Reading spectrograms: Vowels and consonants

Instrumental phonetics

February 13

Inna Sieber

Reading spectrograms: What for?

- Reading language descriptions
- Writing language descriptions
- Working with texts on a language
  - Transcribing texts
  - Annotating texts
- Phonetic studies
- Every time you don’t believe your ears

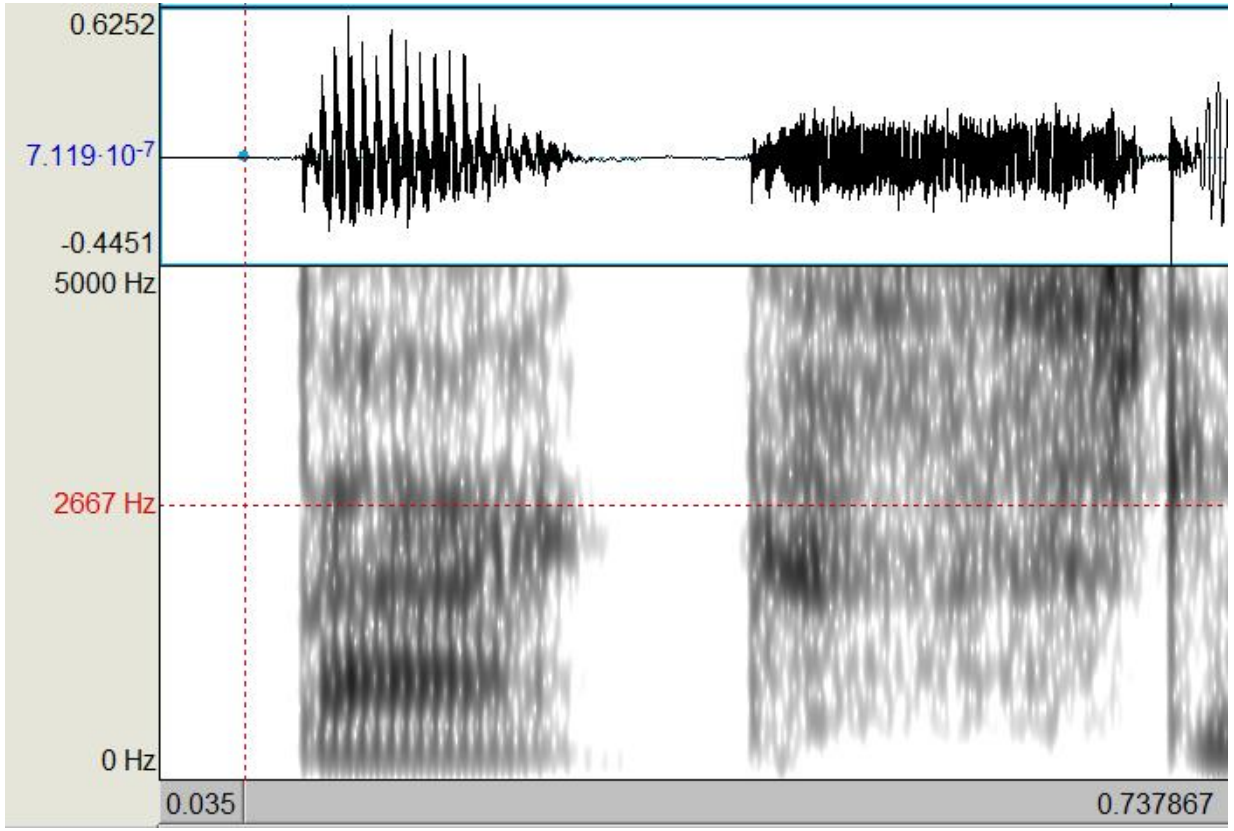
Reading spectrograms: now and in real life

- After the course you are expected to look at the spectrogram and read a simple word in English
- In real life you *usually* know what to expect and what to look for

- Today there are only English irregular verbs
- In real life God knows what can happen

You already know

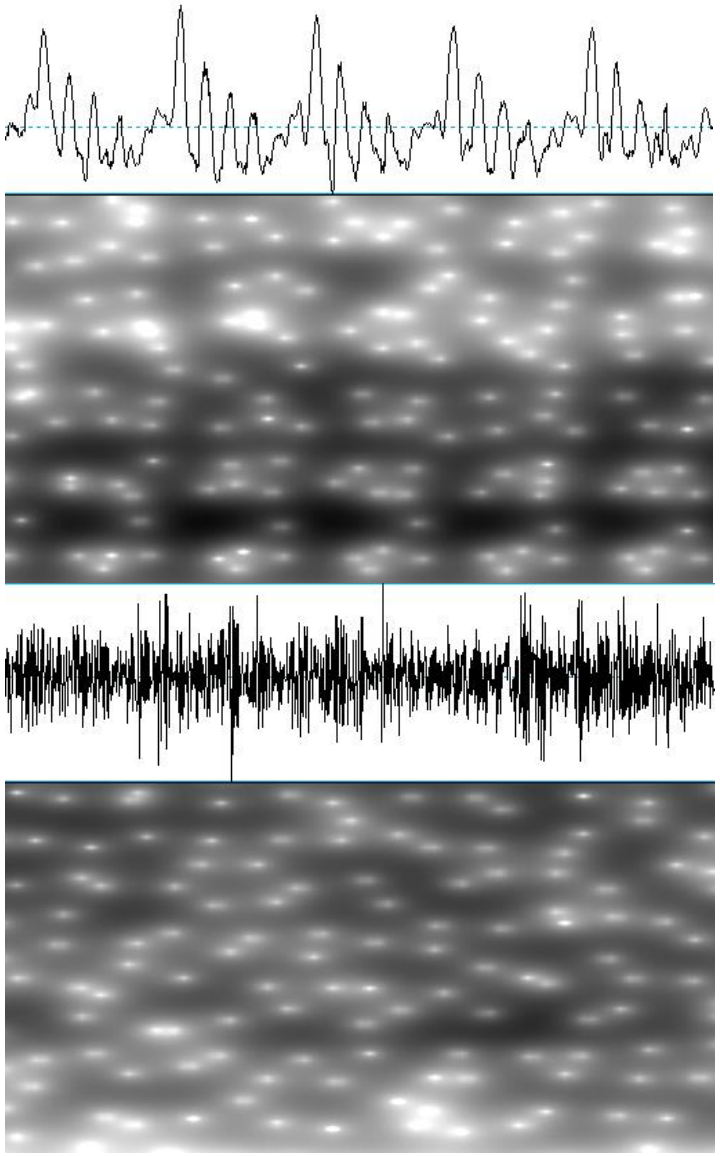
- Intensity (dB)
- Frequency (Hz)
- Duration (ms)

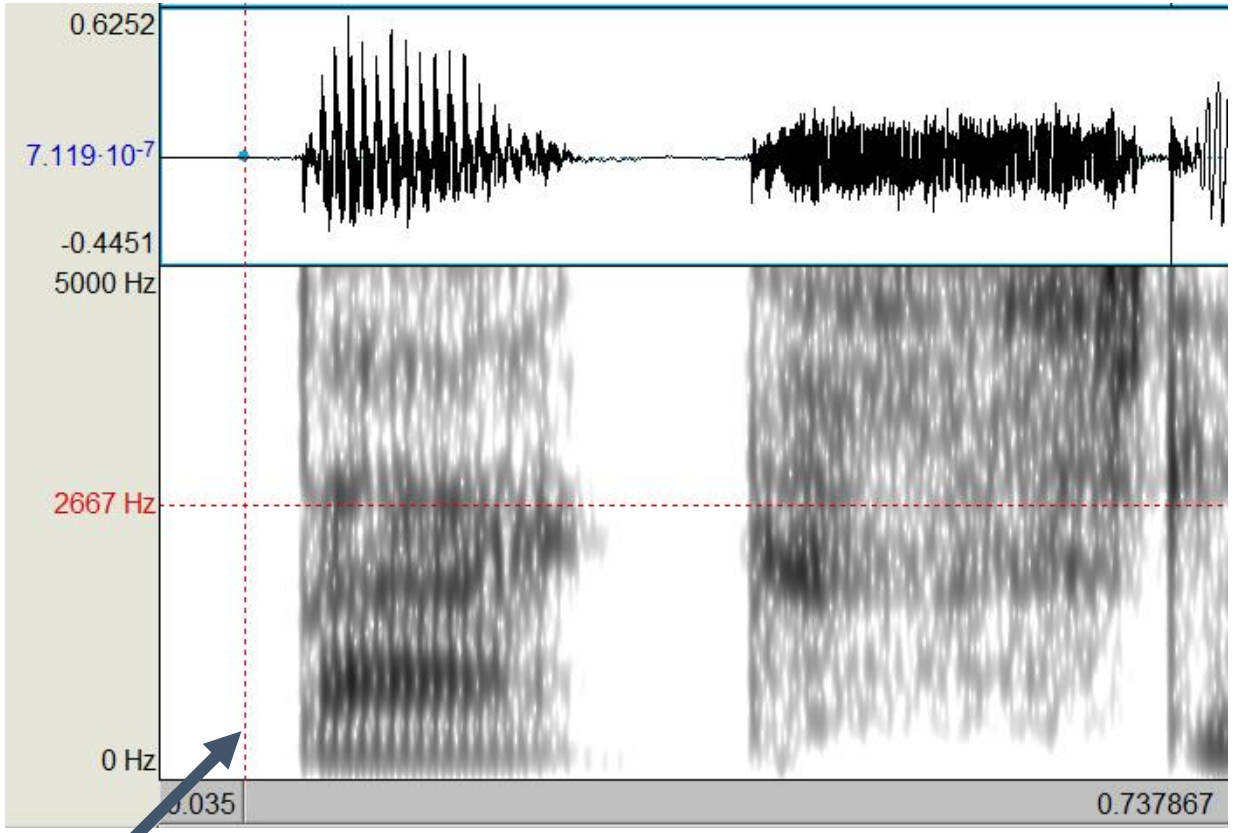


- Spectrum – relative amplitude of frequencies

- The range of audible sound: 16 Hz – 20.000 Hz
- The range we are interested in: up to 5 kHz

Type of oscillation

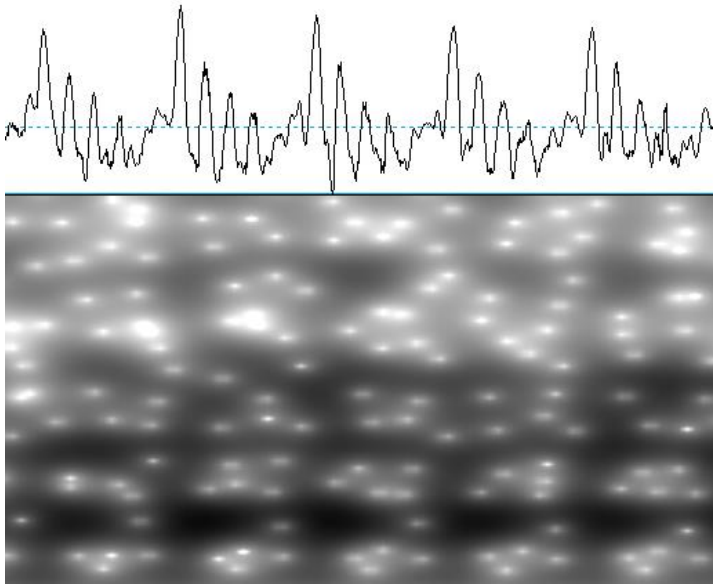


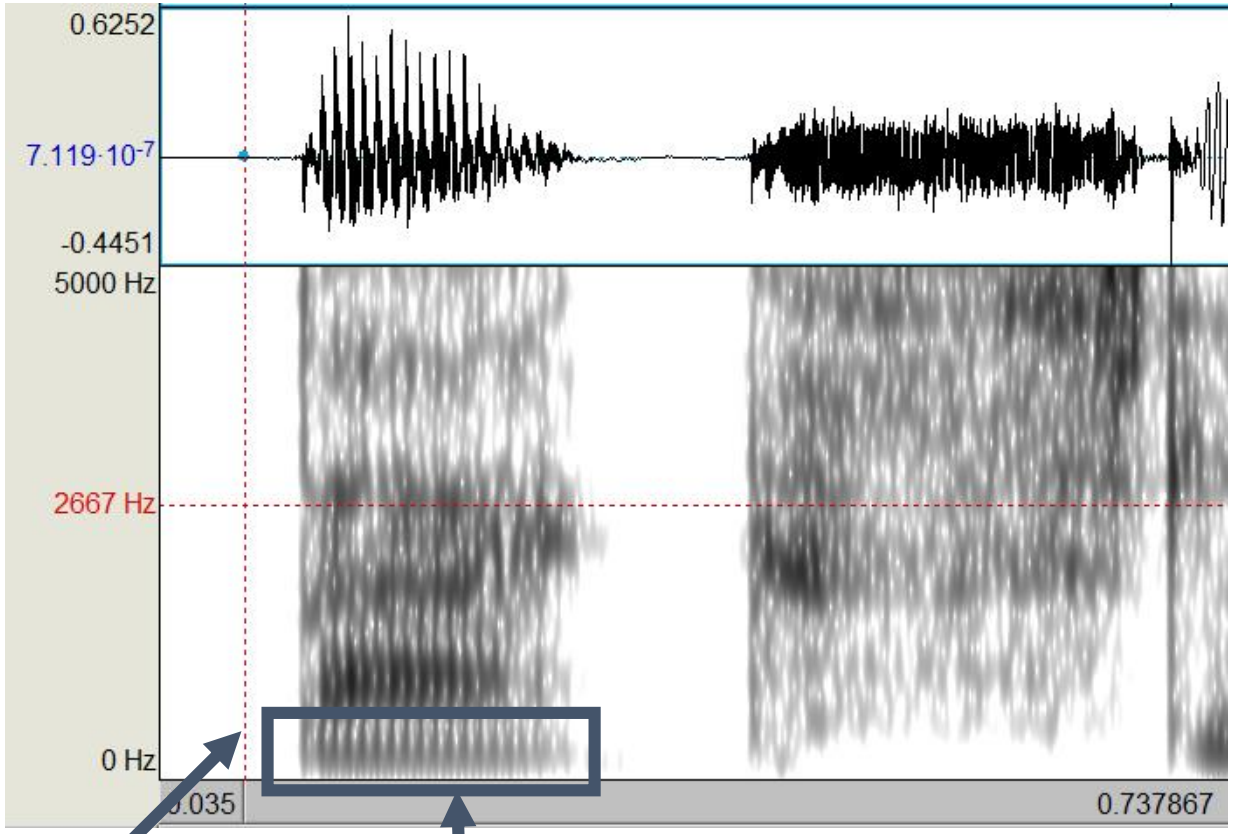


Order, “periodic” oscillations

Chaos, non-periodic oscillations

Where is F_0?

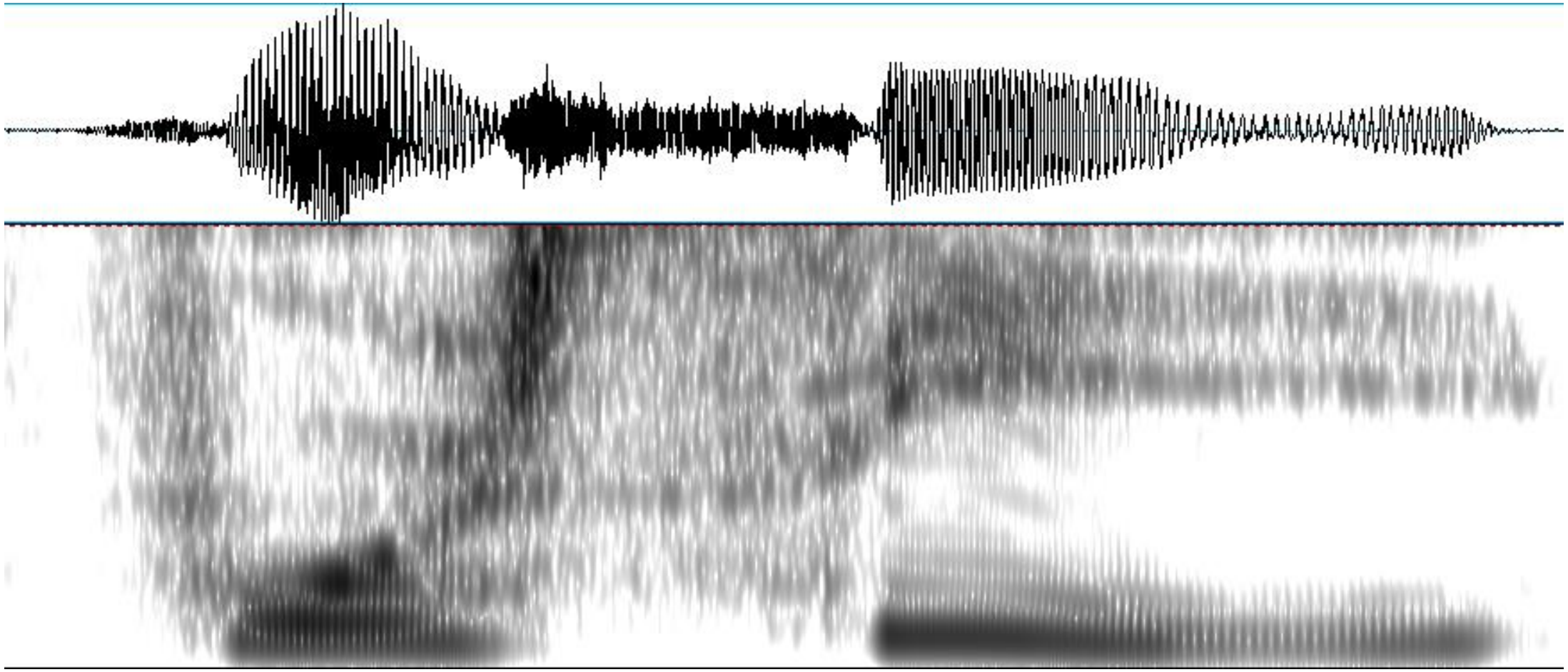




Order, “periodic” oscillations and fundamental frequency (Fo)

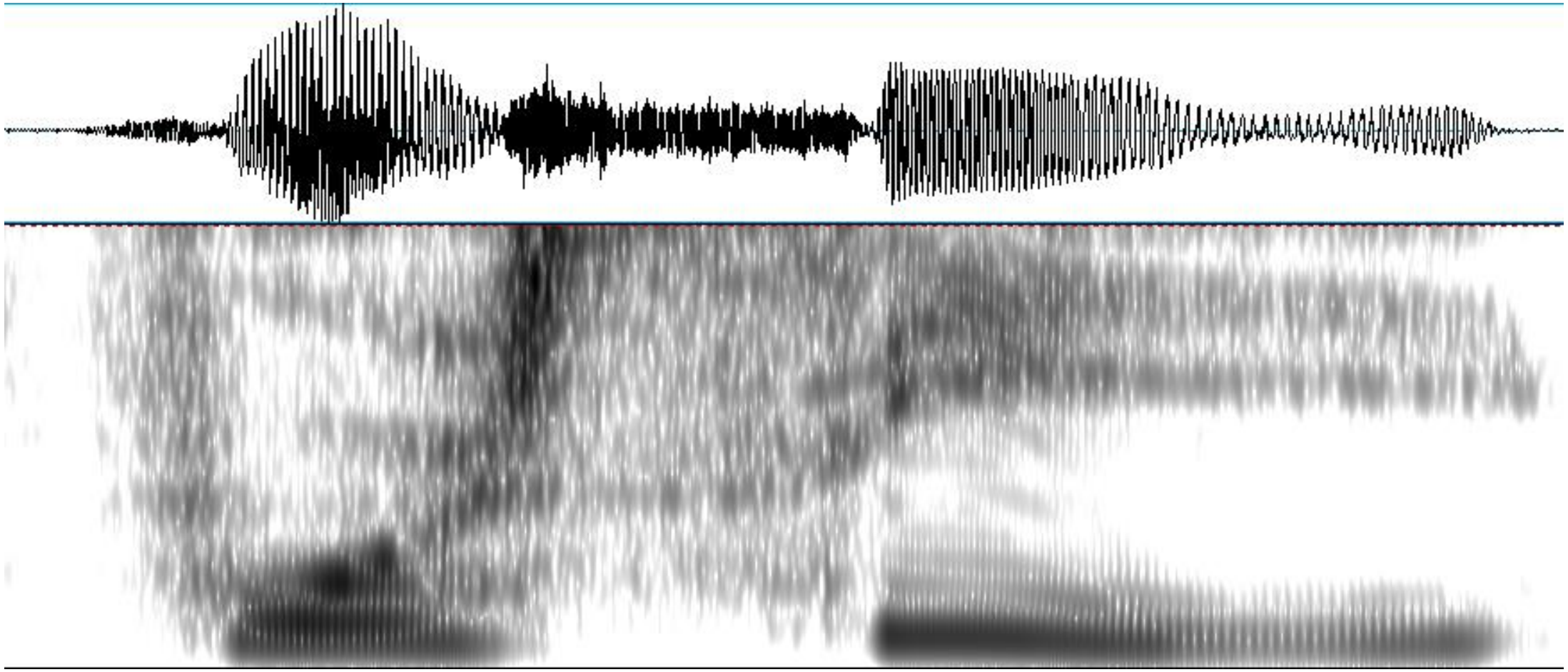
F_0: vowels and voiced consonants

Find periods vs. noise

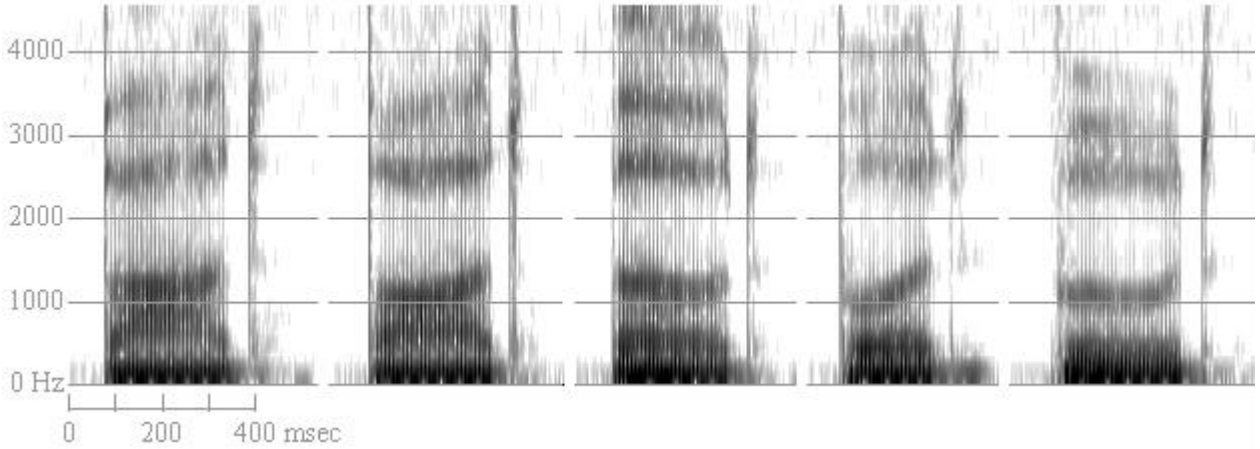


Find periods vs. noise

forsee



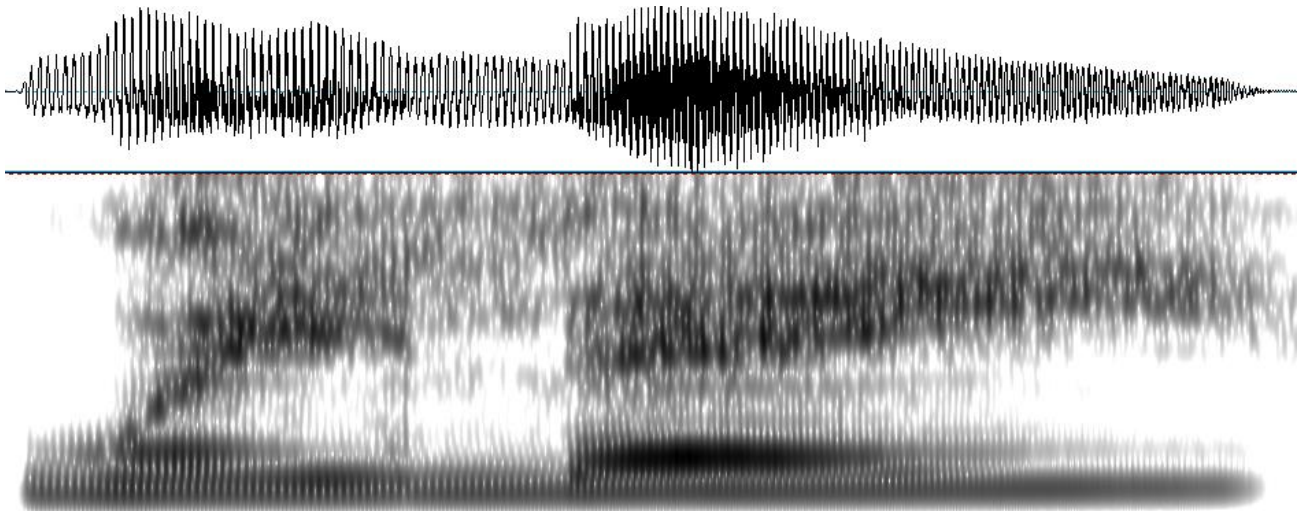
Find vowels



ɑ ɔ o ʊ u

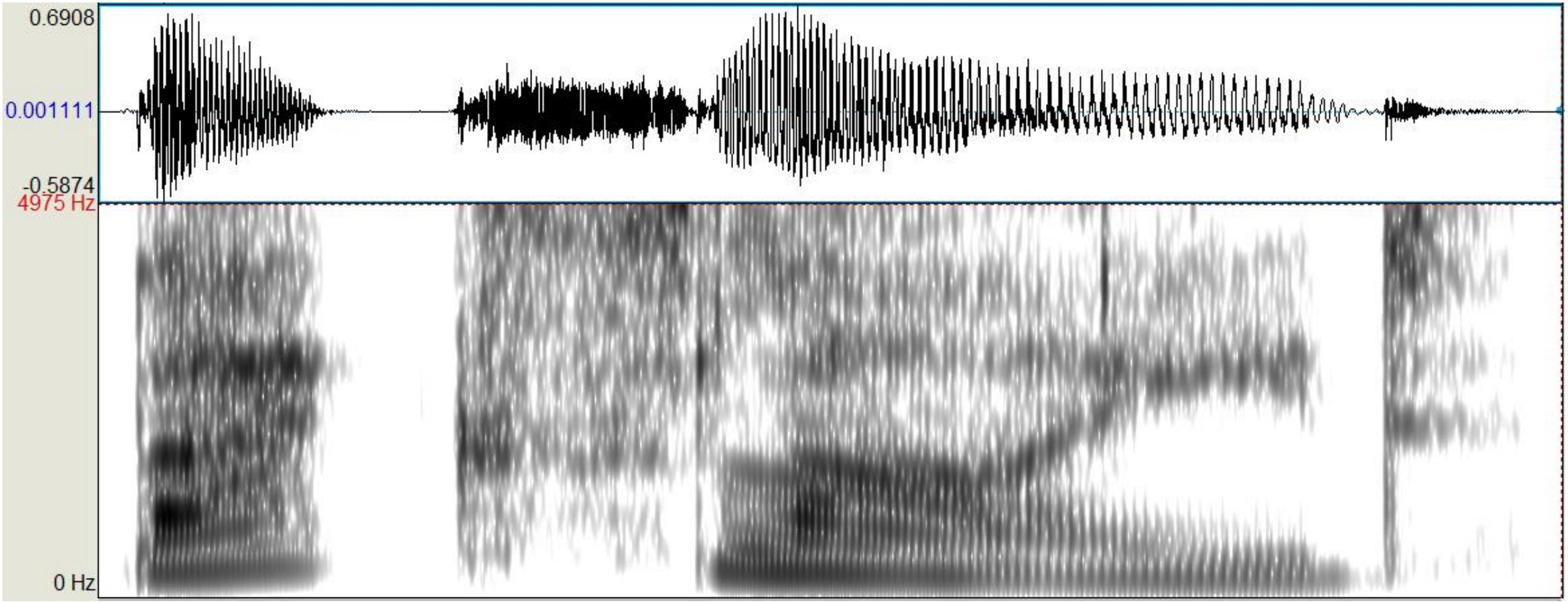
- Formants are the most intensive parts of the spectrum (“worms”)
- We see bright formants in vowels and faint ones in sonorants

waylay

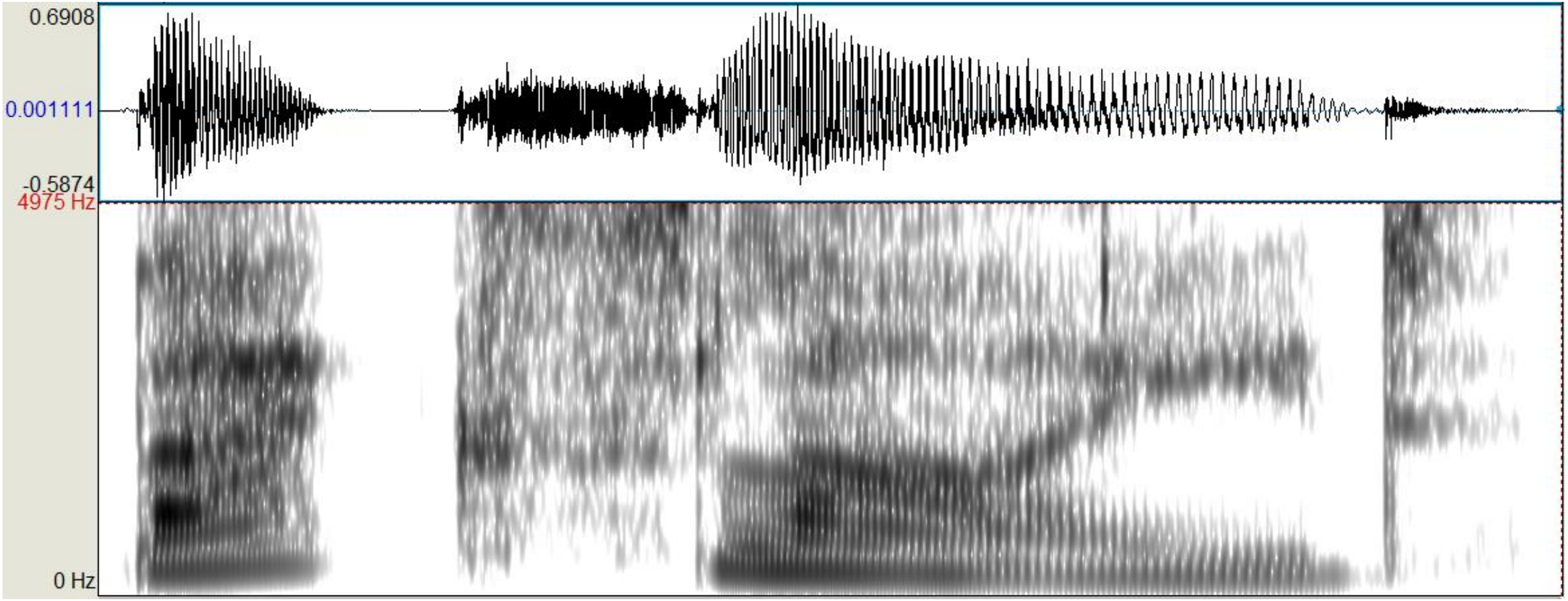


w a y l a y

Find vowels, silence and noise



backslide ‘to return to old, often bad, habits, or to a worse condition’



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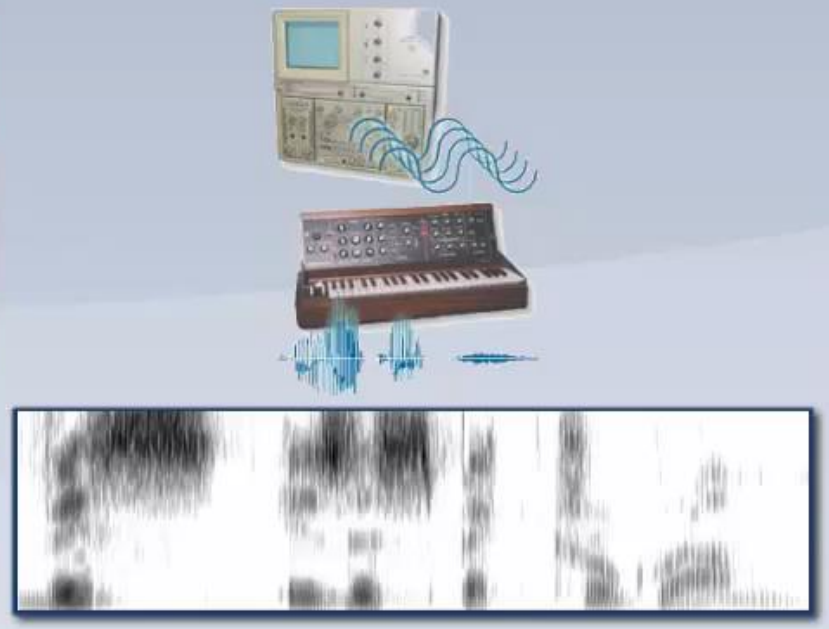
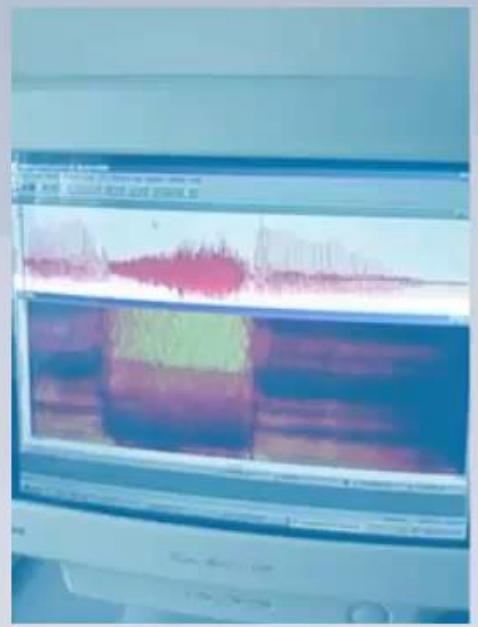
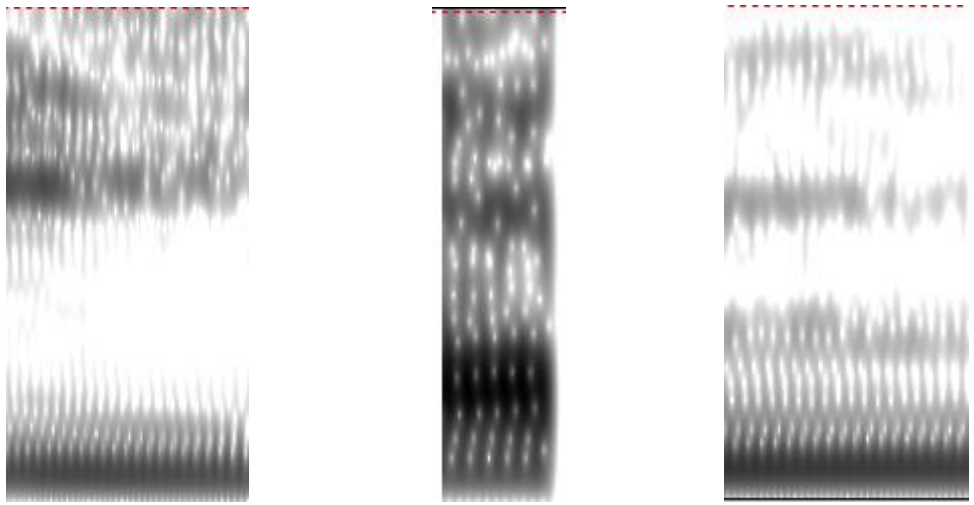




Vowels

Vowels: Articulation and acoustics

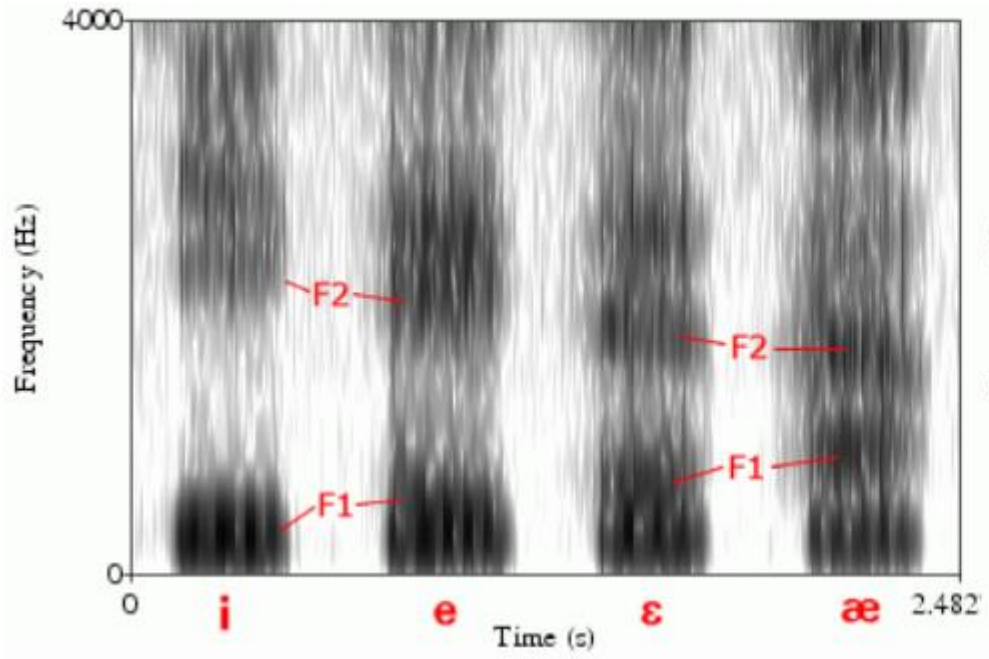
- The larger is the opening, the higher is F1 (height)
- The more front is the tongue, the higher is F2 (backness)
- Roundness lowers F2

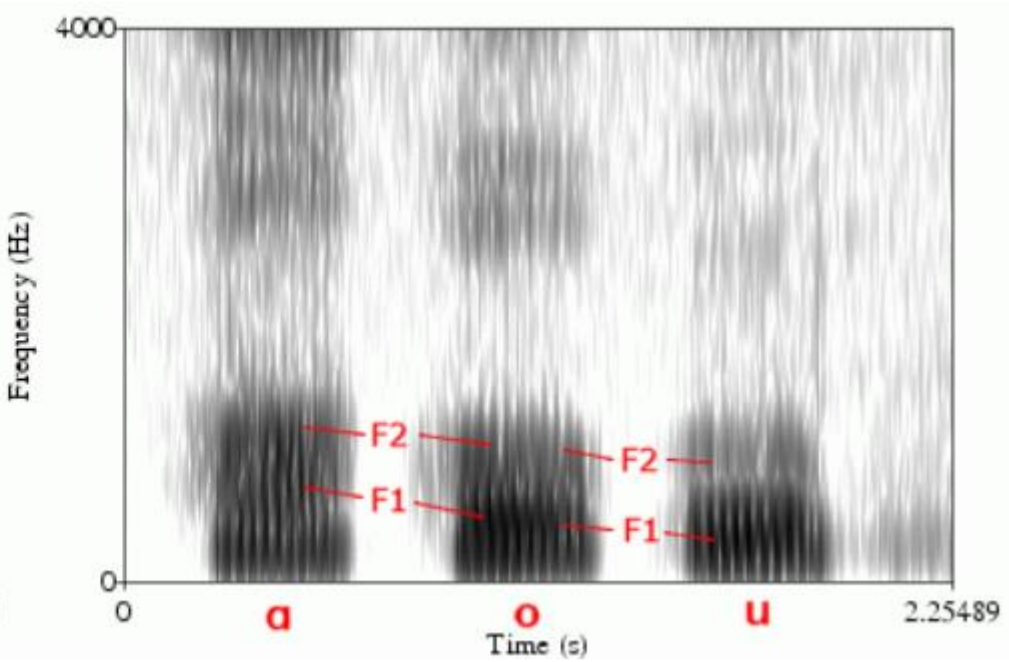


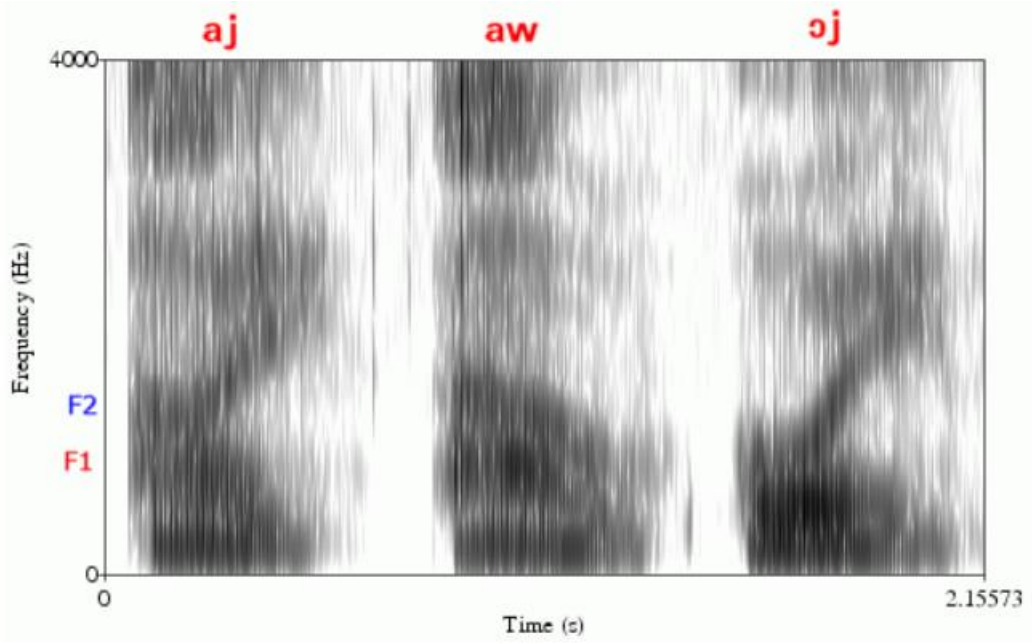
i a u

[i]: F1 F2+F3
[a]: F1+F2 F3
[u]: F1+F2 F3

More pictures







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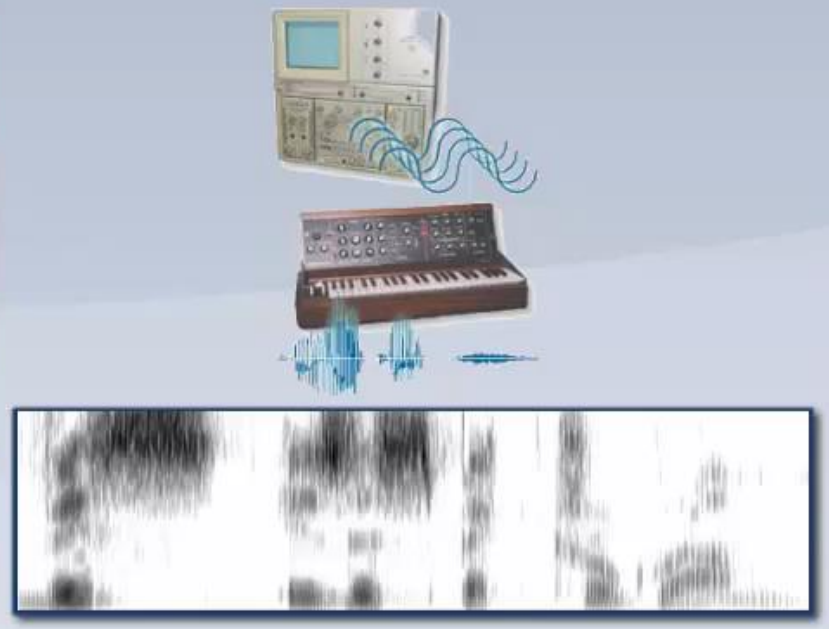
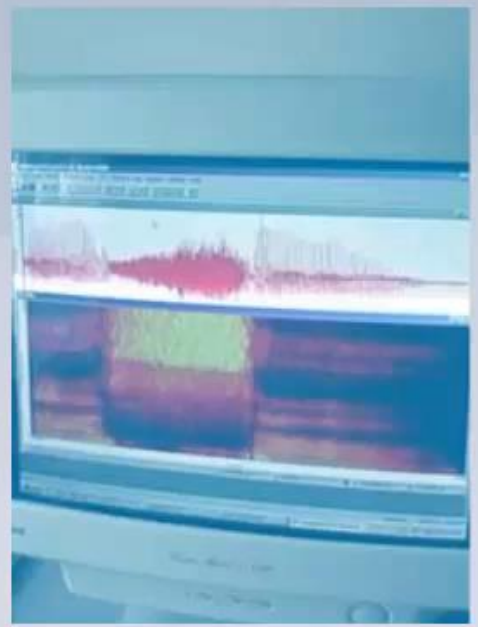




Vowels

Distinguish between consonants

Manner of articulation:

- Obstruents:
  - Stops
  - Fricatives
  - Affricates
- Sonorants:
  - Approximants
  - Nasals
  - Laterals
  - Rhotics

Place of articulation:

- Labials
- Alveorals
- Palatals
- Velars

The noise/formant structure

Formant transitions in vowels

Obstruents. Stops

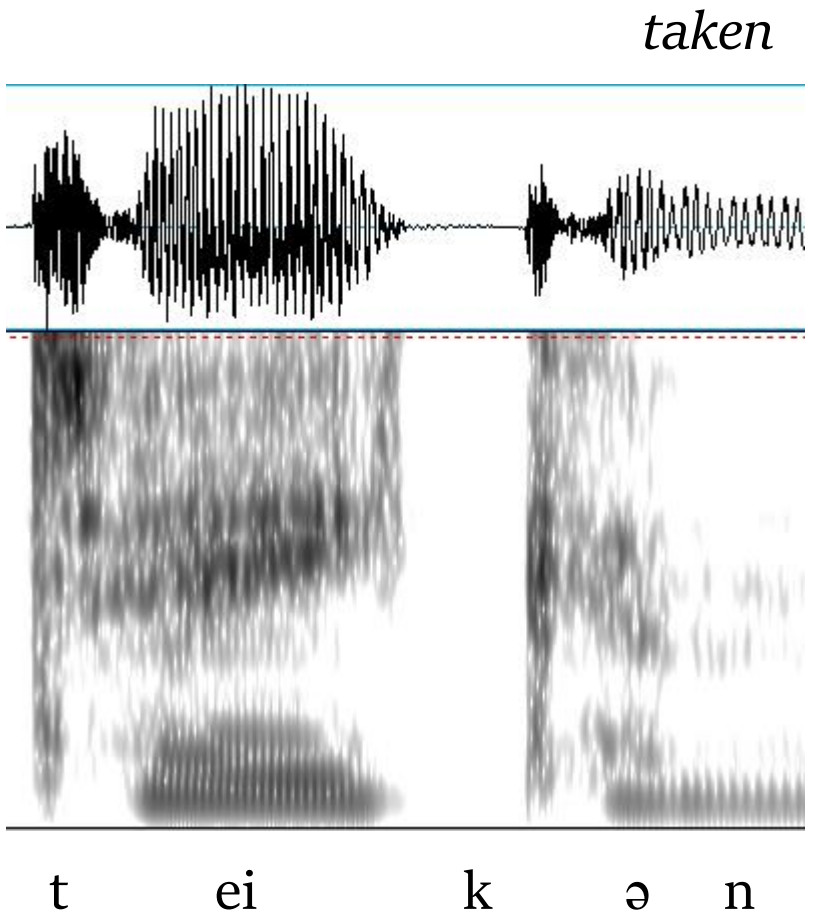
Stops: closure (silence) + burst

Aspirated stops: closure (silence) + burst + h (voiceless vowel)

Labial stops [p b]: long closure, short faint burst

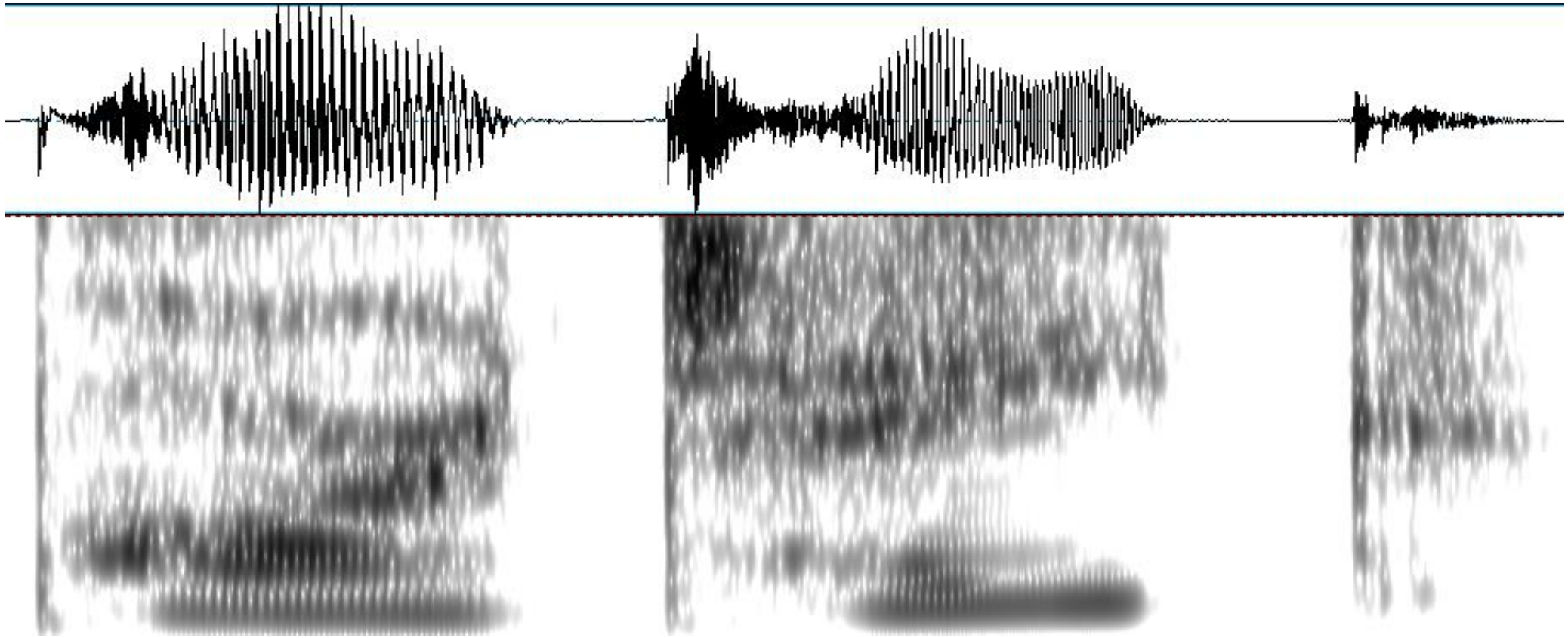
Velar stops [k g]: short closure, long noisy burst (or 2-3 bursts)

Alveolar stops [t d]: somewhere in between



Obstruents. Stops

partake



p ar t ei k

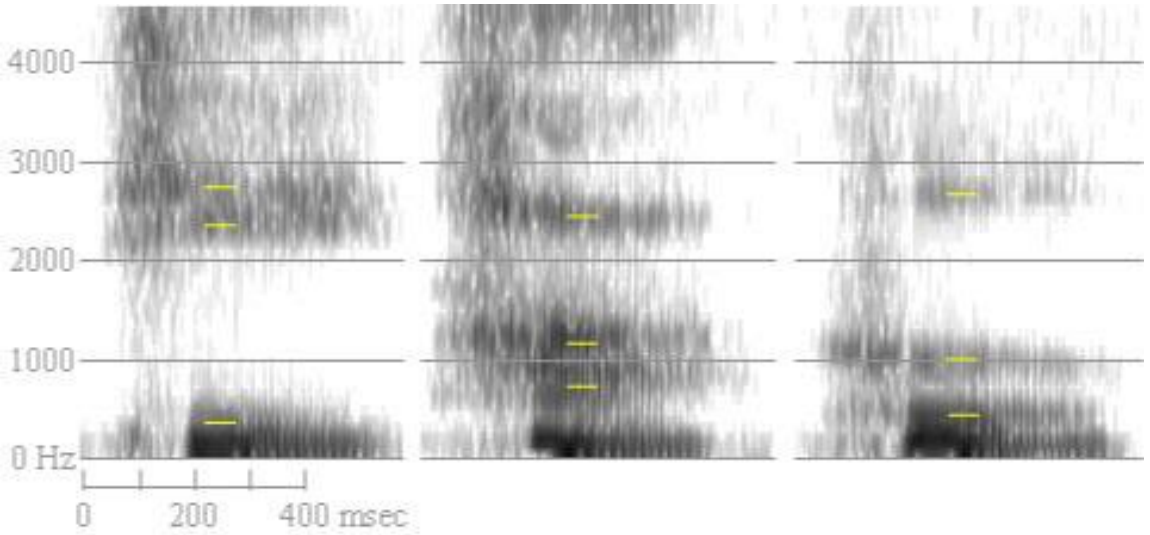
Obstruents. Fricatives

Fricatives: fricative noise

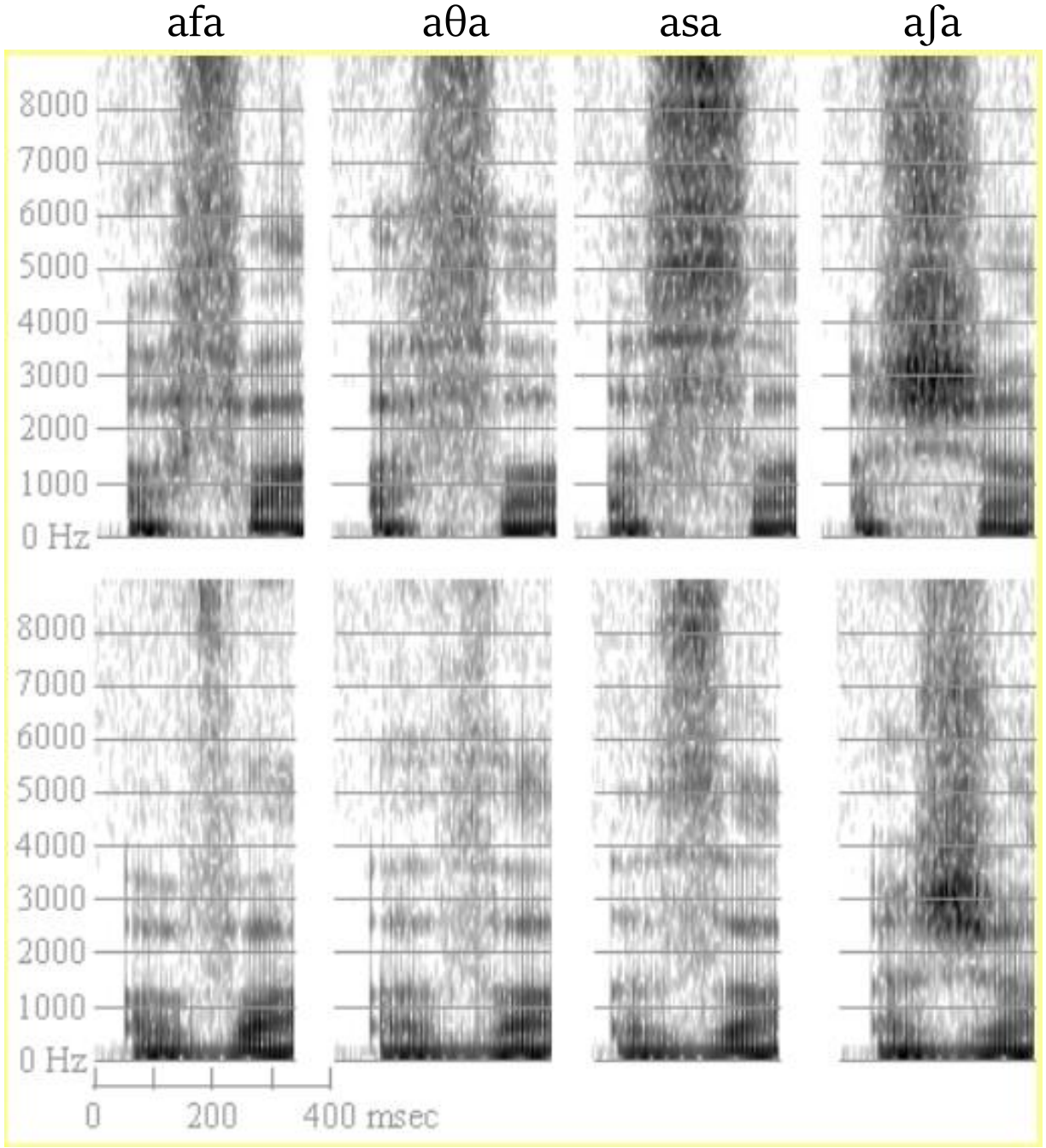
Sibilants [s z ʃ ʒ]: high speed airflow faces the teeth
high intensity, high frequency

Non-sibilants [f v θ]: less intensive, low intensity throughout the spectrum

Obstruents. Fricatives



hi ha hu



ava aða aza aʒa

[U.ofManitoba]

Obstruents. Affricates

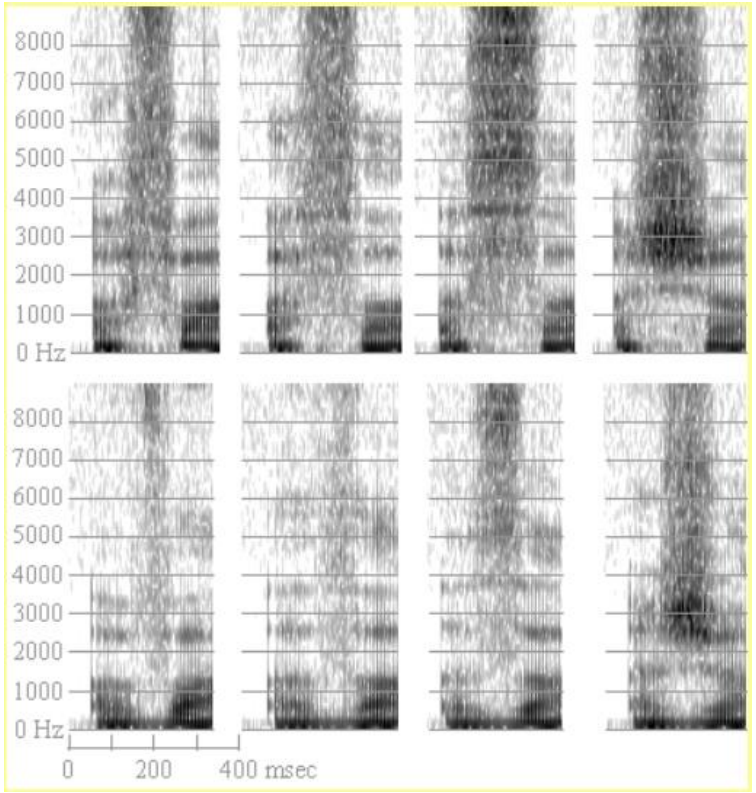
Affricates: closure (silence) + burst + fricative noise

Sibilants [ts dʒ ʧ]: high speed airflow faces the teeth
high intensity, high frequency

Affricates' closure is shorter than that of stops

Affricates' noise is shorter than that of fricatives

Important for all obstruents: voiced are less noisy!

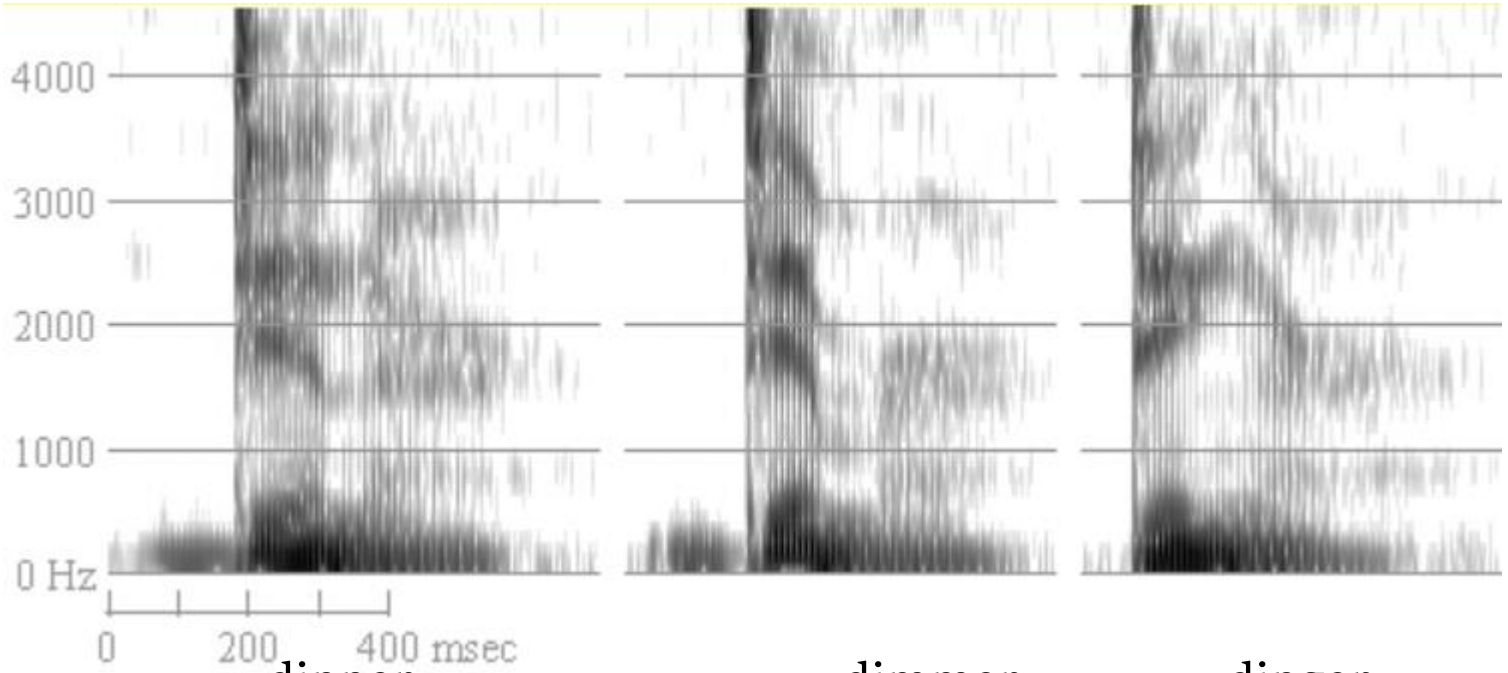


Sonorants: very complicated

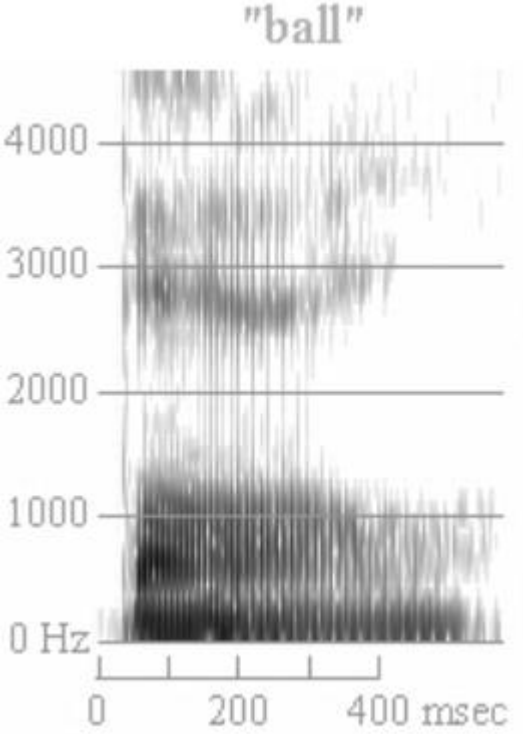
Approximants: like vowels, faint formants (F2 and higher)

Nasals: faint F2, additional 200-300 Hz formant

Laterals: “a window” with silence



dinner dimmer dinger



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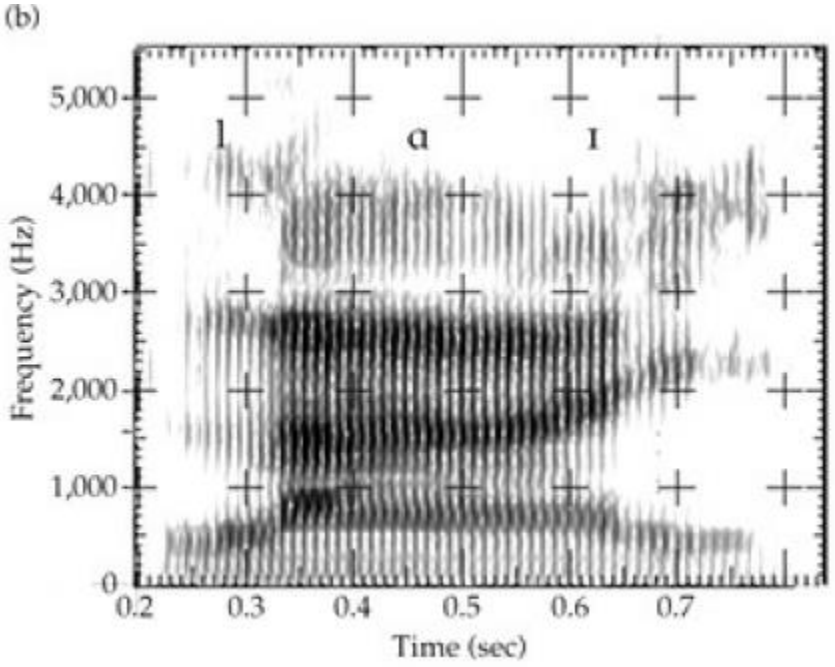
Sonorants: very complicated



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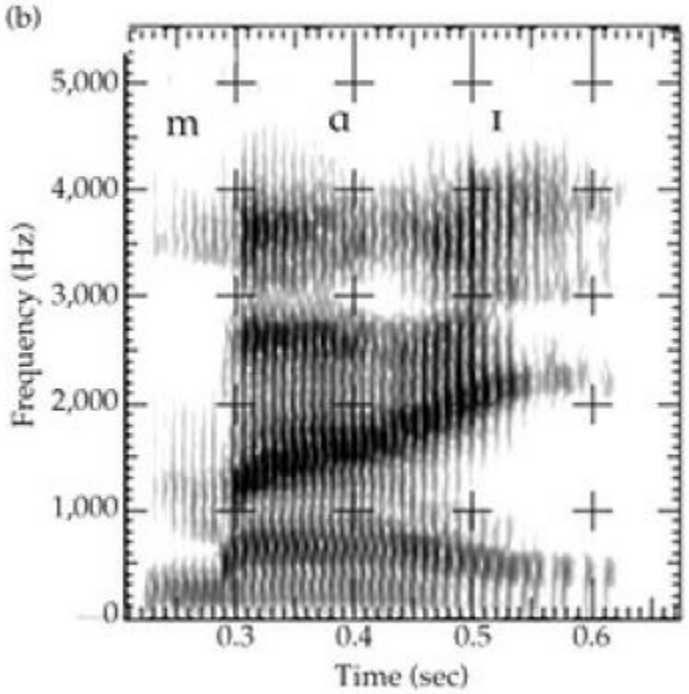

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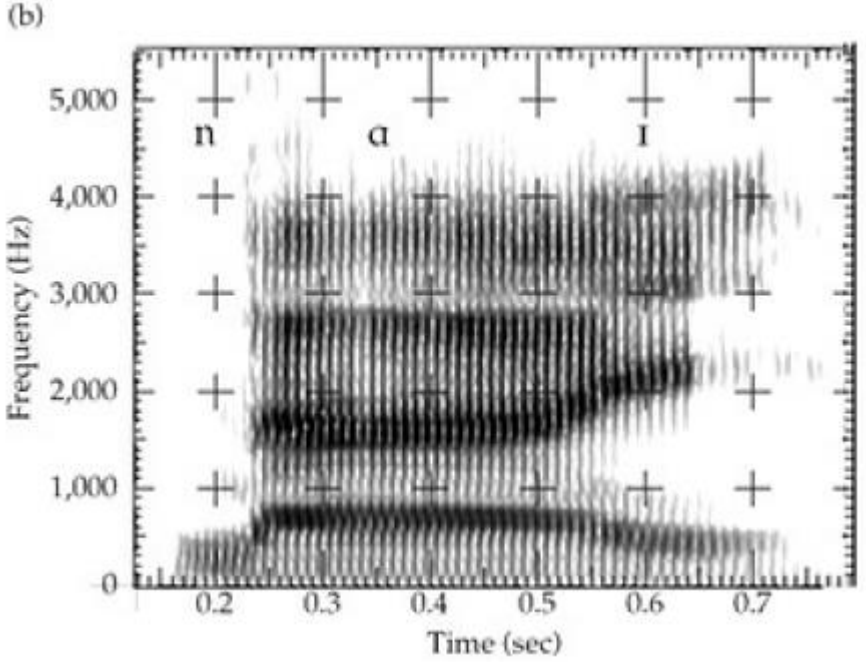

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Johnson 2012

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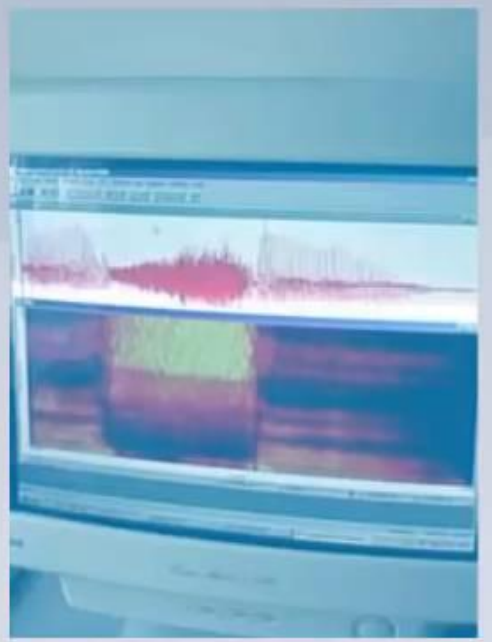
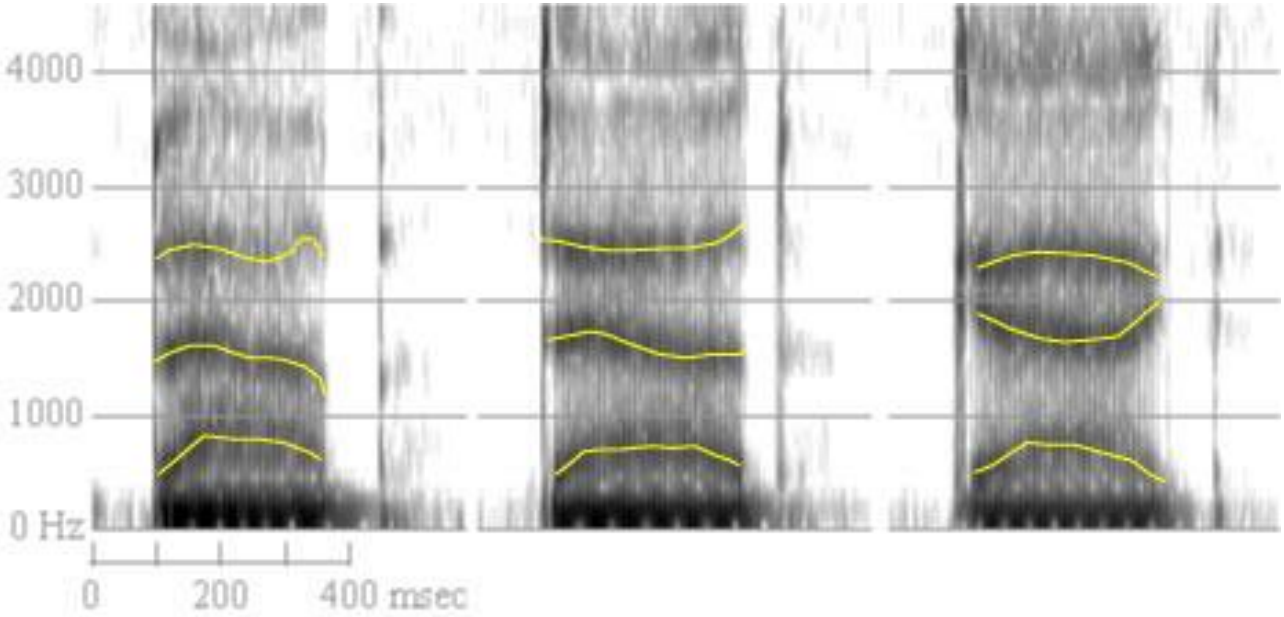


Consonants

Formant transitions



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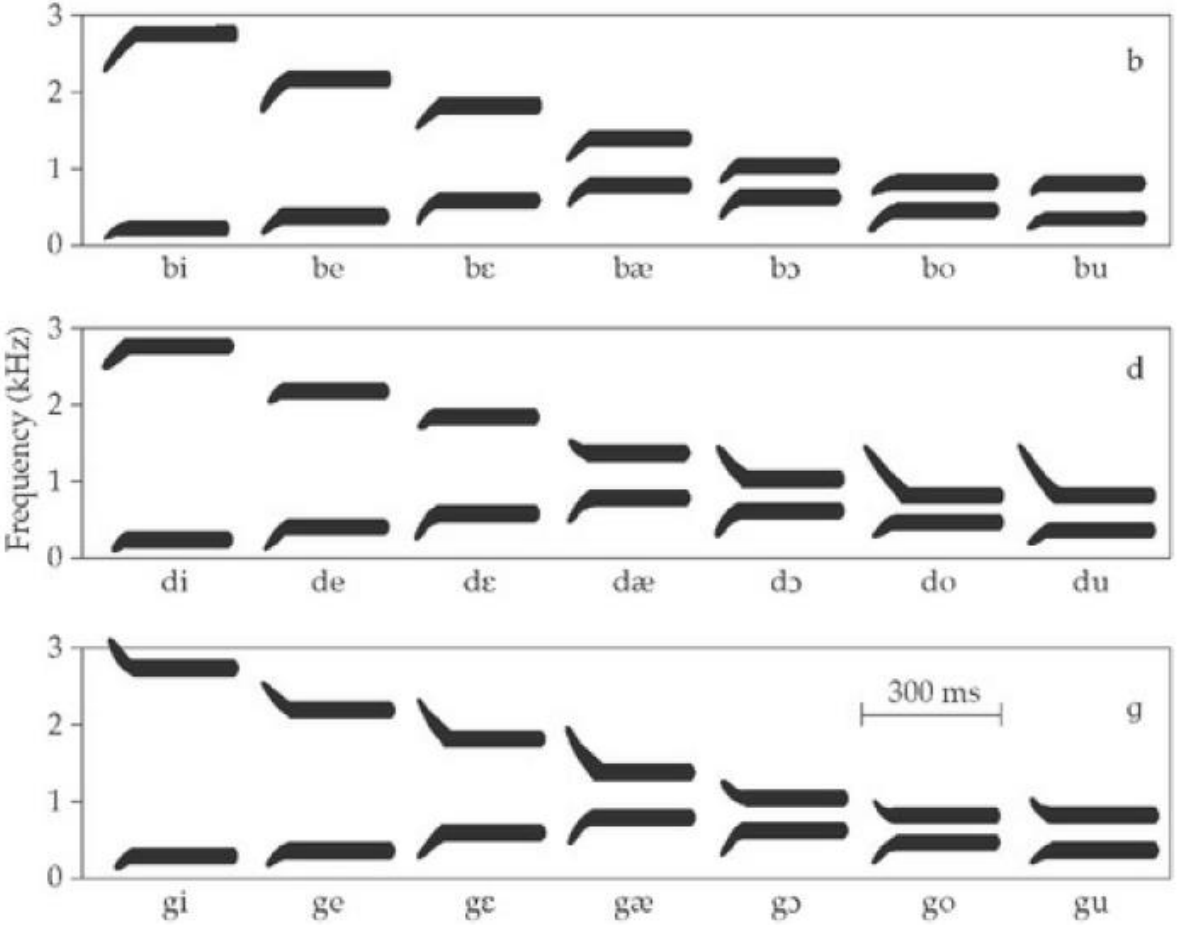
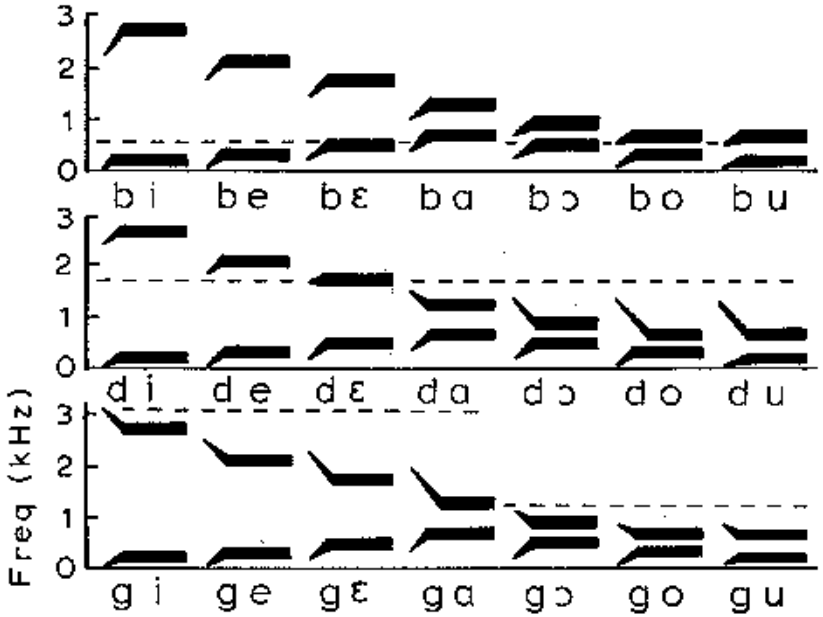
bab dad gag



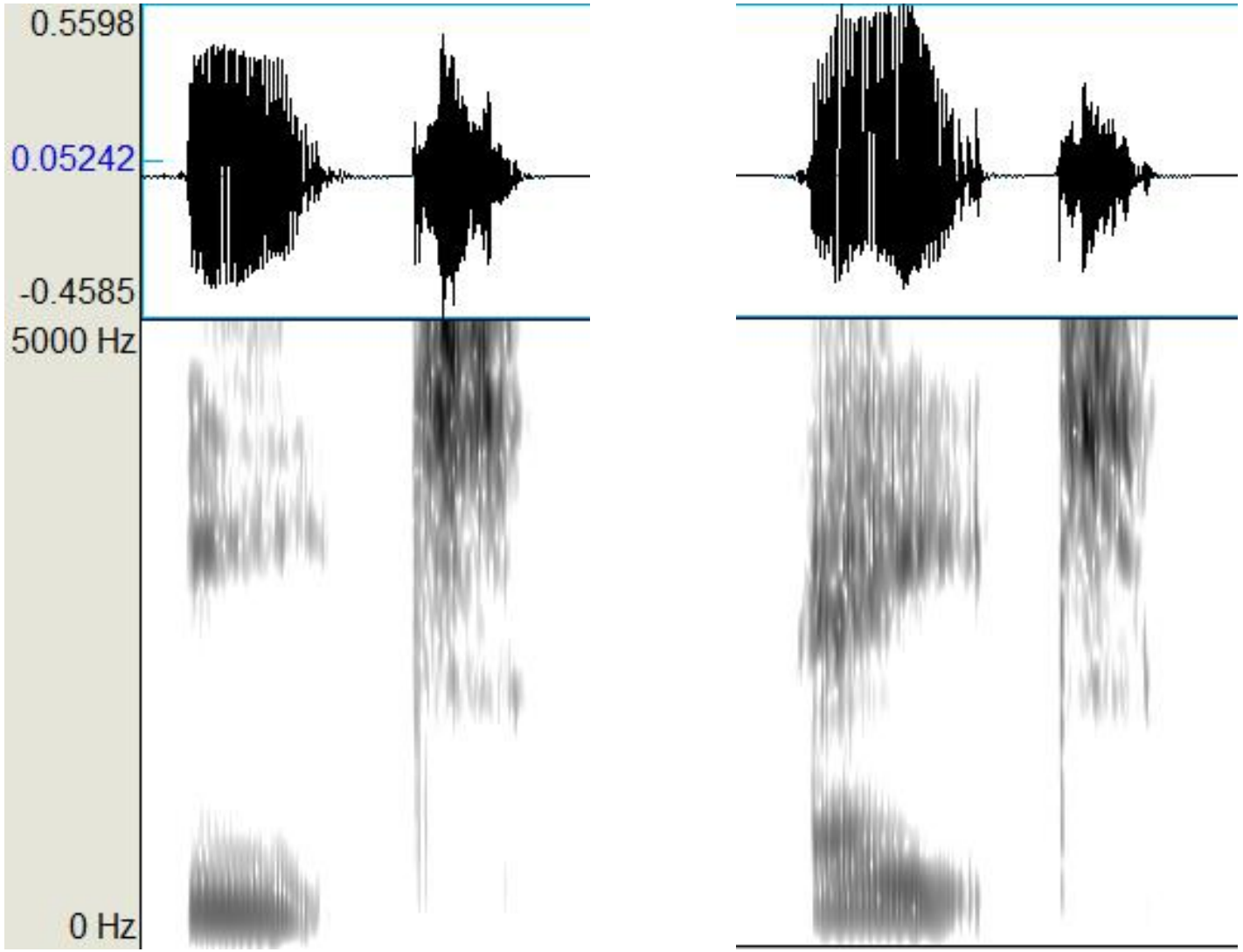


Delattre 1955

How we read spectrograms

1. Find vowels, guess about syllables
2. Find acoustic events (changes): silence / burst / fricative noise / formants + fricative noise
3. Go from the beginning rightwards or start with the segments you are sure of. Guess what are the segments
4. Find the combination that makes sense
5. Brilliant!

Infinitive and Past Simple forms



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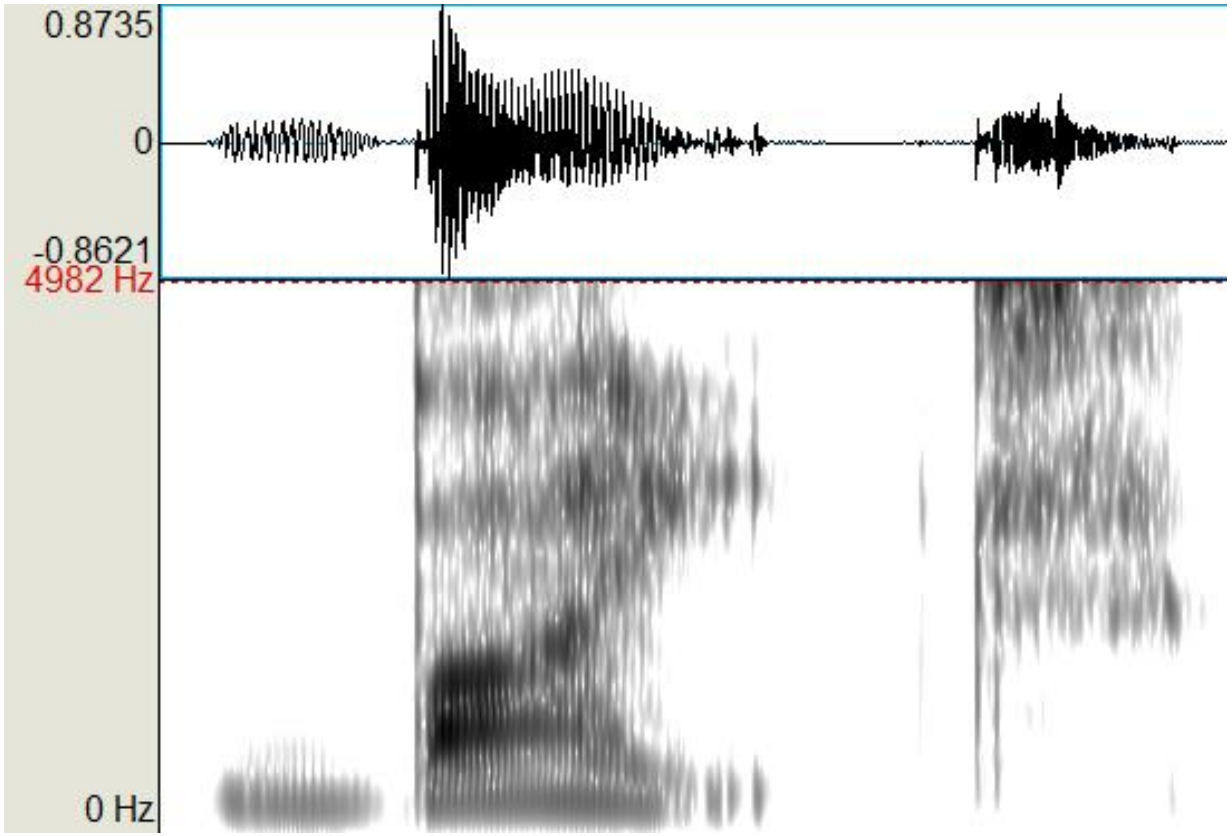

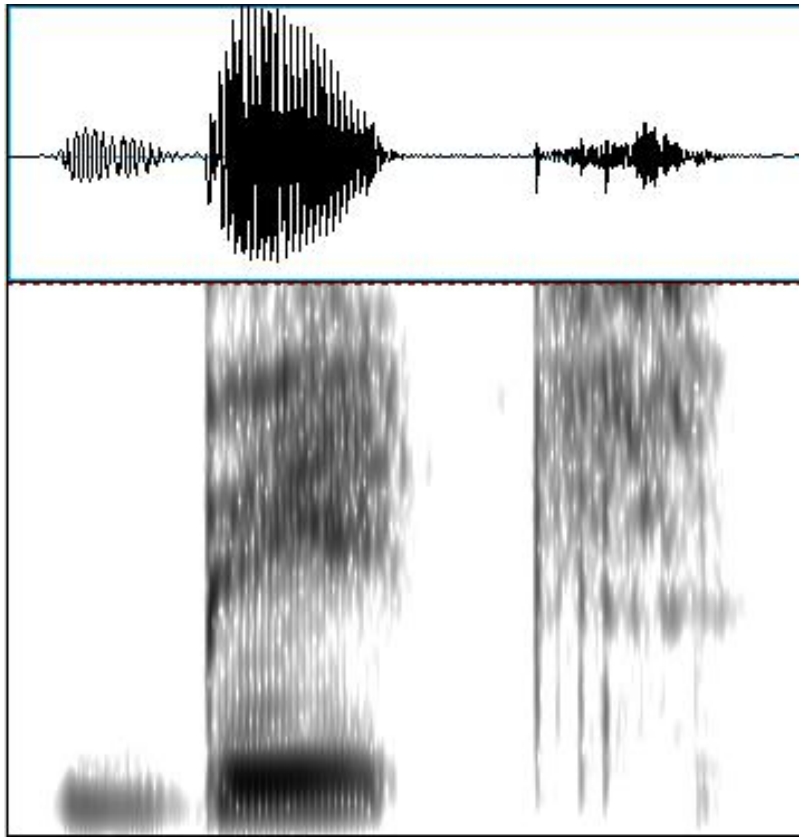

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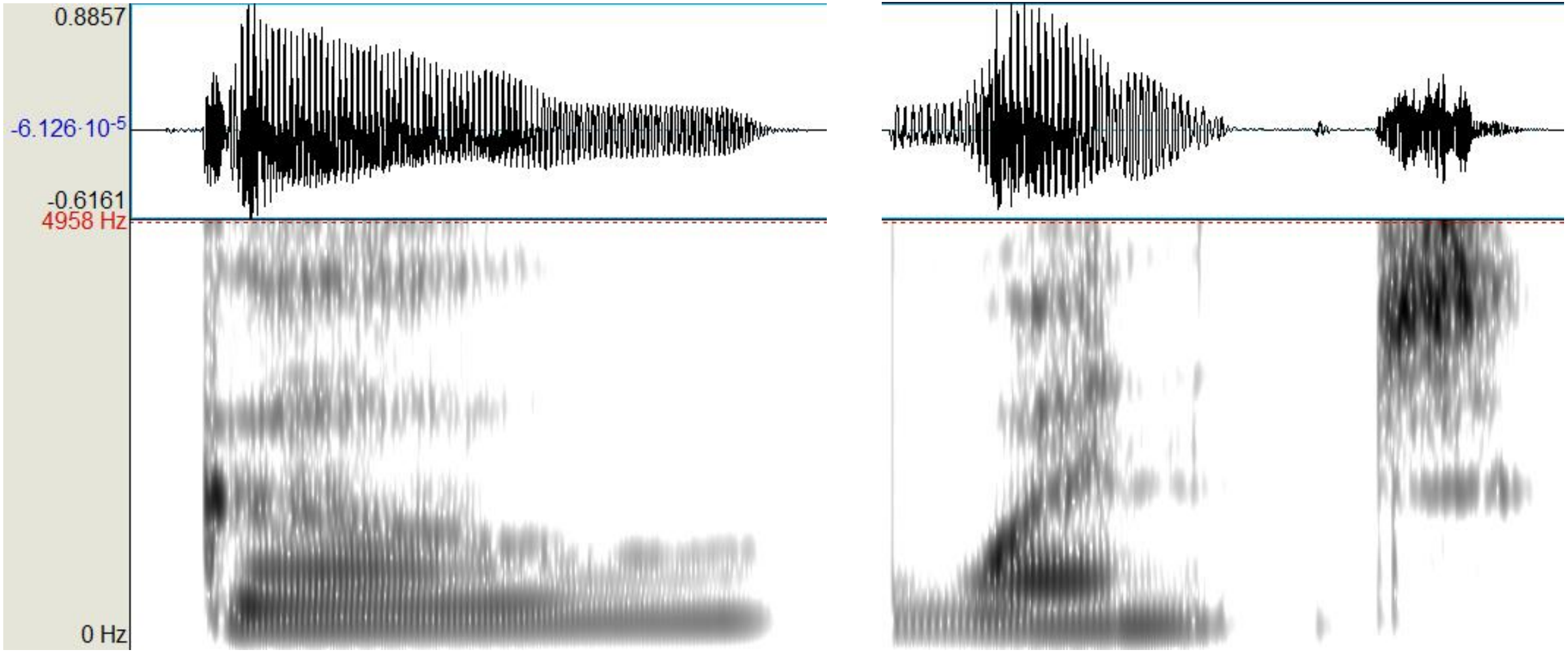

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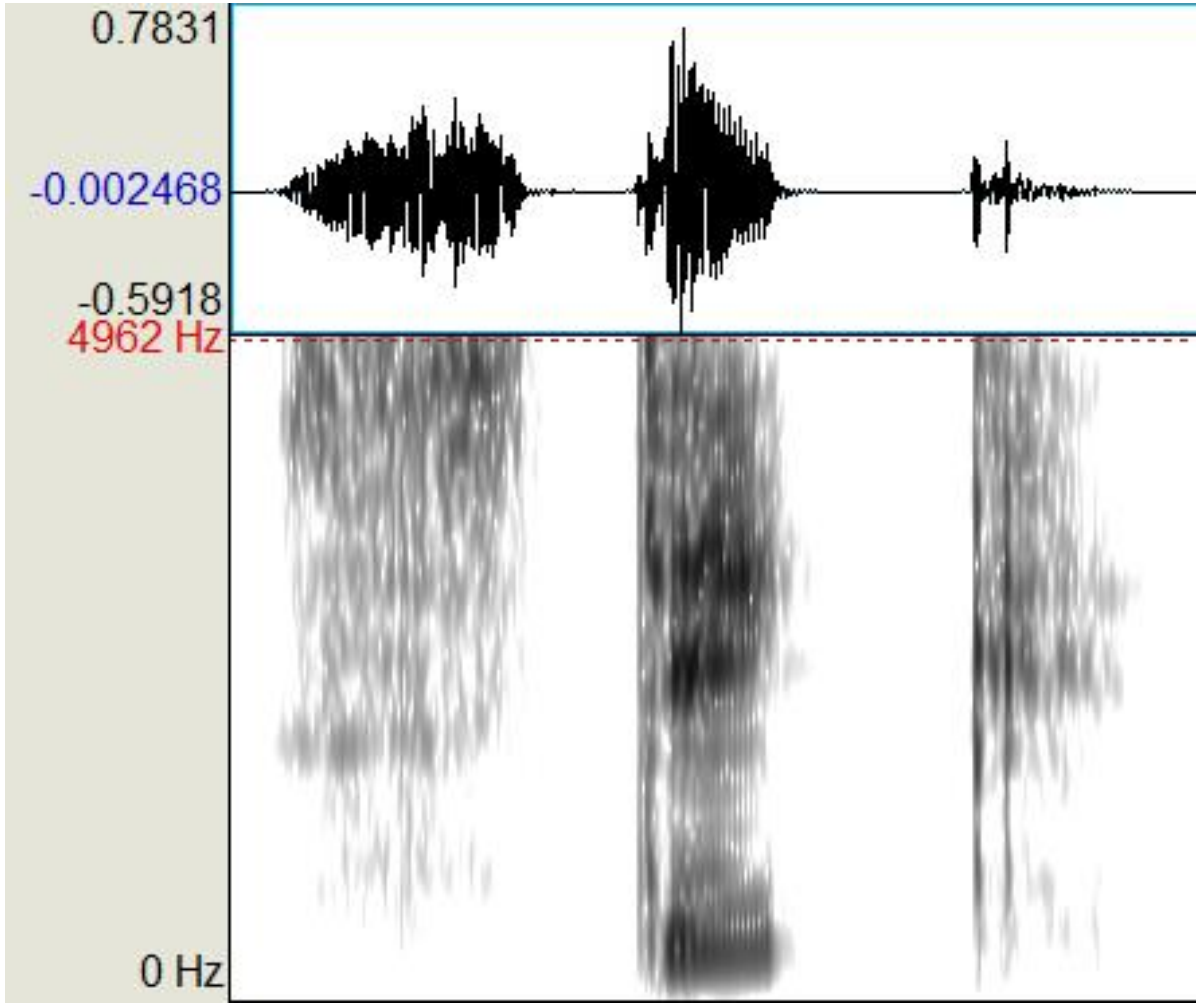
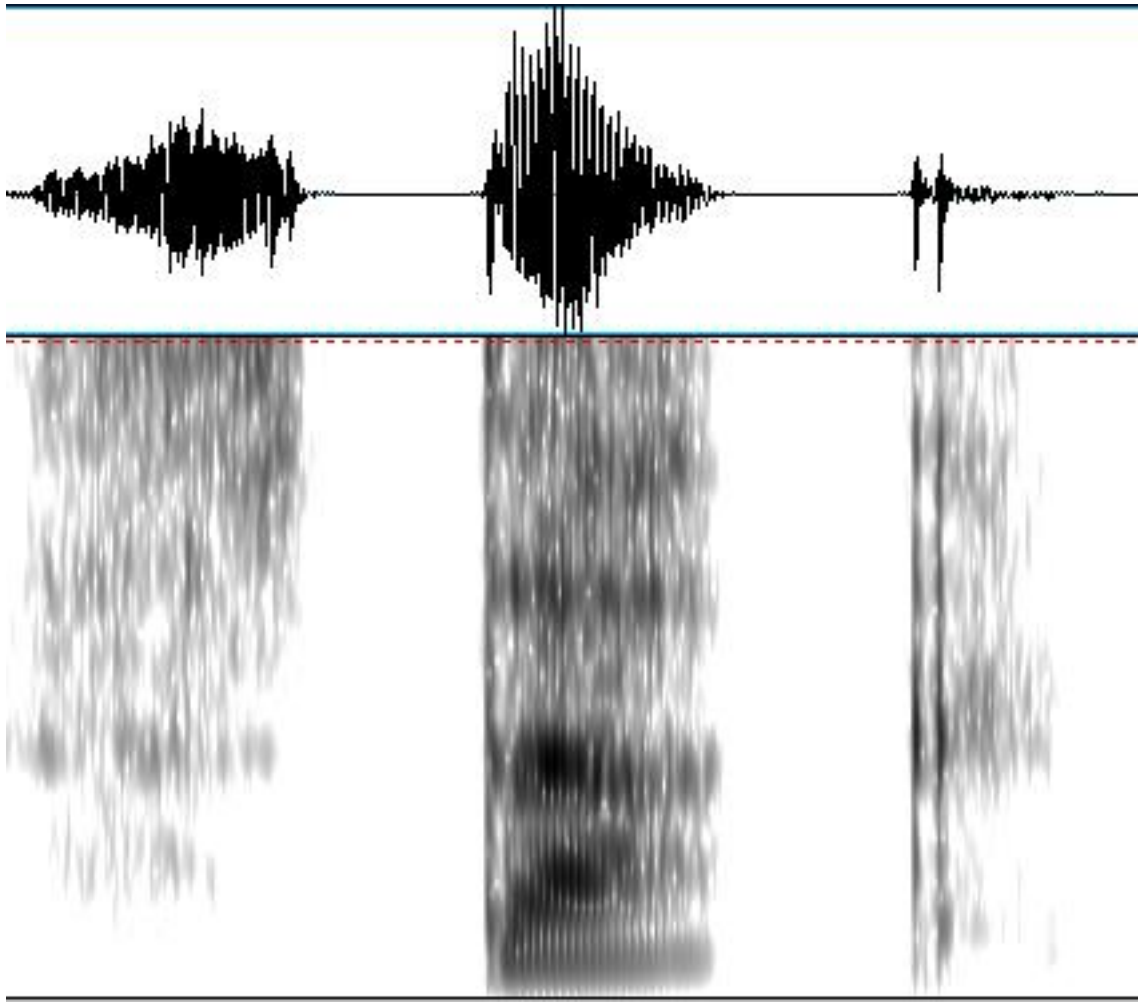
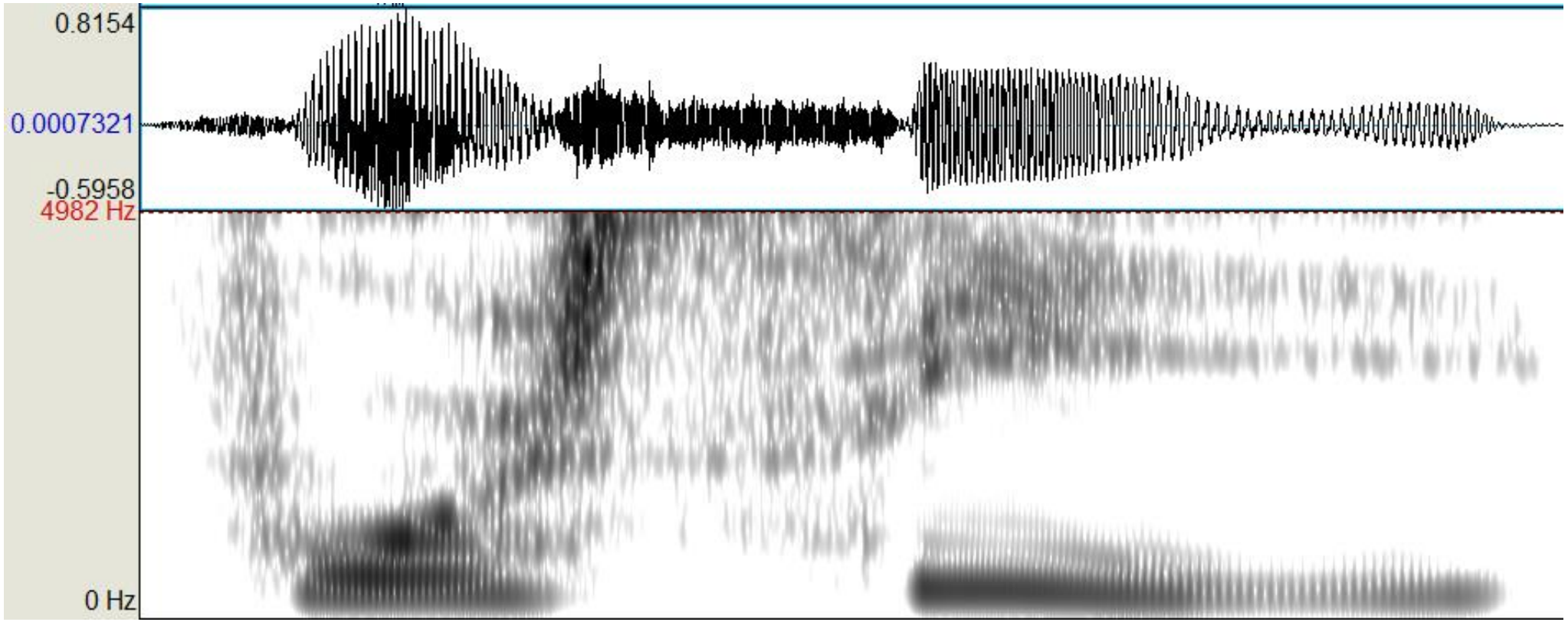




Infinitive



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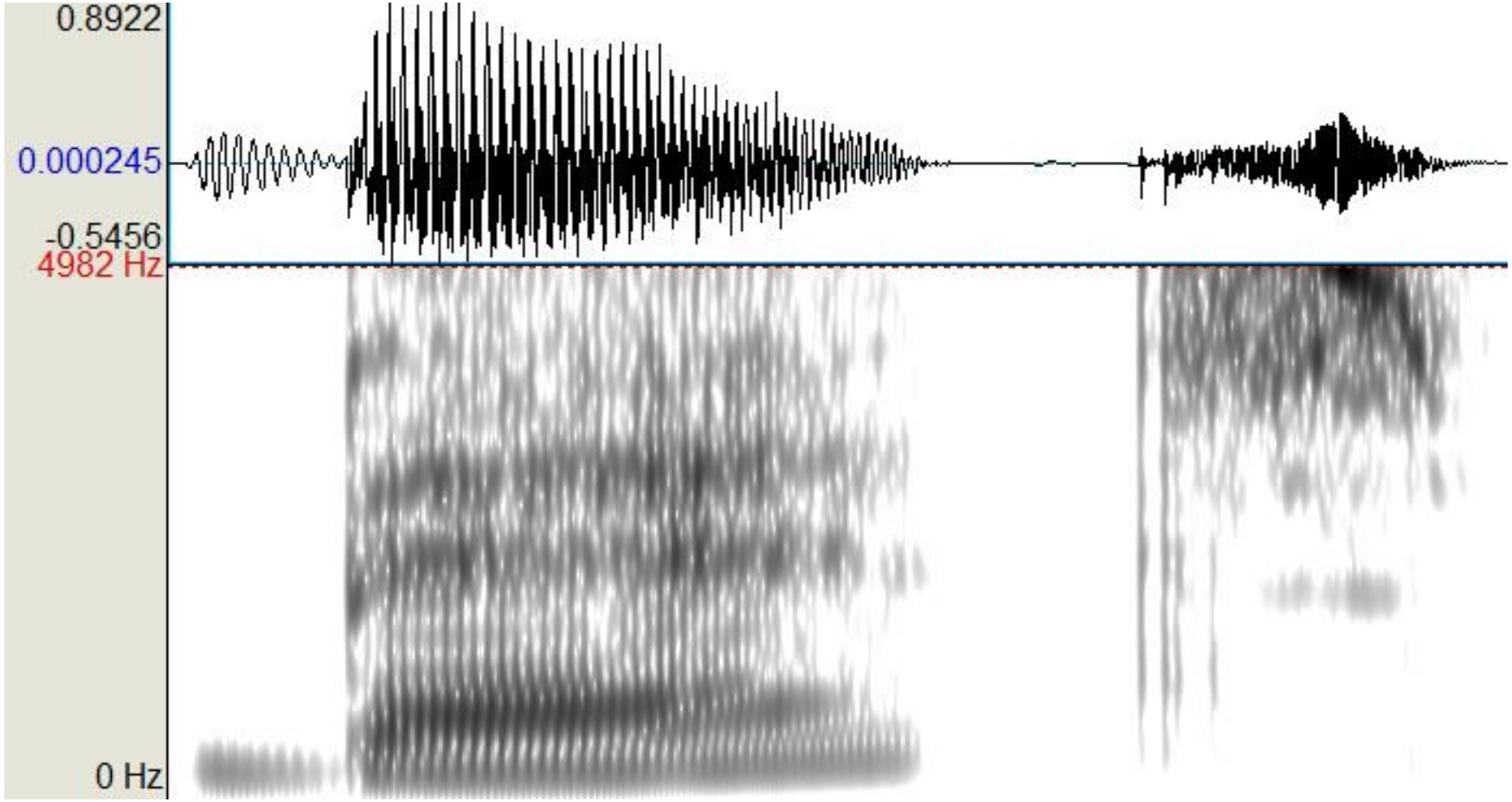

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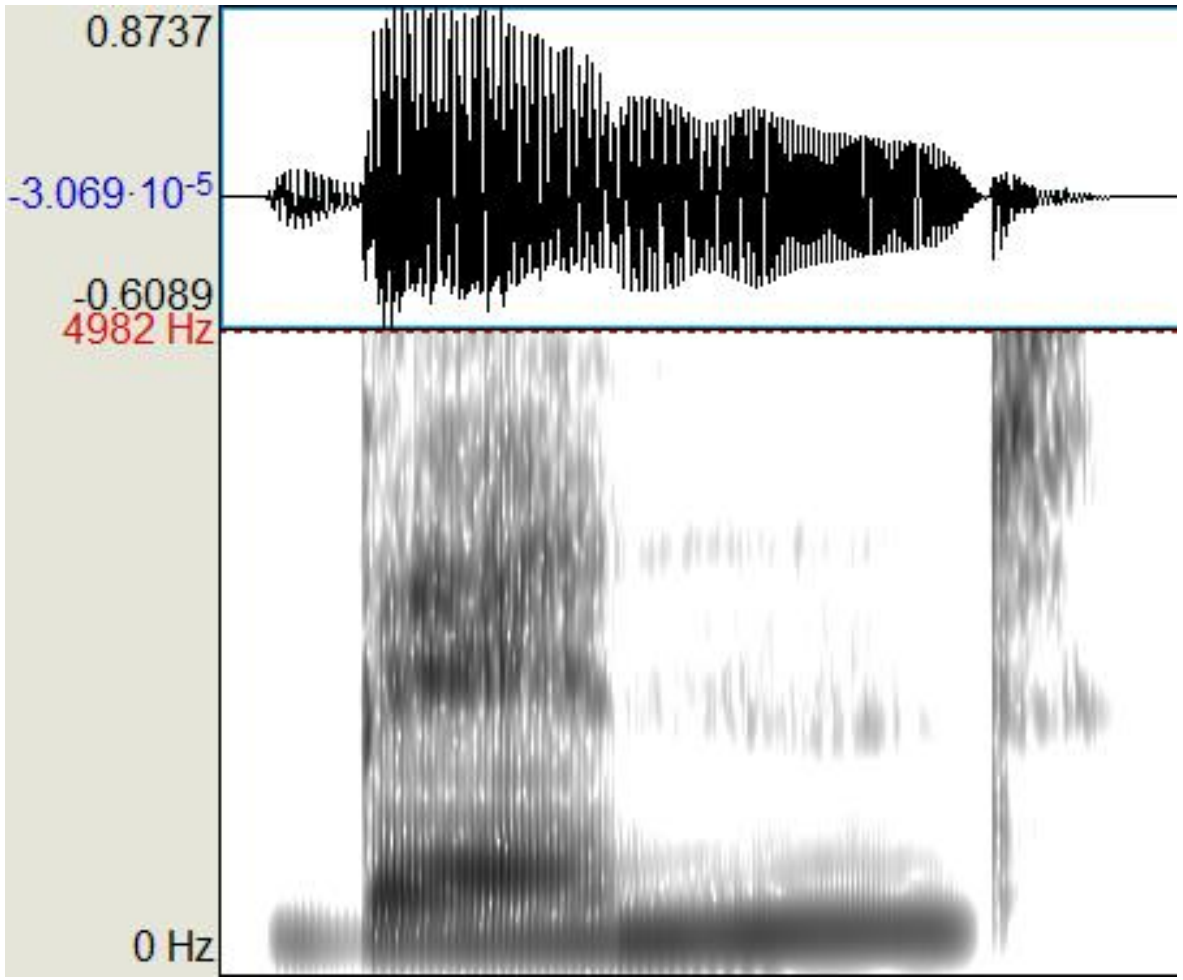

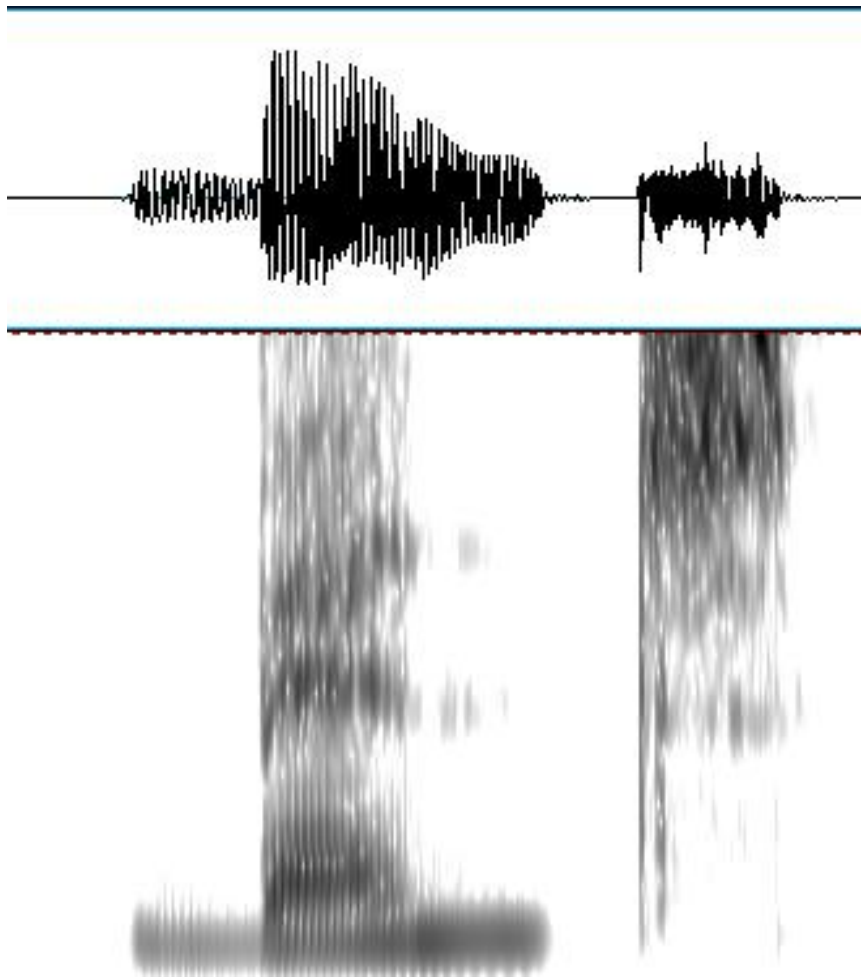

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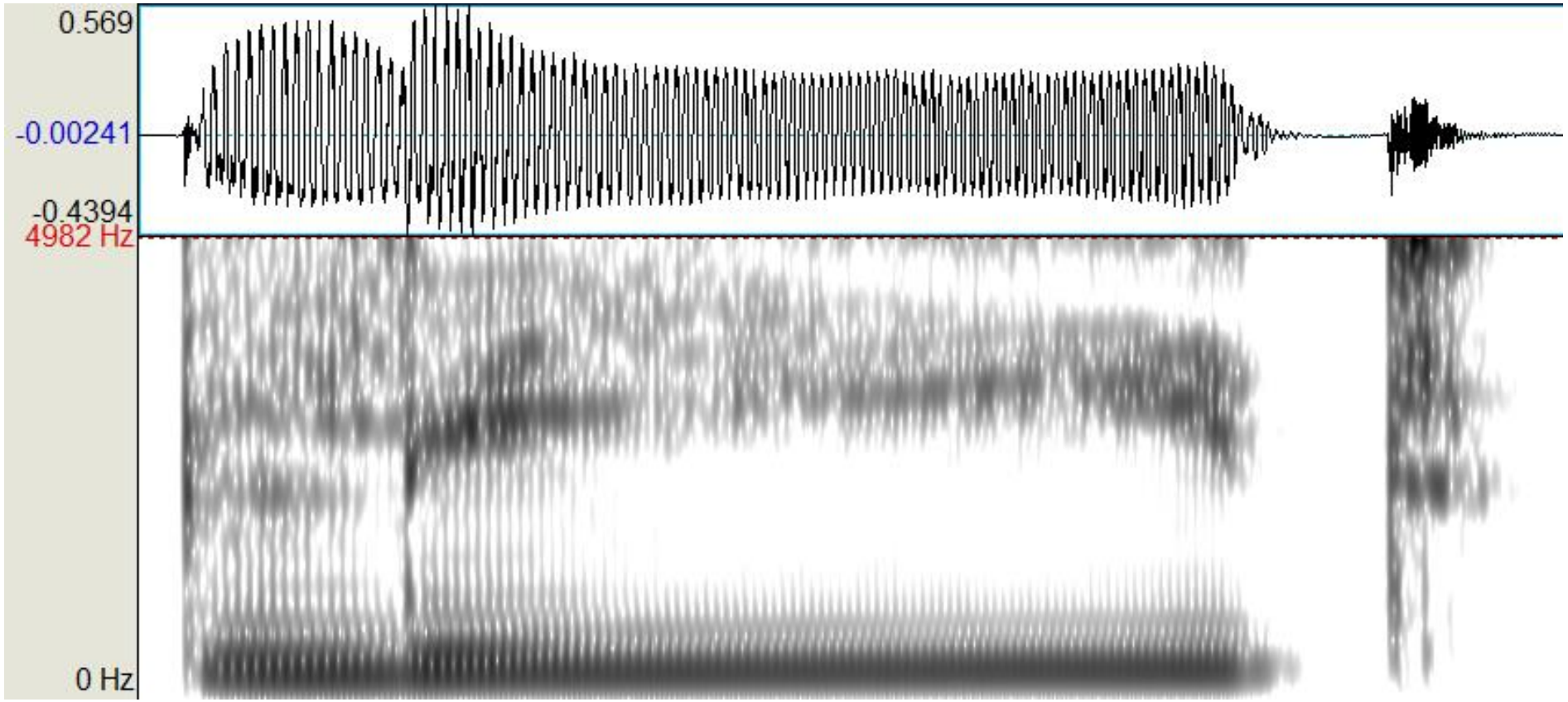
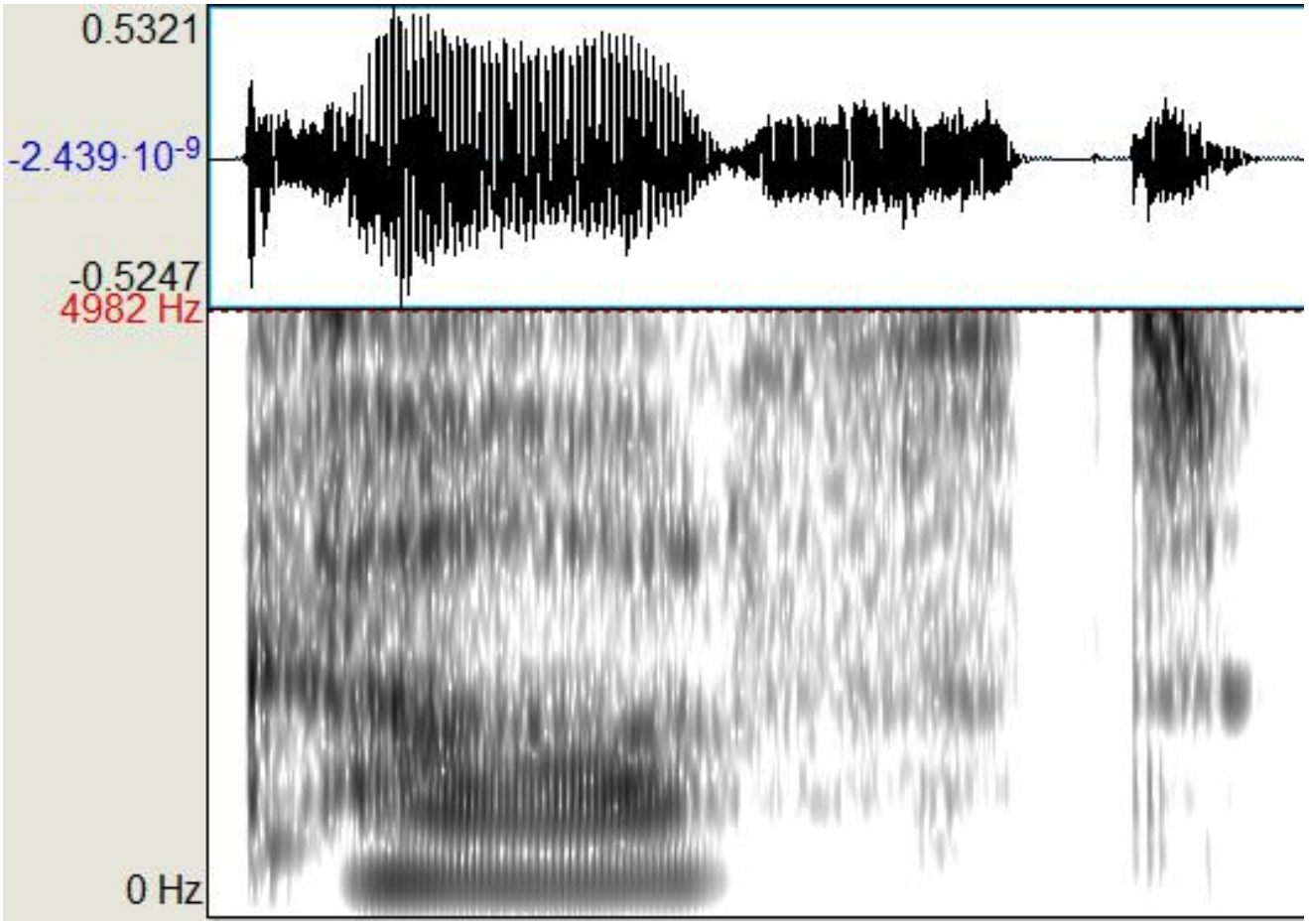


Infinitive



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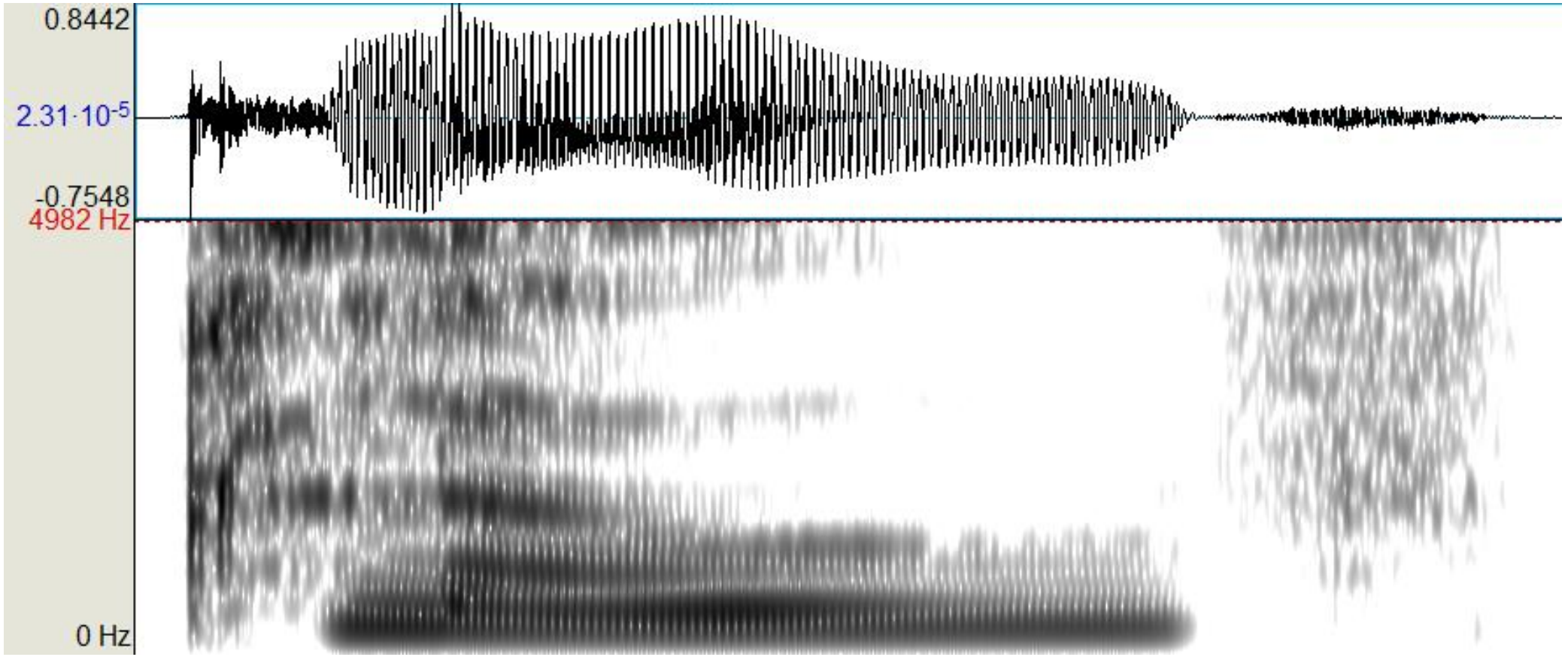

Reading

- Ashby M., Maidment J. (2005) Introducing Phonetic Science. CUP.
- Johnson K. (2012) Acoustic and Auditory Phonetics. Wiley-Blackwell.
- Online reading with pictures here and here.
- Videos about vowels and consonants, reading practice 1 and 2.