

# Intonation and meaning

EGG 2024 in Braşov

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<https://deniz.fr/summers/egg2024/>

# Outline

A bit about waves

Isolating intonation

Narrowing down 'meaning'

Linguistic structure

# A bit about waves

## Articulatory and acoustic correlates of intonation

When you say something, you produce a signal that has physical properties.

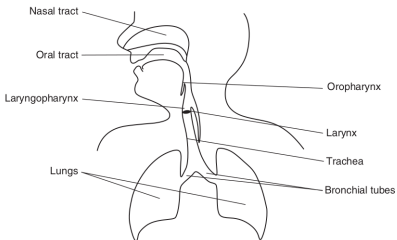
In the vocal-auditory modality, this signal is a **sound wave**, which includes **periodic** and **aperiodic** components, and **breaks**.

Compare with the manual-visual & manual-somatic modalities. It is meaningful to talk about prosody in these modalities as well.

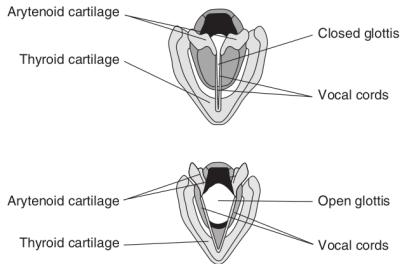
This sound wave is generated by the lungs pushing or pulling air through the vocal tract.

Its properties are determined by vocal fold vibrations, and the shape of the oral and nasal cavities.

Physically, it corresponds to variations in air pressure.



the vocal tract



the larynx, with open and closed vocal folds

Figures from Féry (2017).

## Voice quality

- ✧ modal
- ✧ creaky
- ✧ breathy

# Demos

- ✧ Pink trombone
- ✧ Vocal folds video

content warning: video of the inside of someone's throat

Let's now **visualize the speech signal**, and zoom in on the parts of it that count as intonation and prosody.

Most importantly, **fundamental frequency or pitch**.

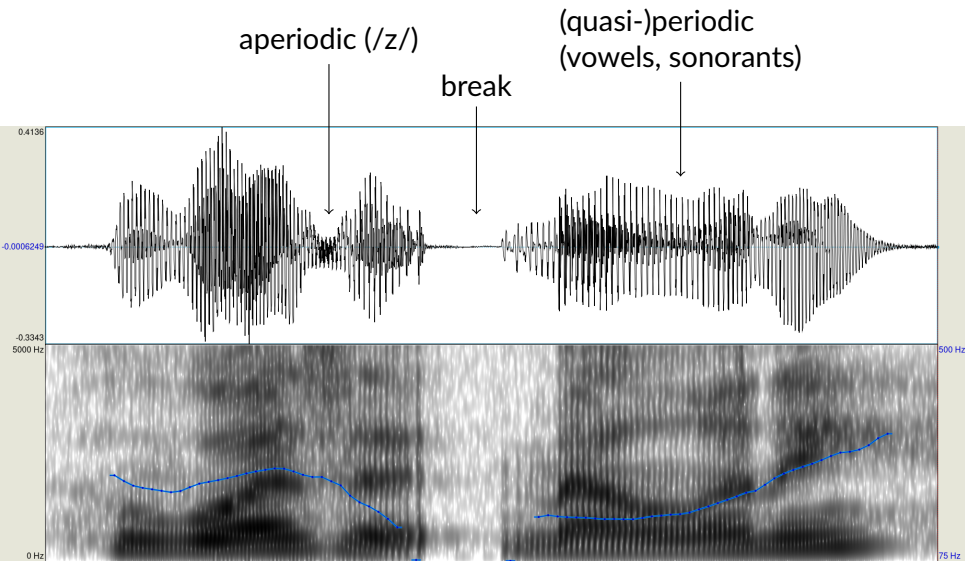
How high or low a sound sounds, often relative to surrounding material.

To do this yourself, download Praat here:

<https://www.fon.hum.uva.nl/praat/>

Record yourselves of course, but some sound files and associated learning materials can be found here:

the MIT Tones and Break Indices (ToBI) course



Waveform and spectrogram of a token of "Who was it? Melanie?"  
(from the MIT ToBI course)



With time on the  $x$  axis,

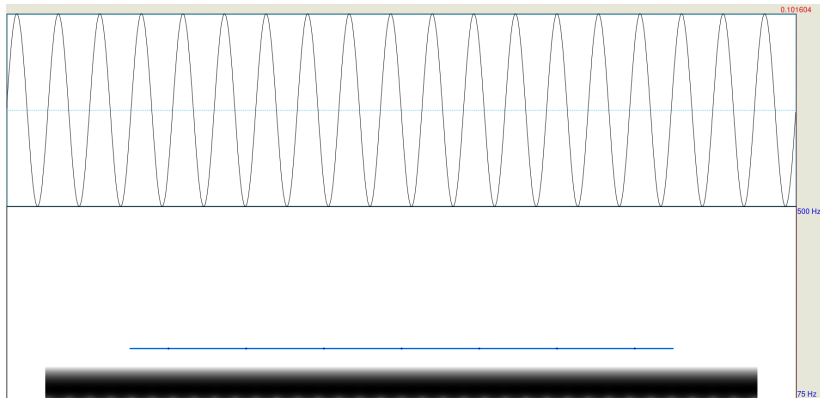
- ✧ a waveform has amplitude on its  $y$  axis,  
It encodes information about amplitude and periodicity.
- ✧ a spectrogram has frequencies on its  $y$  axis and amplitude on its  $z$  axis, towards you.  
It shows component frequencies (if dark) and their relative amplitude (how dark).

Praat represents the fundamental frequency of a wave with a blue line superposed with the spectrogram, aka the **pitch track**.

But of course... what are all these notions??

Simple waves are made up of a single frequency component.

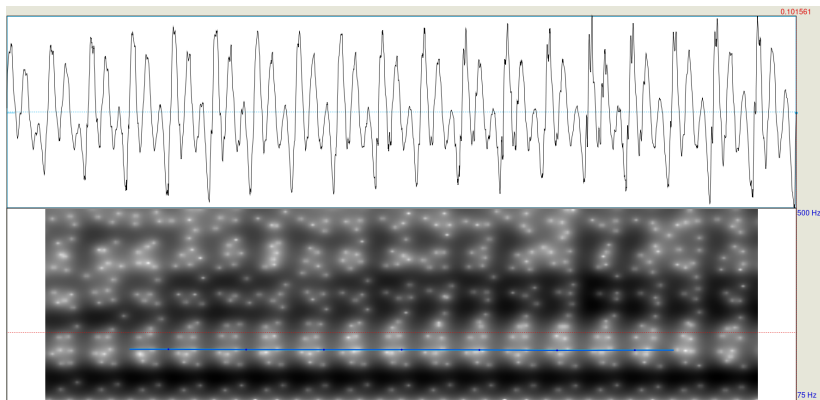
Frequency = Number of cycles per second (in Hertz).



100ms of a pure tone with fundamental frequency  $F_0 = 187\text{Hz}$ , displayed in Praat

Complex waves are sums of multiple simple waves that have different frequencies.

Fundamental frequency = frequency of their lowest component  
= number of big cycles per second



100ms of one realization of the vowel [æ] ( $F_0 \approx 187\text{Hz}$ ), displayed in Praat

'Spectral slices' can also be used to visualize component frequencies.



Spectral slice of the previous realization of the vowel [æ], displayed in Praat

For the speech signal to have a fundamental frequency, the vocal folds need to be able to vibrate (quasi-)periodically.

- ✧ That information is best carried by vowels and sonorants, in modal voice.
- ✧ It is blocked or obscured by obstruents and non-modal voice.

But we may still indirectly recover pitch information across obstruents or in non-modal voice.

# Activity

The difference between assertion a. and question b. can be marked by a change in intonation.

Can you mark this difference when you whisper, i.e., in breathy voice?

- (1) a. Mariana made the marmelade.
- b. Mariana made the marmelade?

There is much more to be said about sound waves, but we must carry forward.

# Outline

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**Isolating intonation**

Narrowing down 'meaning'

Linguistic structure



# Isolating intonation

We've talked about the physical properties of the speech signal, but we produce & perceive more than just a physical signal.

We organize the speech signal into **segmental** and **suprasegmental** information.

- ✧ **Segmental:**

  - Speech sounds

- ✧ **Suprasegmental:**

  - Fundamental frequency/pitch**

  - Intensity/loudness

  - Duration

  - among other things: pauses, voice quality, ...

**Intonation** and other tonal phenomena have to do with **variations in fundamental frequency/pitch.**

### **'Intonation' vs. 'prosody'**

*Prosody refers to all suprasegmental aspects of speech, including pitch, duration, amplitude and voice quality [...]*

*Intonation refers to the melodic facet of speech, although the two terms are sometimes interchangeable.*

Xu (2019)

*[Intonation is] the use of suprasegmental phonetic features to convey 'post-lexical' or sentence-level pragmatic meanings in a linguistically structured way.*

*Ladd (2008: p. 4)*

Three key notions:

1. Suprasegmental features
2. Sentence-level pragmatic meanings
3. Linguistically structured

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## Sentence-level meanings

The use of suprasegmental features to convey 'post-lexical' or *sentence-level* pragmatic meanings.

This excludes lexically determined differences in stress or tone.

- (2)
- a. pérmít vs. permít
  - b. tonal contrasts in tone languages

But:

- ✧ stress position does interact with sentences' pitch contours.
- ✧ whether/how intonation manifests itself is a valid question.

Table 1.1. *Beijing Mandarin Lexical Tones*

Basic Pitch Shape	Pitch Value	Examples
T1. High level (H)	55	mā 'mother'
T2. Rising (LH)	35	má 'hemp'
T3. Low or falling-rising (L)	21(4)	mǎ 'horse'
T4. Falling (HL)	51	mà 'to scold, to blame'

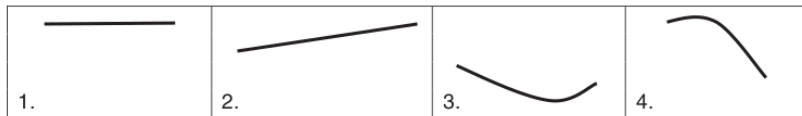


Figure 1.3. Beijing Mandarin lexical tones.

from Féry (2017)

Listen here

## Paralinguistic effects/meaning

Intonation can also be used to convey (intentionally or accidentally) things like mood or emotion.

This is also usually excluded from the study of linguistic meaning.

*[T]he grammatical aspects of intonation do not change as a result of emotion: there is no change in lexical tone, or in the place of a lexical stress, and a prosodic boundary is never intentionally inserted at the wrong place because of happiness, anger or fear.*

Féry (2017)



The use of suprasegmental features to convey 'post-lexical' or *sentence-level* pragmatic meanings.

Ladd *includes*:

- ▶ sentence type or speech act
- ▶ focus or information structure

Don't worry too much about whether the relevant class of meanings are pragmatic or semantic.

## Sentence type

Intonation can, 'on its own,' distinguish between sentence types:

- (3) a. Marianna made the marmelade. ends in a low  
b. Marianna made the marmelade? ends in a high

It is used 'on top of' other devices that determine sentence type:

- (4) a. Did Marianna make the marmelade? ends a high  
b. Who made the marmelade? ends in a low

Note: These patterns are language specific. In Turkish, e.g., yes/no questions end in a low, and wh- questions end in a high.

- (5) a. Marianna marmelat mı yaptı? ends in a low  
b. Kim marmelat yaptı? ends in a high

## Information structure

Not all words are equally prominent, acoustically...

- (6) a. mariANna made the marmelade.
- b. marianna made the MARmelade.

...and informationally.

- (7) Who made the marmelade?
  - a. mariANna made the marmelade.
  - b. #marianna made the MARmelade.

Here, words with capitalized syllables are *focused*. Focus typically attracts prominence and imposes constraints on interpretation.



r/TodayI Learned • 12 yr. ago  
amazin\_azian

**TIL that the sentence, "I never said she stole my money," has 7 different meanings depending on the word you stress.**

## Information structure

Information structural categories are independent of sentence type.

- (8) a. mariANna made the marmelade?
- b. marianna made the MARmelade?



There are other information structural categories, with different intonational and interpretive signatures.

- (9) Contrastive topics

Ukulele, I studied formally. Accordion, I learned on my own. Constant (2014)

- (10) Givenness

A: Smith walked into a store. What happened next?

B: A detective arrested Smith. Wagner (2012)



**Dogs must  
be carried**

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# Linguistically structured way

*[Intonation is] the use of suprasegmental phonetic features to convey 'post-lexical' or sentence-level pragmatic meanings in a **linguistically structured** way.* Ladd (2008: p. 4)

## We impose structure on intonation

- ✧ The speech signal is continuous and contains variability due to, e.g., anatomy, mood, emotion, etc.
- ✧ We abstract away from that and organize the signal into:
  - ✧ categorically distinct entities (low tone, boundary rise)
  - ✧ and relations (stronger than, higher than)
- ✧ These 'entities' or tonal events are *aligned* with the text:
  - ✧ with certain syllables "pitch accents"
  - ✧ with the edges of groups of words "boundary tones"
- ✧ Their sequencing is not random or arbitrary...



# Illustrating variability

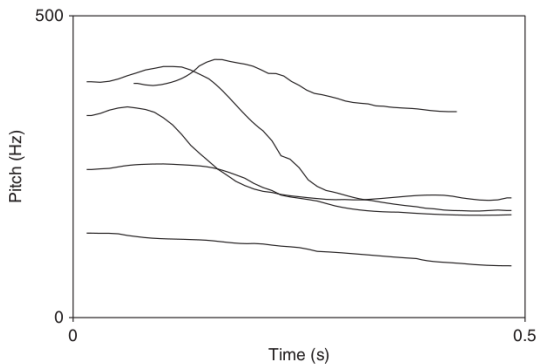


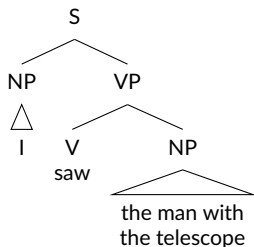
Figure 2.4. Realizations of the word *Anna* by different German speakers.

from Féry (2017)

## Linguistically structured way

**Intonation is constrained by syntactic structure**

The same string can parse into different syntactic structures.

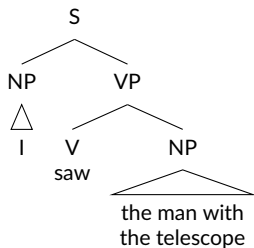


I saw (the man with the telescope)

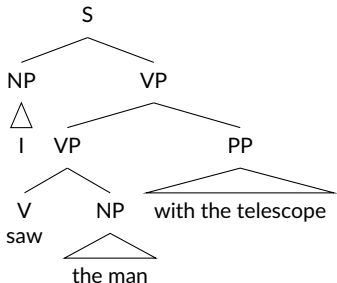
# Linguistically structured way

## Intonation is constrained by syntactic structure

The same string can parse into different syntactic structures.



I saw (the man with the telescope)



I (saw the man) (with the telescope)

These are parsed into different prosodic structures.

## More examples

### Licit boundary tone positions

- (11) a. Three mathematicians in ten % derive a lemma.  
b. Three mathematicians % intend to rival Emma.  
Pierrehumbert (1980)

### Licit pitch accent positions

- (12) a. George has PLANS to leave.  
b. George has plans to LEAVE. via Féry (2017)

Note here that intonation isn't directly making a meaning difference. It's indicating differences in syntactic structure (and these often map onto different meanings).

We'll introduce prosodic constituency and the mapping between syntax and prosody more rigorously in the next two sessions.