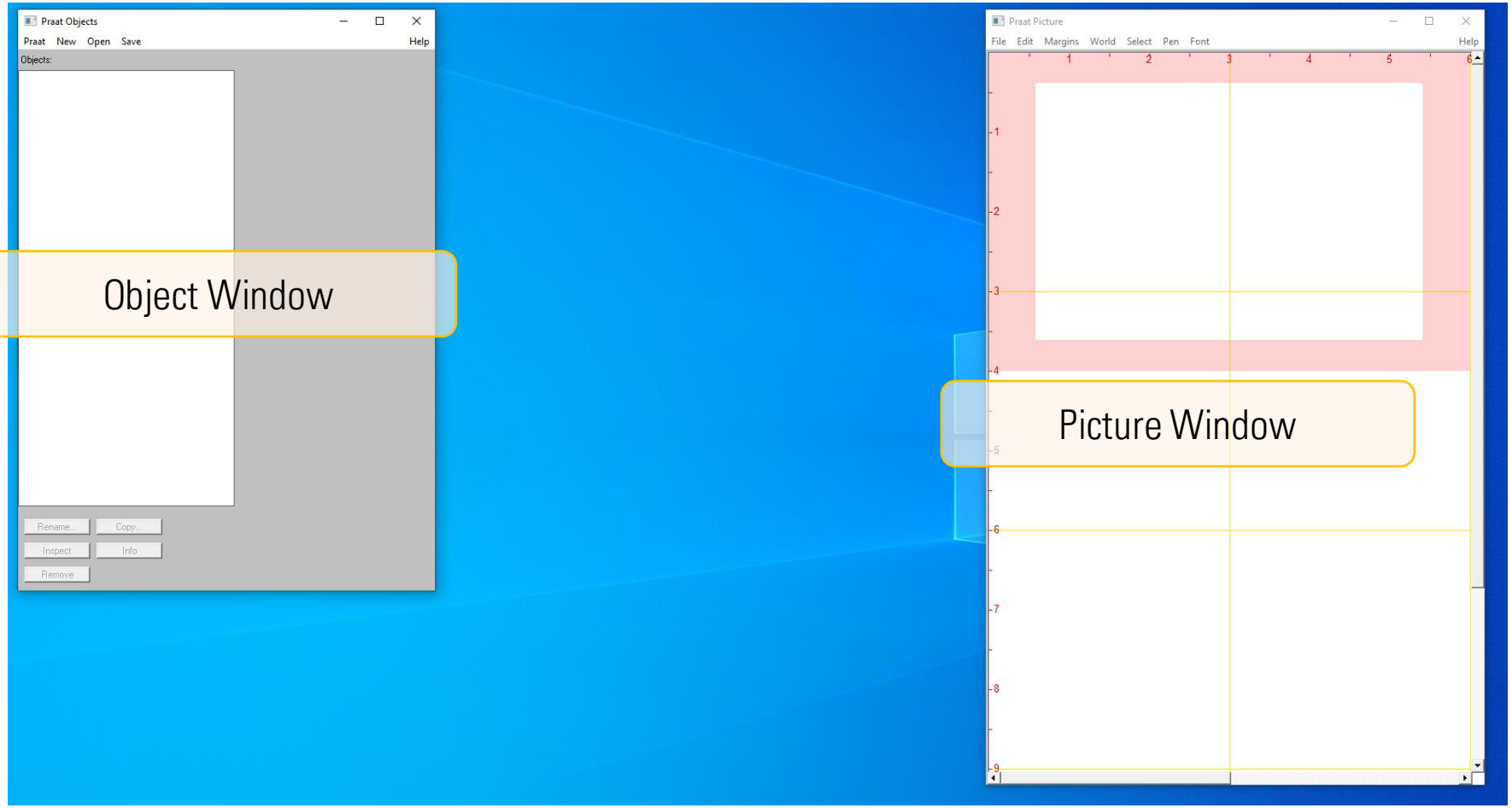
STEP 4: Save the Sound/TextGrid/Output Data

Part 3

Let's Practice!!!

STEP 1: Record or Import a Sound

1. Open Praat



STEP 1: Record or Import a Sound

2-1. If recording...

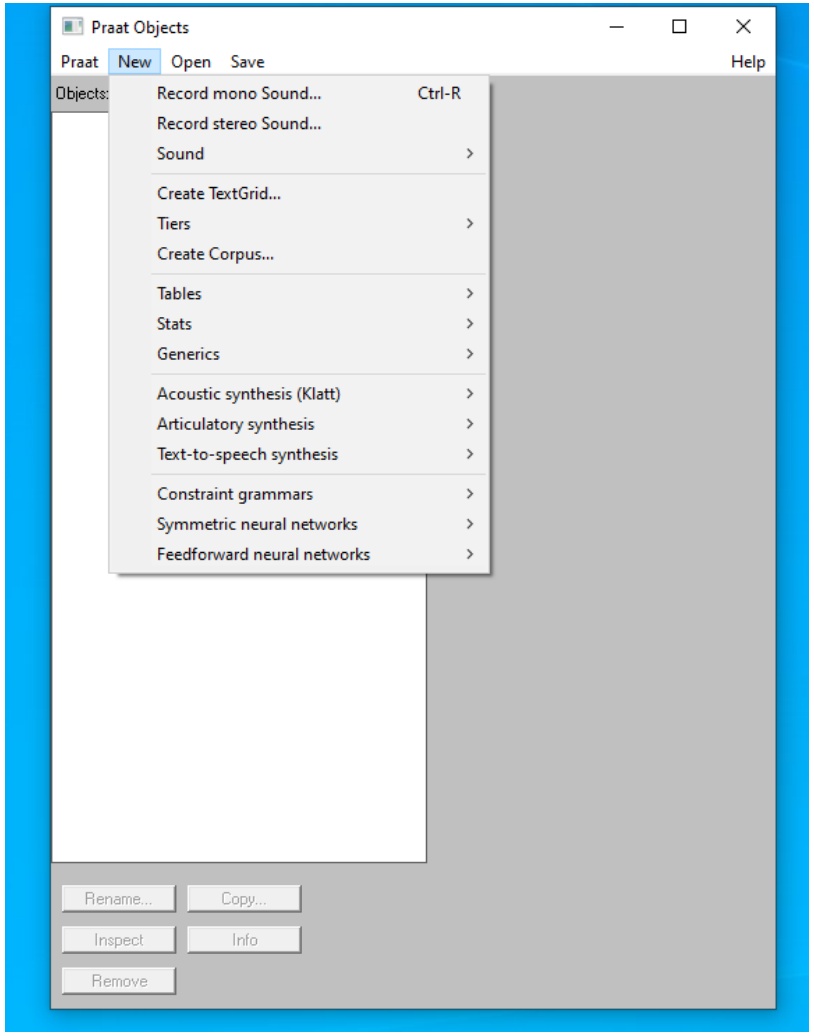
"New" tab

v

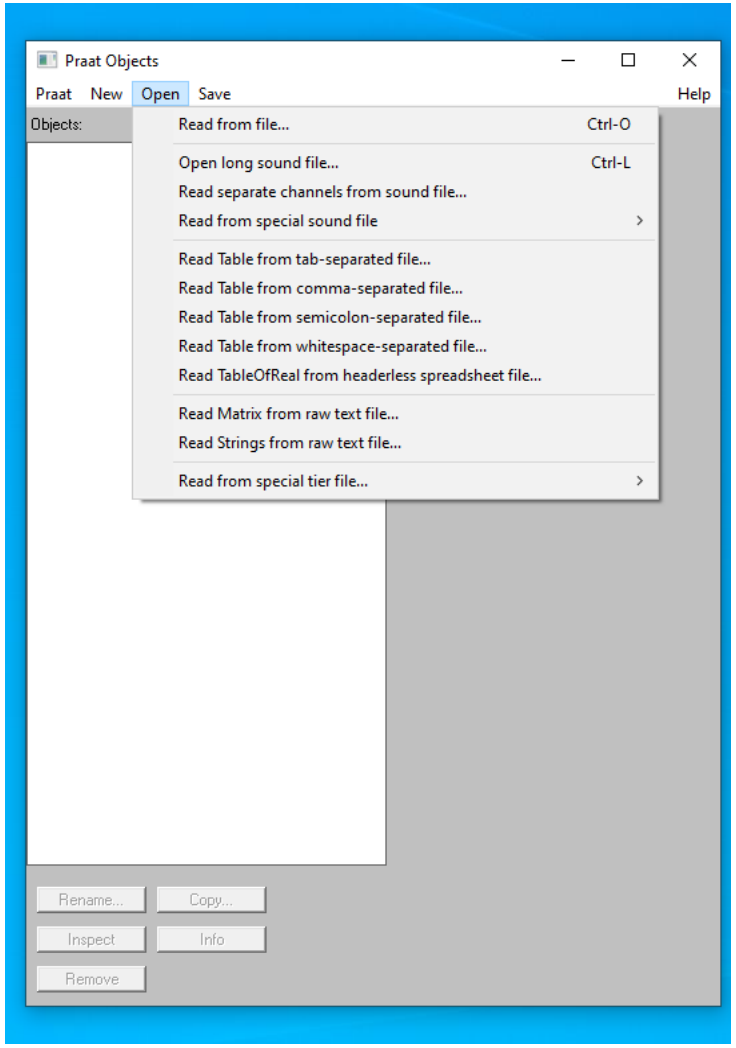
Record Mono Sound...

Or

Record Stereo Sound...



2-2. If importing...



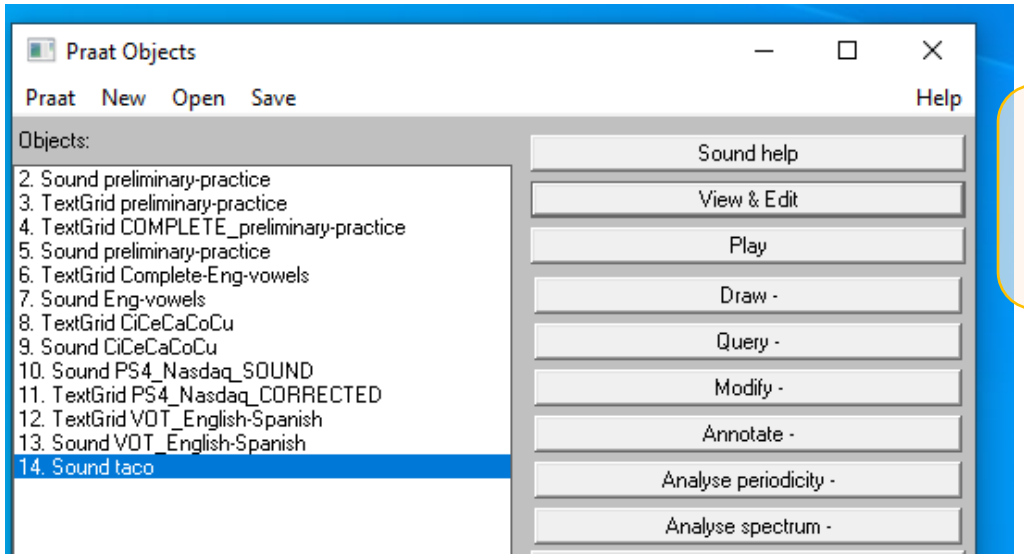
"Open" tab

v

Read from file...

STEP 1: Record or Import a Sound

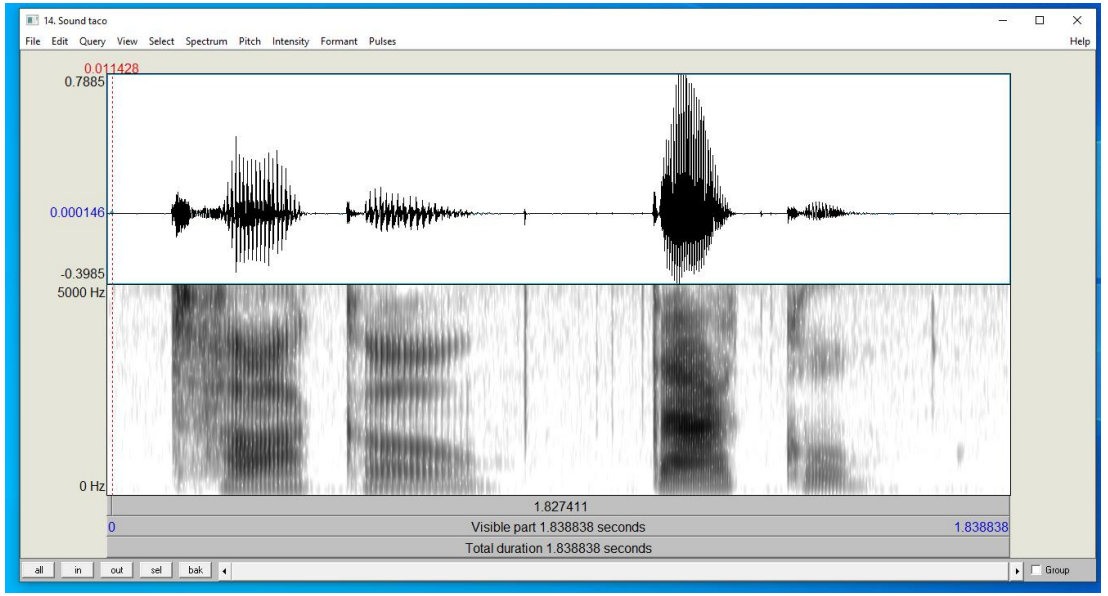
3. View Sound



(1) Select Object

(2)
View & Edit

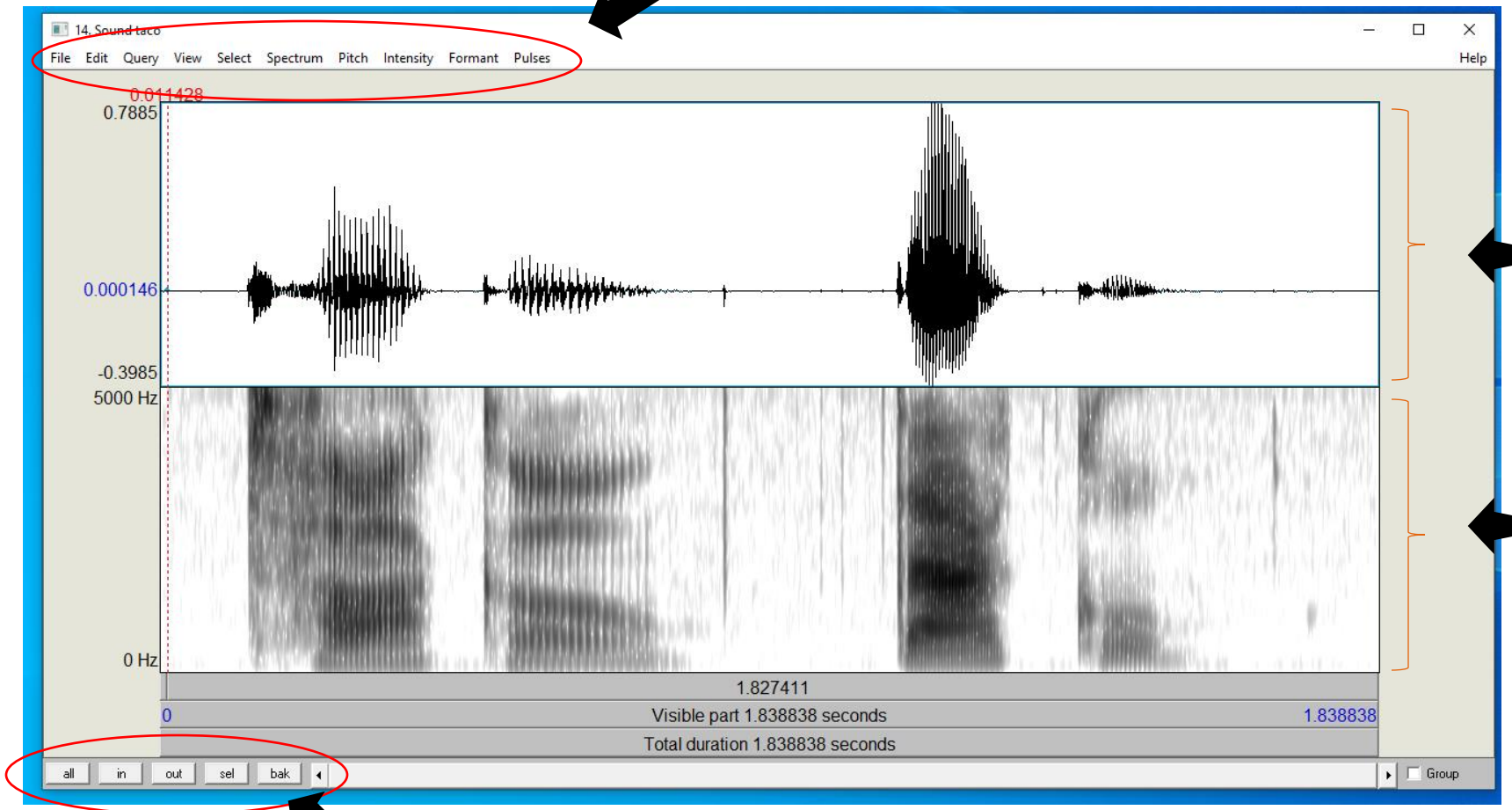
⇒



STEP 1: Record or Import a Sound

3. View Sound

Lots of functions!



Y axis = loudness/Intensity
Shape of wave = type of sound

Waveform
X axis...Time
Y axis...Amplitude

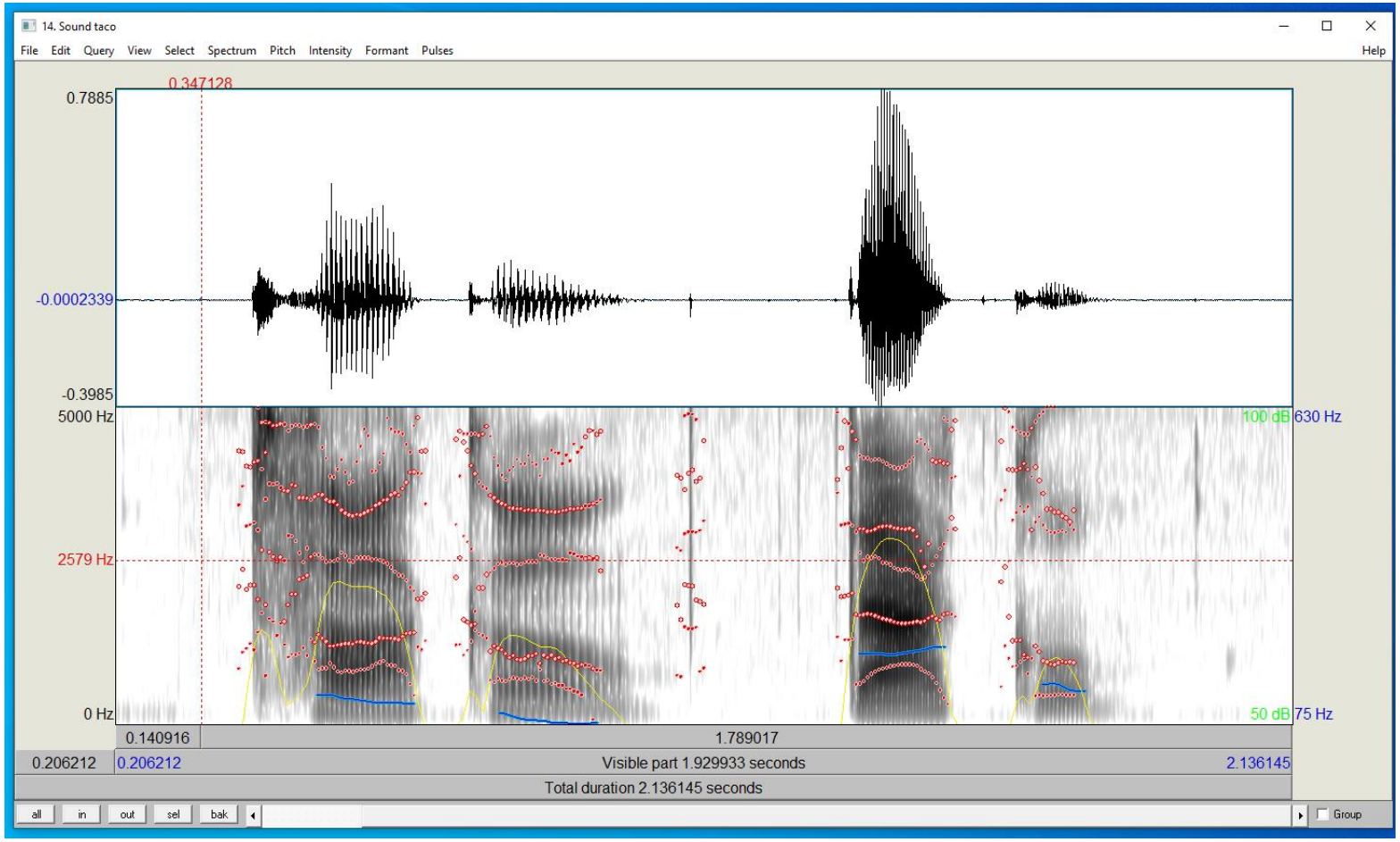
Spectrogram
X axis...Time
Y axis...Frequency

Degree of shades = amplitudes of that frequency bands

From left: view entire sound, zoom in, zoom out, zoom in to highlighted section, undo

STEP 1: Record or Import a Sound

3. View Sound



Short cuts to see&hear sounds:

Tab --> play
Click & Drag --> select a part of sound
Ctrl + N --> zoom into the selected sound
Ctrl + O --> zoom out

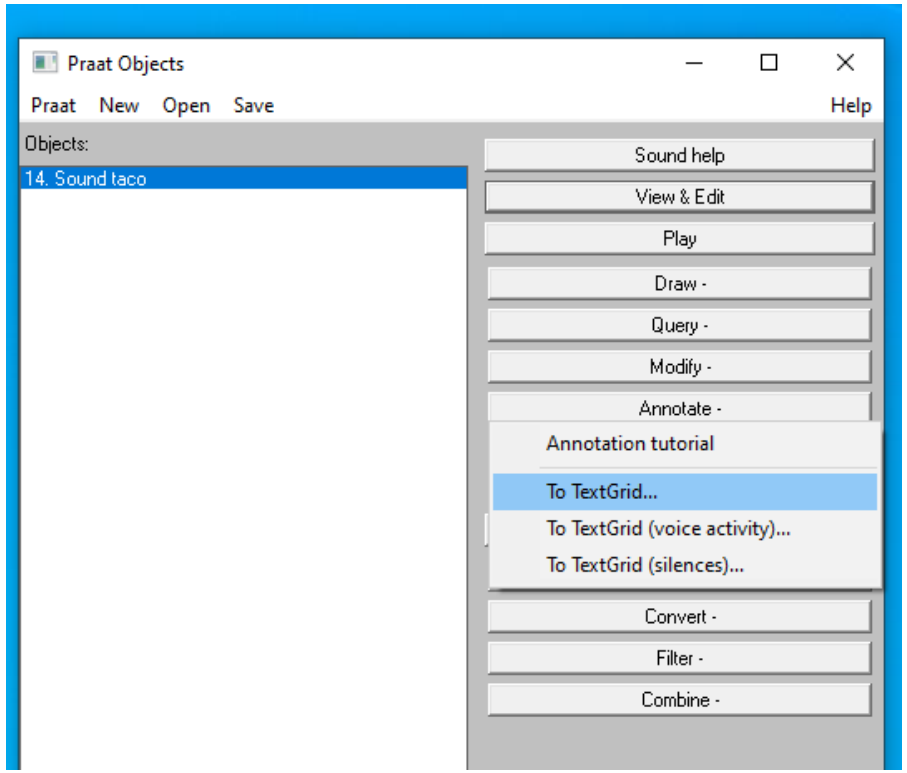
Functions to visualize the sound features:

Pitch > Show Pitch ==> pitch in blue
Intensity > Show Intensity
==> intensity in yellow
Formant > Show formant
==> formants in red dots

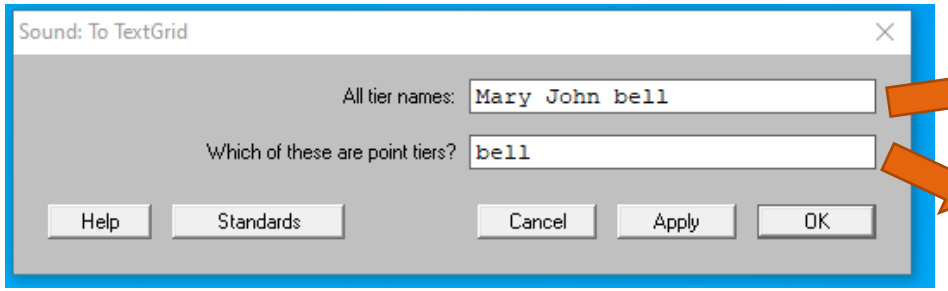
STEP 2: Make a TextGrid

1. Back to Object window

(1) Select your Sound object > Annotate (right column) > To TextGrid...

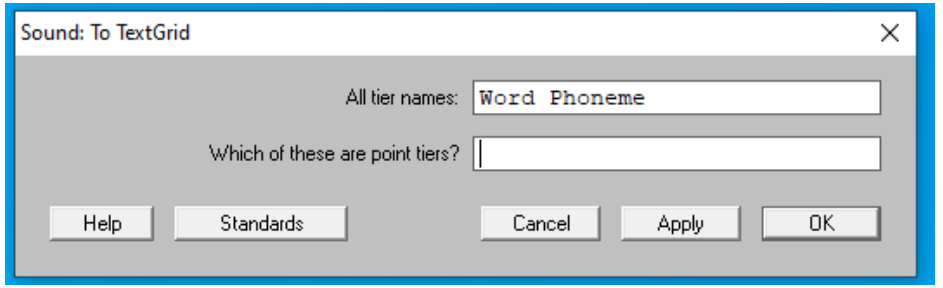


(2) Change this Pop up window's content and Click OK



"How many tiers do you want? And what are their names?"

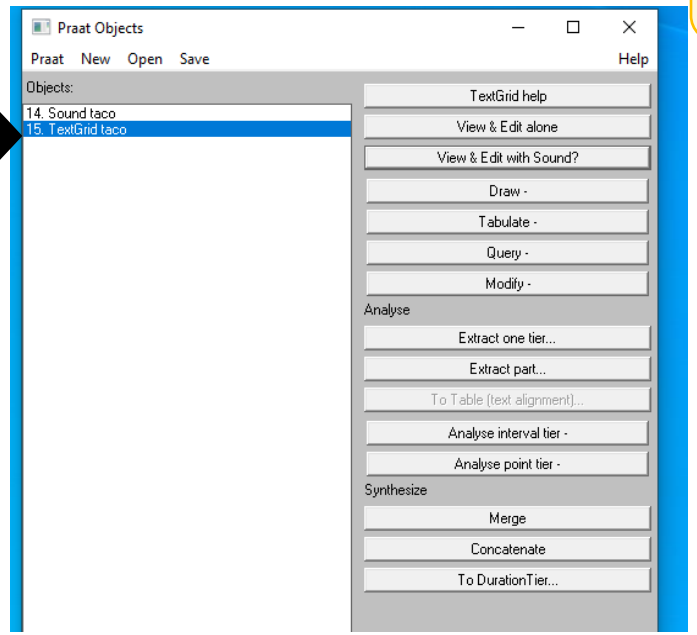
"Among your tiers you just told me, which ones are 'point tier' type? The rest will be the 'interval tiers'!"



STEP 2: Make a TextGrid

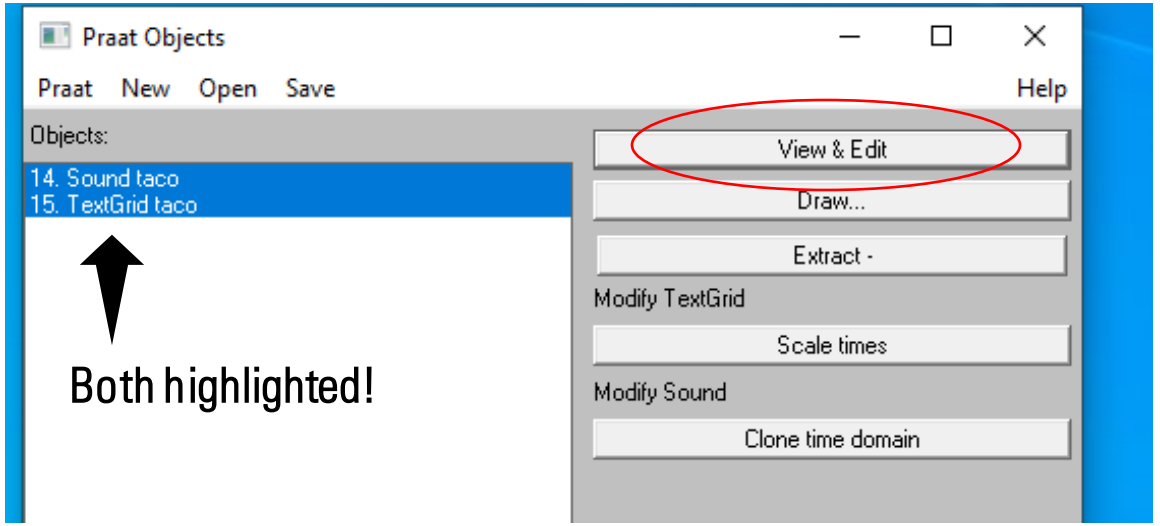
2. View the Sound with TextGrid

You just made this new TextGrid object!!



Now, keep pressing on the Ctrl key
--> Select the Sound object

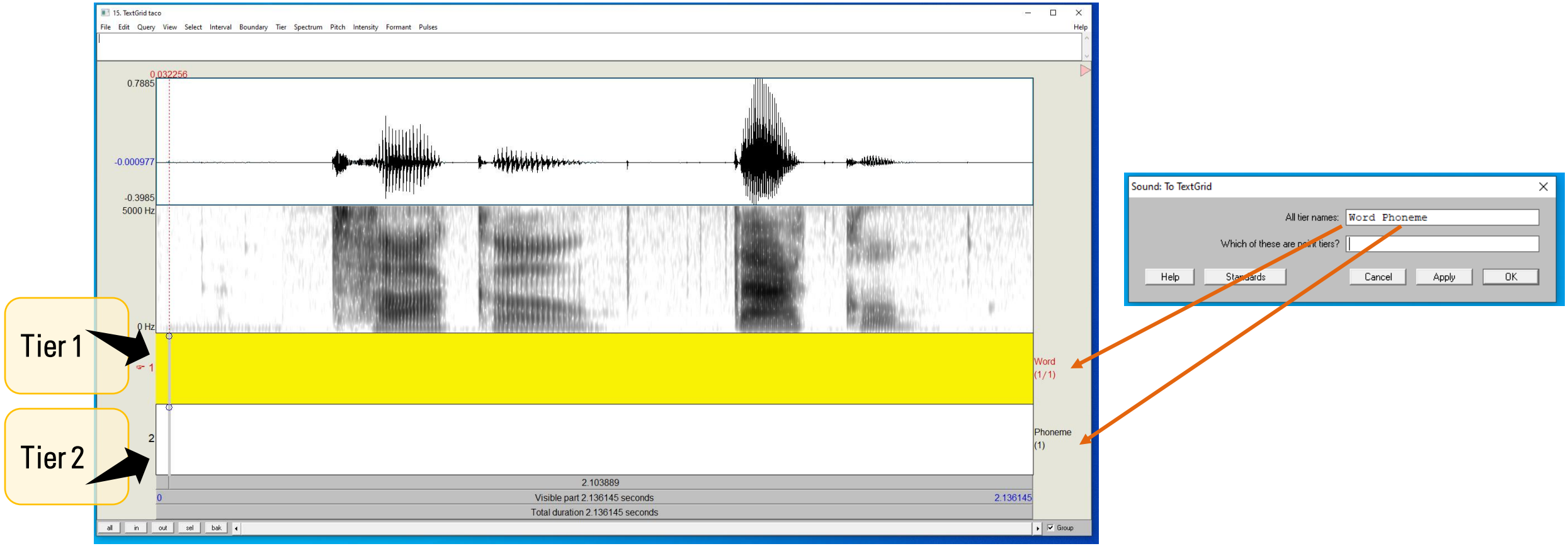
Then, Click on " View & Edit"



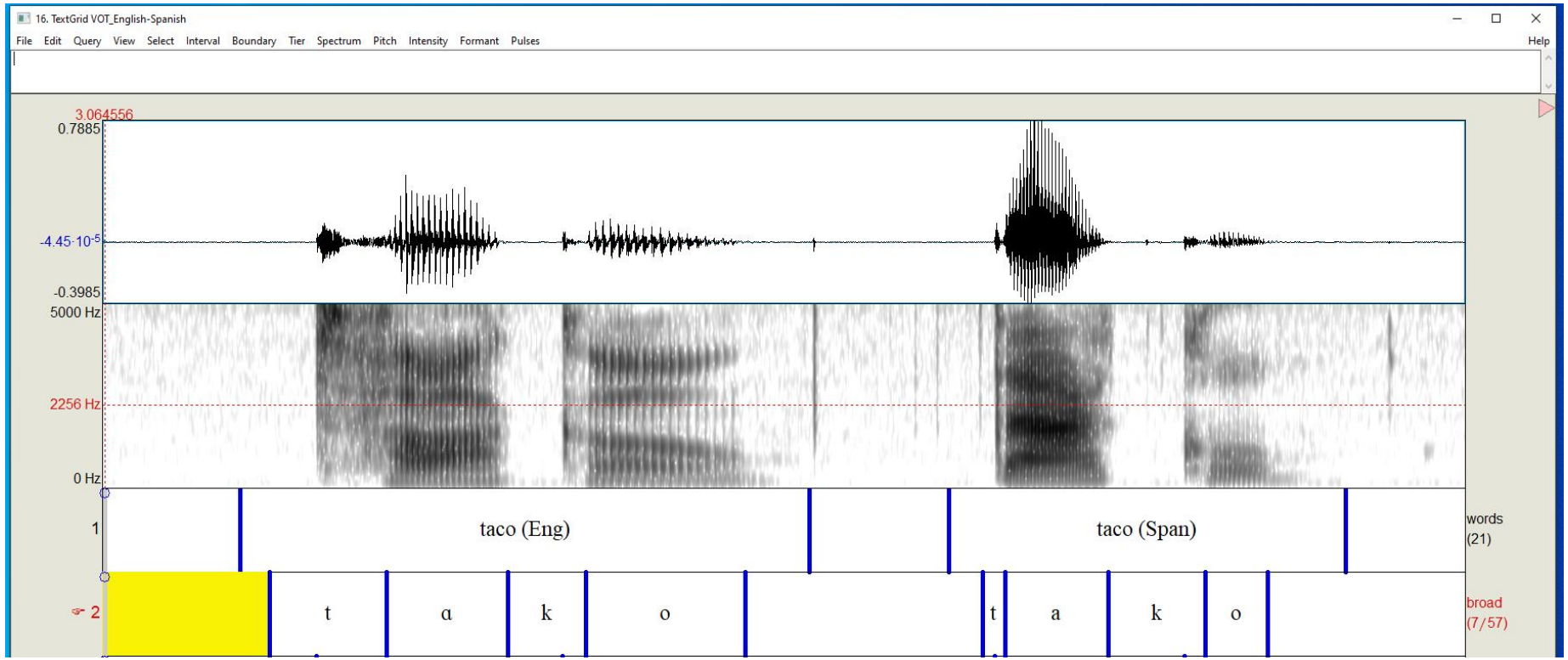
Both highlighted!

STEP 2: Make a TextGrid

3. Let's Understand Tiers



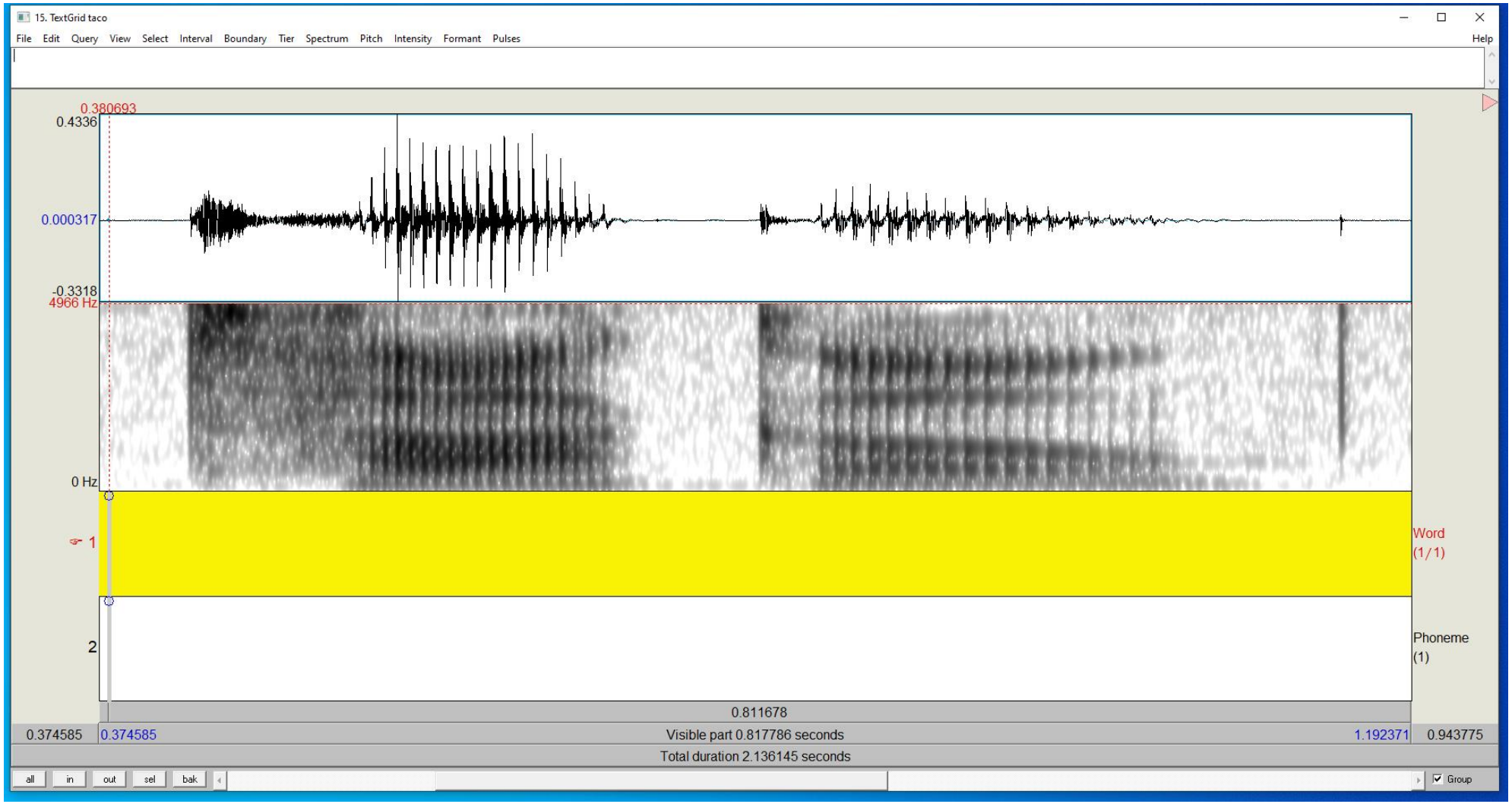
STEP 2: Make a TextGrid



We are trying to make something like this!

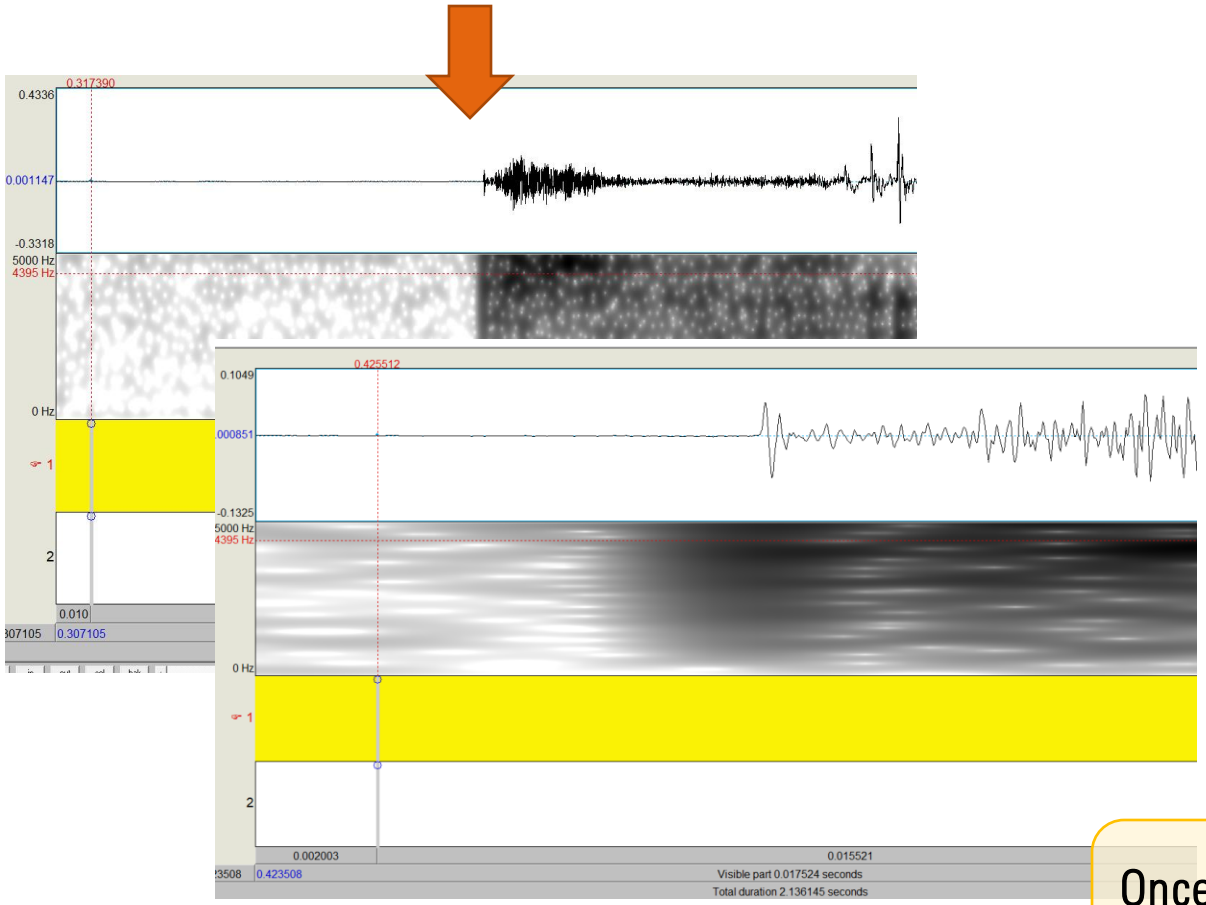
STEP 3: Analyze the Sound

1. Let's Look at English Taco



STEP 3: Analyze the Sound

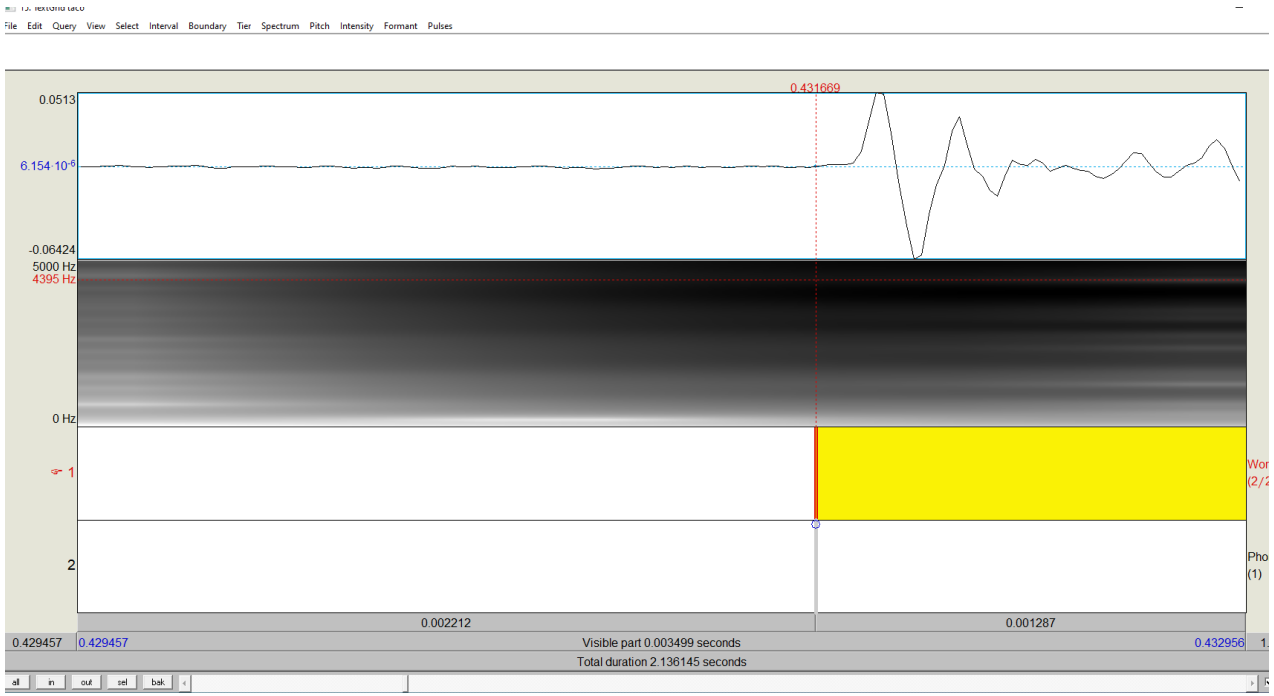
2. Segment by word! (word onset)



Select > Move Cursor to nearest zero crossing

↓

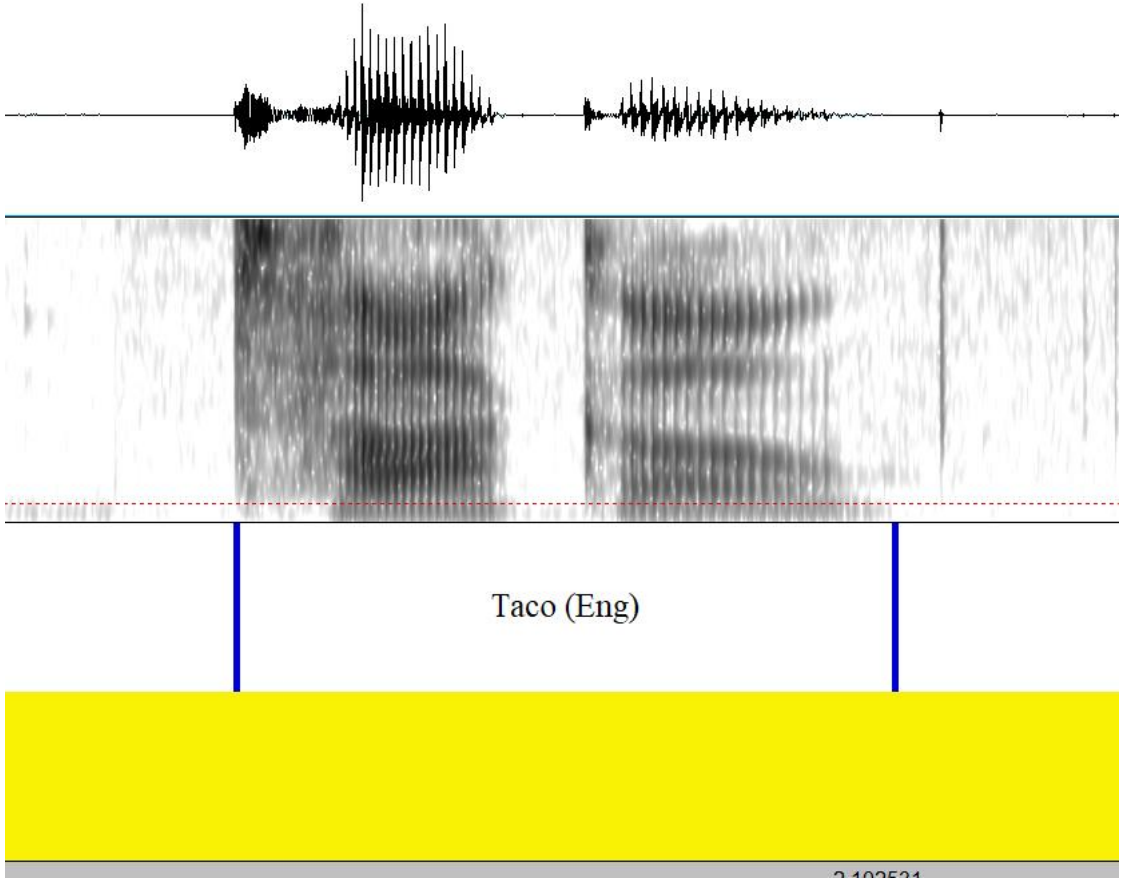
Click on the little blue circle on Tier 1 --> boundary made! (in red)



Once done, do the same for the word final boundary
(Tips: Look at where the wave pattern ends)

STEP 3: Analyze the Sound

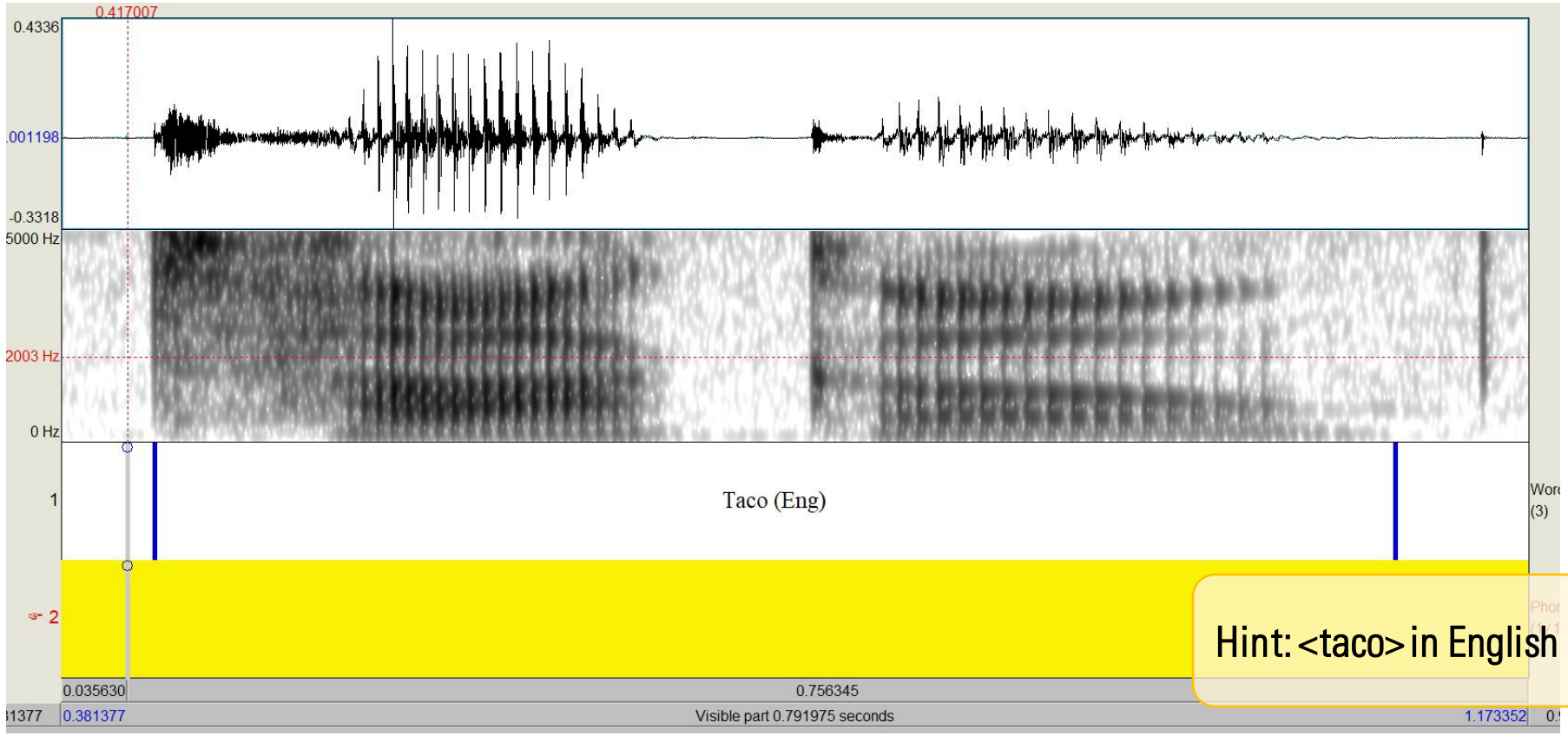
3. Label it!



STEP 3: Analyze the Sound

4. Segment by Phoneme!

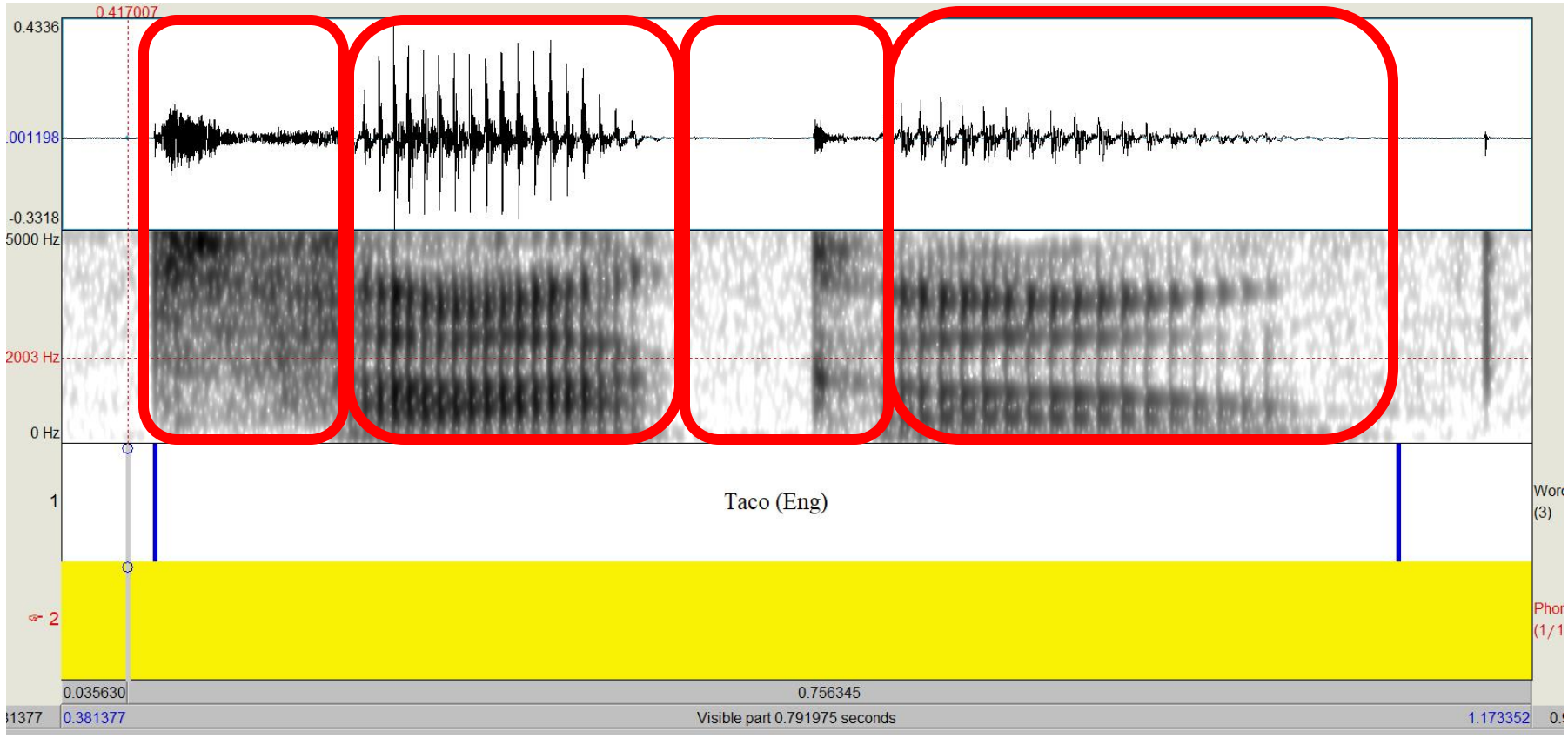
Do you see any patterns in the spectrogram?



Hint: <taco> in English is transcribed as **/takoʊ/**

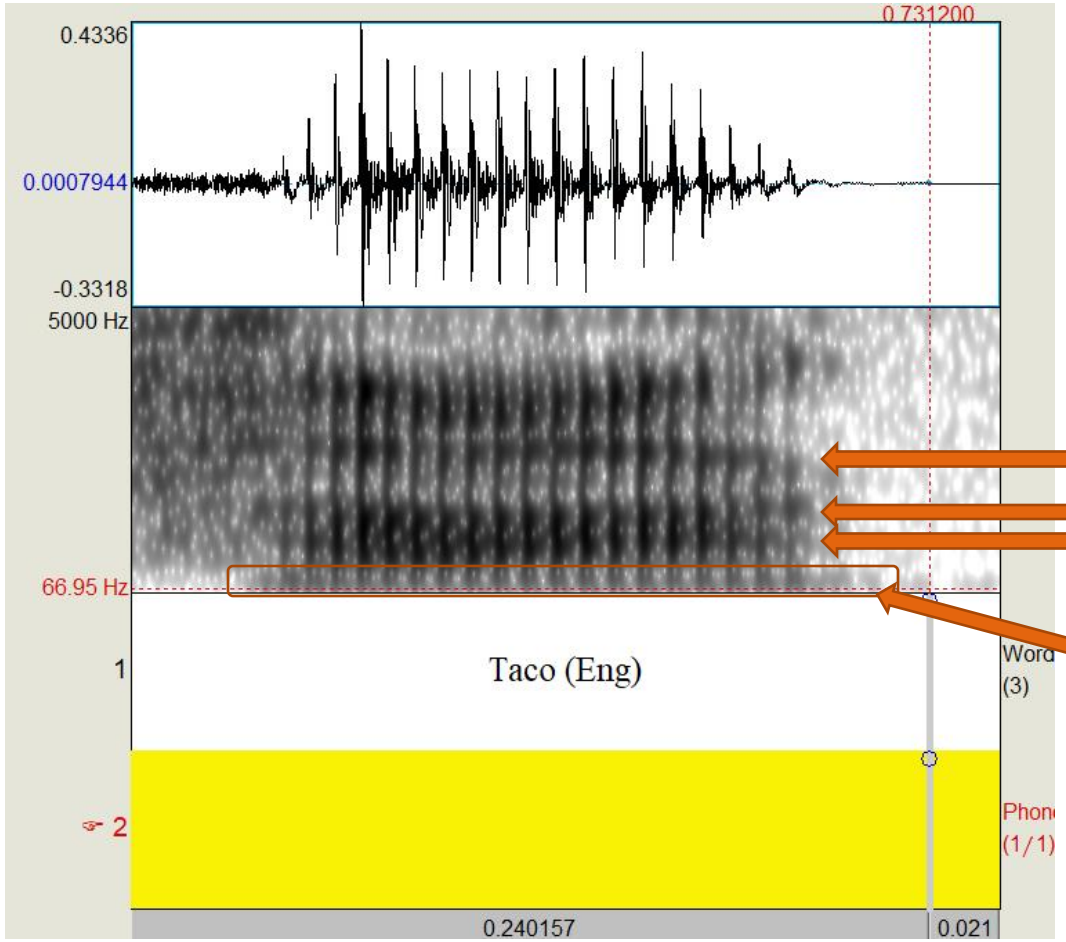
STEP 3: Analyze the Sound

4. Segment by Phoneme!



STEP 3: Analyze the Sound

5. Vowels in Spectrogram



- Relatively Larger amplitude and longer duration than consonants
- Clear Formants in spectrogram
- Clear periodicity in waveform

F3 (Roundness)?

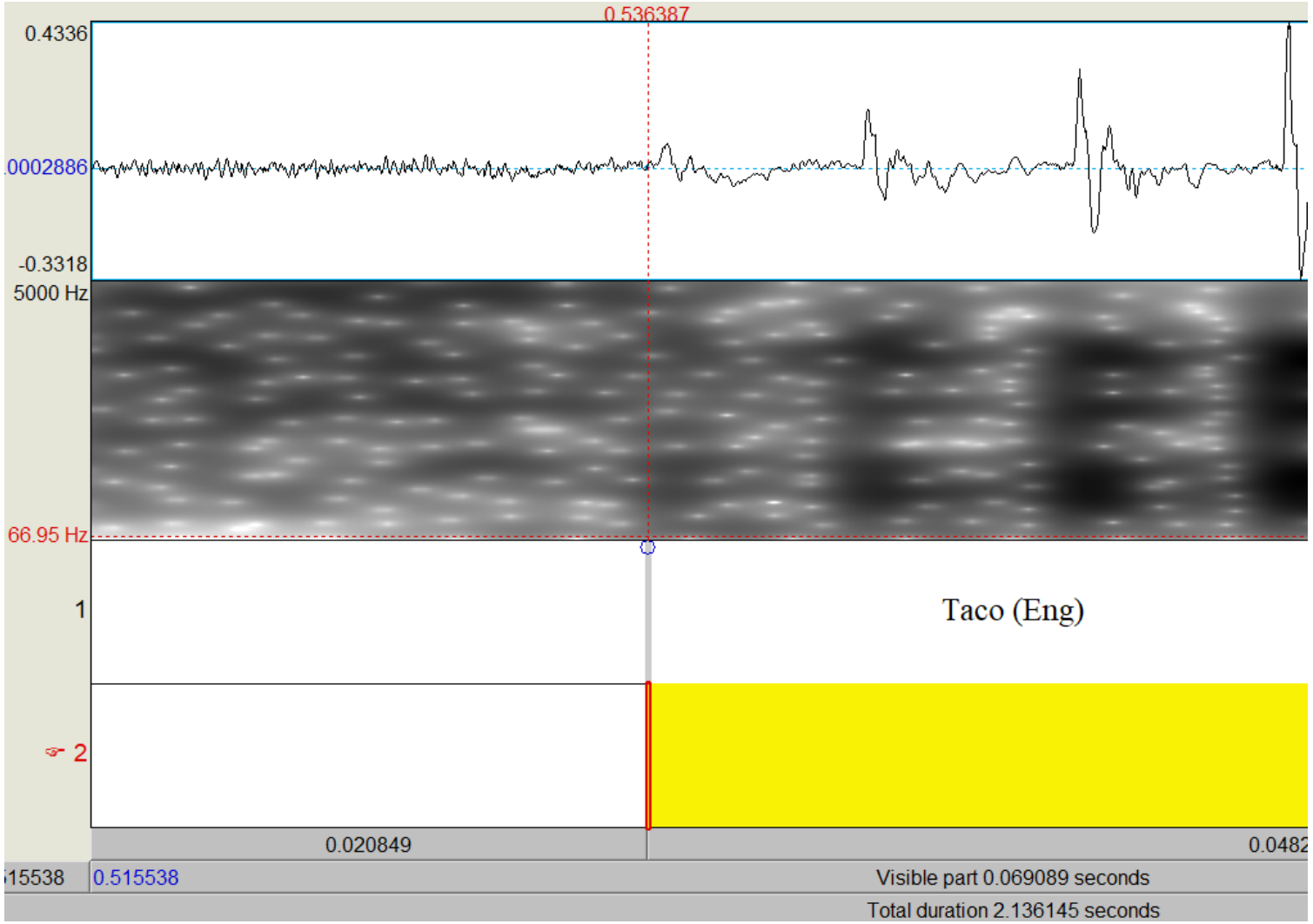
F2 (Front/Backness)...high F2 = more front

F1 (High/Low or Close/Open)...high F1 = Lower or more Closed

F0 (Voicedness). Also called "Voice Bar"

STEP 3: Analyze the Sound

6. Mark the vowels for taco

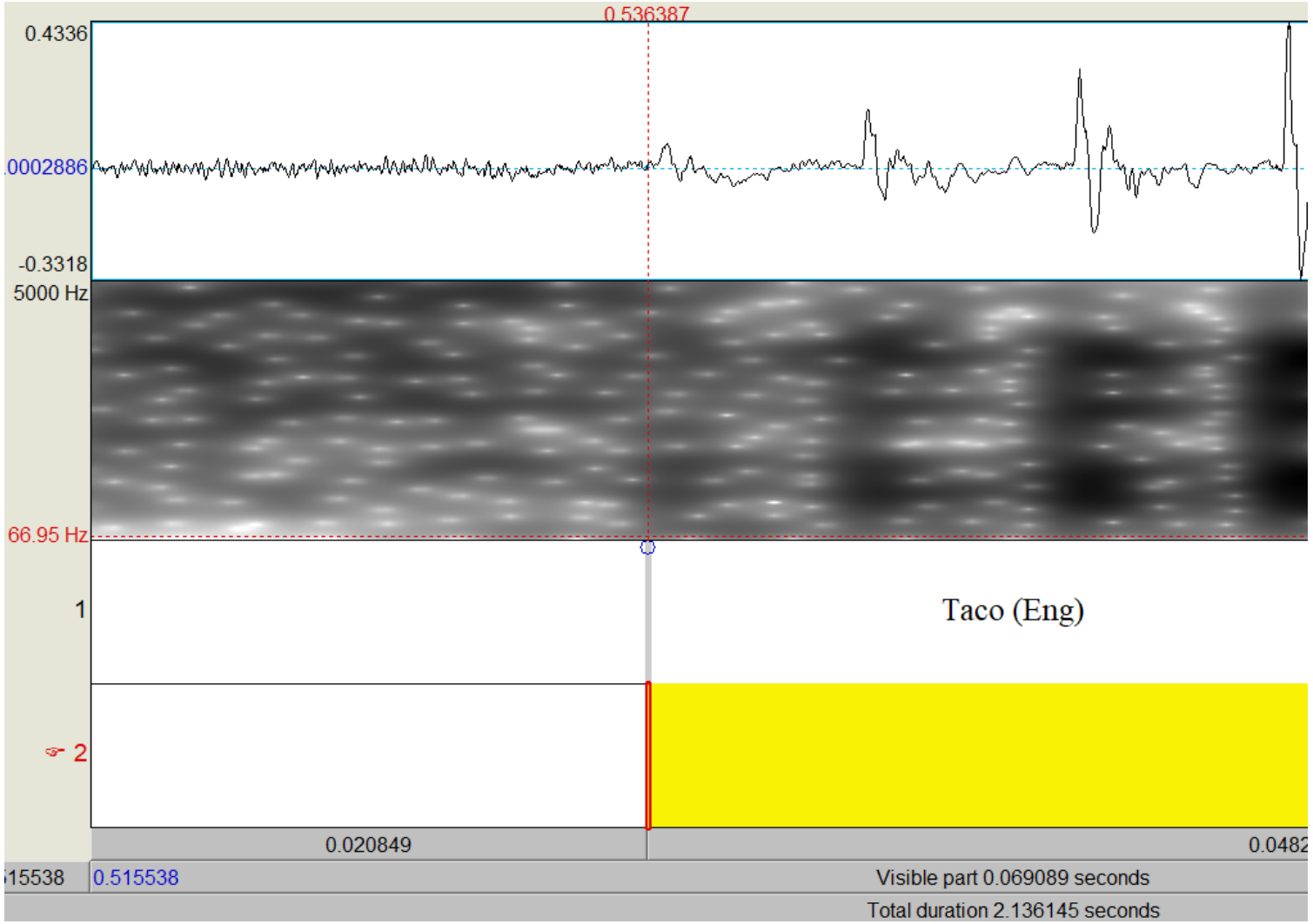


Zoom in and make a boundary at where the vowel's sound wave pattern starts. (On Tier2)

--> try the same for vowel ending

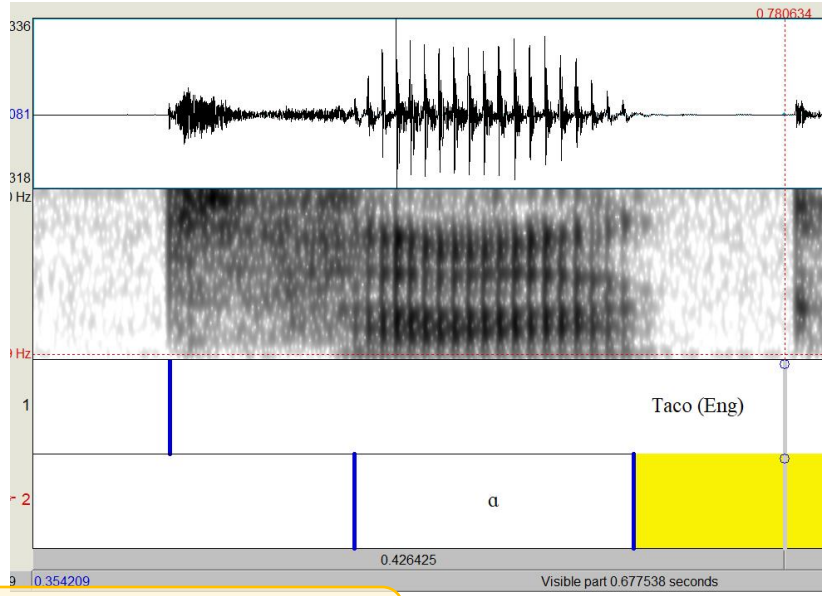
STEP 3: Analyze the Sound

6. Mark the vowels for taco



Zoom in and make a boundary at where the vowel's sound wave pattern starts. (On Tier2)

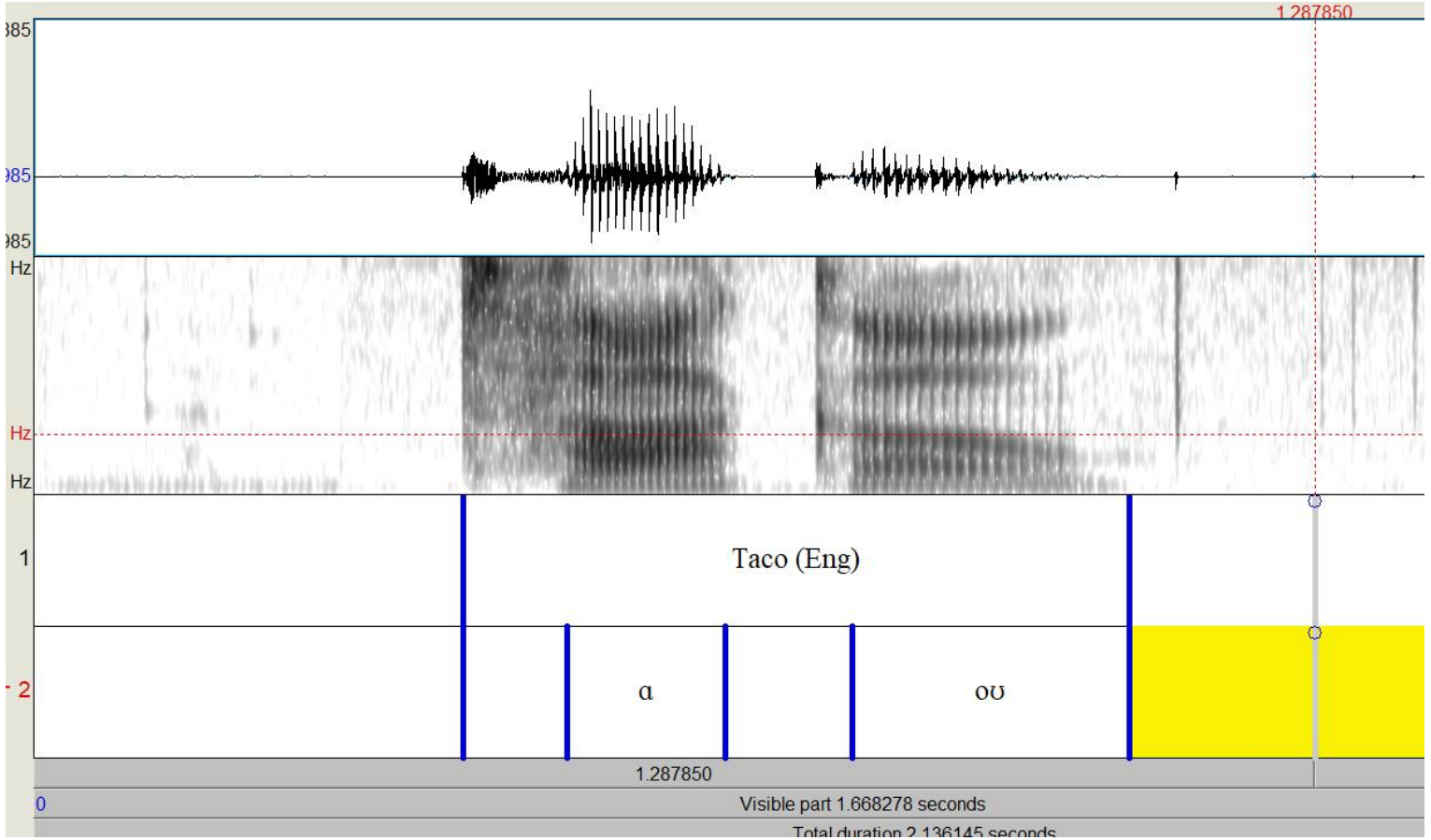
--> try the same for vowel ending
--> label as [ɑ]



Next, try this for **[oʊ]!!**

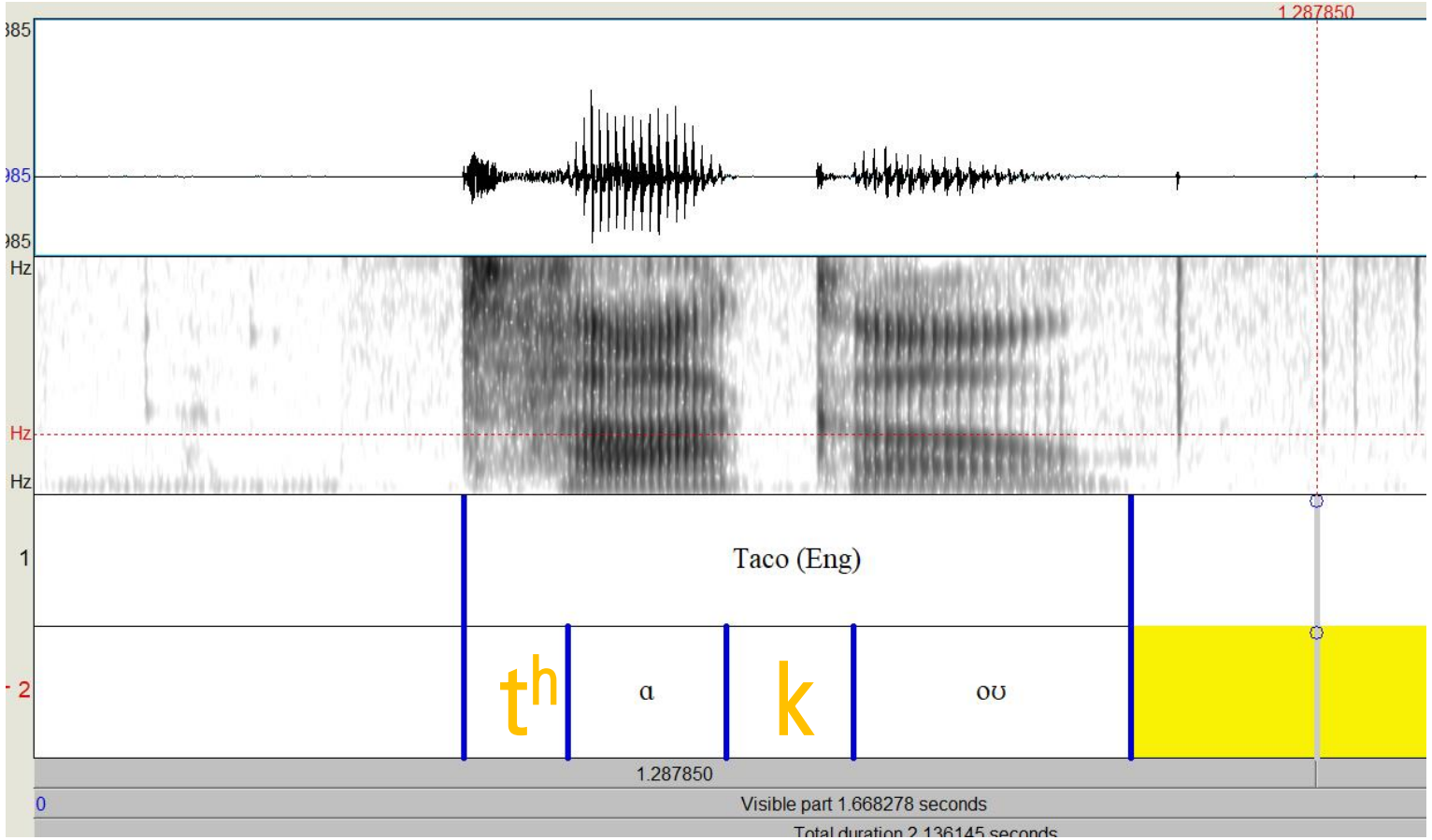
STEP 3: Analyze the Sound

6. Mark the vowels for taco



STEP 3: Analyze the Sound

7. Mark the Consonants for taco



STEP 3: Analyze the Sound

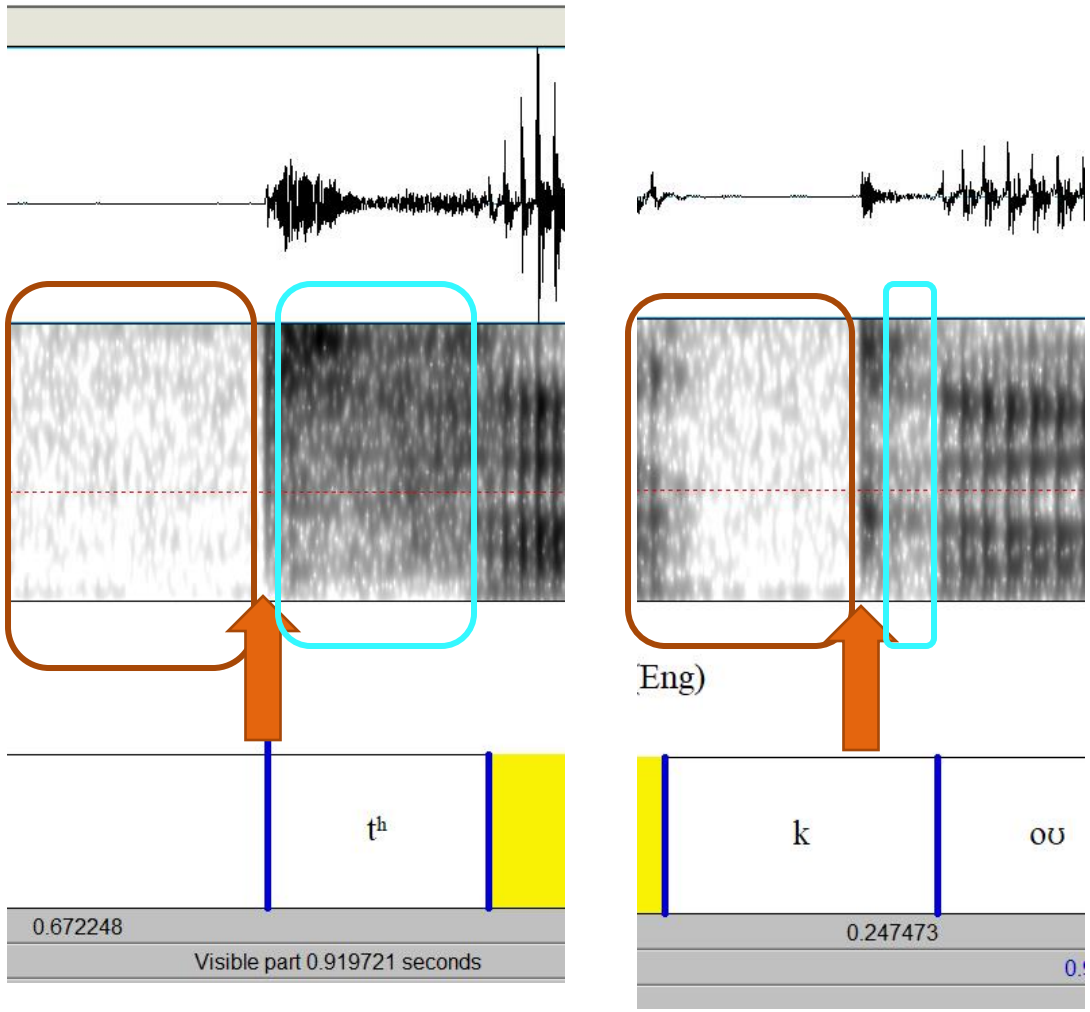
8. Stop Consonants in Spectrogram

Stops can consist of 3 components

...Closure (where you are making a closure in your vocal cavity with tongue and mouth ceiling and prepping for the burst of air)

...Burst (you open the closure to creat the burst of air)

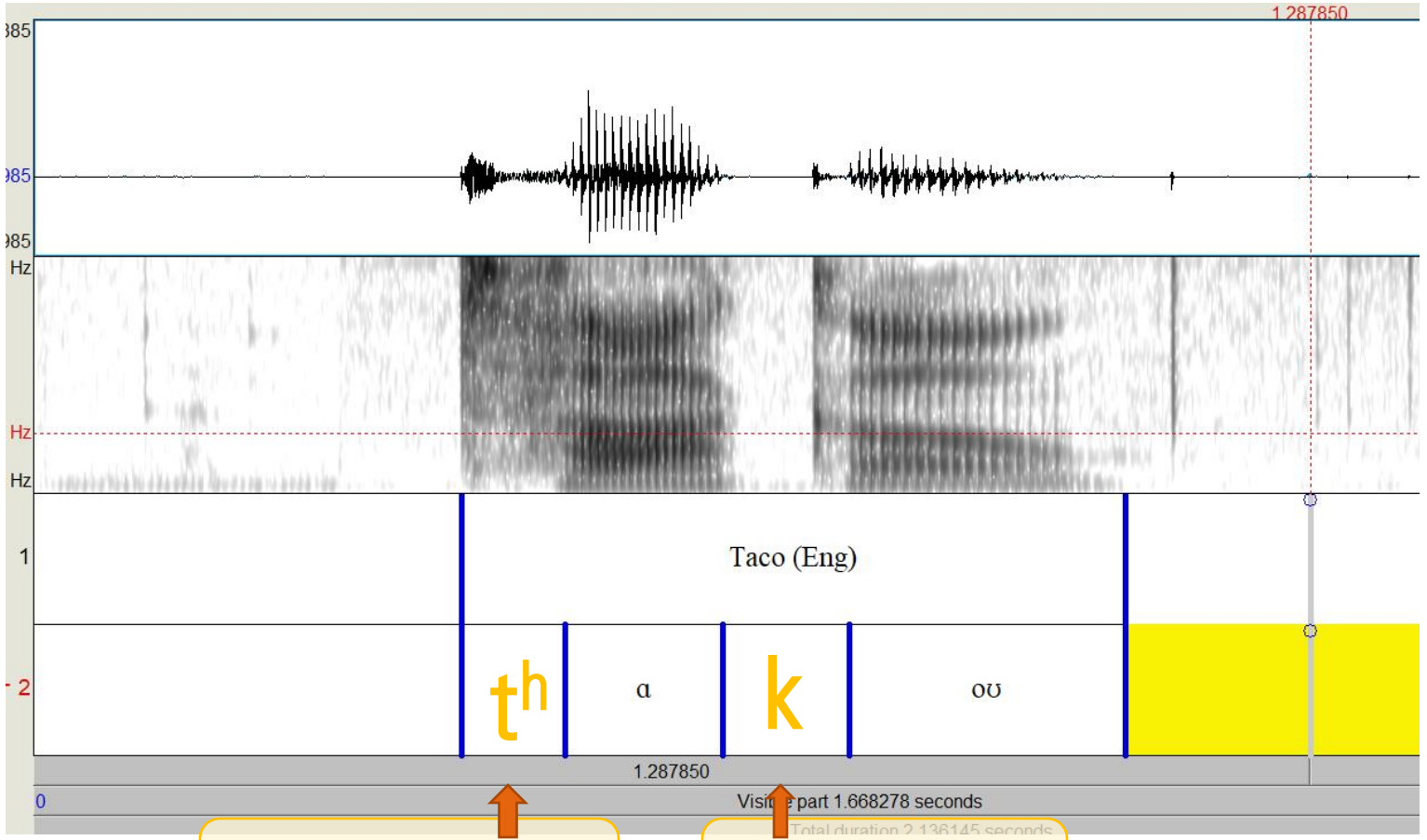
...aspiration (optional; you let the air flow before you go to the next phoneme)



Also, check the voice bar for the voicedness ([t] and [k] are both voiceless)

STEP 3: Analyze the Sound

9. Mark the consonants for taco ---decide the standard depending on your goal



In this segmentation:

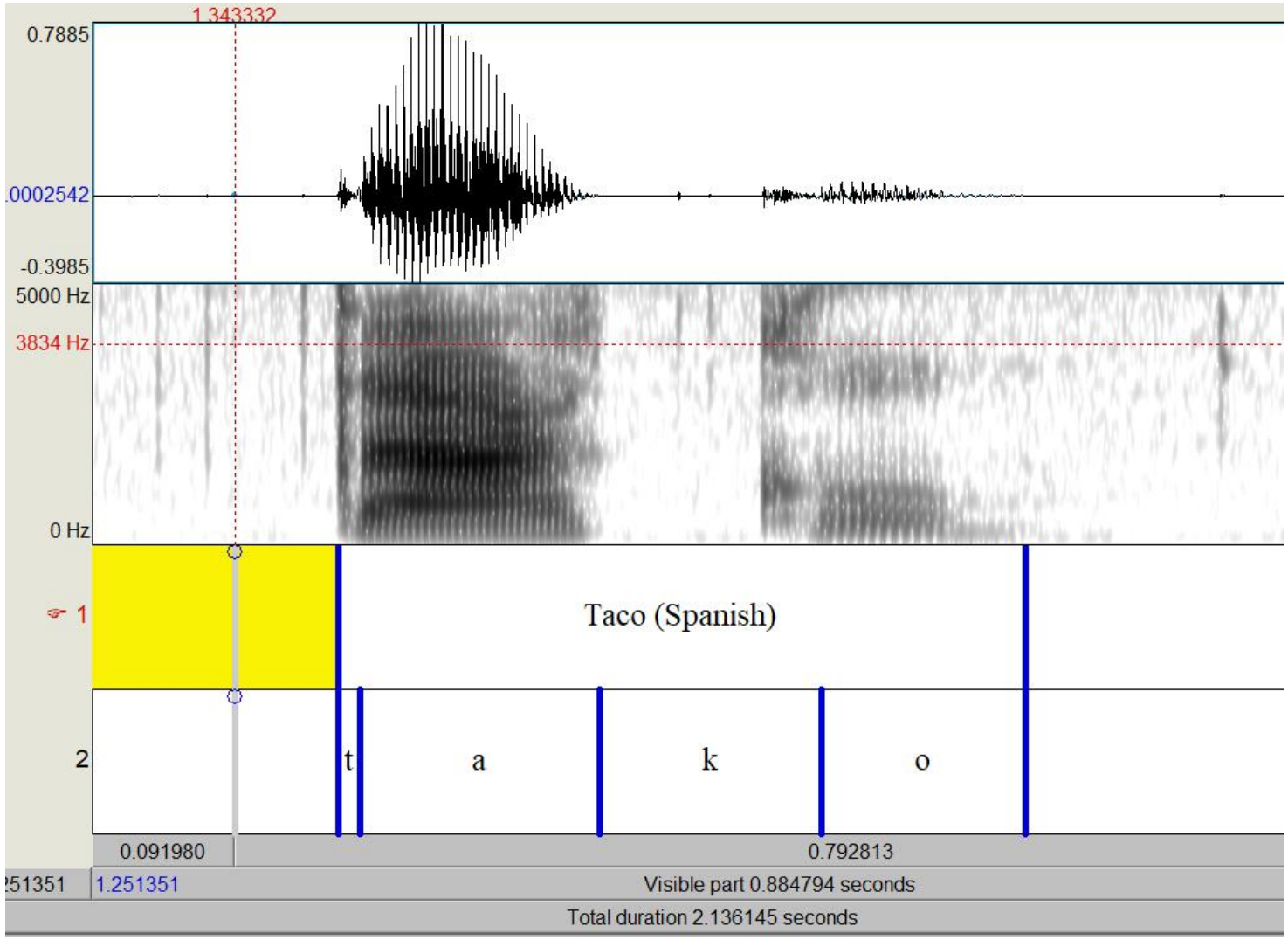
NOT Includes closure

Includes closure

Next let's try for Spanish Taco!
Hint: [tako]

STEP 3: Analyze the Sound

10. Spanish taco



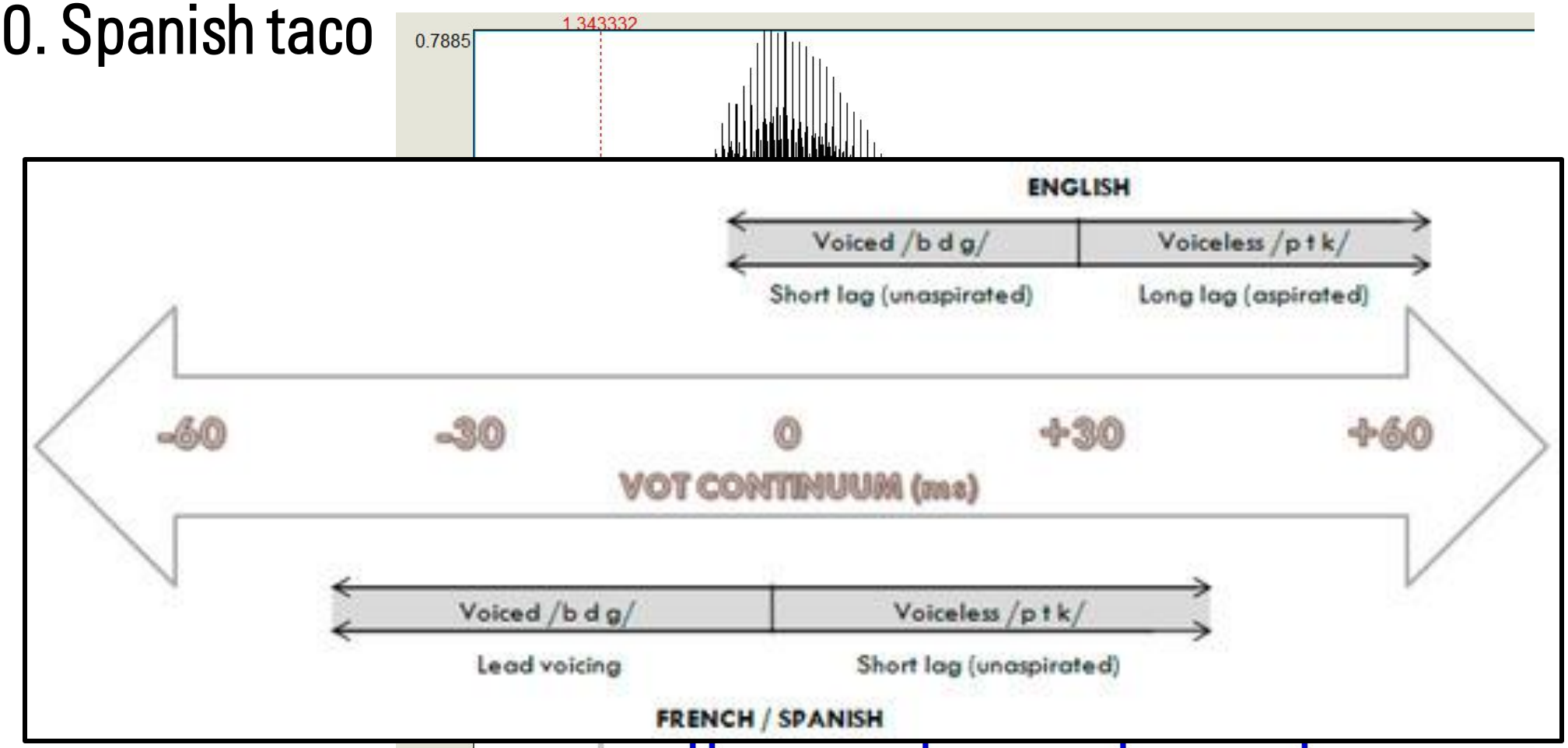
You can see that word-initial [t] for the Spanish taco is not aspirated.

(Spanish stops do not get aspirated)

Also the Vowel difference: formants contour in [o] vs [**oʊ**]

STEP 3: Analyze the Sound

10. Spanish taco



You can see that word-initial [t] for the Spanish taco is not aspirated.

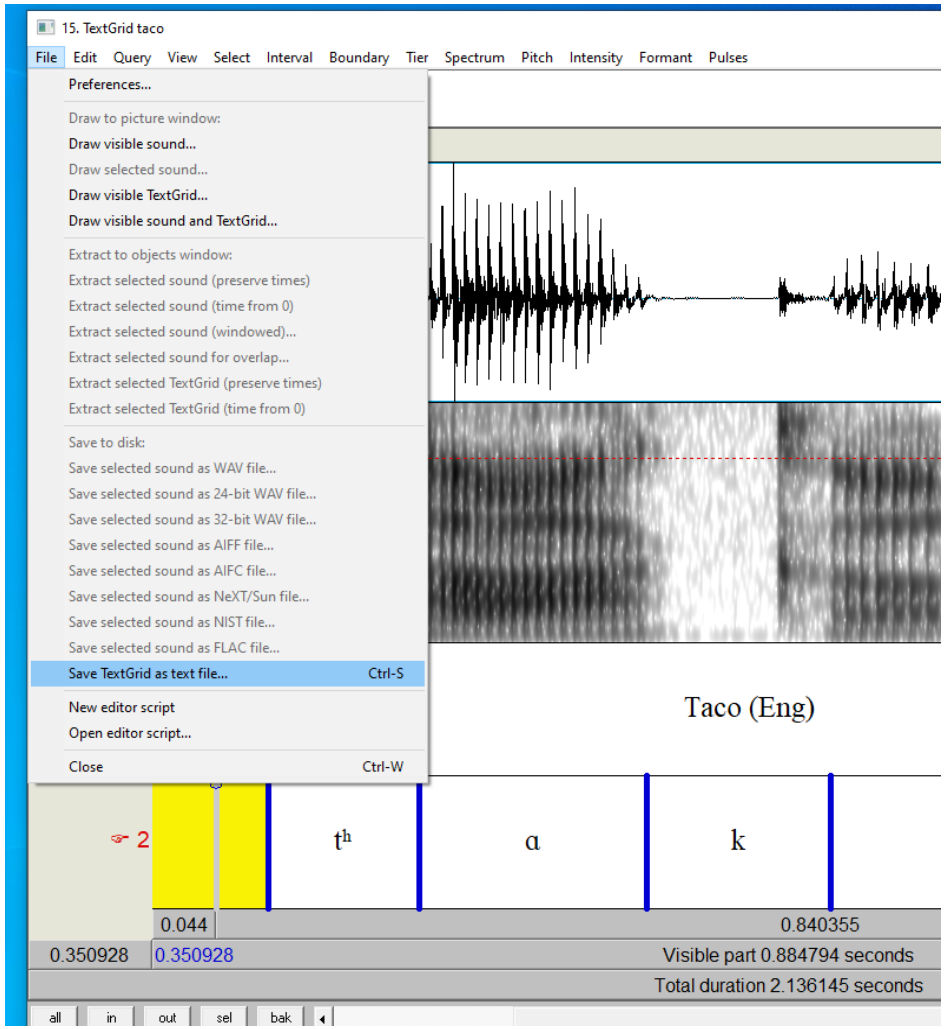
(Spanish stops do not get aspirated)

Also the Vowel difference: formants contour in [o] vs [**oʊ**]

STEP 4: Save the Sound/TextGrid/Output Data

1. Save TextGrid

Praat does not autosave, so frequently save anything you changed! (this time, just the TextGrid)



Make sure you are not choosing a specific segment of the TextGrid

Step1-4 done!
Now, let's try different things you can do with Praat!
(also, we only covered how to segment vowels and stop consonants so far, so...)

- Segmenting other phonemes
    - nasals
    - fricatives
    - approximants
    - more on vowels...formants contour changes
    - (+ alpha) Voice Quality
- Sound Manipulation
    - Change pitch, intensity, and duration
    - filtering
- Getting graphics
- Getting acoustic data

MENU!!

Nasals

- In English, [m, n, ŋ] are the nasal consonants (narrow transcription might include mŋ, as in <inform>)
- Nasals look like "fainted" vowels; some formants structures exist, but lower amplitude than vowels
- cannot really distinguish just from its shades. --> look at transitions to&from the vowel

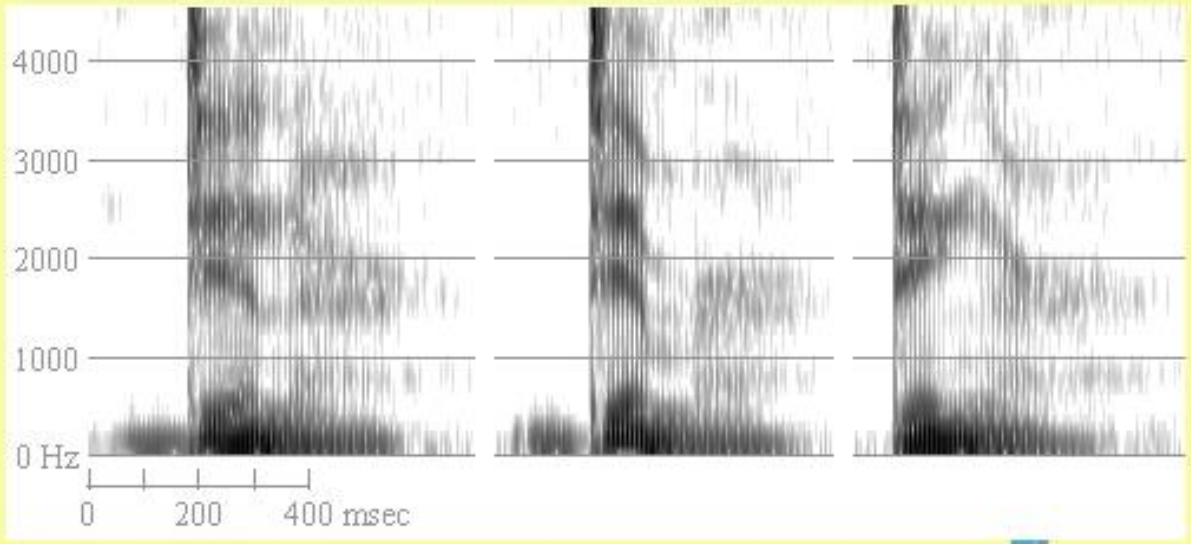
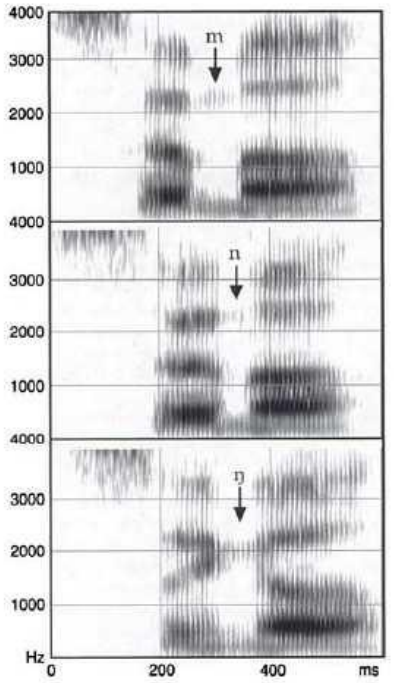


Figure 7. Spectrograms of "dinner", "dimmer", "dinger".

Formants movement before nasals are...



⟵ **[m]**: *falling* F2

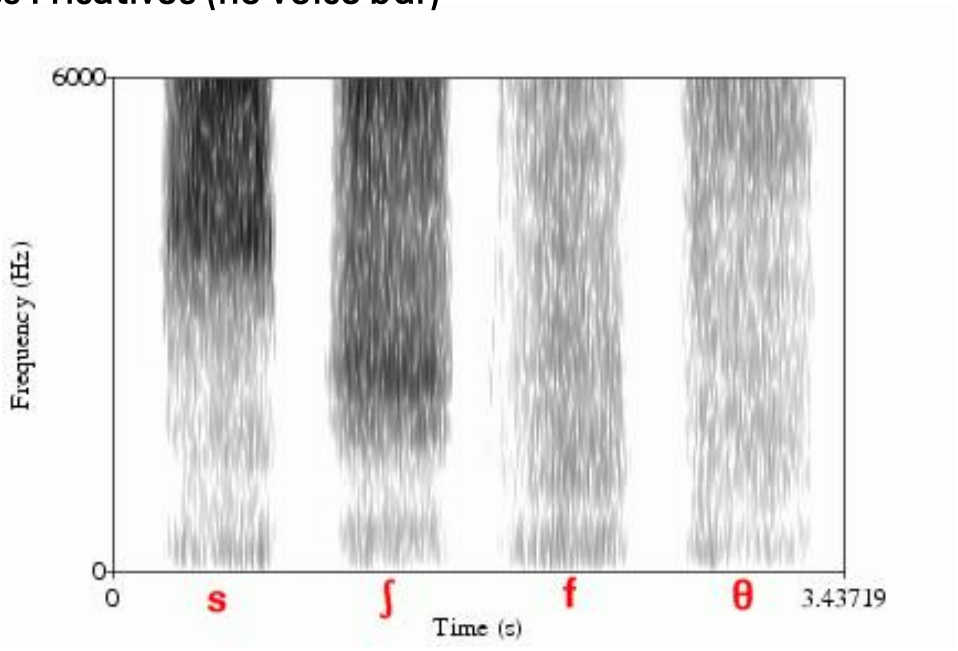
⟵ **[n]**: *level* F2

⟵ **[ŋ]**: *rising* F2

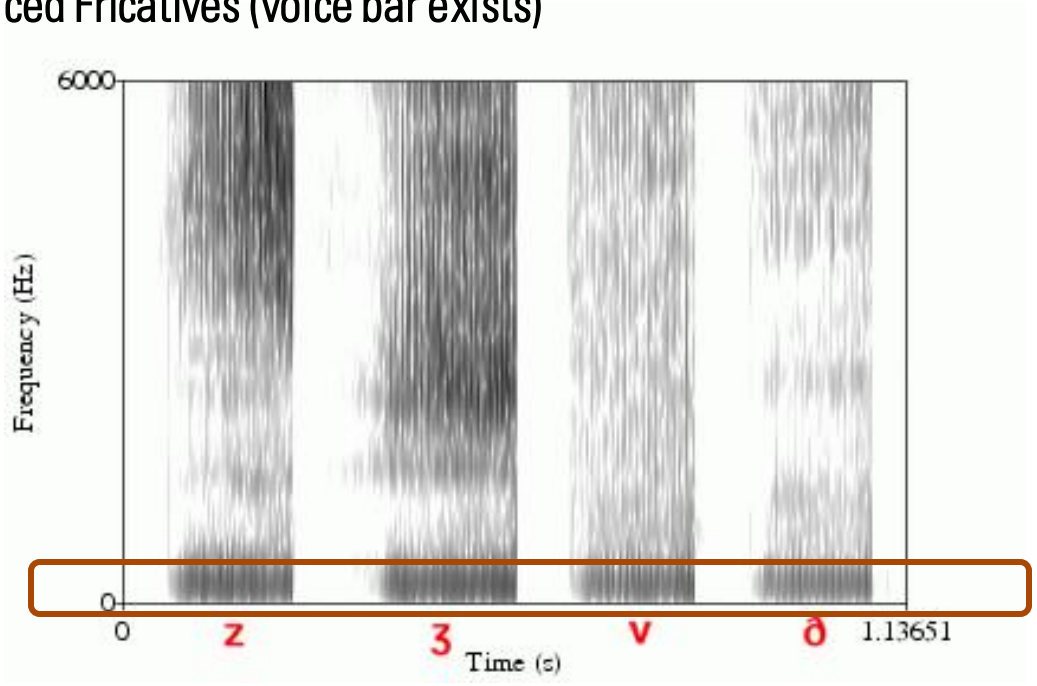
Fricatives

- you can see a very distinct pattern: the "friction" in the spectrogram at upper frequency bands (3000Hz-8000Hz)
- [s , ʃ] are the loudest fricatives. [s] is the darkest above 8000Hz. [ʃ] is the darkest around F3-F4 range and sometime no noise for 1500Hz –2000Hz
- [z, ʒ] : lesser amplitude of frication & shorter duration of frication, relative to [s , ʃ]. A voice bar is visible.
- [f , v] vs [θ , ð] are very hard to distinguish and low intensity. They may barely have noise and almost like approximants. One way is to look at transitions.

Voiceless Fricatives (no voice bar)

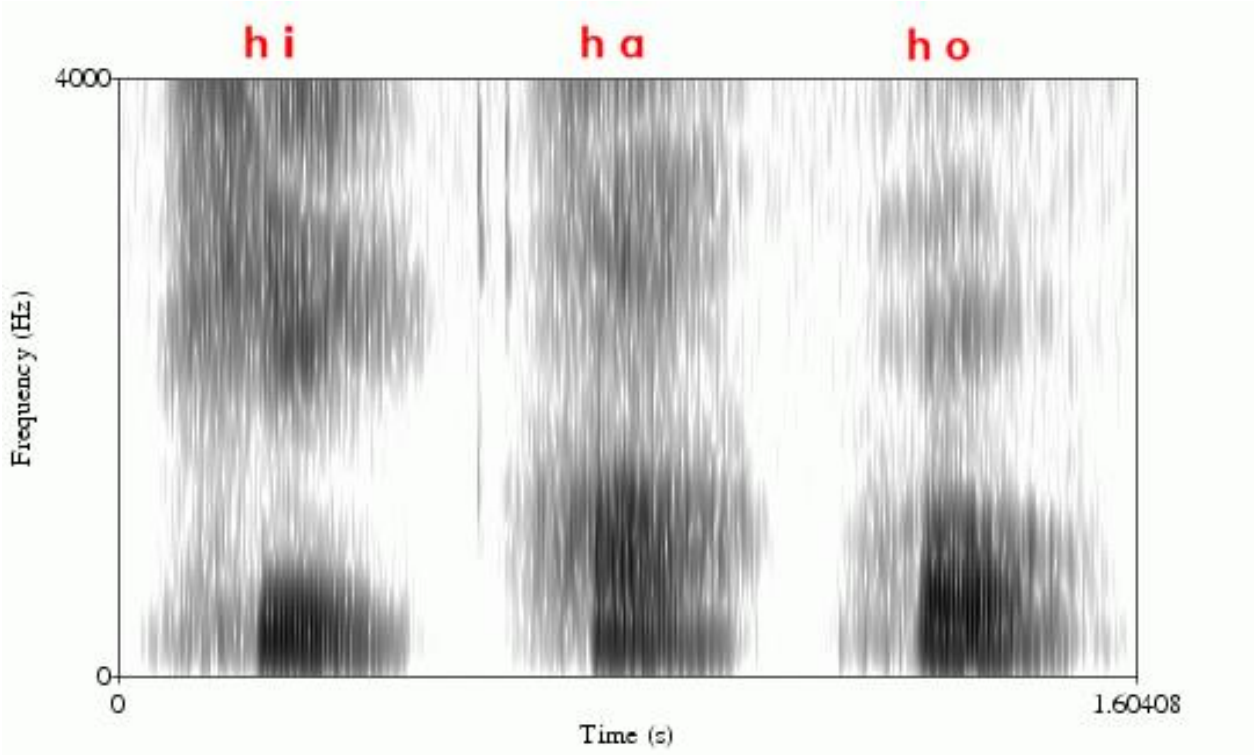


Voiced Fricatives (voice bar exists)

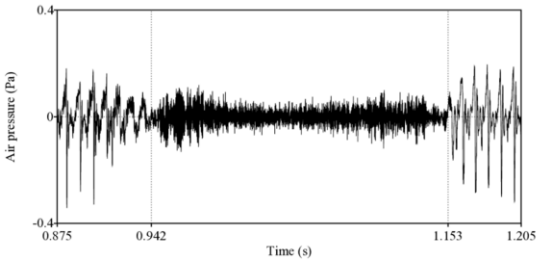


Fricatives

- [h] looks like a voiceless version of the following vowel, with the fricative quality (turbulence)
- may see the "fainted voice bar" for the word-medial [h] (in English)



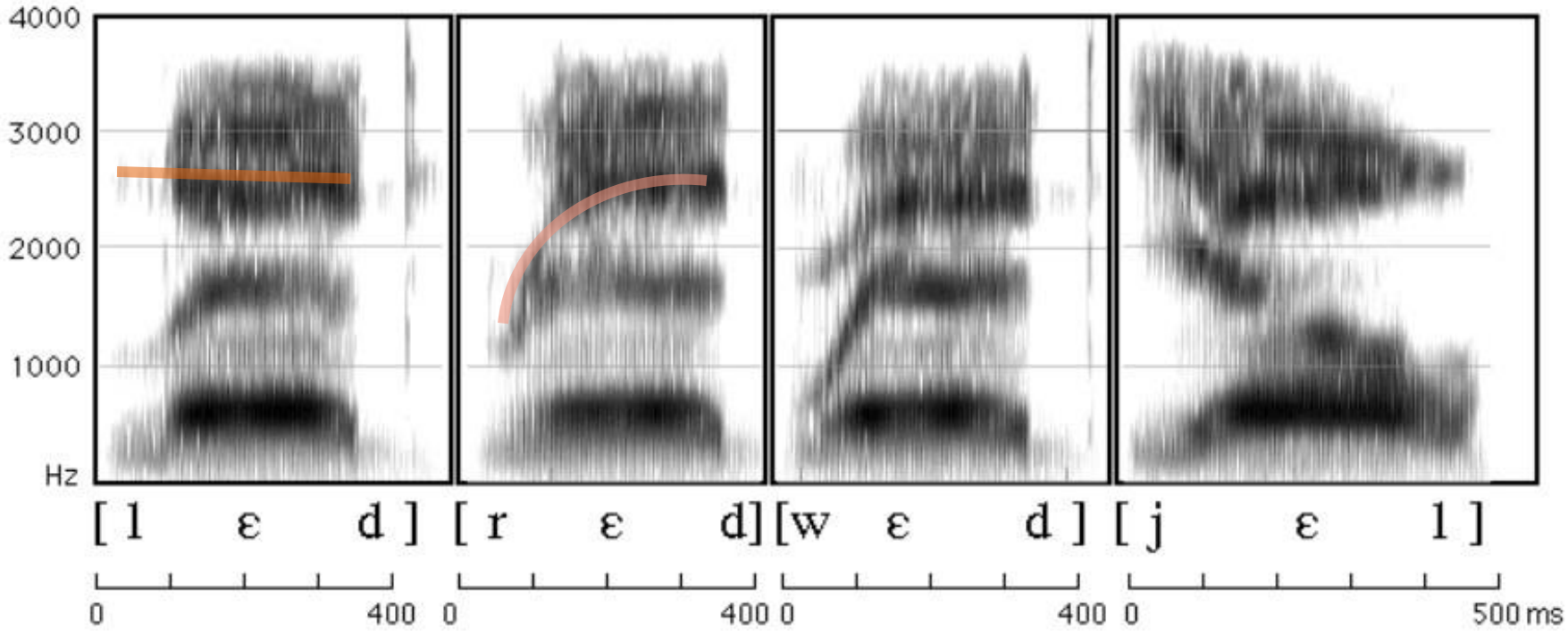
Waveform of fricatives: aperiodicity



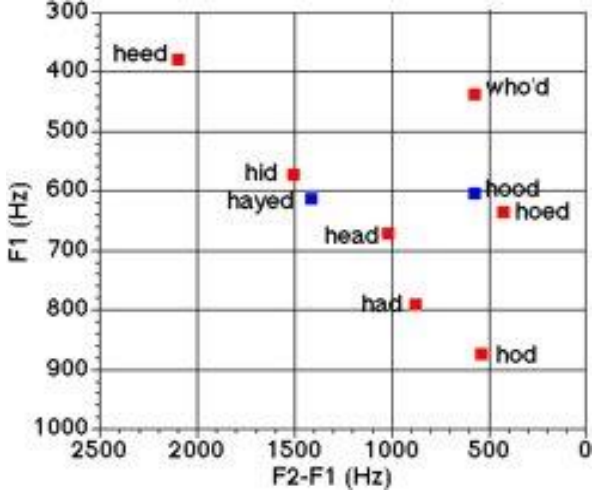
Approximants

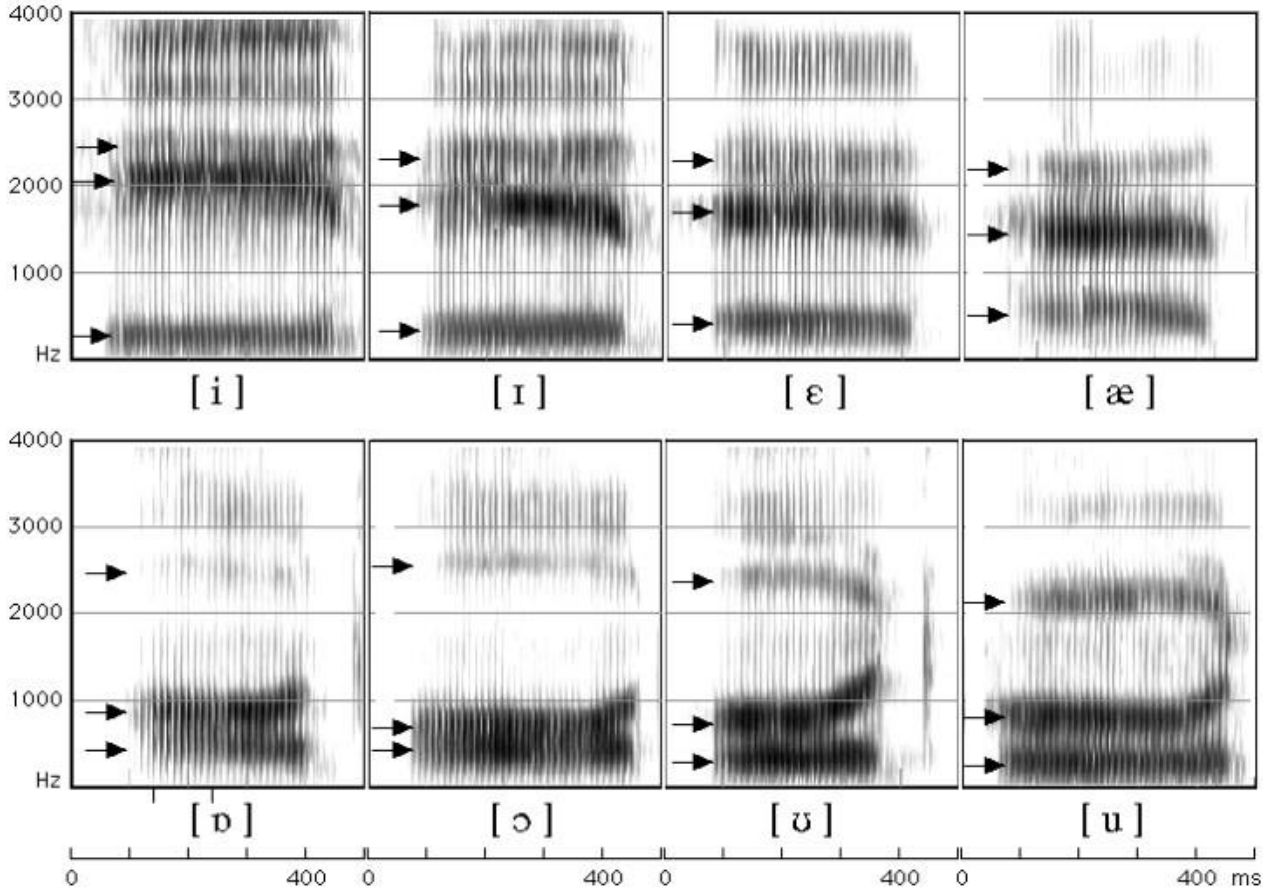
In English, there are 4 approximants: [l, r, w, j].
These are the consonants "almost like a vowel"

- rely on the formants contour of the vowel next to it
- [l]...flat line to F3 vs [ɹ]...very low to high F3

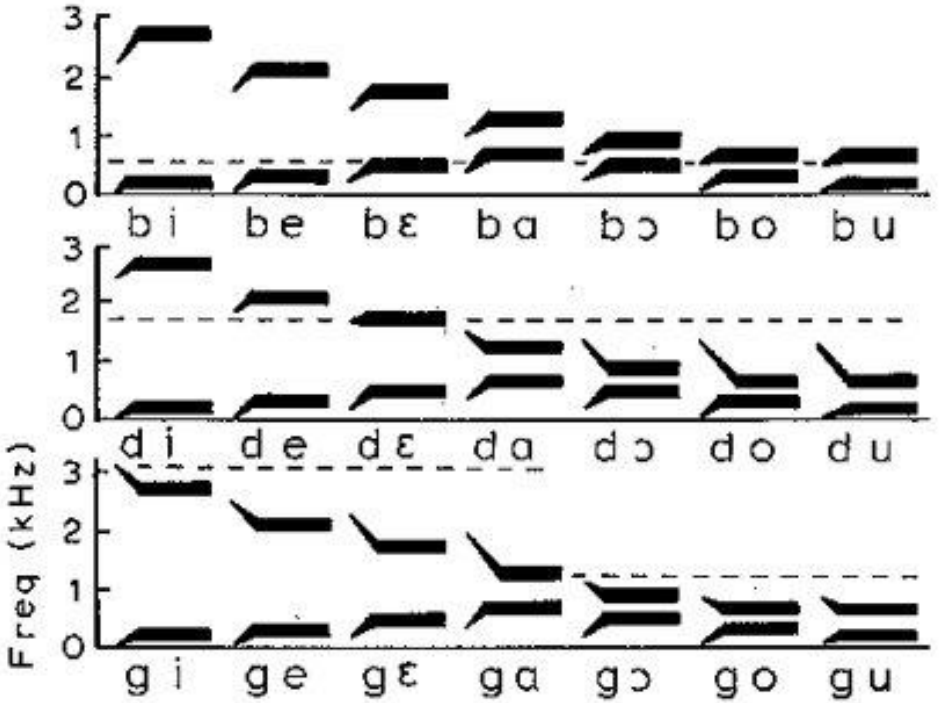


More on Vowels



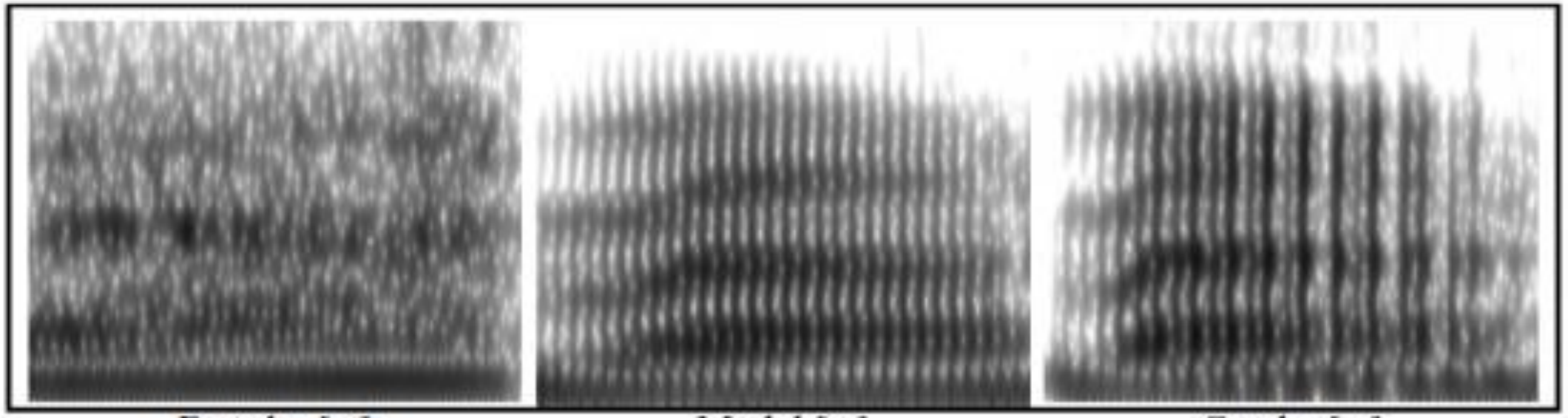


Formants change after stops:



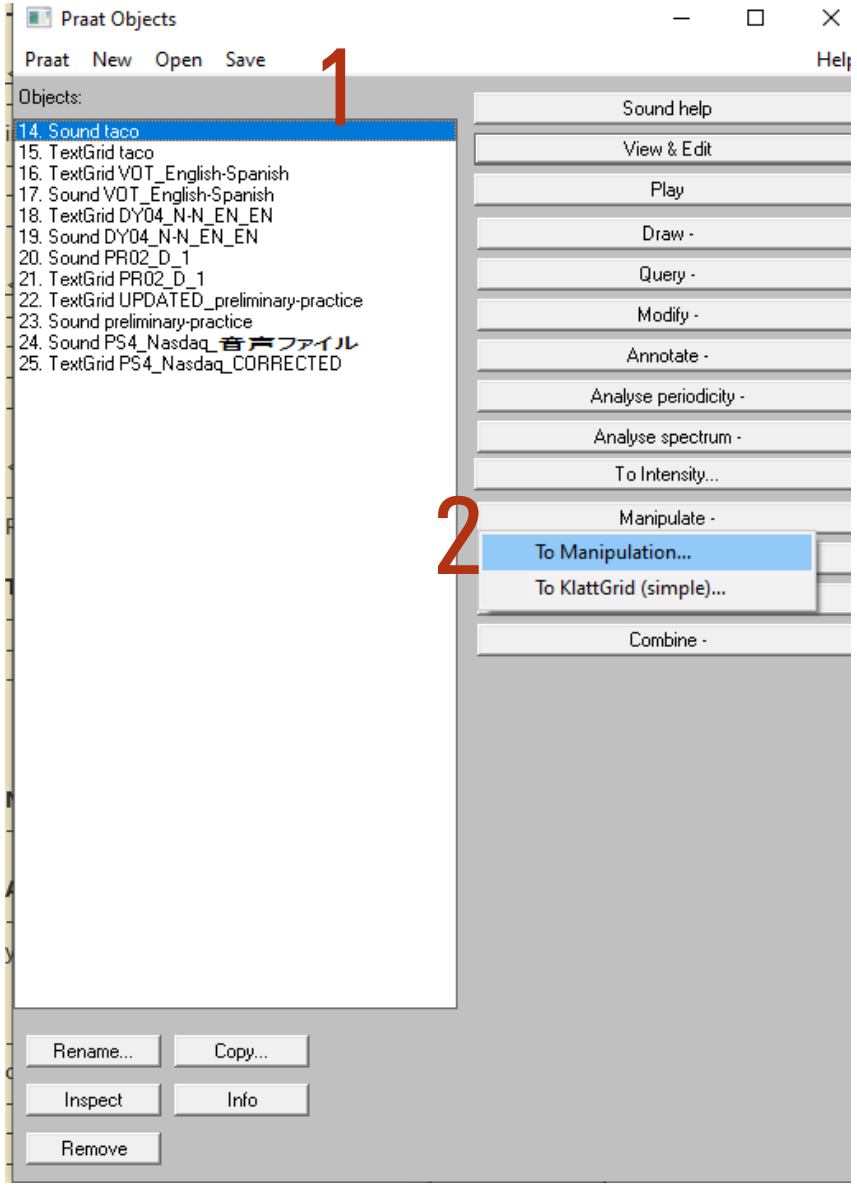
Voice Quality

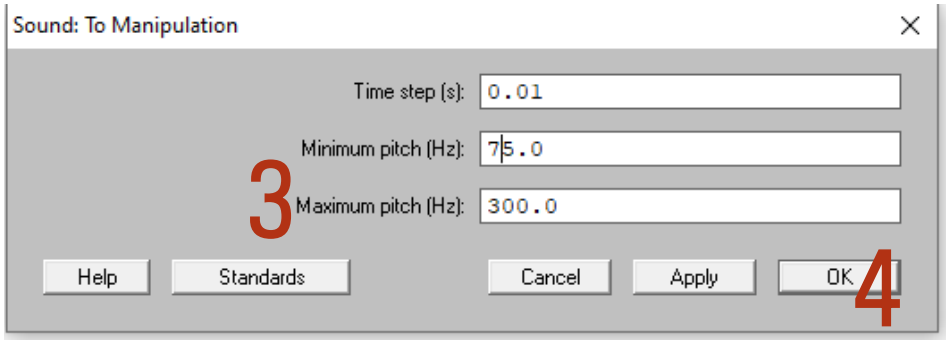
Pretty Clear from the "Pulses" on spectrofram



Change pitch/Duration/Intensity etc.

1. Make a Manipulation Object

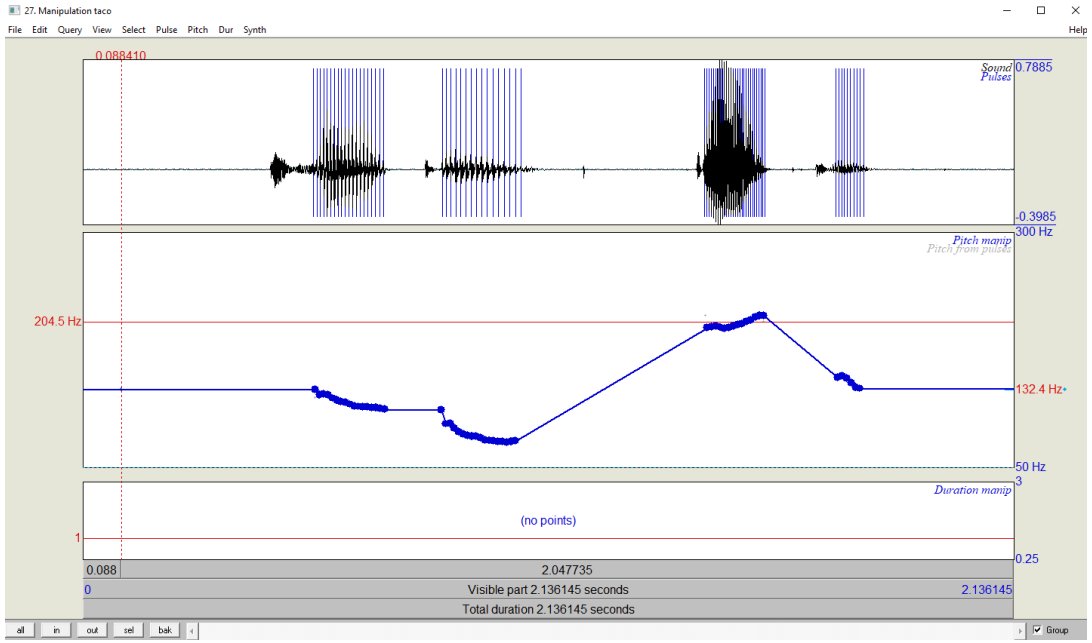




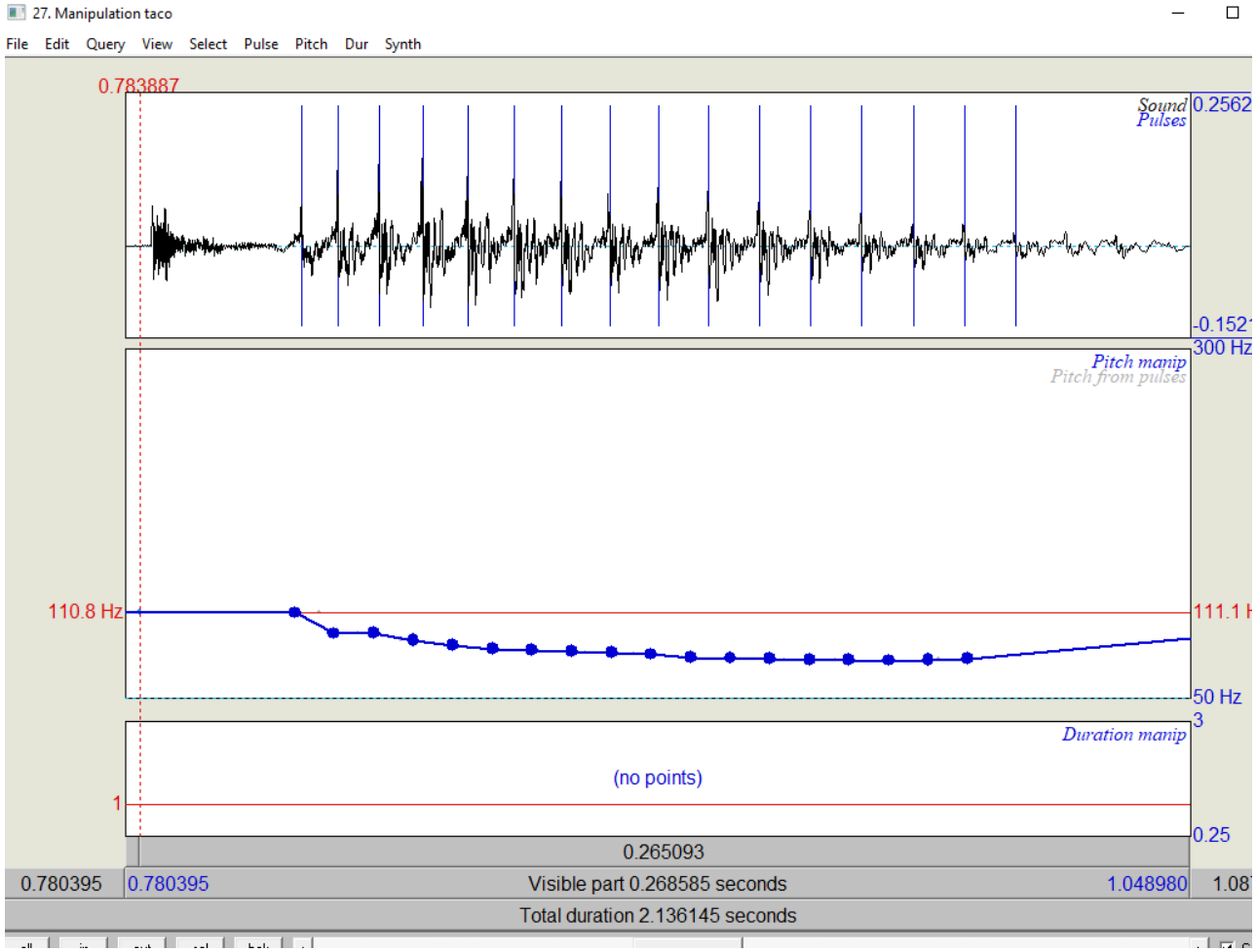
This will create "Manipulation" object

Change pitch/Intensity etc.

2. "View&Edit" the manipulation object



Zoomed-in View for [koʊ] for Eng Taco

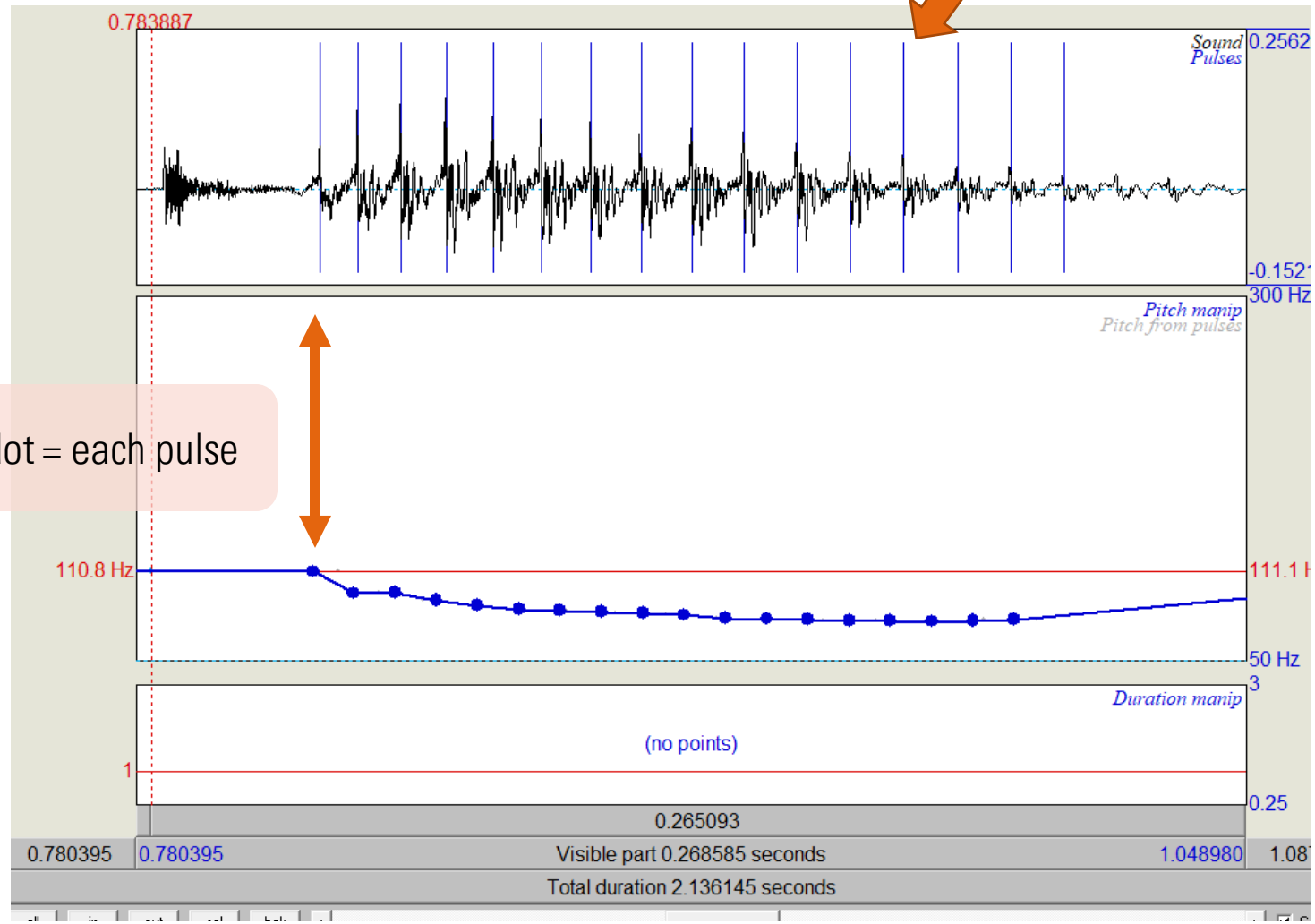


Change pitch/Intensity etc.

2. "View&Edit" the manipulation object

Blue Vertical Lines = **Pulse** = Lines drawn for every periodic wave pattern

That's why you can do this on vowels only!



each dot = each pulse

TRY dragging the dots to make a new pitch contour!

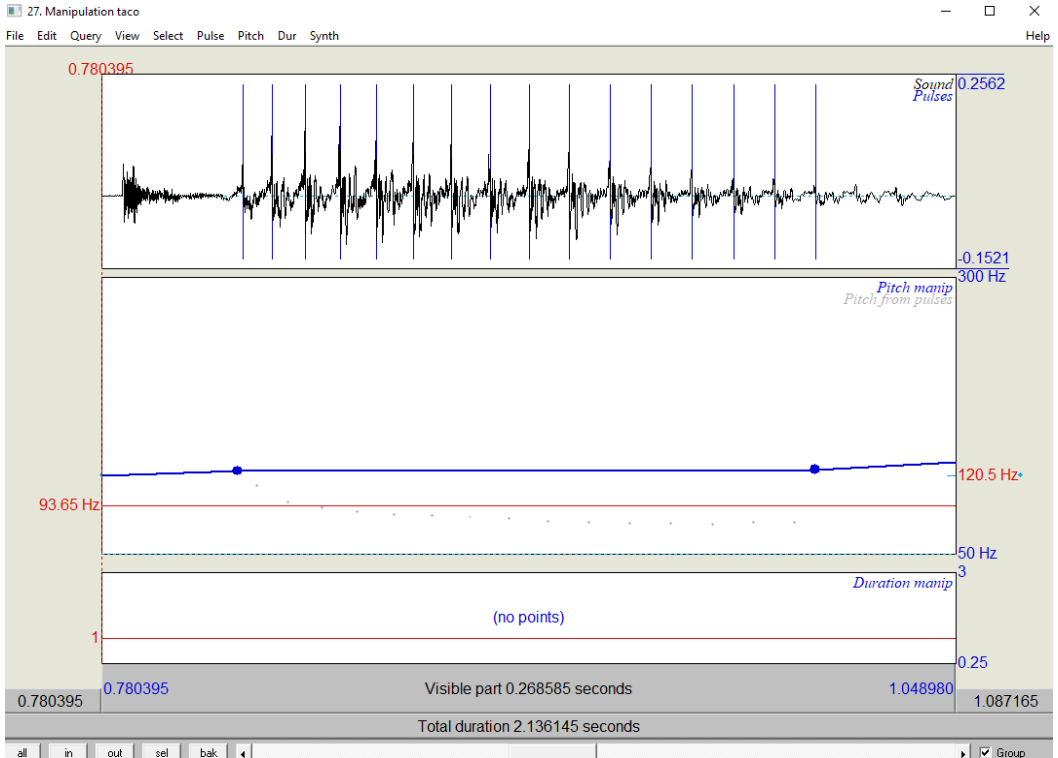
Change pitch

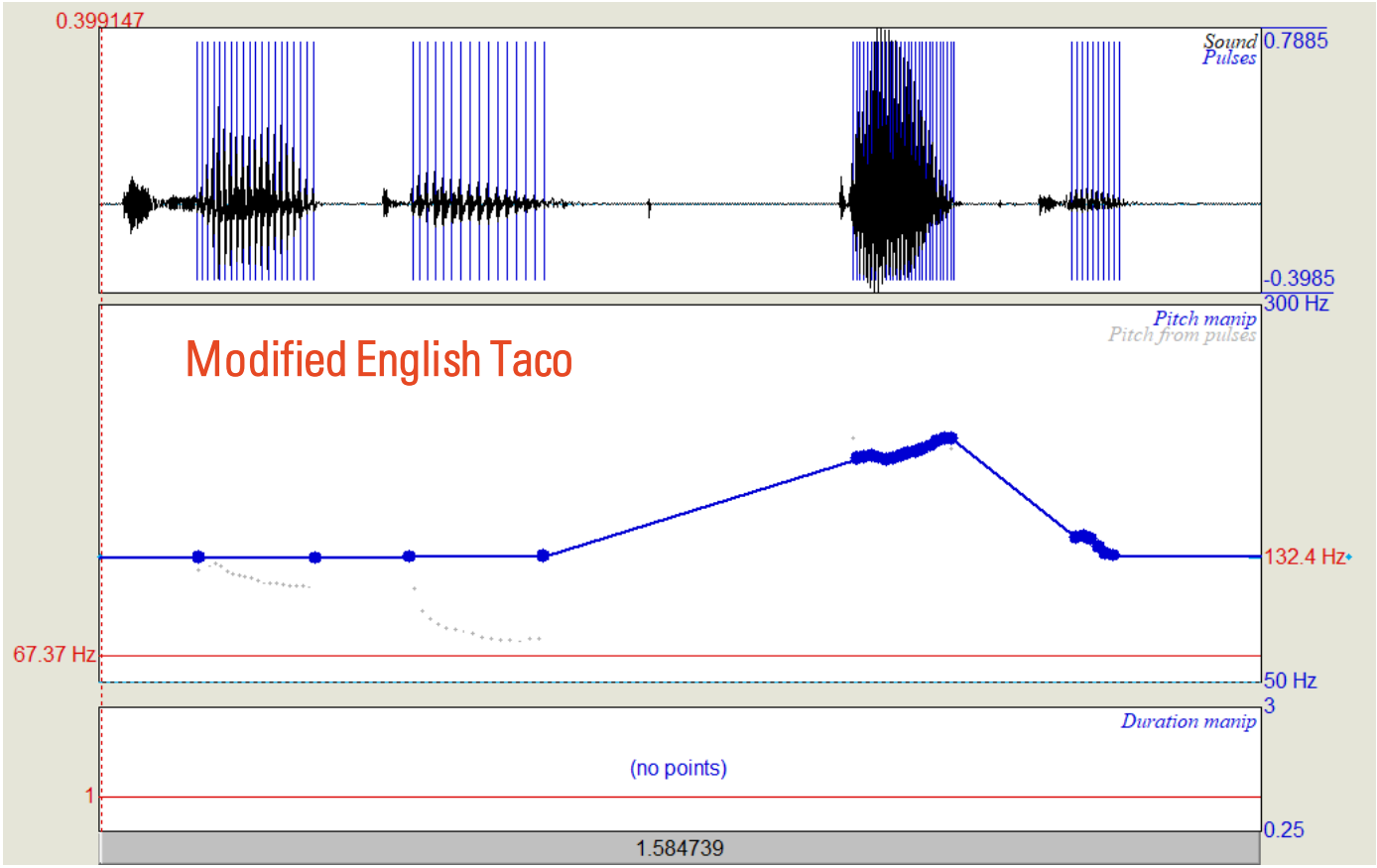
TRY dragging the dots to make a new pitch contour!

3. Different contours!

Quick way: delete points by
1. highlight points you want to delete
2. "Pitch" tab
3. "Remove pitch points"

(Or Ctrl+Alt+T)

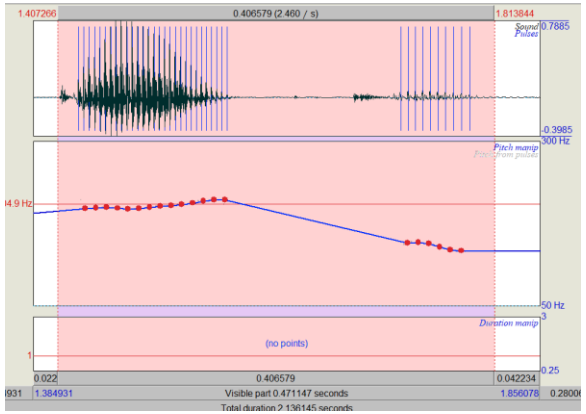




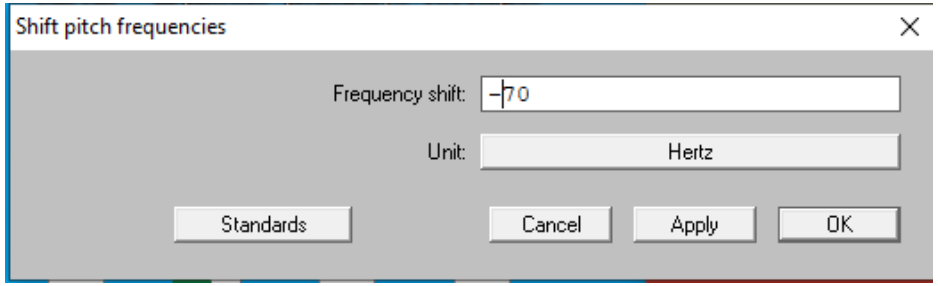
Shifting pitch

4. Shift the whole pitch for Spanish Taco

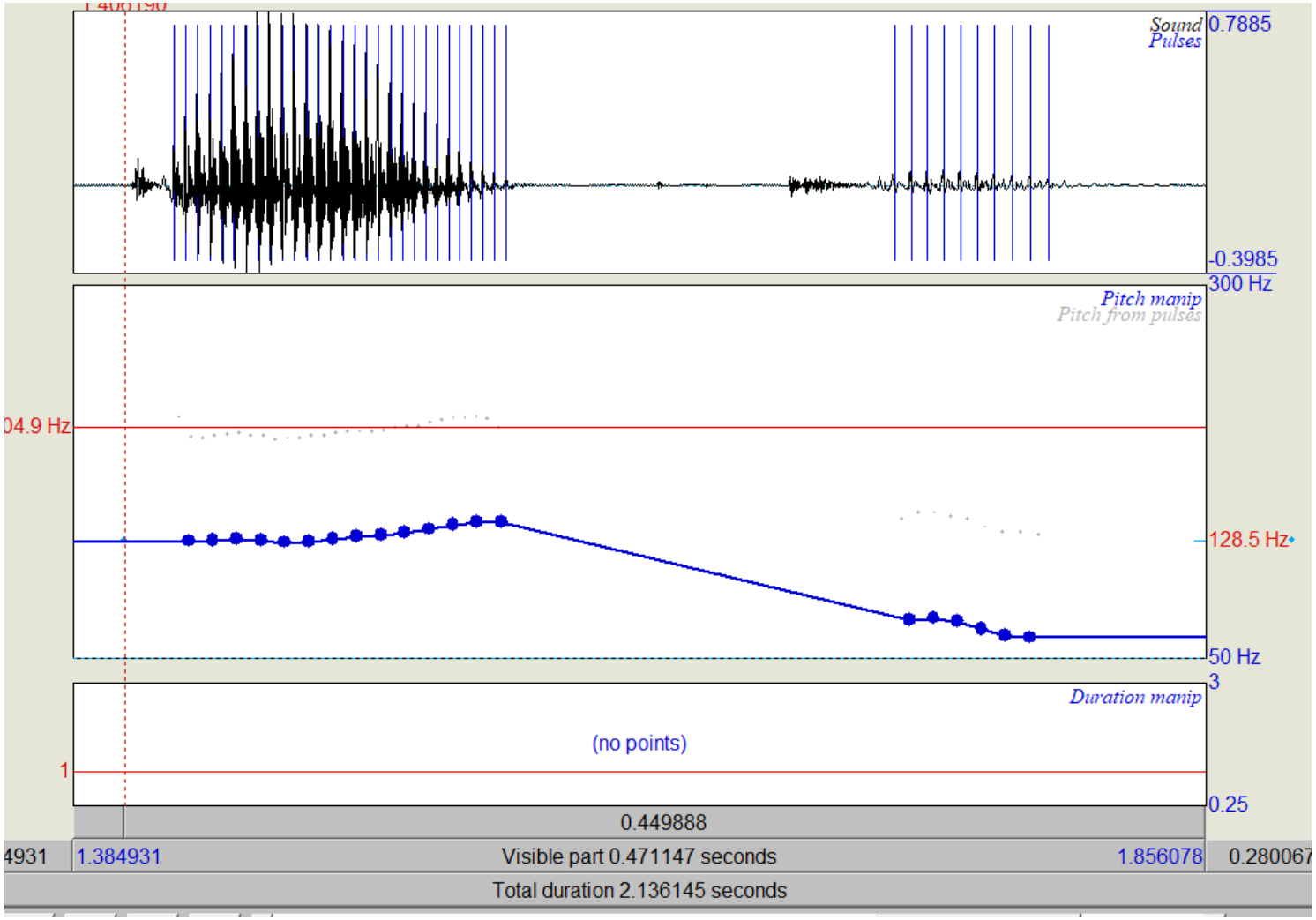
1.Highlight



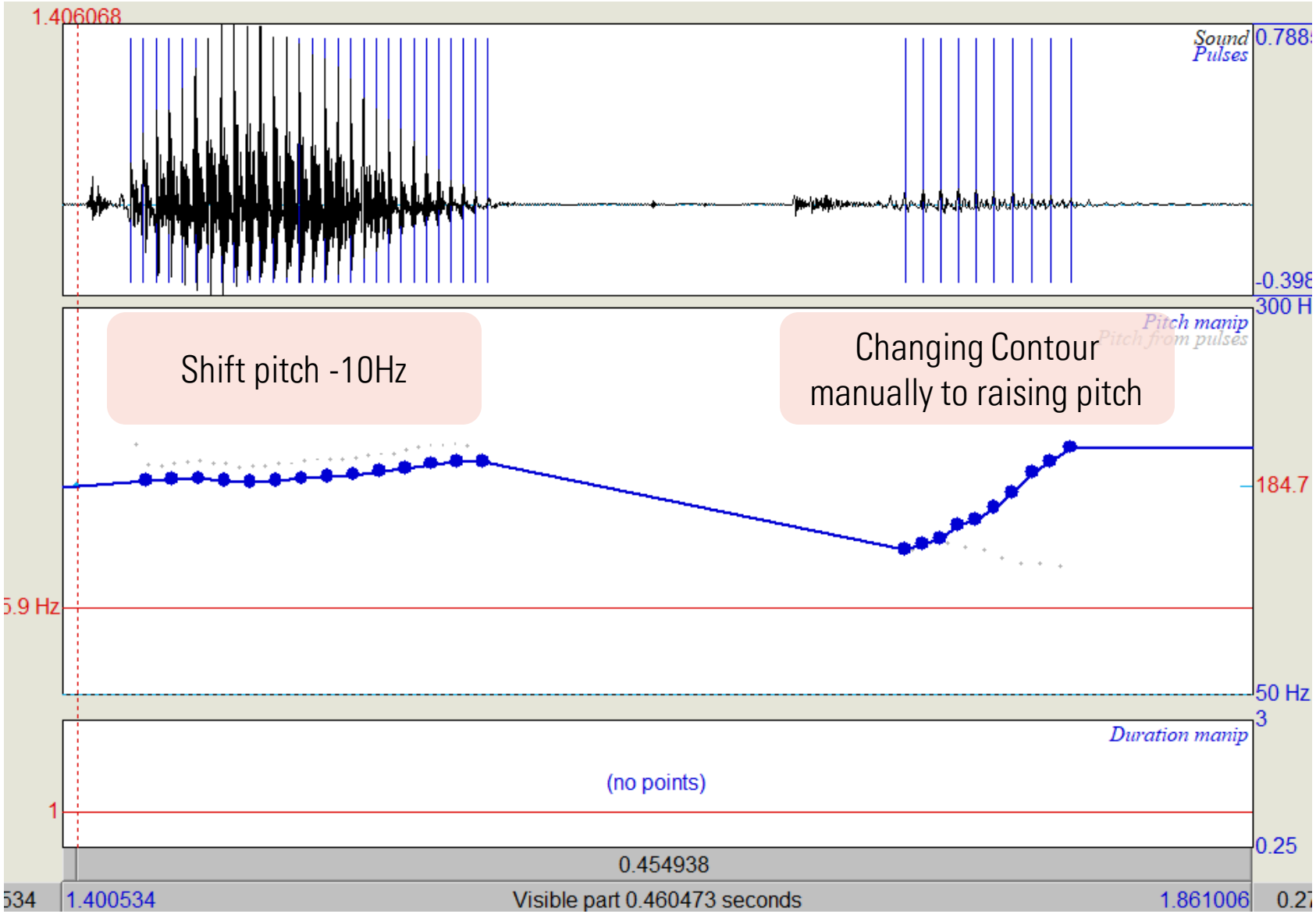
2. Enter how much shifts you want



3. the entire pitch shifted for -70Hz

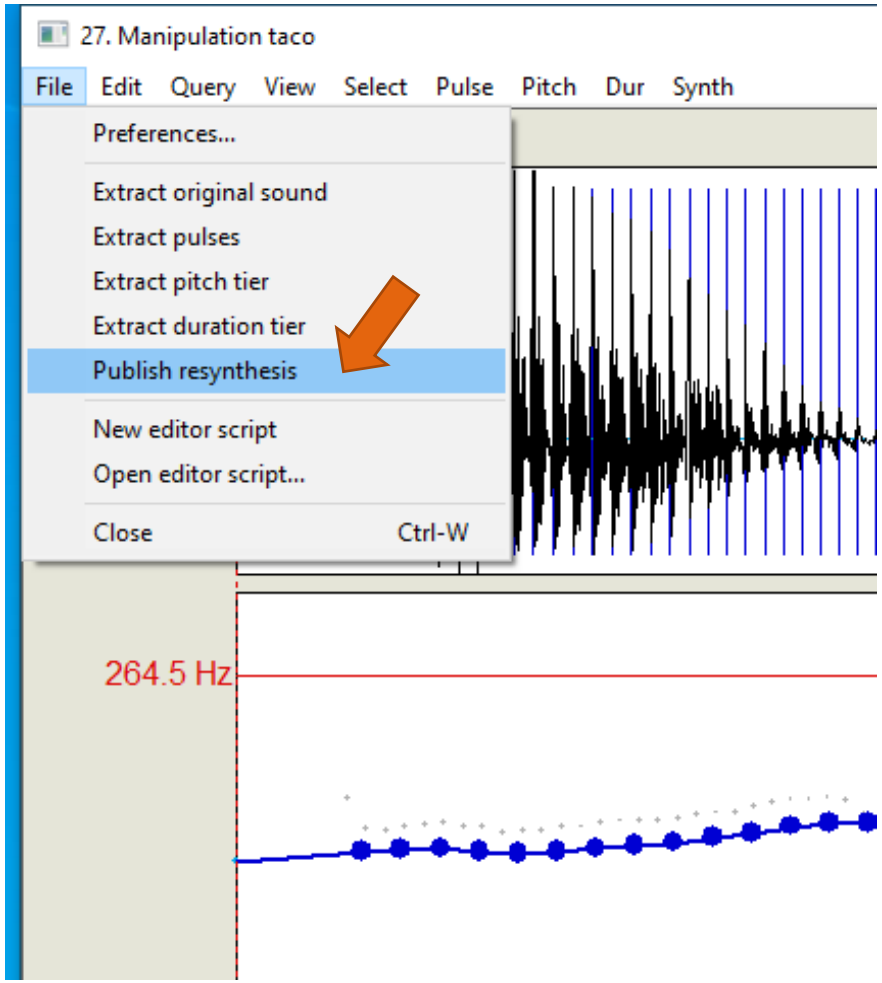


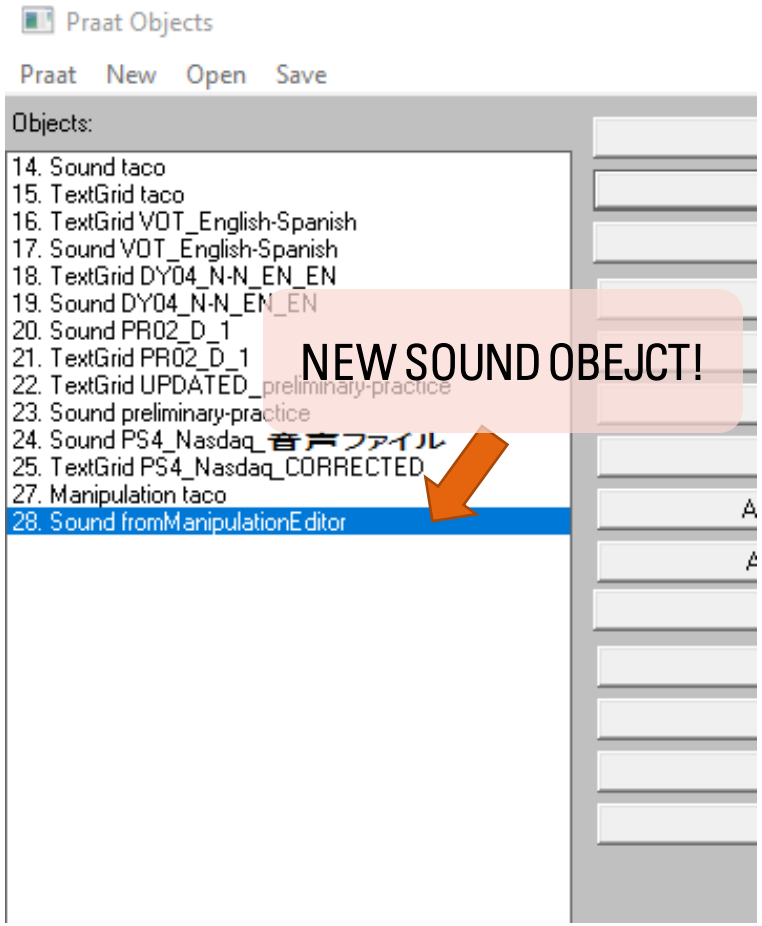
Shifting + Changing pitch



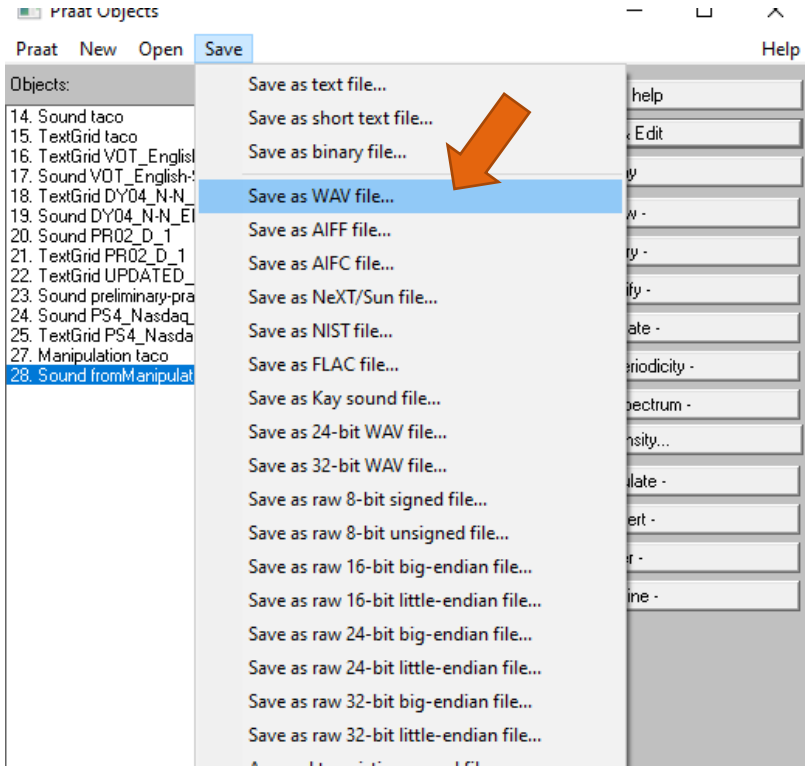
Save this new sound!

I recommend WAV file because it keep as much acoustic information as possible





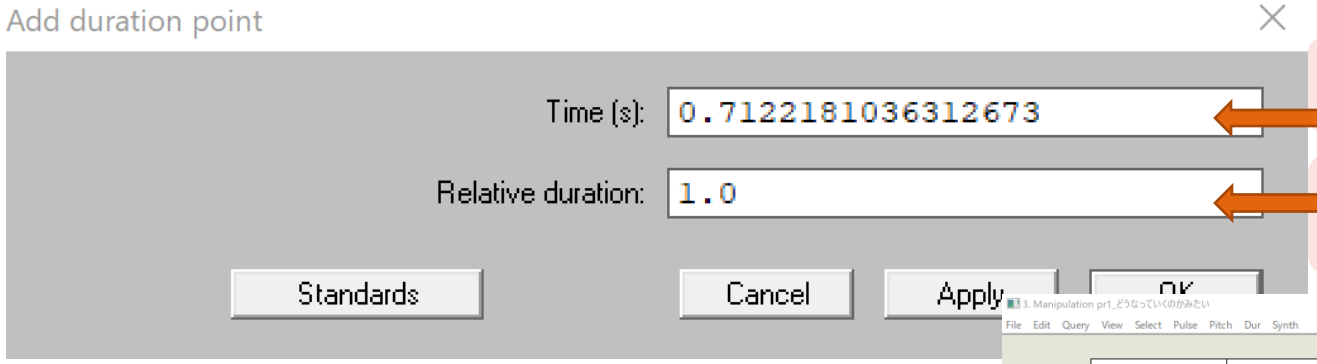
NEW SOUND OBEJCT!



Shifting duration

Use the bottom square area of the ManipulationEditor for duration modification!

1. Dur > Add duration point at... >

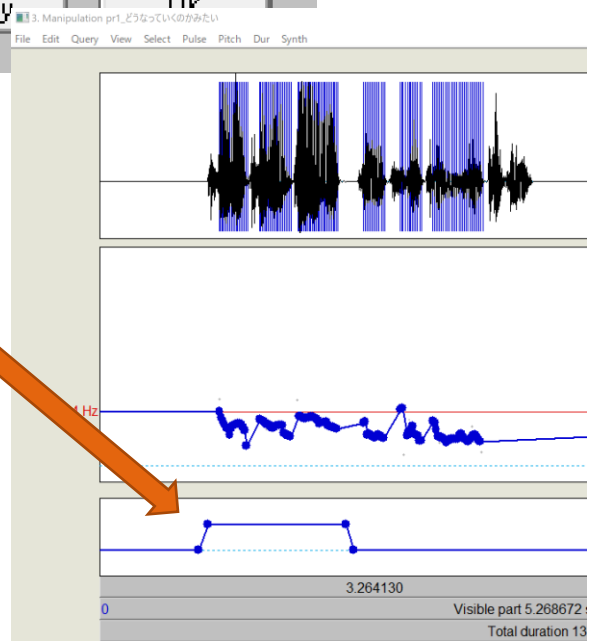


At what time point you want to add the point?

how much you want to change the duration, relative to original?

1.0 = same as original
2.0 = twice longer than original
0.5 = half duration of original

2. Duration point added!
3. To make 1 phrase/word longer, make a trapezoid.
   - initial and last points = 0
     (so that other parts remains the same)
   - middle 2 points = target relative duration

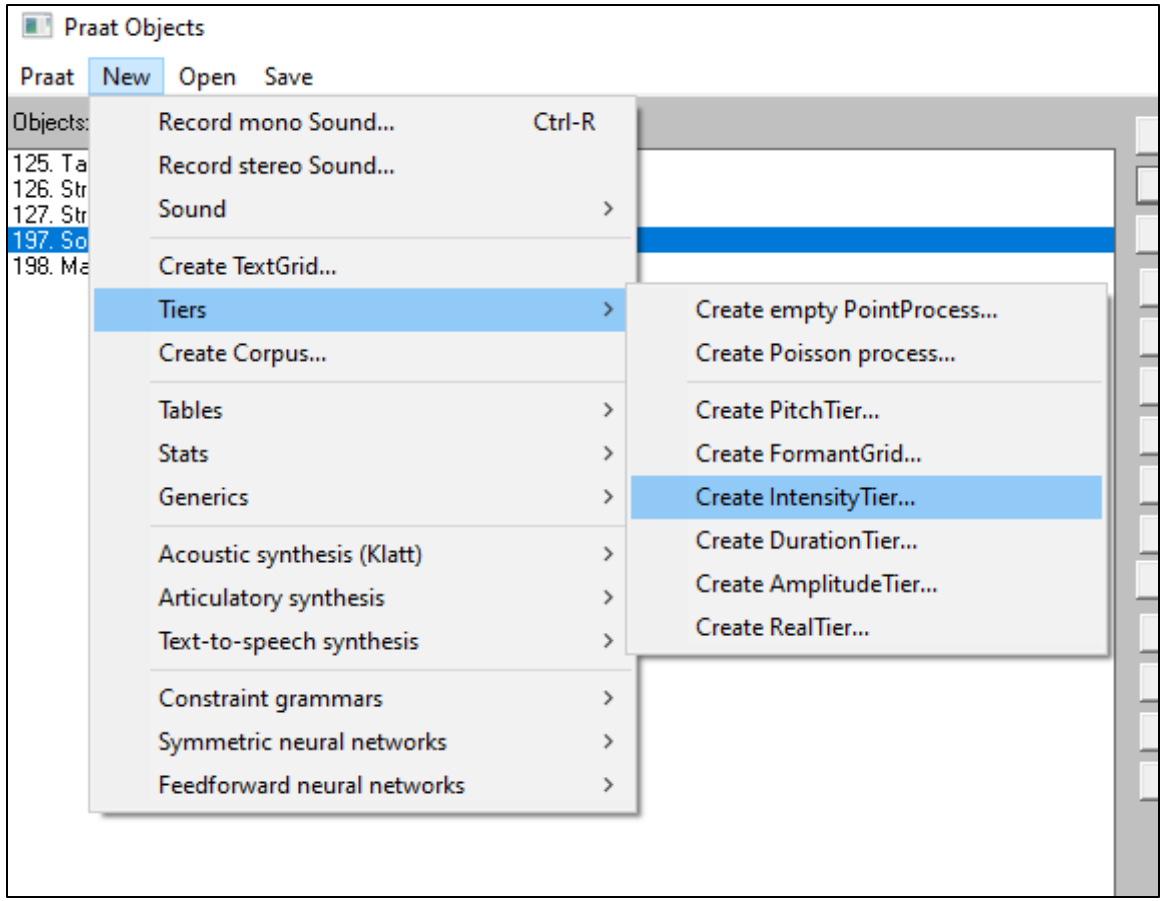


If you need the precise manipulations for multiple sounds, Script is usually the easier way

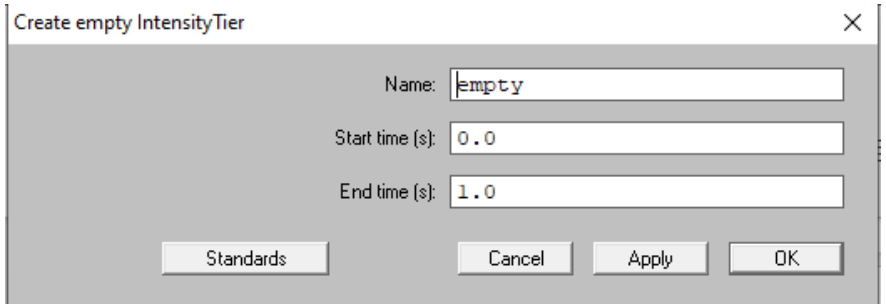
Shifting Intensity

For the intensity, the process is a bit different...

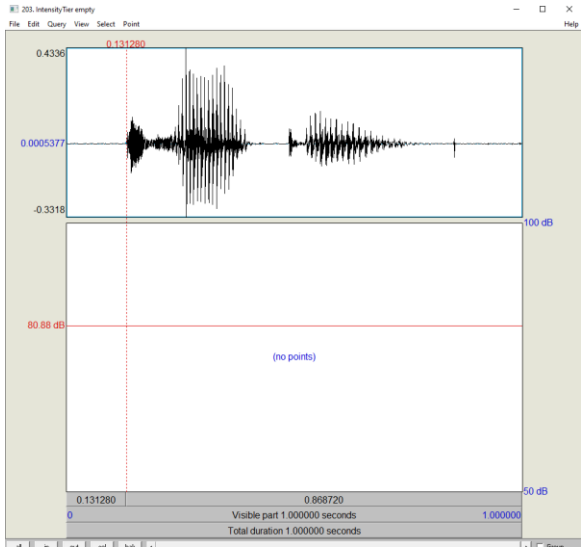
1. Select the target sound obj > New > Tier > Create Intensity Tier



2. Click OK (for English Taco)



3. Select Sound obj & Intensity obj > View & Edit

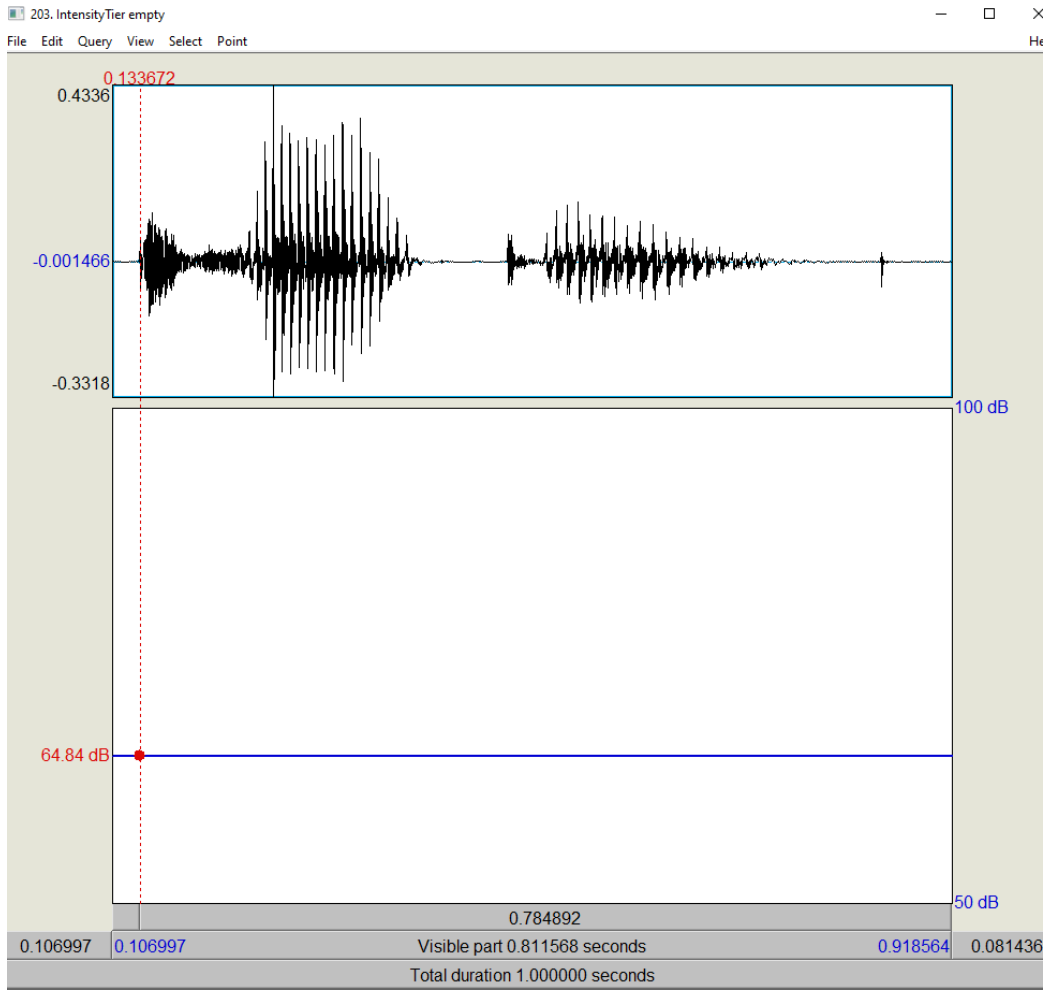


Duration editing section

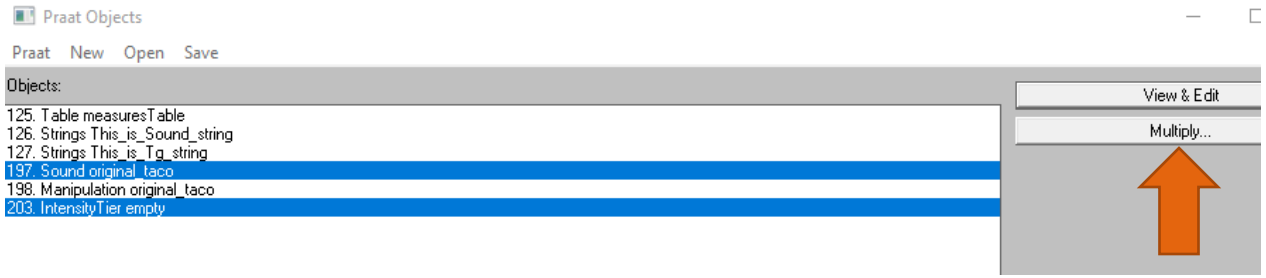
Shifting Intensity

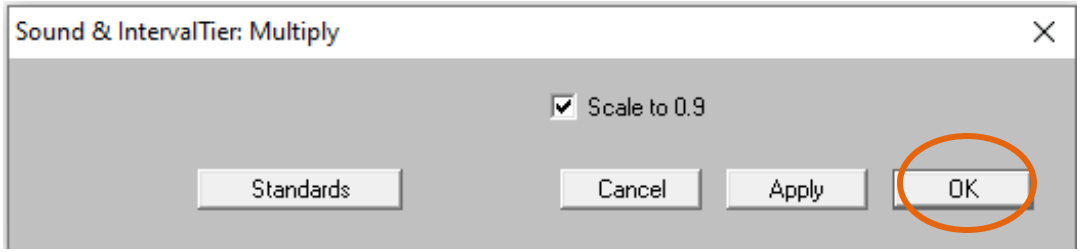
4. add point (Point > At Point at... or At Point at cursor >

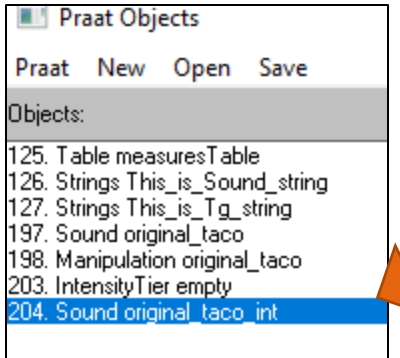
example: flattening the intensity at a mean of selection Eng "taco"



5. Select both Sound & Intensity obj > Multiply > OK







Now you got this new sound! (rename it if you want!)

Q: how do I equalize pitch/dur/Int for all sound files?

Quick Answer: [STEP1] you decide HOW you want to equalize. [STEP2] repeat the GUI actions or write a script.

Example: you wanted the duration of all of your sound files to be 5 seconds.

[STEP1]
There are different options HOW you want to do it.
1) Make each sound elongated/shorten to match 5sec total.
2) Add a silence after each sound to make each file has 5 sec in total.
3) Add a silence before each sound to make each file has 5 sec in total.
4) Add a silence before AND after each sound so that the sound gets centralized and has 5 sec total.
….etc.

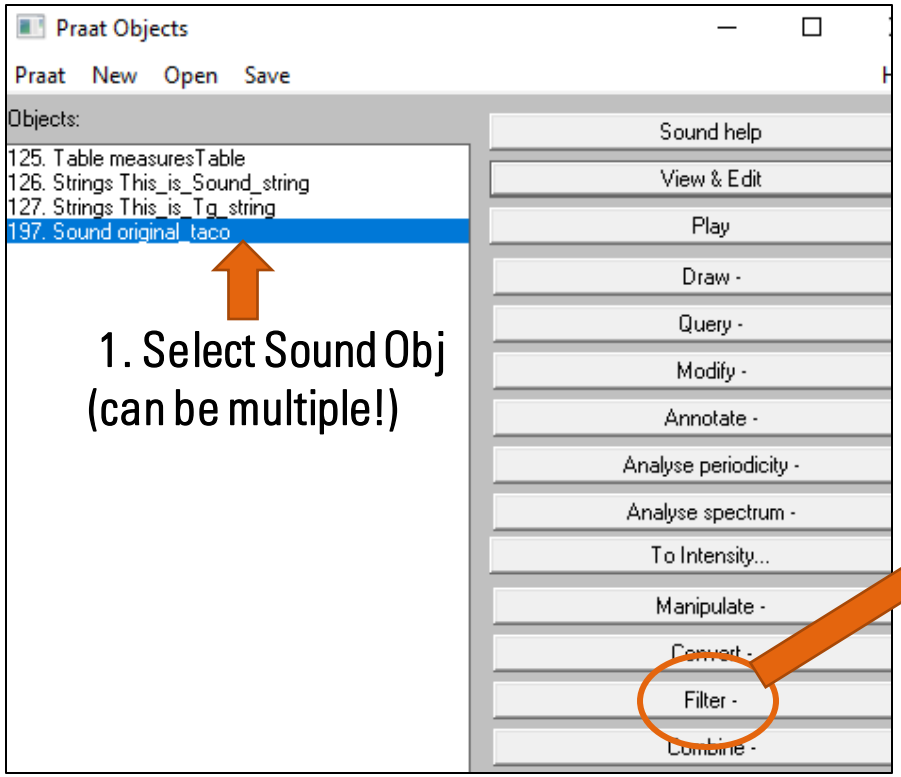
[STEP2]
If there are not too many files and you think you can do it by hand with no variation, do so!
But Usually, you would want to write a script to automate.

Sound Filtering

High-pass filtering ...allow high frequencies = attenuate low freq. amplitudes e.g., Sharpening the speech (by filtering below 80Hz)

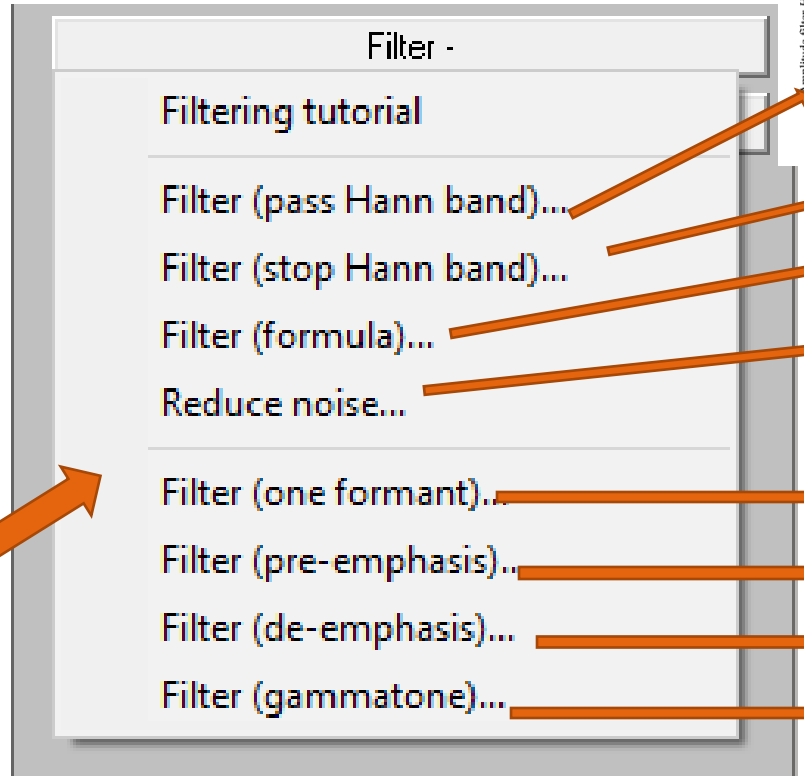
Low-pass filtering ...allow low frequencies = attenuate high freq. amplitudes e.g., Noise cancelling, underwater effect

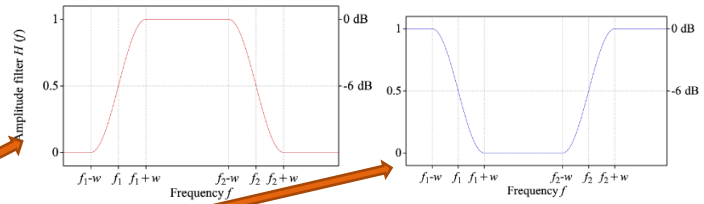
Band-pass filtering...combination of high-&low-pass filtering to only allow frequencies in a specific "frequency band"



1. Select Sound Obj (can be multiple!)

2. Filter menu





Next slide

you specify how to smooth

Filter 1 formant of your choice

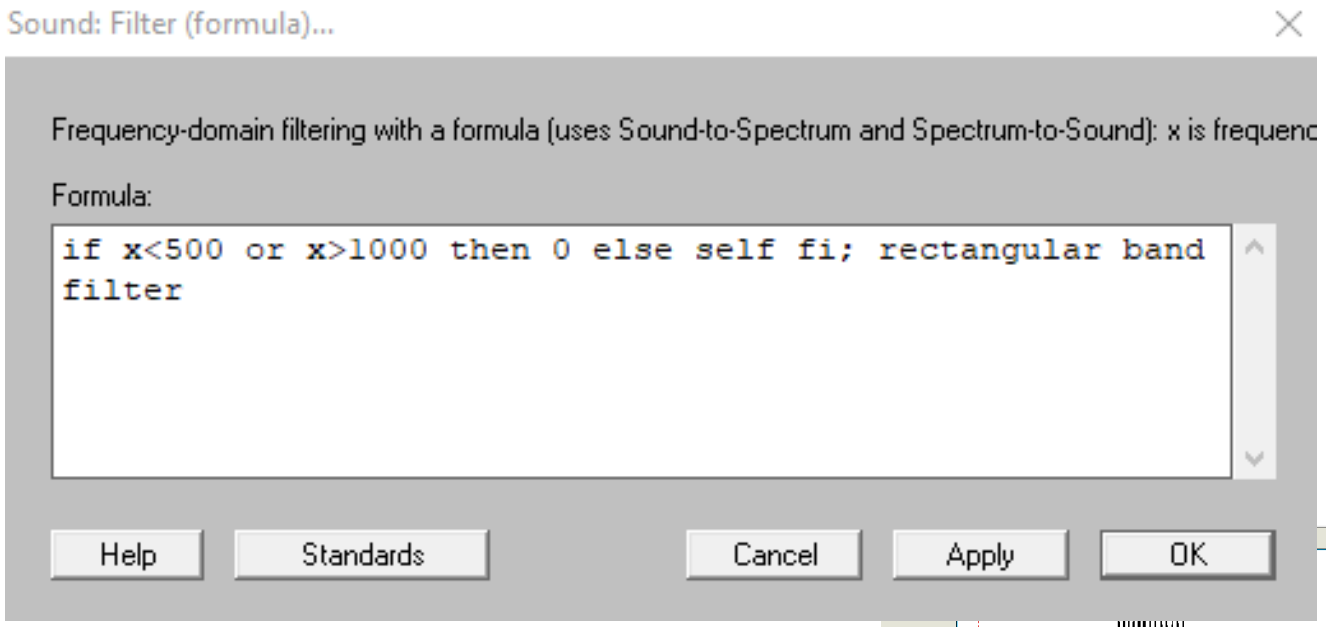
to get higher spectral slope sound

to get lower spectral slope sound

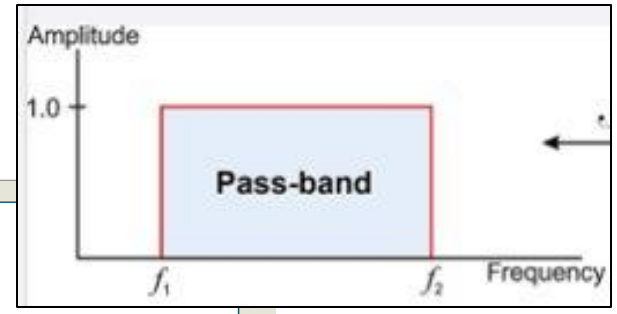
Scaled to unity at the center freq

Sound Filtering

1. If you choose Filter (formula)… for example:

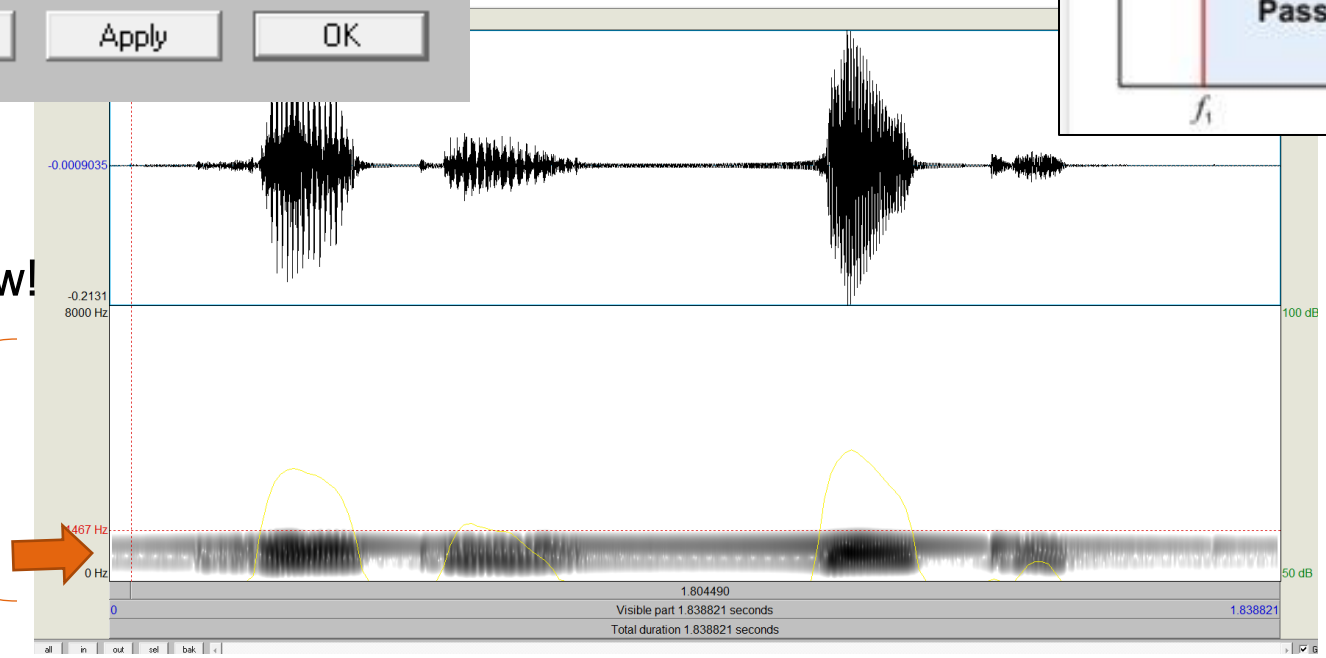


← this means:
I want the high pass filter at 500Hz (I do not want freq below 500Hz)
AND
I want the low pass filter at 1000Hz (I do not want freq above 1000Hz)
With
Rectangular shaped pass-band



2. You get a new sound in your objects window!

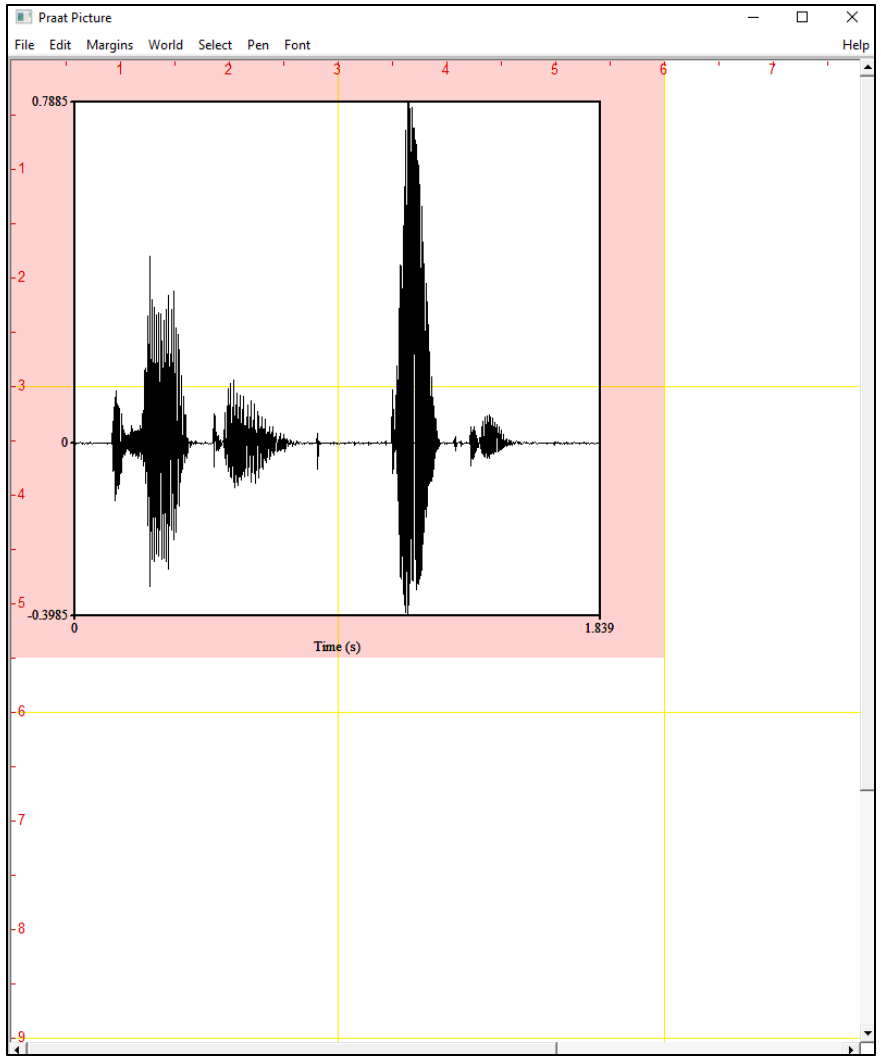
you see freq other than 500Hz-1000Hz are almost blanked out



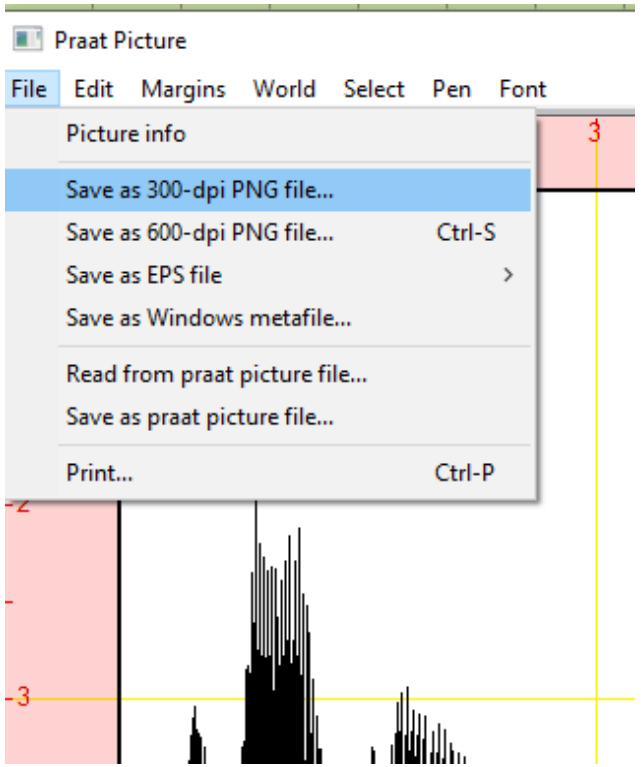
Produce Drawings

Introducing the Picture Window!

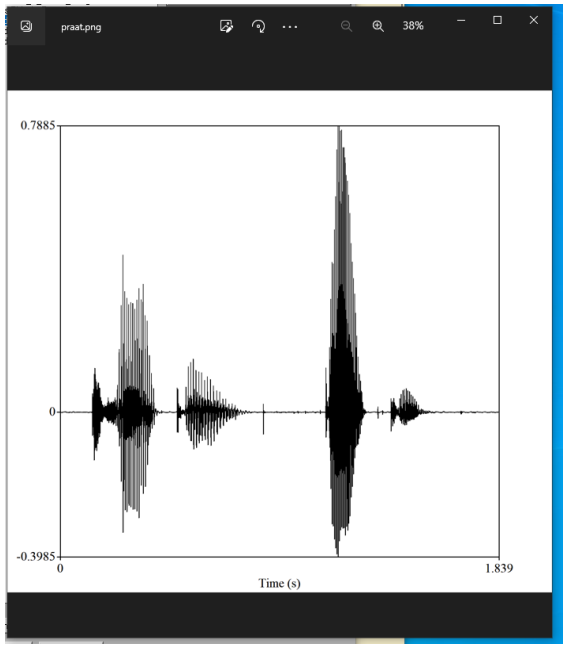
1. Let's do: select the original taco sound > Draw > Draw... > OK



2. Save as 300-dpi PNG file...



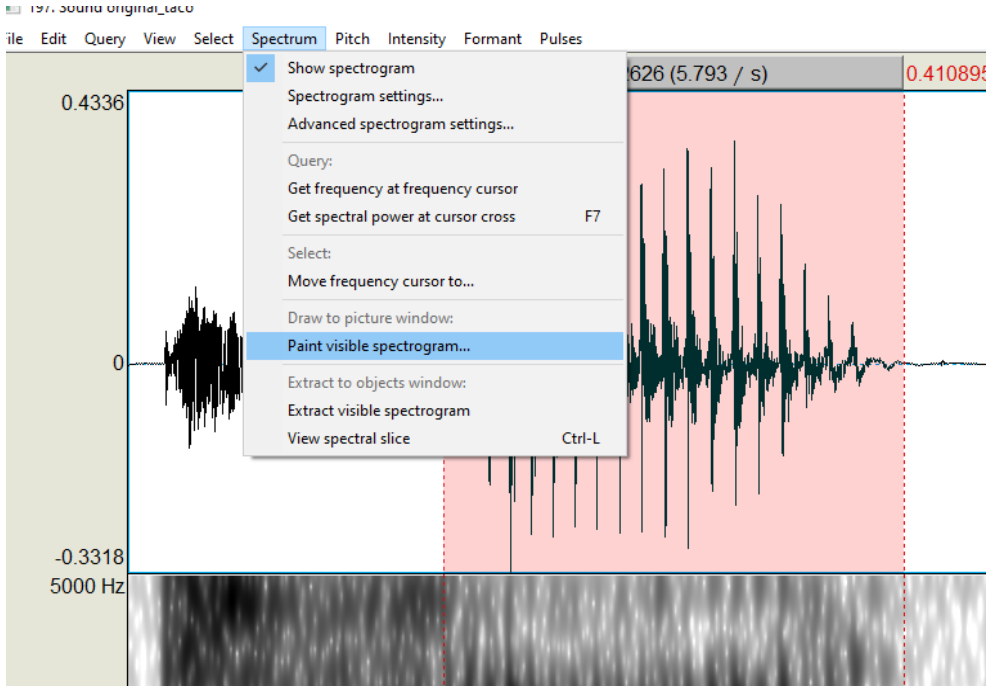
Ta-da!



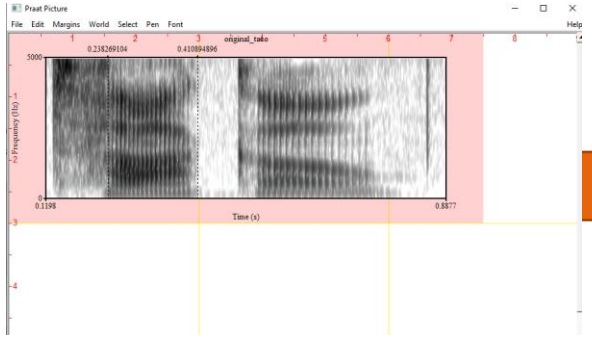
Produce Drawings

You can also do from View&Edit view.

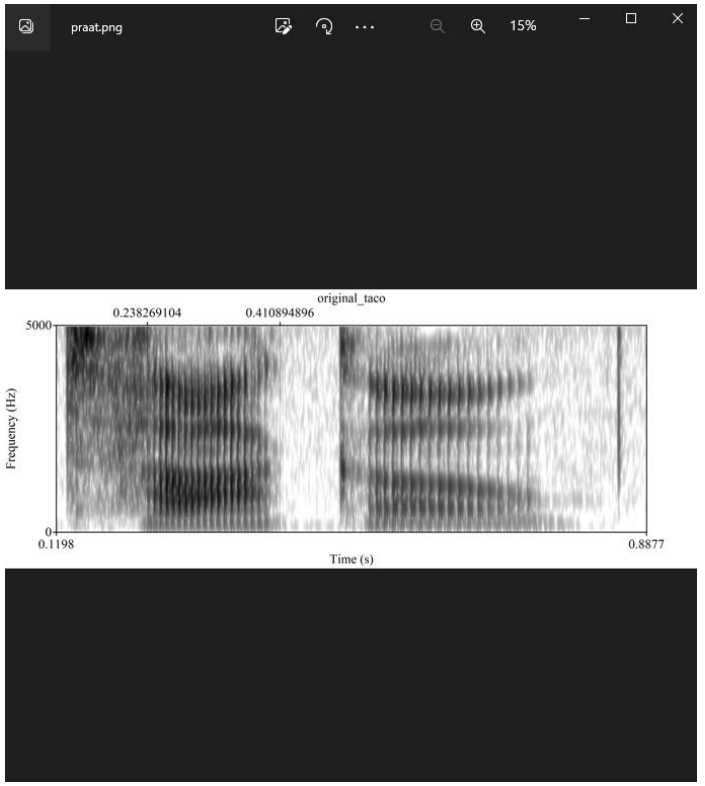
Example: highlight the part you want > Spectrum > Paint visible spectrogram > OK



Save this as PNG....



Ta-da!

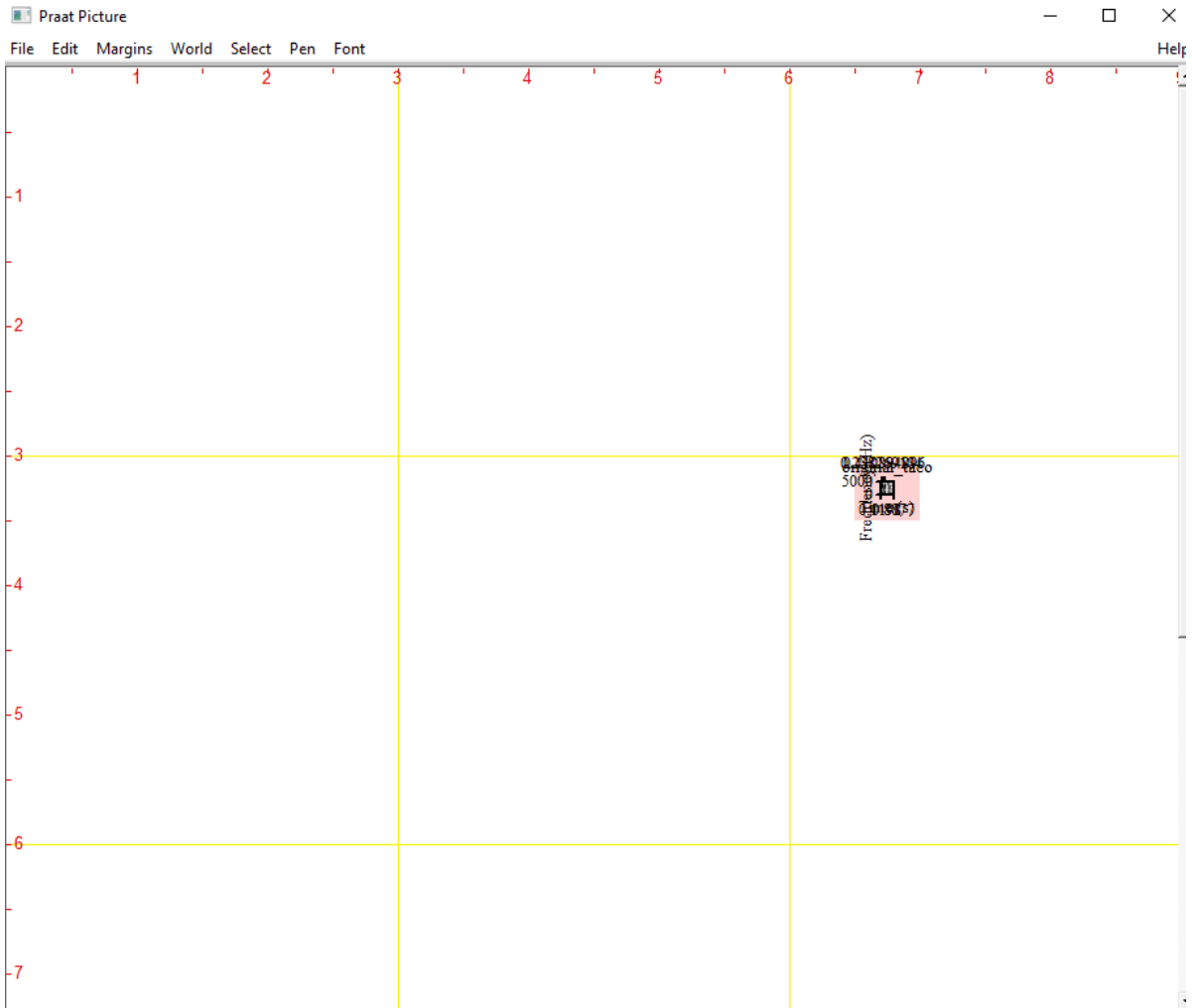


You can do similar for other objects too! (Pitch contour, Textgrid, etc...

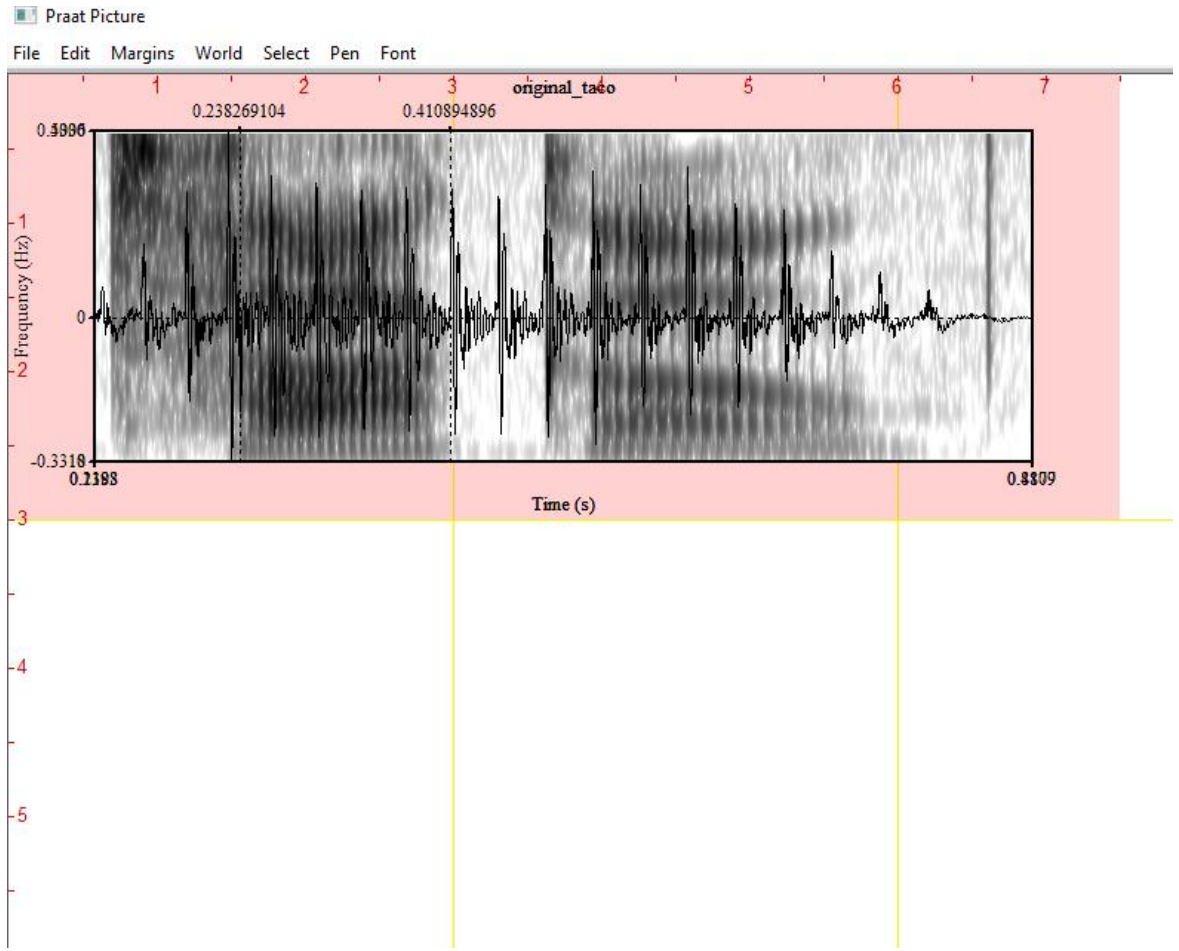
Produce Drawings

Note: the image will appear in the originally highlighted red area, and OVER the existing drawings (unless you specify)

Otherwise you get this:



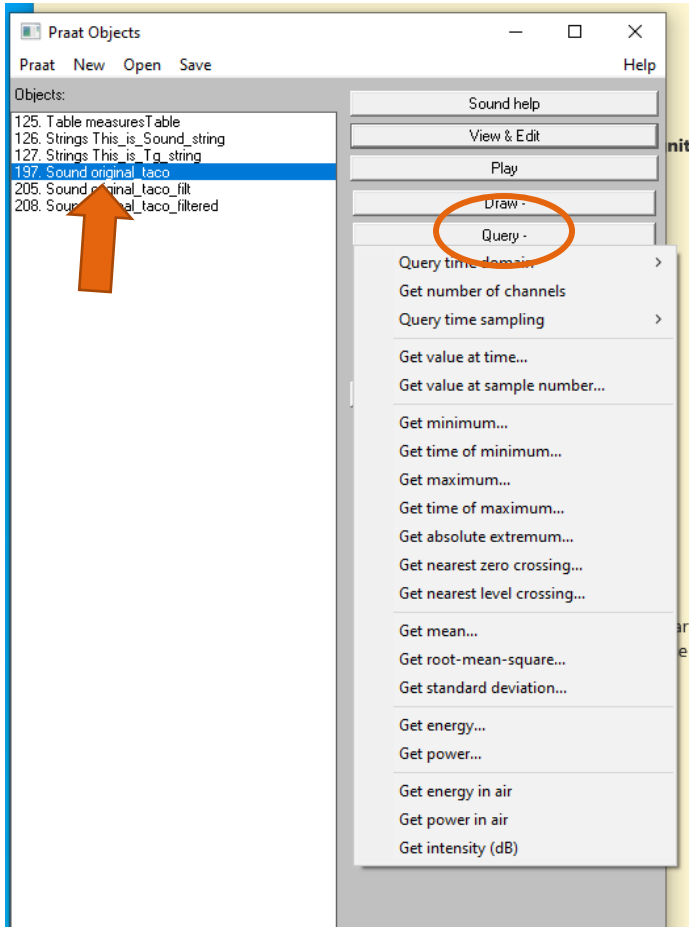
Or that:



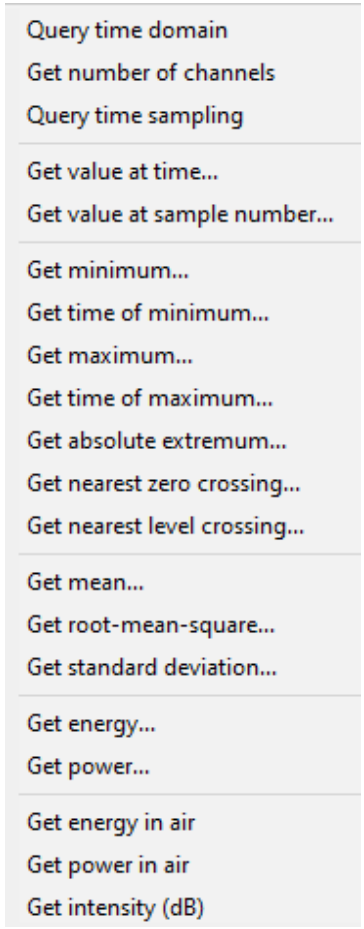
Get acoustics data

Introducing "Query"! = asking about the data of the sound

1. Select the sound > Query



2. so many options!

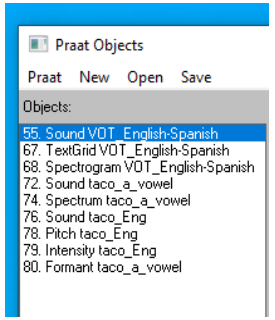


Get start time, end time, total duration
Channel Number (mono sound = 1, stereo = 2)
e.g., Sampling number used to make that spectrogram?
Get estimated amplitudes in Pascal (for a specified time)
Get estimated amplitudes in Pascal (for a specified sample number)
Get minimum amplitudes in Pascal
Get the time associated with the minimum amplitude of your interest
Get max amplitudes in Pascal
Get the time associated with the max amplitude of your interest
...

https://www.fon.hum.uva.nl/praat/manual/Sound.html

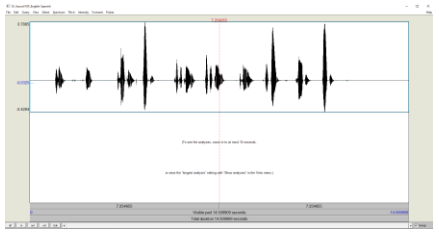
- You can inquire different things depending on the...-

Object types

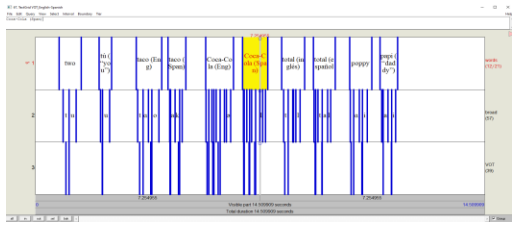


1. Sound _____
2. TextGrid _____
3. Spectrogram _____
4. Spectrum _____
5. Pitch _____
6. Formant_____
7. Intensity_____

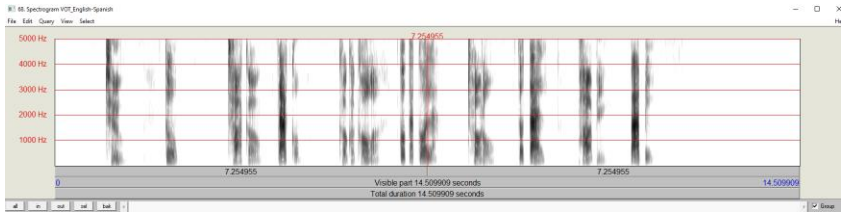
[1]



[2]

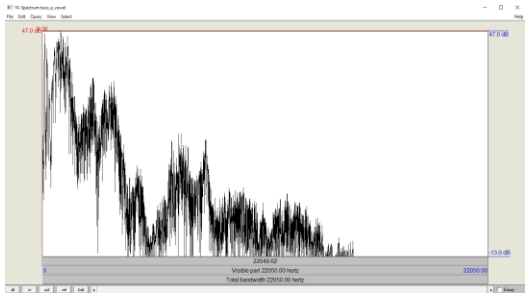


[3] Select Sound > Analsyze spectrum > Sound: To Spectrogram...

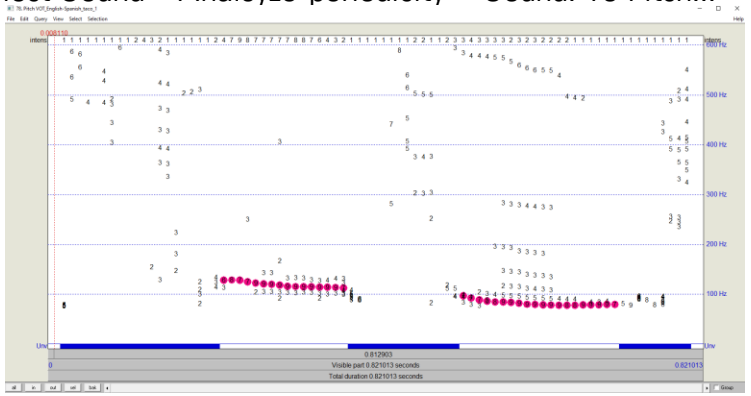


*Draw this onto Picture Window; select this object > Spectrogram: Paint...

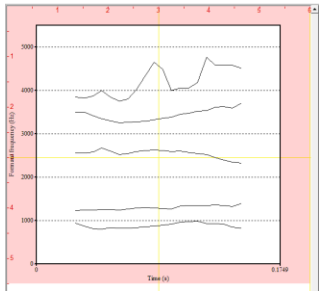
[4] Select Sound > Analsyze spectrum > Sound: To Spectrum...



[5] Select Sound > Analsyze periodicity > Sound: To Pitch...

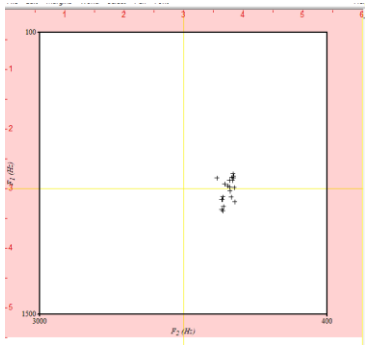


[6] Select Sound > Analyze spectrum... > Sound: To Formant (burg)...

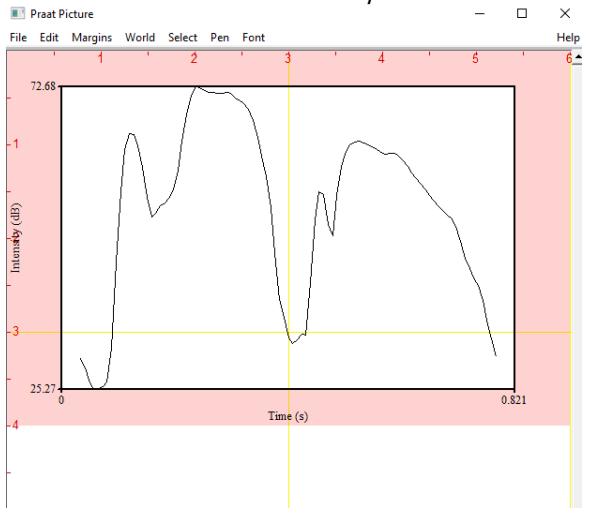


Draw > Draw Tracks

Draw > Scatter Plot



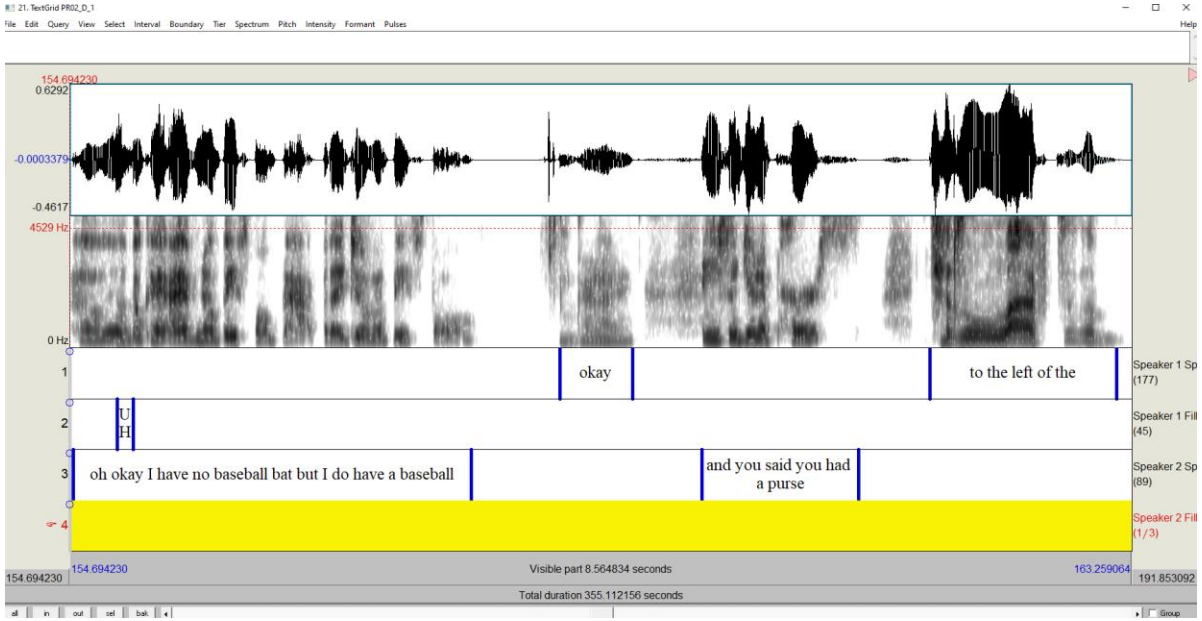
[7] Select Sound > To Intensity...

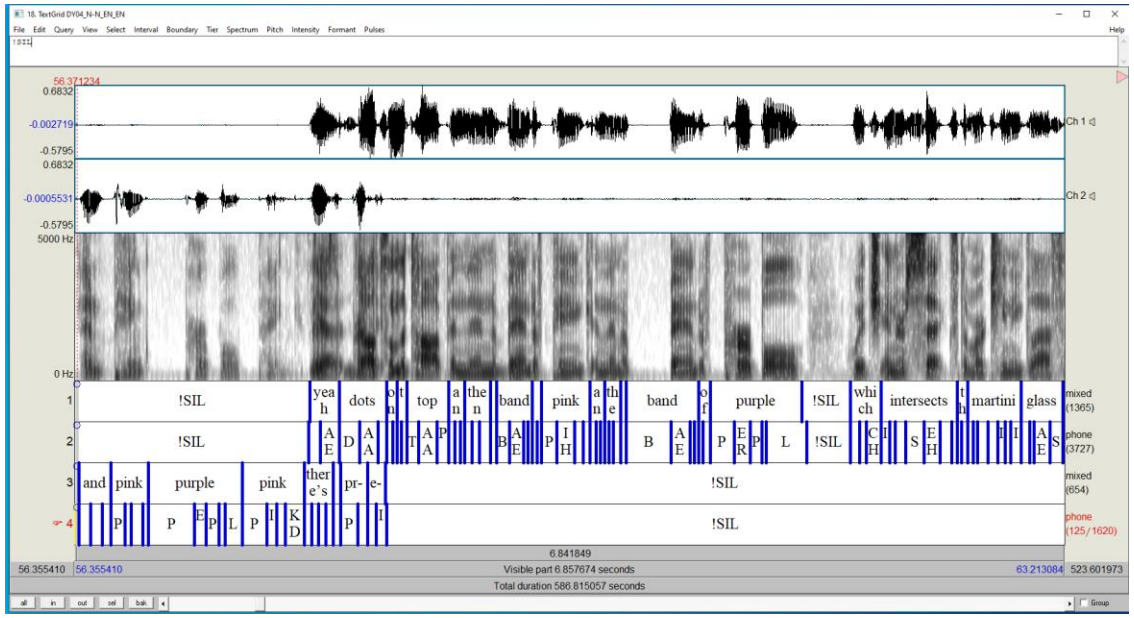


Part 4
What other cool things can be done with Praat?

Use Corpus with Praat data

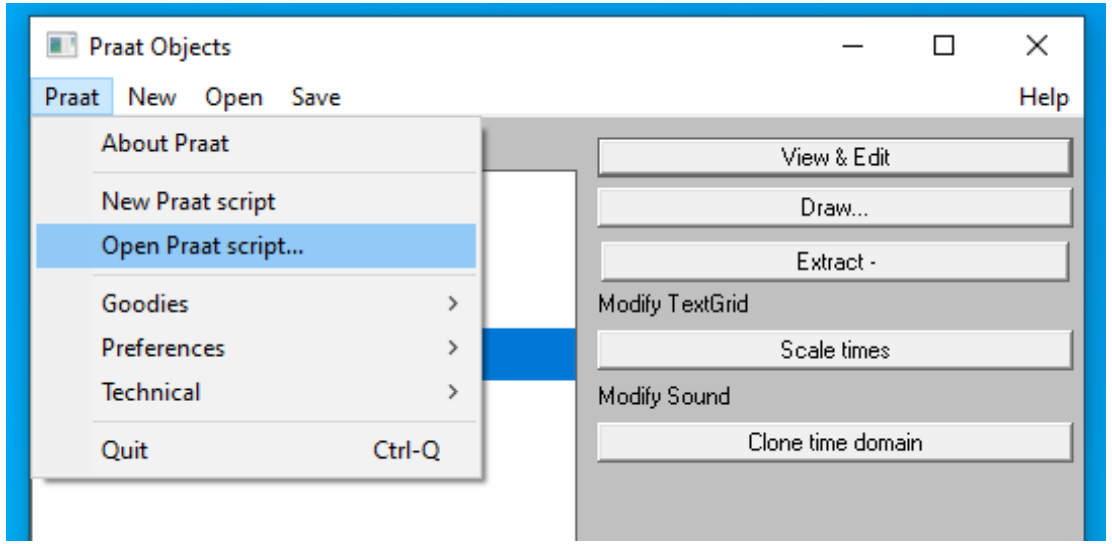
e.g., Wildcat Corpus





Praat Scripting

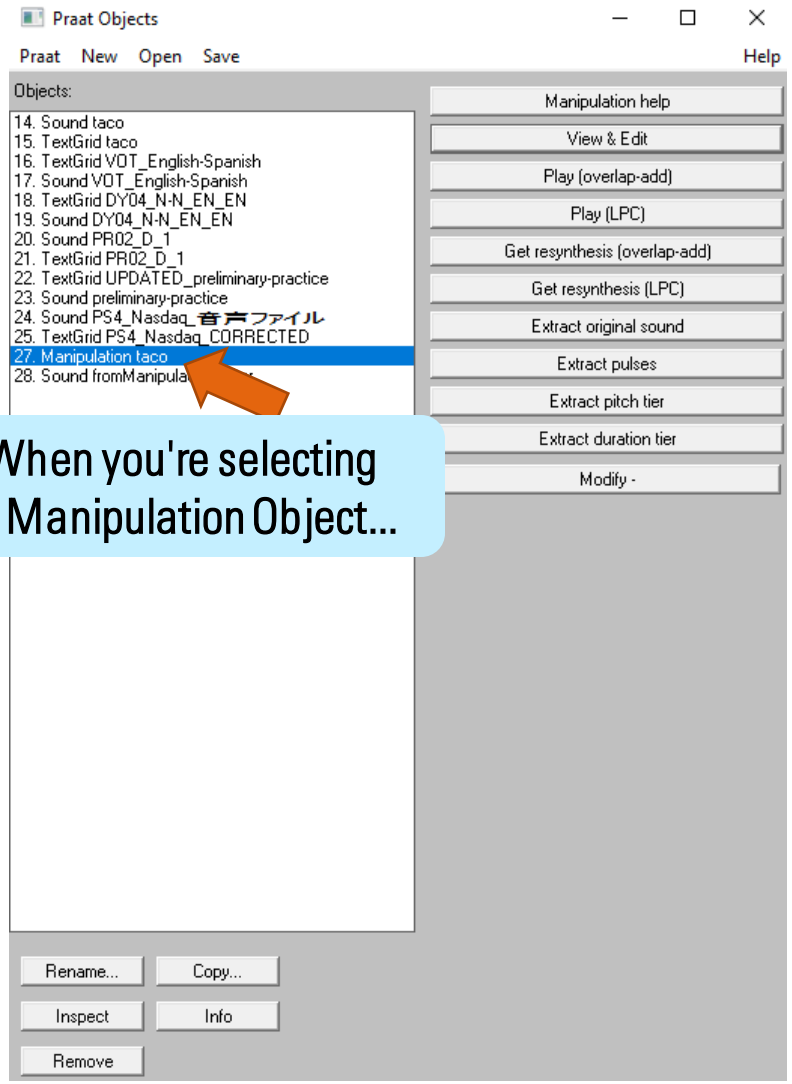
- coding(-ish) to automate your Praat data processing
- you can write one, or use others



the topic for the intermediate level workshop!!

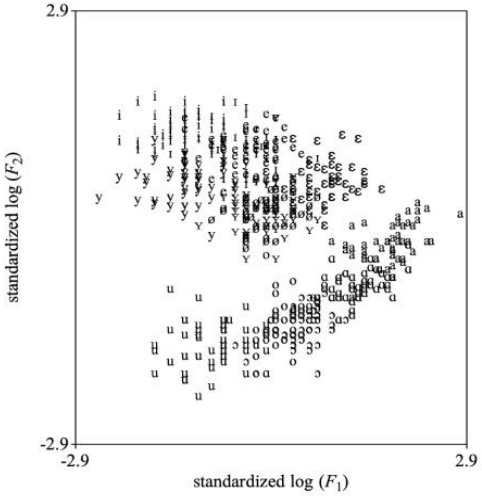
SO MANY FUNCTIONS!!

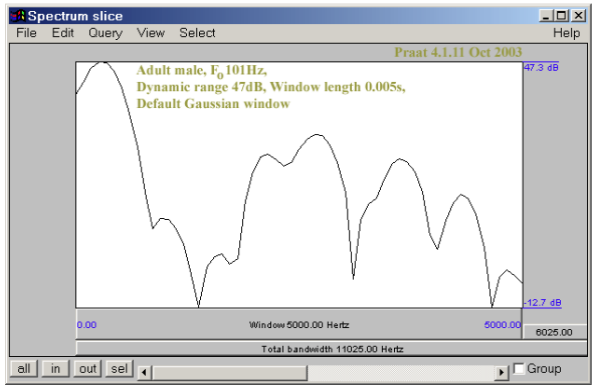
For example...



When you're selecting a Manipulation Object...

Lots of other editing options!





There are so many functions and I cannot cover everything today, but you should know where to go look for by now! :)

[θæŋkju]!!

Reach out to me if you got any questions about Praat:)

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