# Phonetics 3.3:
# Reading Spectrograms

April 17, 2020

# Summary of how to read spectrogram — clues

**Vowels**: look for formants. (don't need to know for class: increasing F1 means decrease in vowel height; increase in F2 means increase in vowel frontness)

**Approximants and nasals**: formants may be present, but not as prominent as vowels; usually no abrupt change in the spectrogram

**Stops**: Abrupt change in the spectrogram. If voiced, look for voicing bar preceding abrupt change.

**Fricative**: No formant structure at all.... just grayness across some range of frequencies. Different fricatives will give different ranges

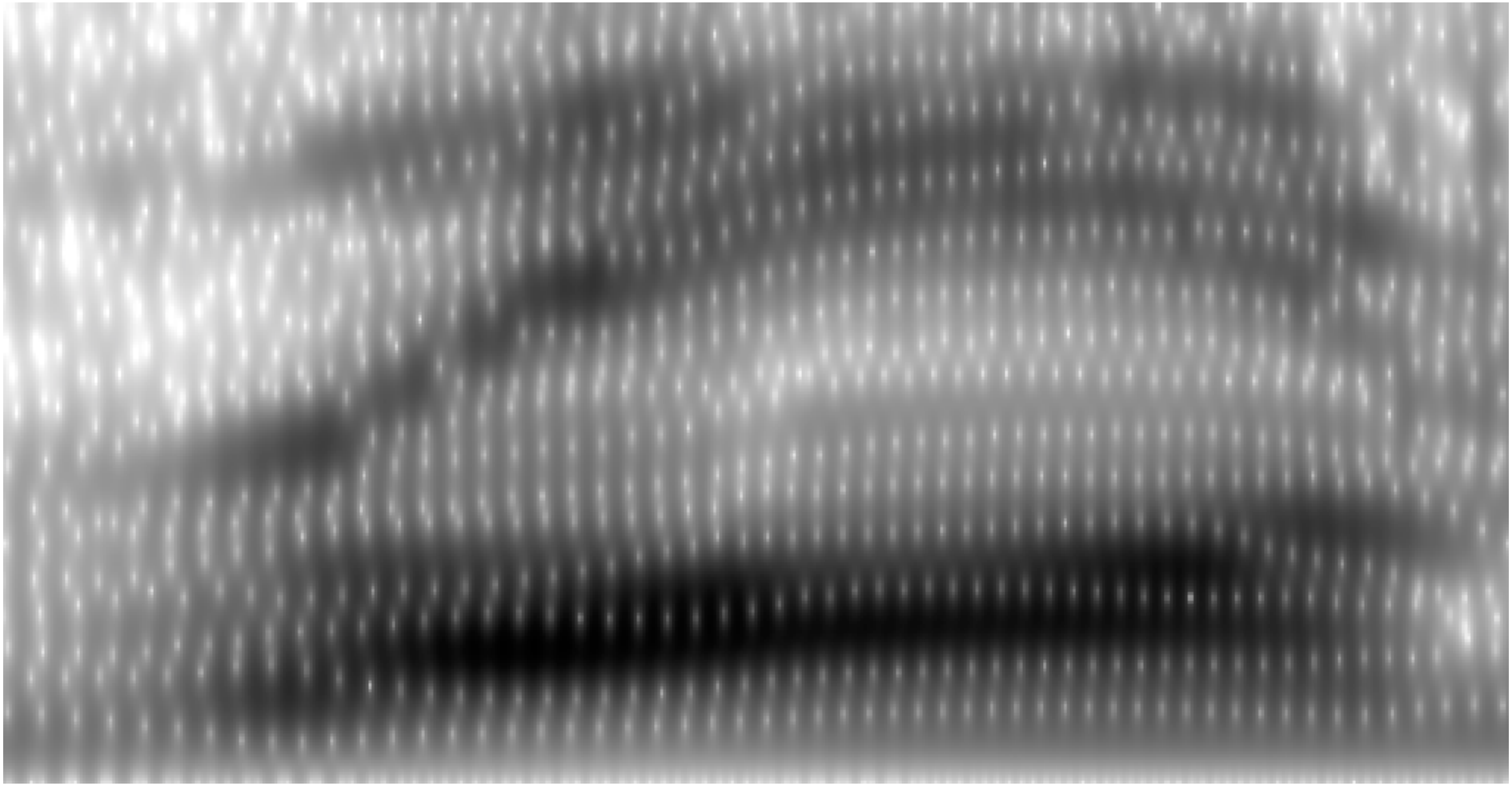
**Affricates**: look for abrupt change followed by frication (which looks like what I describe above). If voiced affricate, look for voicing bar

# Summary of how to read spectrogram — periodicity

More periodic sounds will have clearer formants; aperiodic sounds probably won't have any clear formants

| | |
|---|---|
| **Vowels** | PERIODIC |
| **Approximants and nasals** | SOMEWHAT PERIODIC |
| **Fricative** | APERIODIC |
| **Stops** | NOT REALLY EITHER; ABRUPT CHANGE |
| **Affricates** | HAS BOTH STOP FRICATIVE CHARACTERISTICS |

# Recall



# Using waveforms and spectrograms

Can you read a spectrogram?

Kind of...

When you have both the waveform and the spectrogram available, some things are relatively easy to identify:

# Using waveforms and spectrograms

Relatively easy:

. Vowel vs. consonant

. Manner of articulation

. Vowel height (general)

. Vowel backness (general)

. Voicing

# Using waveforms and spectrograms

More difficult:

. Place of articulation

. Vowel rounding

. Exact vowel height

. Exact vowel backness

. Distinguishing very similar consonants

# Using waveforms and spectrograms

We'll focus on two things:

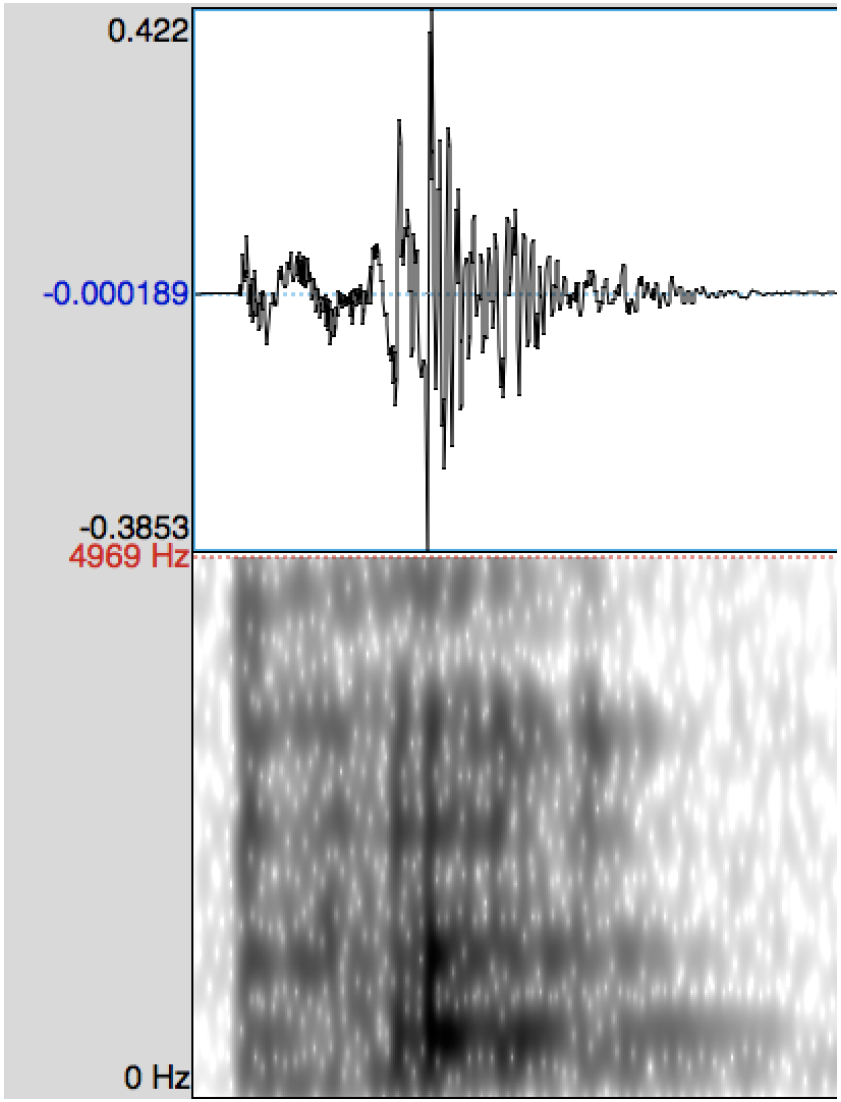
1) Distinguishing vowels from consonants

2) Identifying manner of articulation for consonants

# Using waveforms and spectrograms

What do the waveforms and spectrograms look like for vowels and the various manners of articulation for consonants?

# Stops

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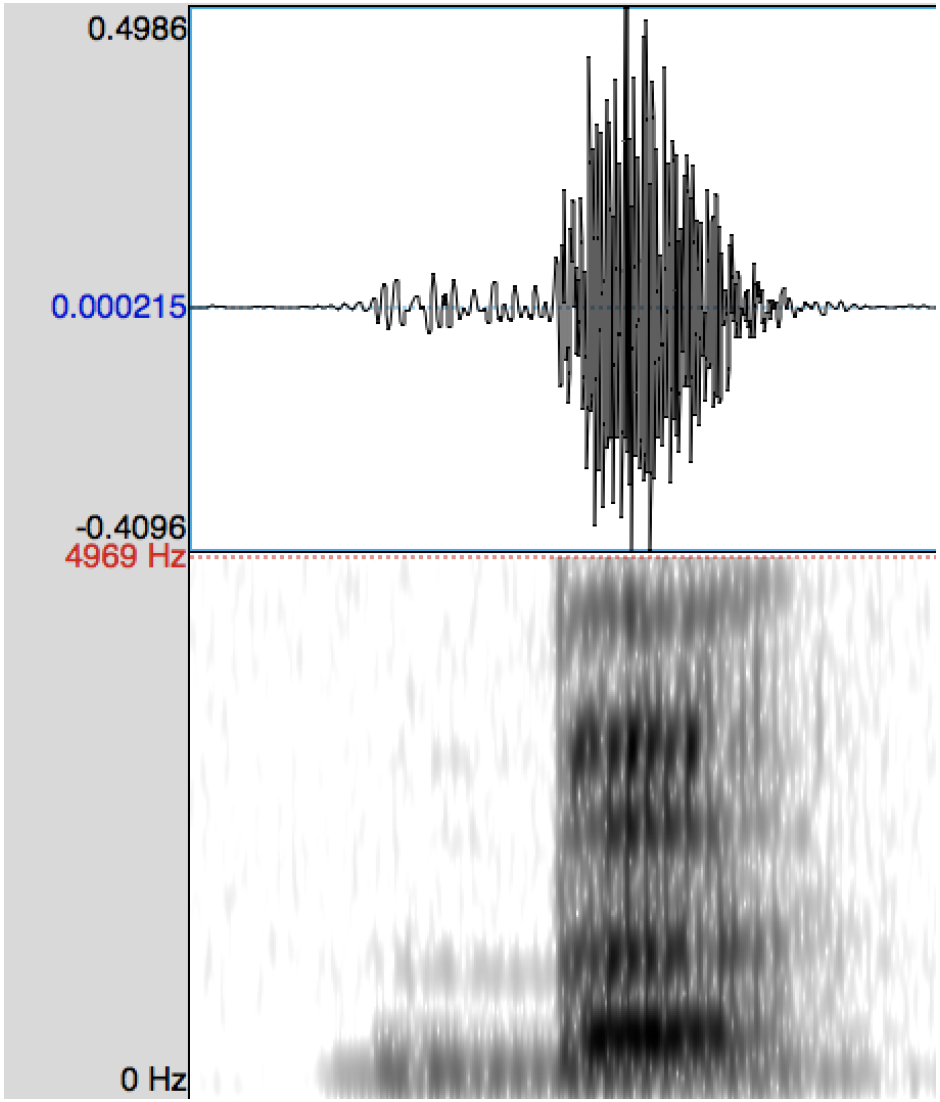
# (Oral) Stops

Most important: abrupt onset on spectrogram

In general, they don't do much else. The next segment usually comes pretty quickly.

Voiceless stops at the beginning of syllables might have some turbulent, aperiodic sound after the stop release (this is called **aspiration** — don't need to know)

# (Oral) Stops

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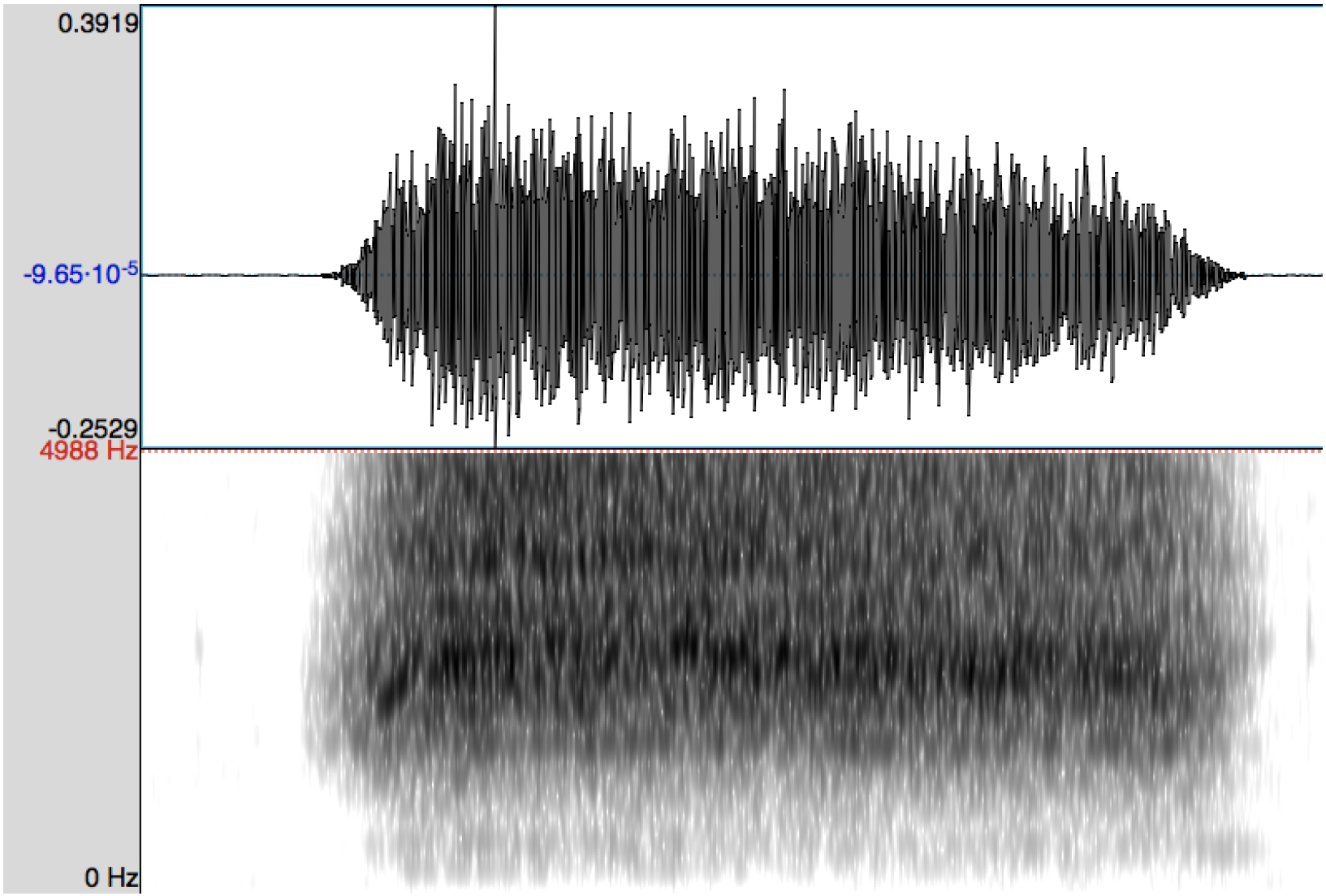
# (Oral) Stops

Voiced stops often have "prevoicing", meaning we've actually started vibrating the vocal folds before the stop release.

**Voicing bar** at low frequencies.

Quiet, periodic waveform before stop release.

# Fricatives

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# Fricatives

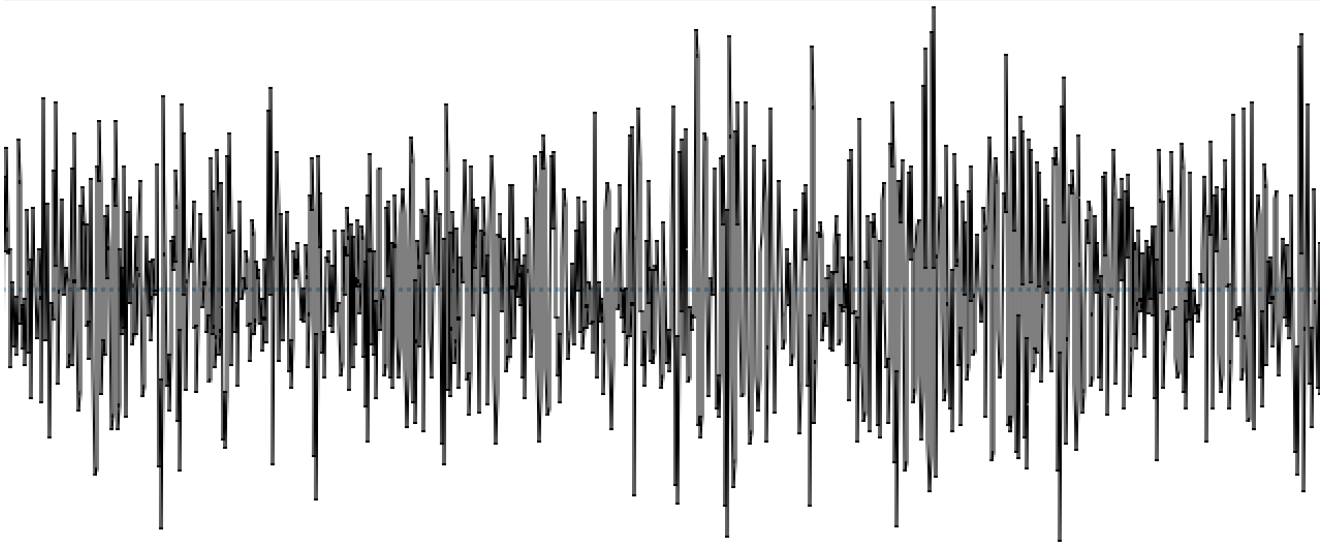
Fricatives are turbulent.

The spectrogram generally shows... noise.

The noise is distributed across wide frequency bands.

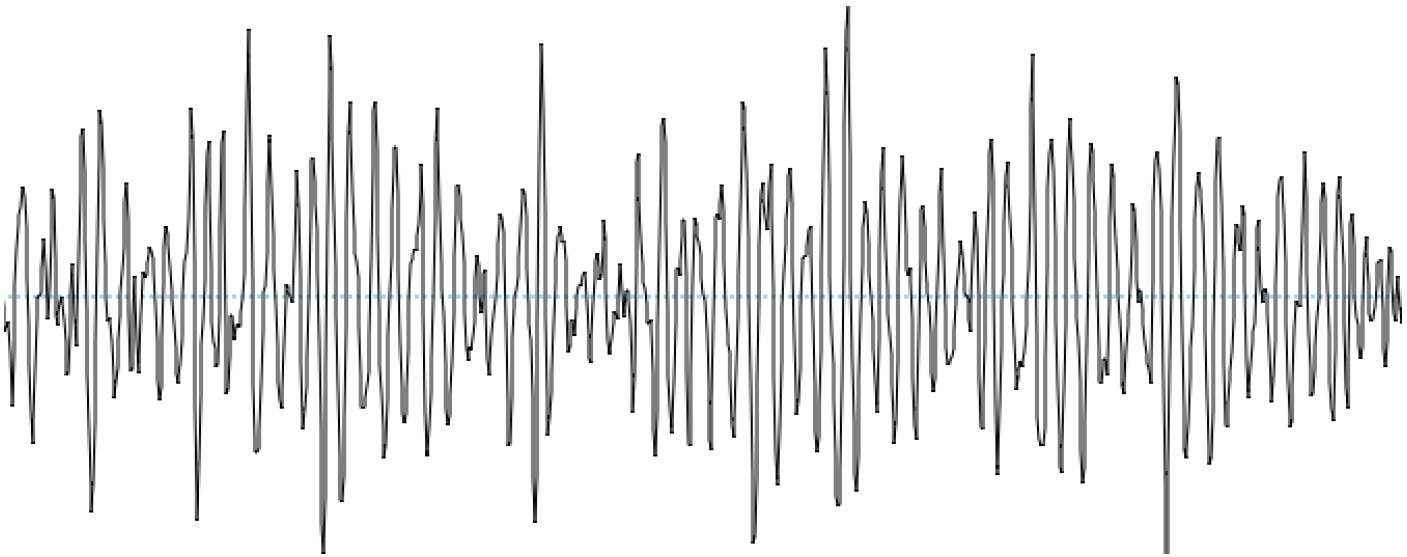
# Fricatives

The waveform is highly *aperiodic*.

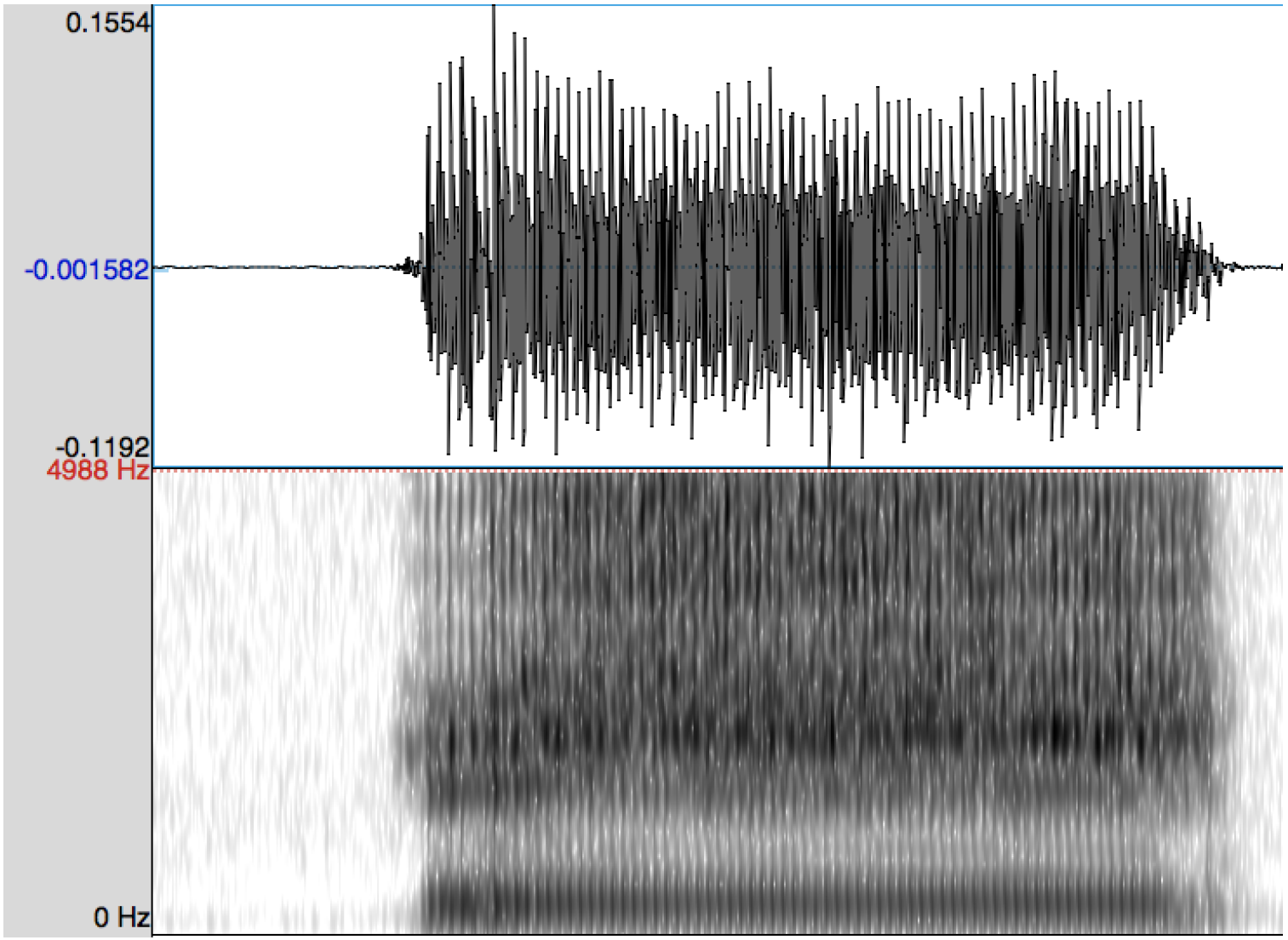


# Fricatives

The waveform is highly *aperiodic*.



# Fricatives

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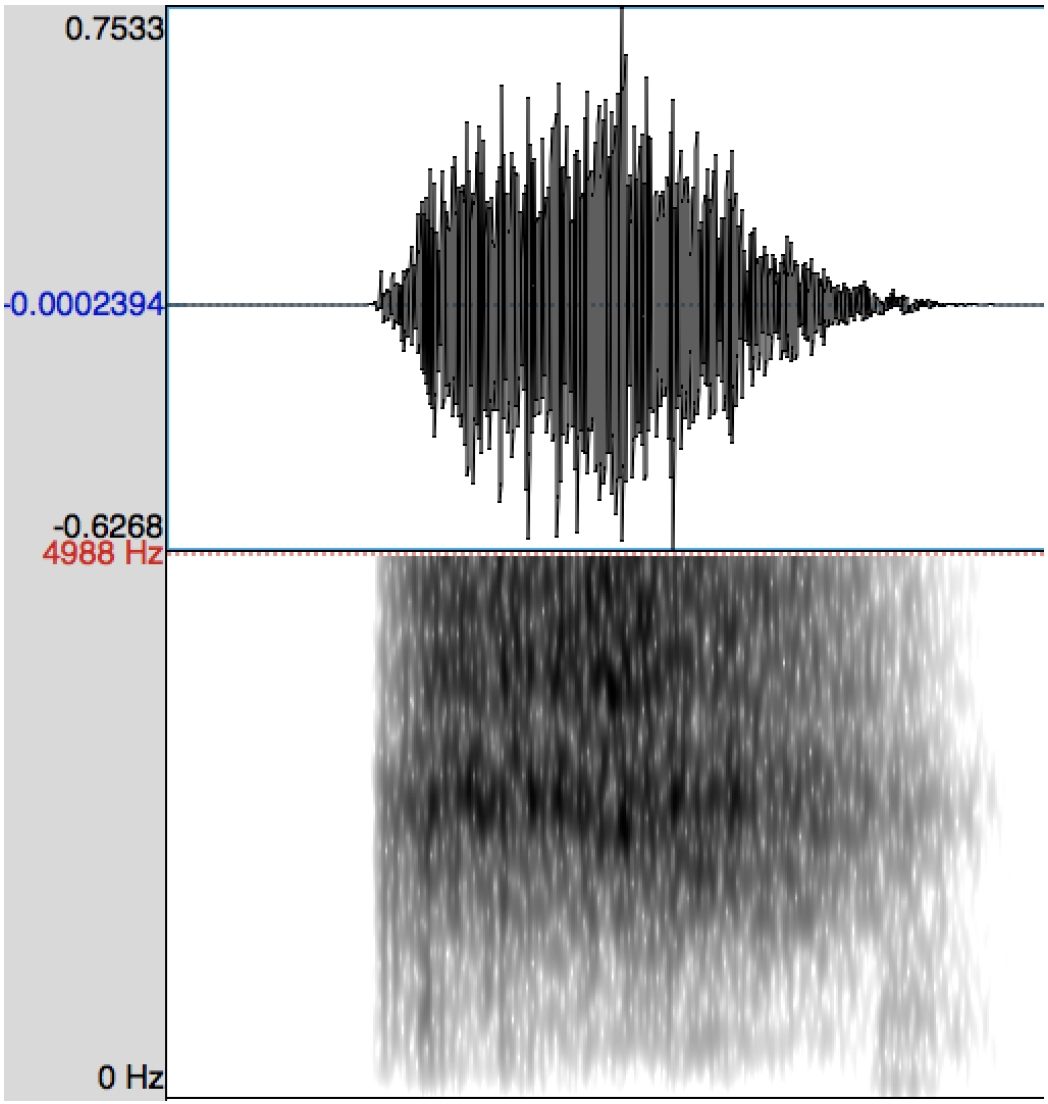
# Fricatives

Voiced fricatives: Same, but with a voicing bar.

# Affricates

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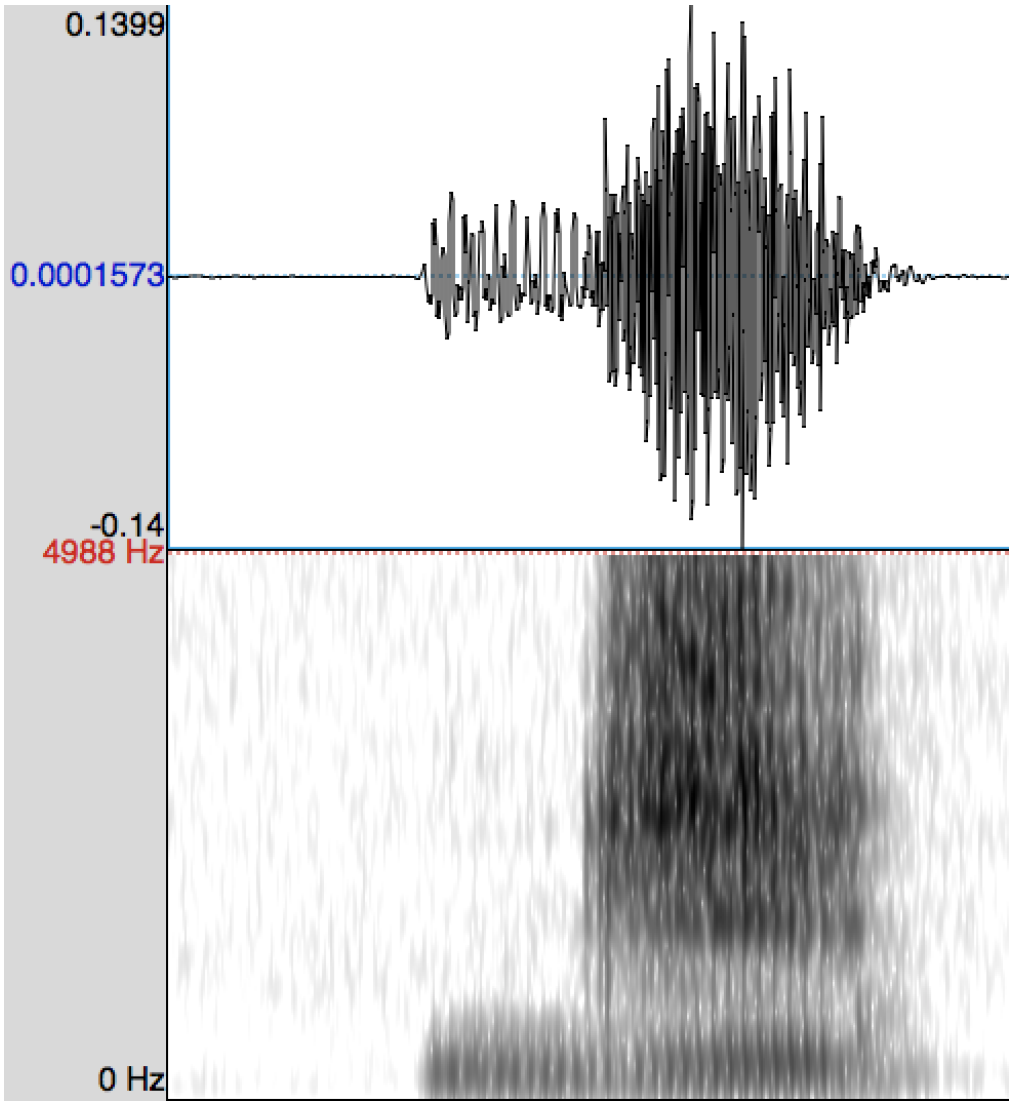
# Affricates

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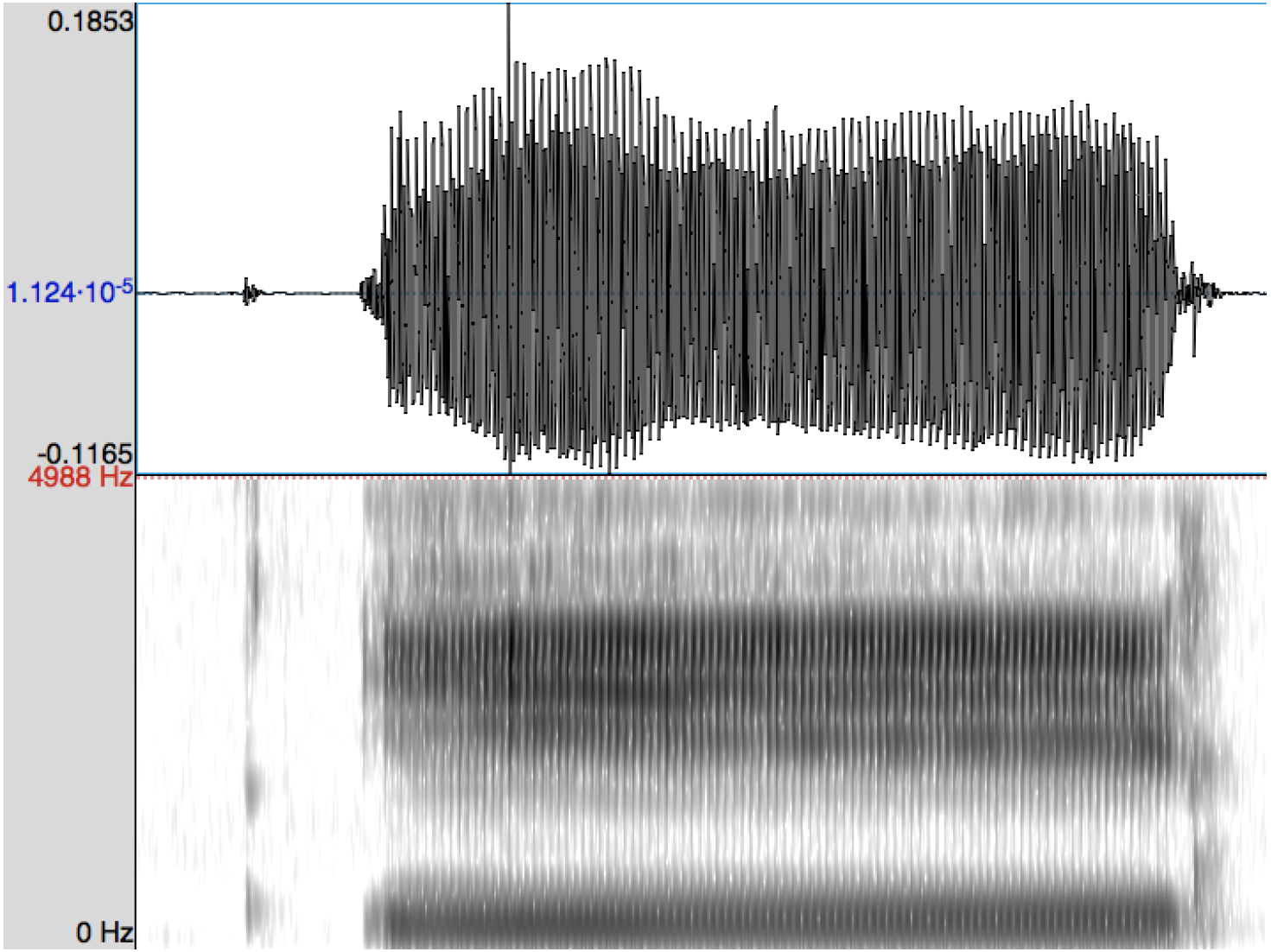
# Affricates

Affricates look like fricatives, but with a more abrupt onset.

Note possibility of prevoicing and voicing bar on voiced affricate.

# Vowels

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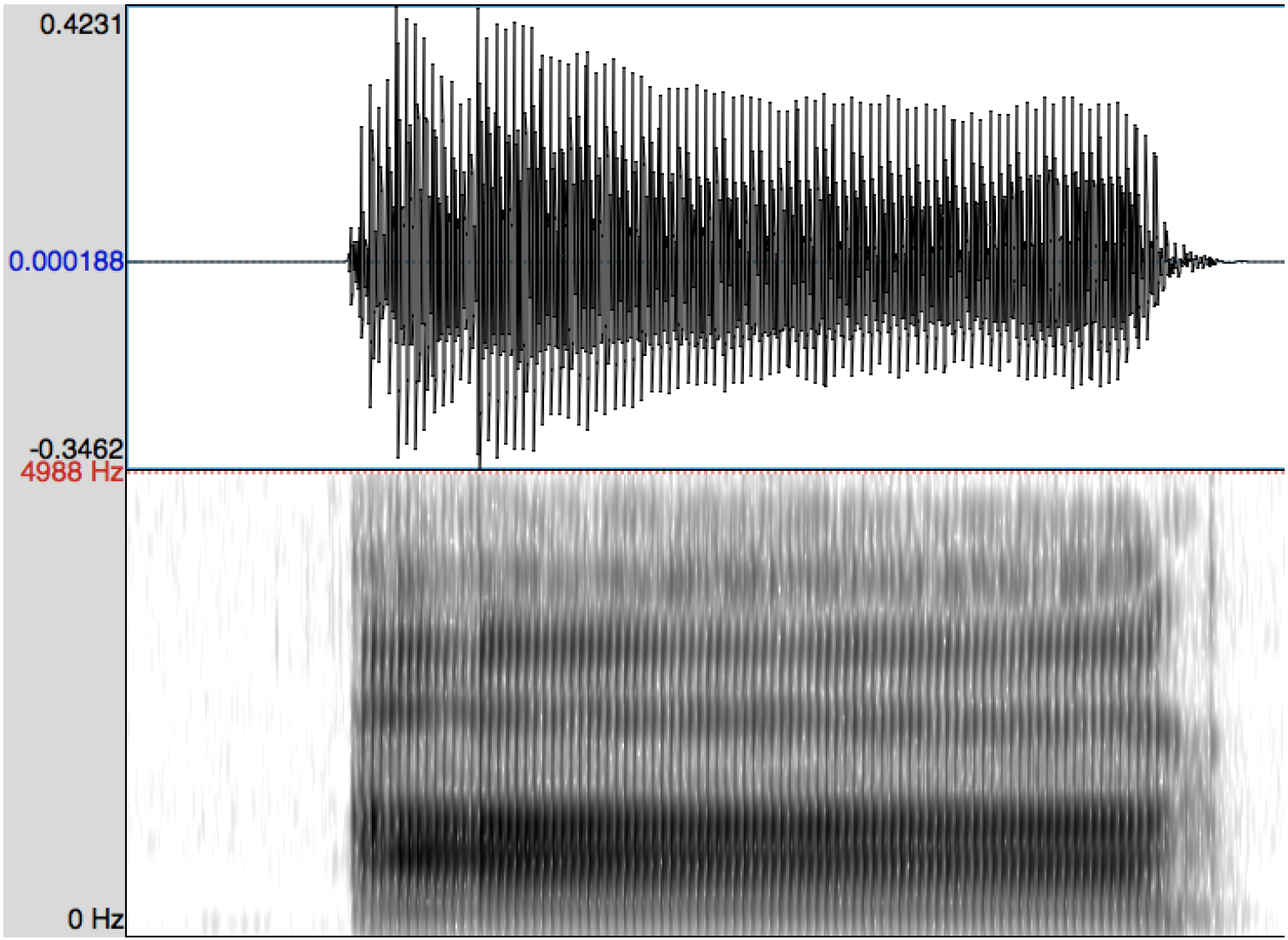
# Vowels

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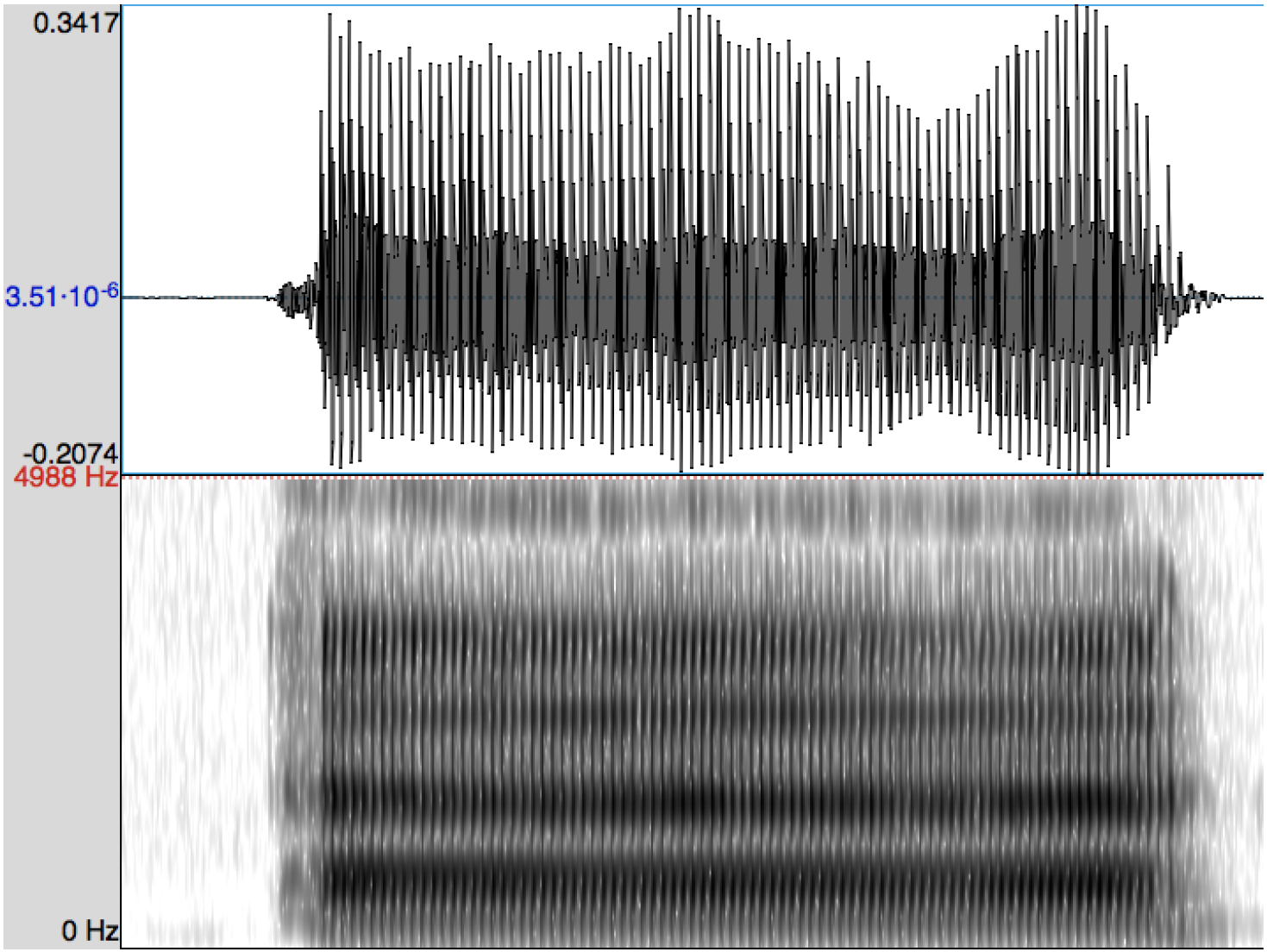
# Vowels

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# Vowels

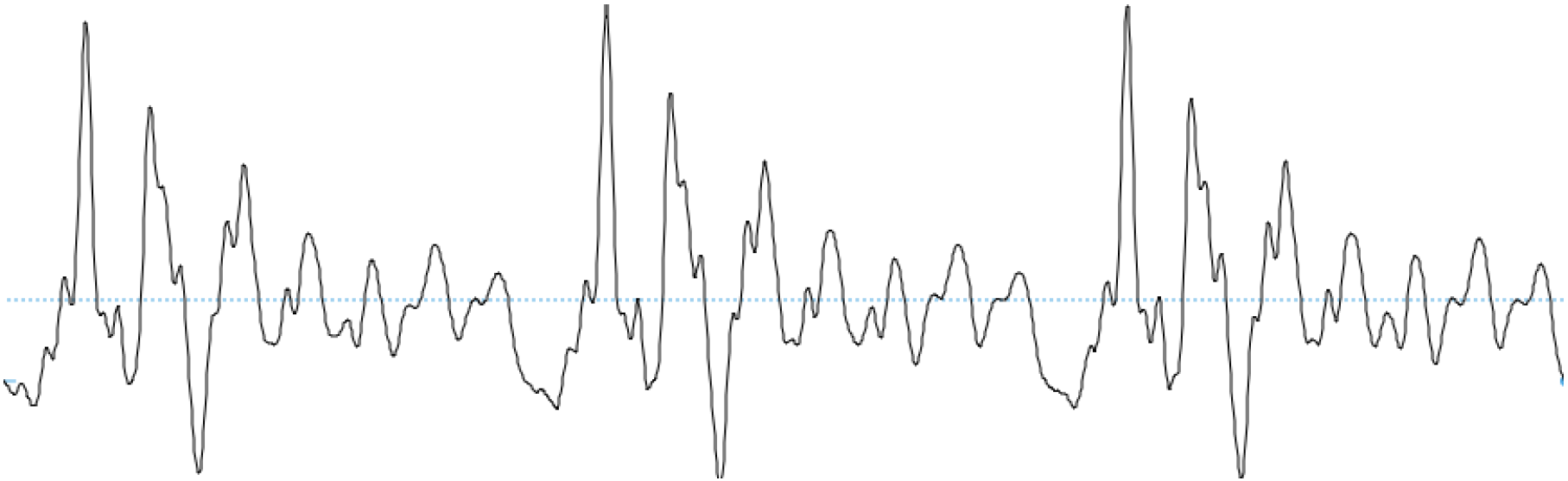
Vowels have a clear *formant structure* on the spectrogram.

There is a principled relationship between vowel height, backness, rounding, etc. and what the formants look like.

We won't go into that in this class, but ask me if you're curious.

# Vowels

The waveform of a vowel is highly periodic.

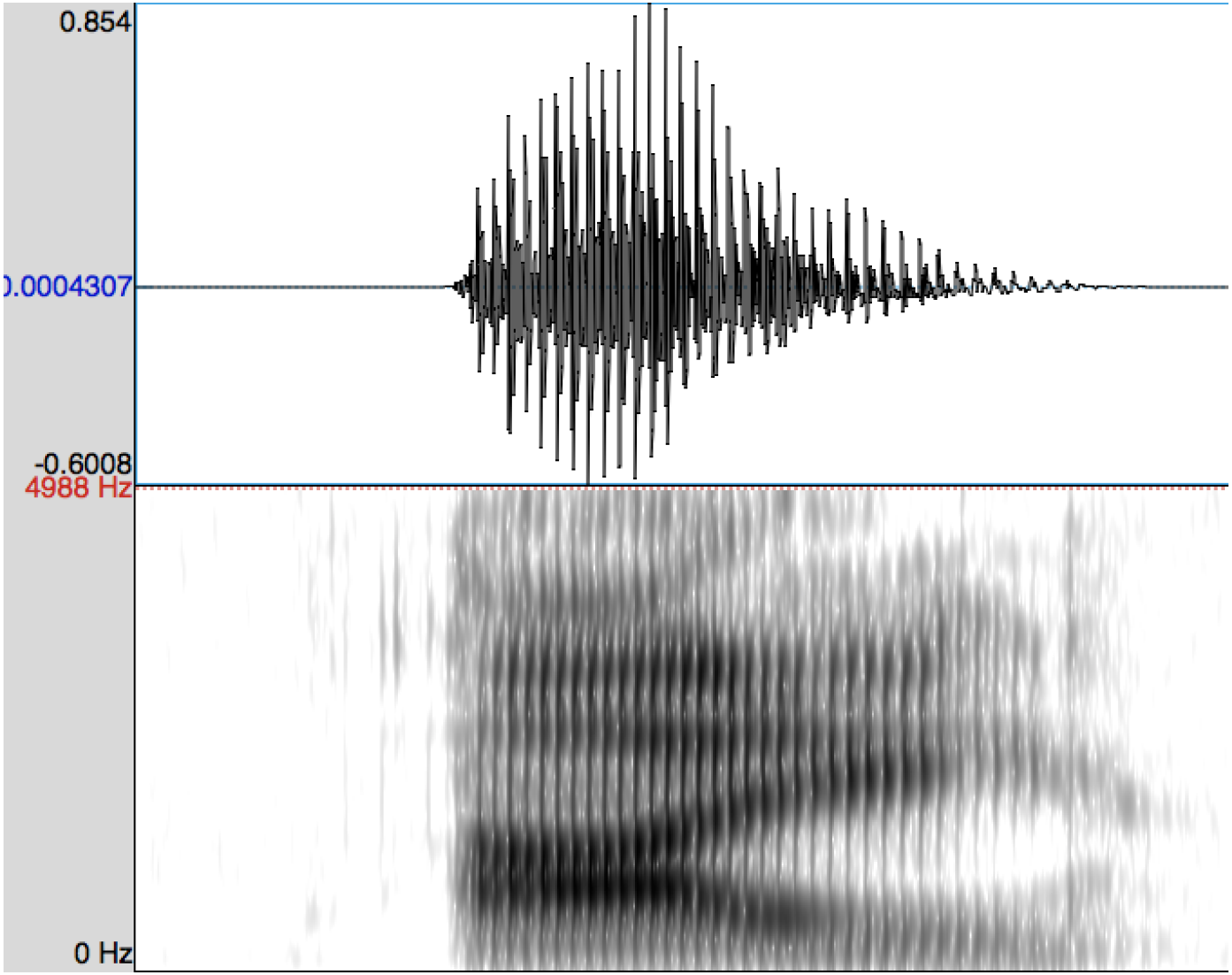


This probably accords with our intuition that a vowel is the closest speech sound to a "pure" tone.

# Vowels

Note that we can see formant *transitions* on the spectrogram for diphthongs.

# Vowels

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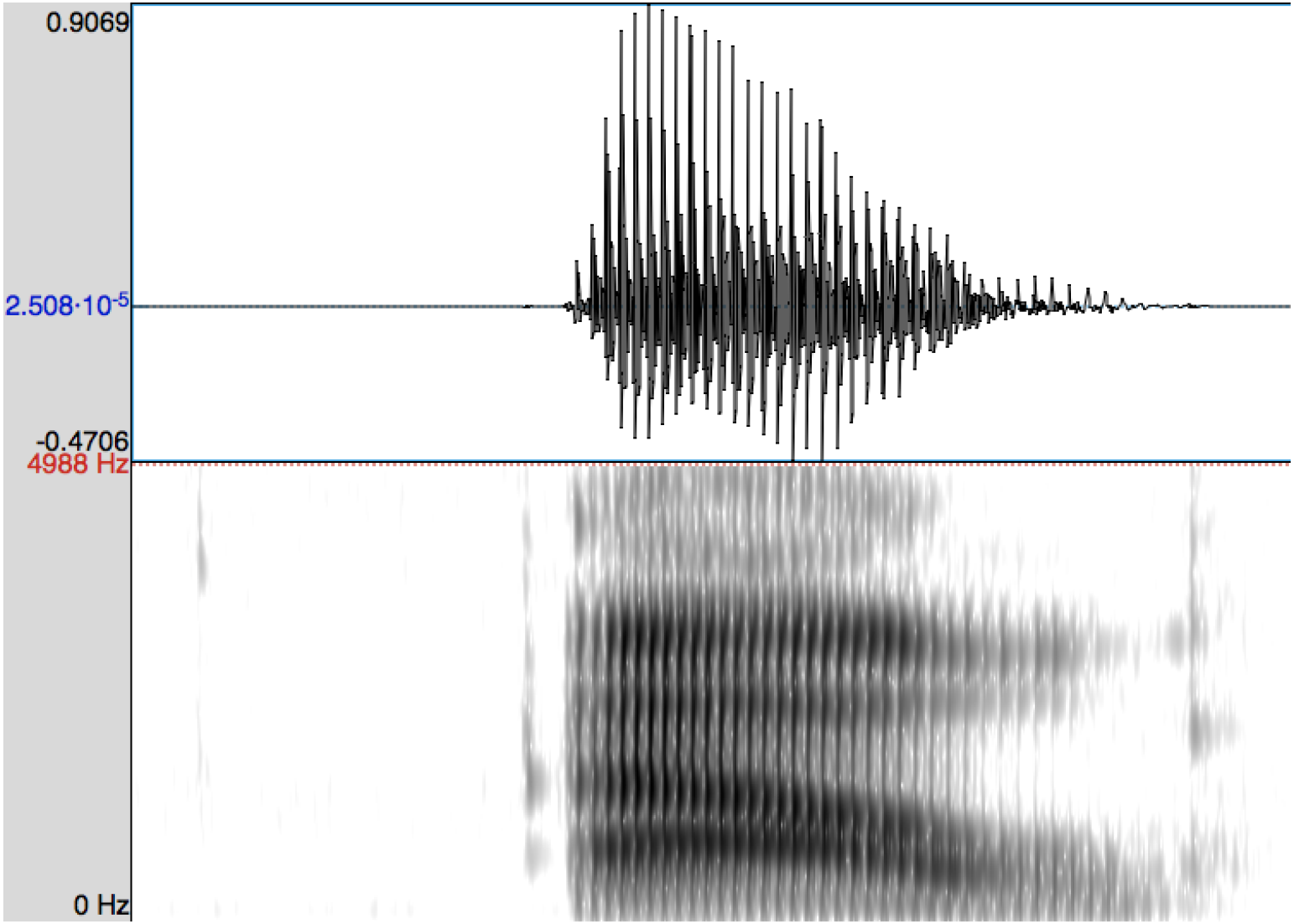
# Vowels

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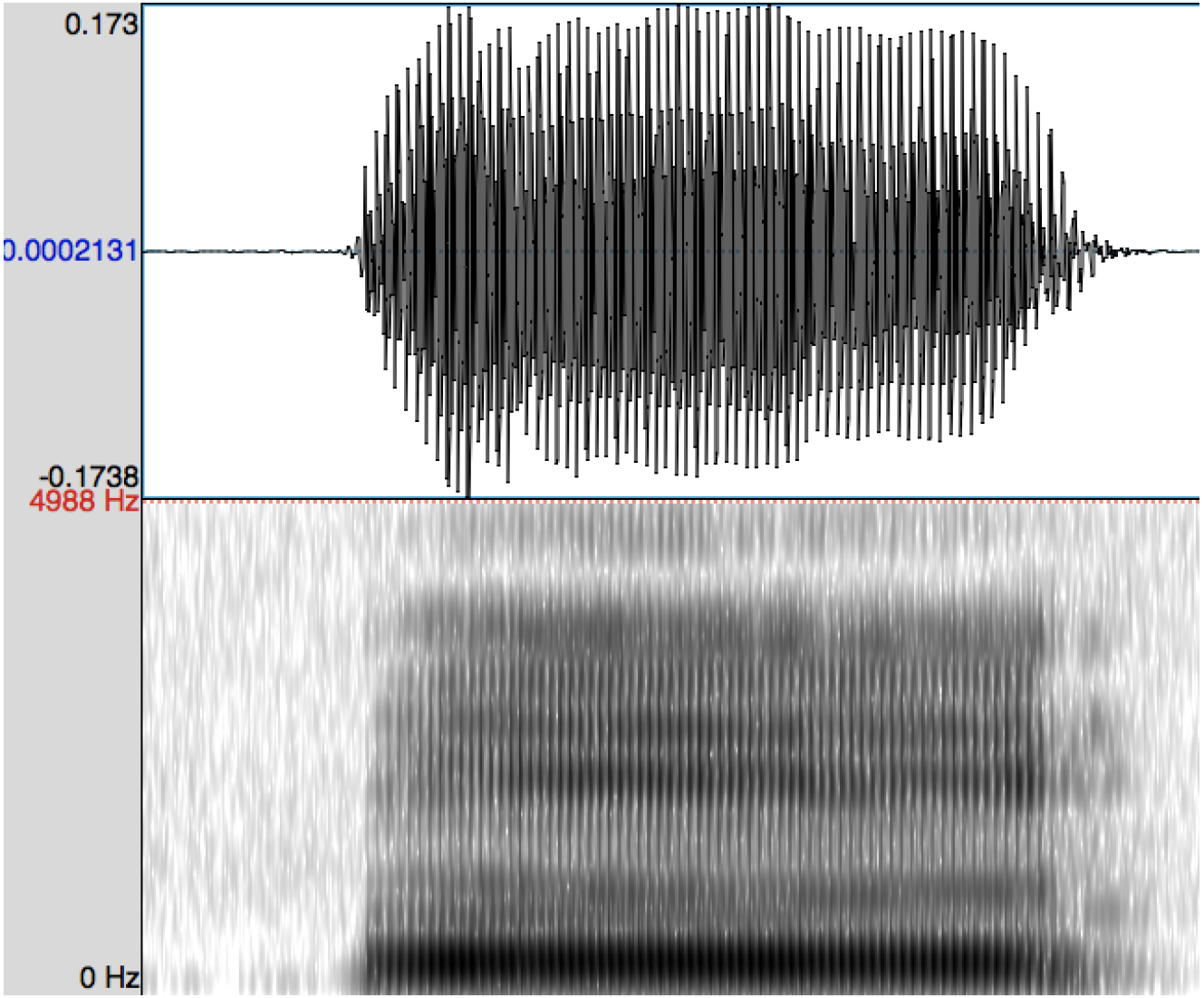
# Nasals

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# Nasals

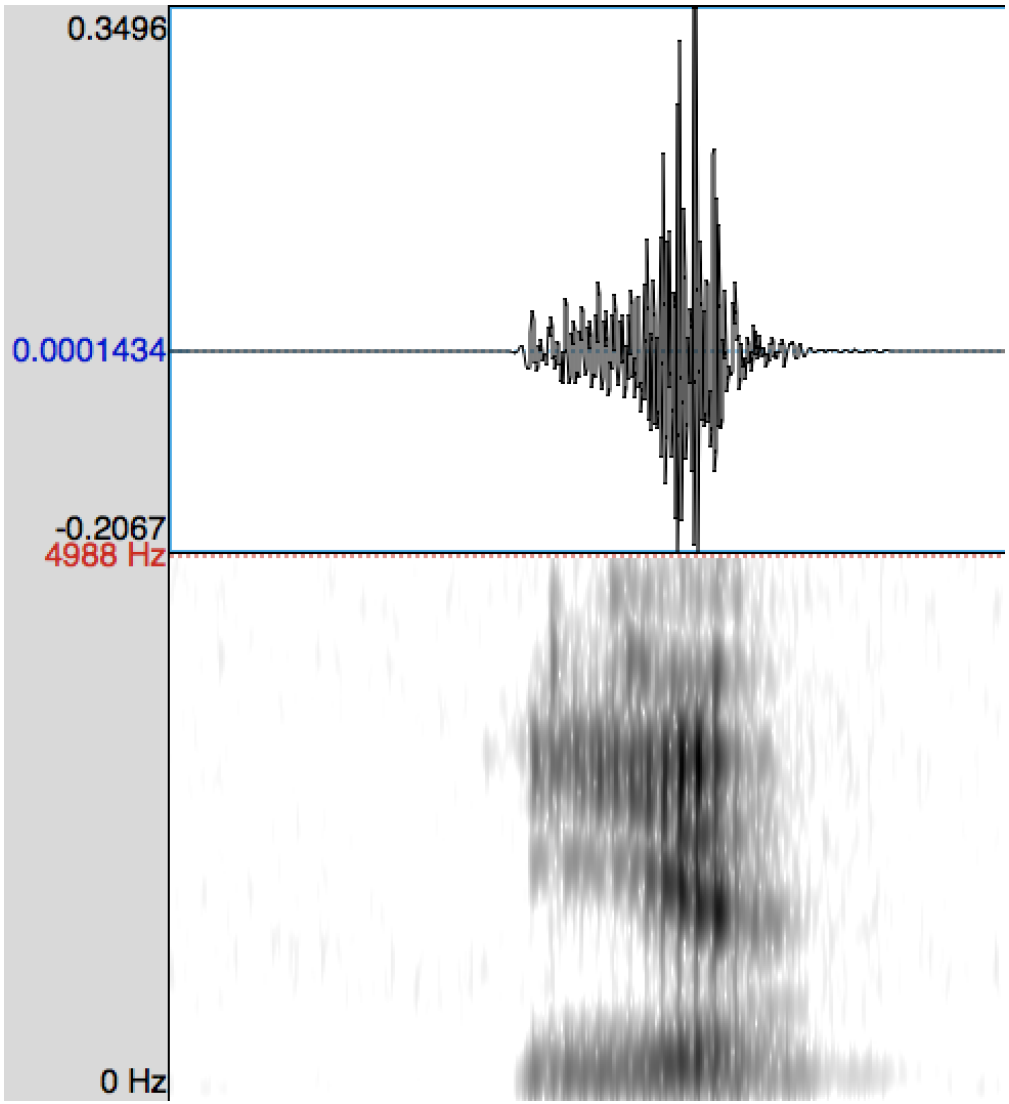
Nasal stops look... a lot like vowels.

Note 1: Prominent voicing bar.

Note 2: Formants somewhat less prominent.

I won't put you in a position where you have to distinguish between nasals and vowels.

# Approximants

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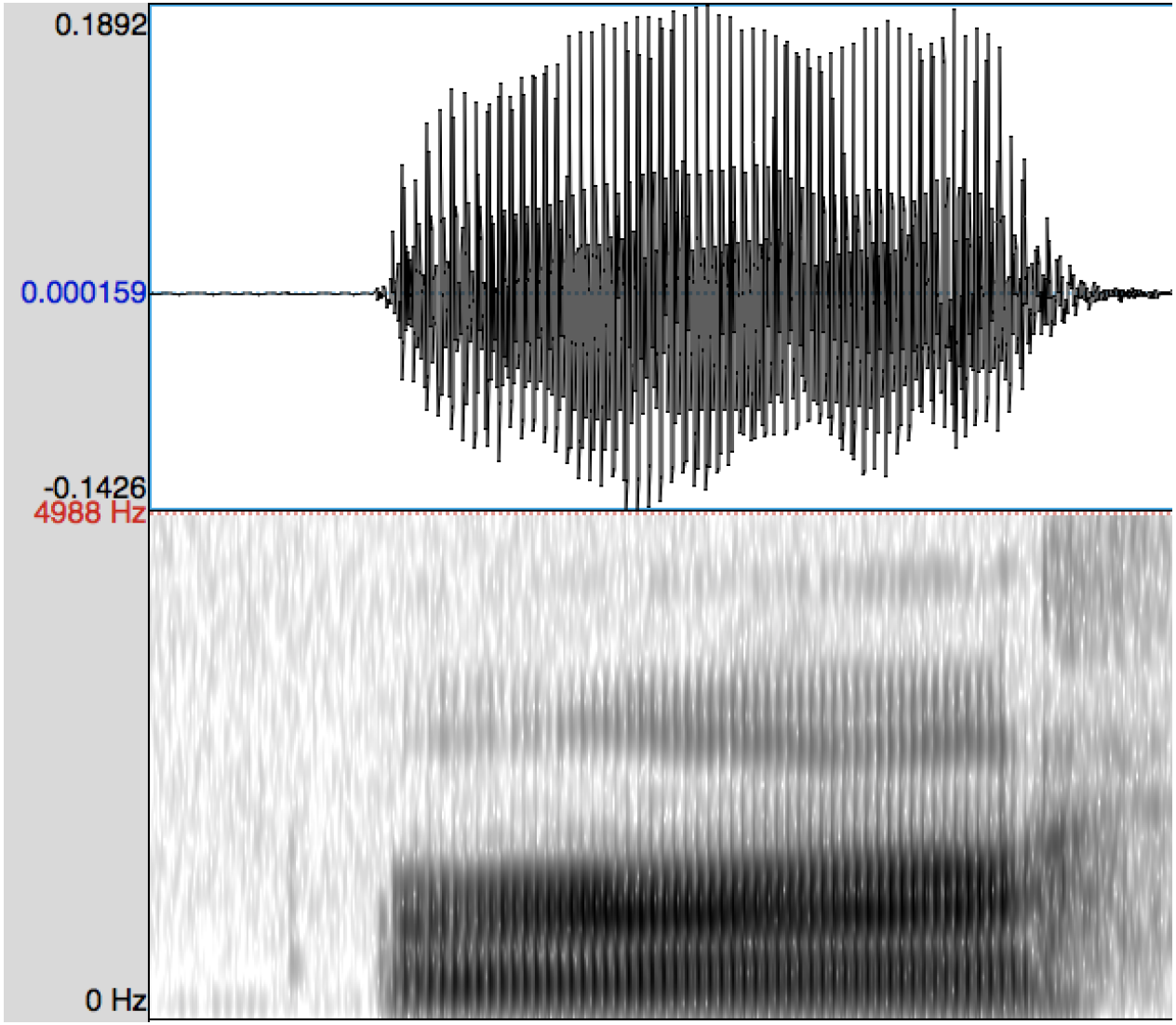
# Approximants

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# Approximants

These... also look a lot like vowels.

# Approximants

These... also look a lot like vowels.

Formant structure!

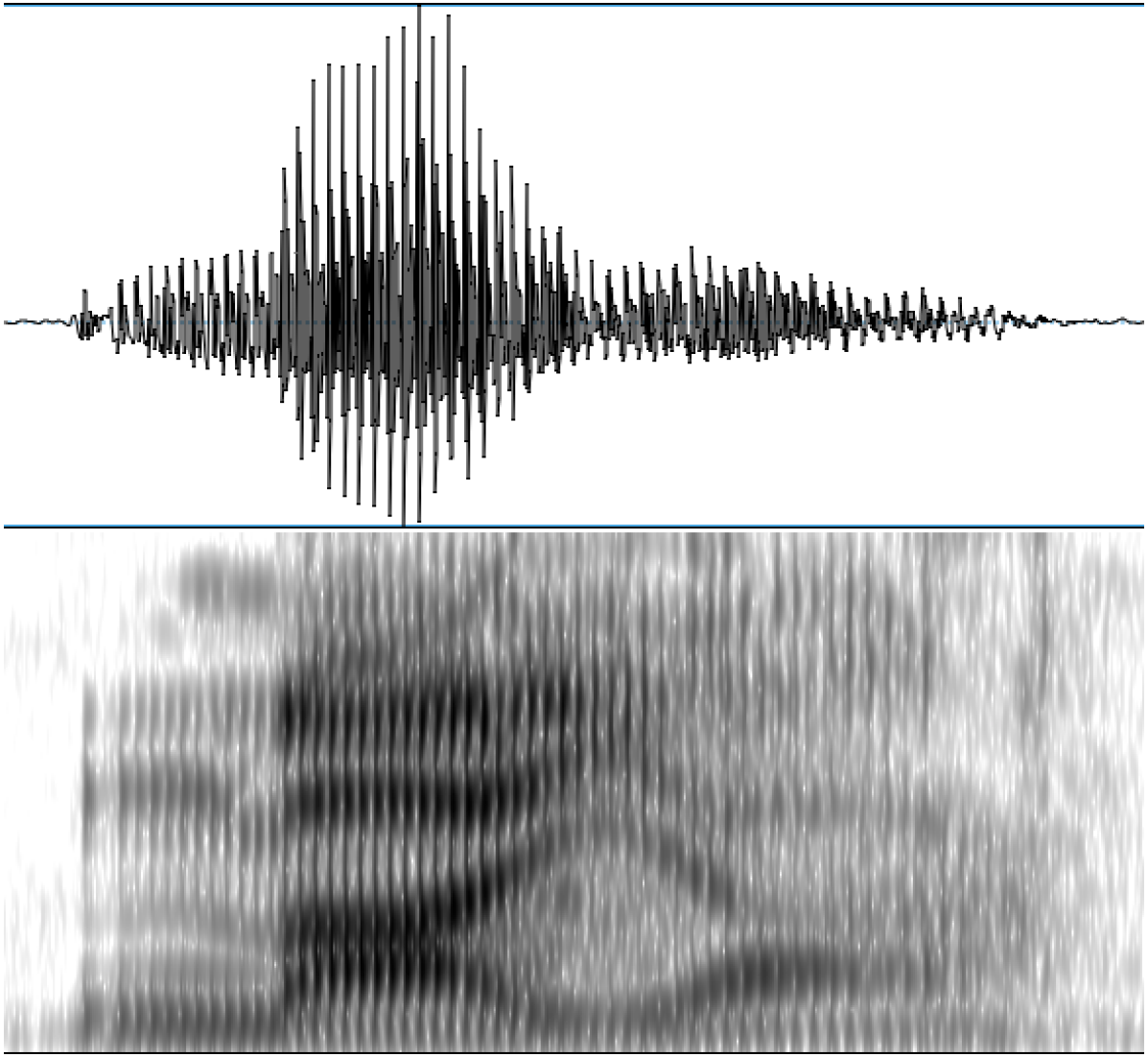
# Approximants

These... also look a lot like vowels.

Formant structure!

You won't have to distinguish between these and vowels or nasals.

# Approximants



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# Need to know

So, you should be able to classify a spectrogram into one of these categories:

. Oral stop

. Fricative

. Affricate

. Vowel or nasal or approximant

. **And** be able to tell if an oral stop, fricative, or affricate is voiced or voiceless.

# Do not need to know

You **don't** need to be able to:

Tell vowels from nasals from approximants

Recognize vowels from their formants

Identify the place of articulation for consonants

End of this video's lecture material. End of phonetics. Have fun with Kat in phonology and morphology. See you for syntax.