Introduction to Linguistic Phonetics

Sounds and Waves

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Recap and Reflection

Reflection

- Spend ∼3 minutes reviewing your notes from last lecture, homeworks, exit tickets, etc.
- Look for questions you have or clarifications you would like.

What is sound?

- The basic definition = a pressure wave that moves through some medium (like air, water, etc.)
- It is a vibration of the particles in that medium, and it propagates, or moves, through the medium

Acoustic waves

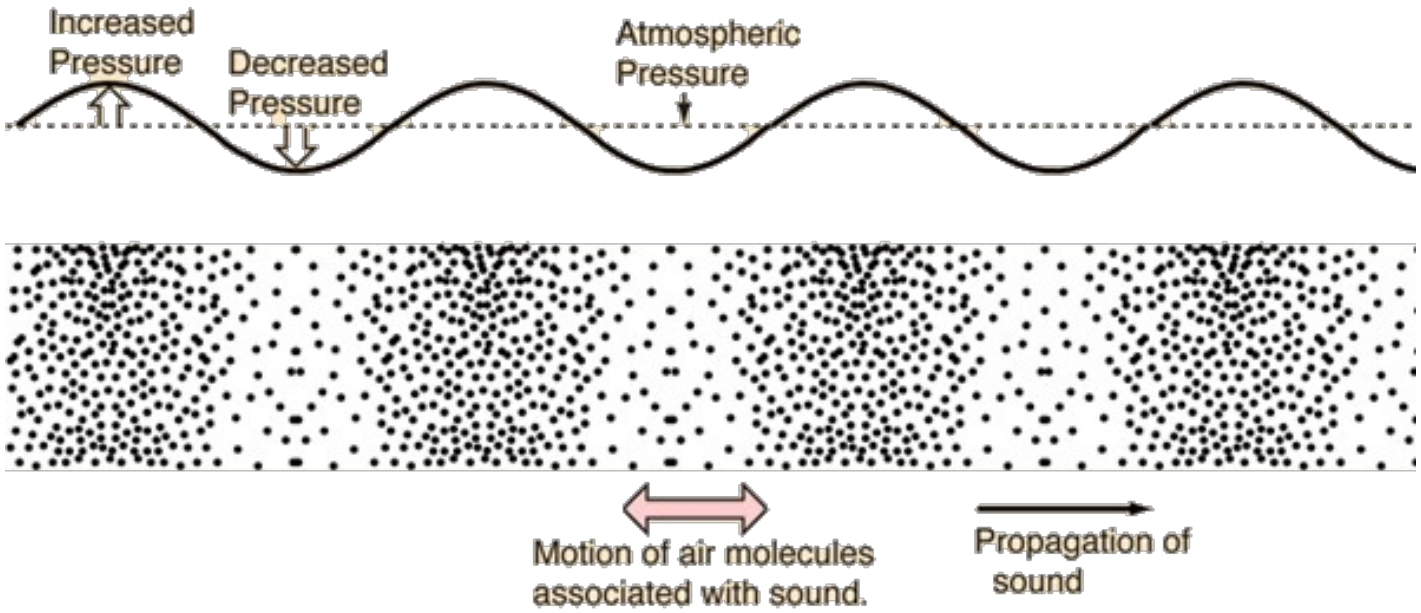
- Acoustic waves are typically generated by compression of particles, which then expand back to their original position
- This **compression** and expansion (more technically called **rarefaction**) expands and affects nearby particles, spreading in a wave-like pattern
  - Important: the particles themselves move in a relatively restricted area, the waves travel much further!
  - It can be analogized to be spring-like or slinky-like (see images)
- Sound waves in gasses and liquids travel as **longitudinal** waves
  - Examples of wave types from Daniel Russell
  - The Magic Schoolbus - Inside the Haunted House (14:25–17:50)

Wave propagation

- Sound waves "propagate" or move away from the source in all directions, unless obstructed or modified by changes in the medium
- The speed of propagation of sound in air depends on the temperature and humidity
  - In our atmosphere, near sea level it is $\approx$ 34,300cm/s (343m/s, 767mph[1])
  - In water, it's 148,000cm/s (1480m/s, 3310mph)
  - The vocal tract is fairly warm and humid, and the speed of sound is $\approx$35,000cm/s (350m/s, or 783mph)
    - This is what we will be using for the speed of sound.
  - If sound is traveling through a different medium, that differs in density, it might be faster or slower

[1] For us non-SI crazies.

Wave propagation



- Top part is the **waveform** (fancier term: **oscillogram**) and graphically represents sound waves
  - It shows changes from **atmospheric equilibrium**
  - We typically assign zero to atmospheric equilibrium and refer to relative changes from it
  - Thus it is commonly called the **zero**, or **zero line**
- Bottom is a visualization of the compression and rarefaction of the particles

Two types of waves

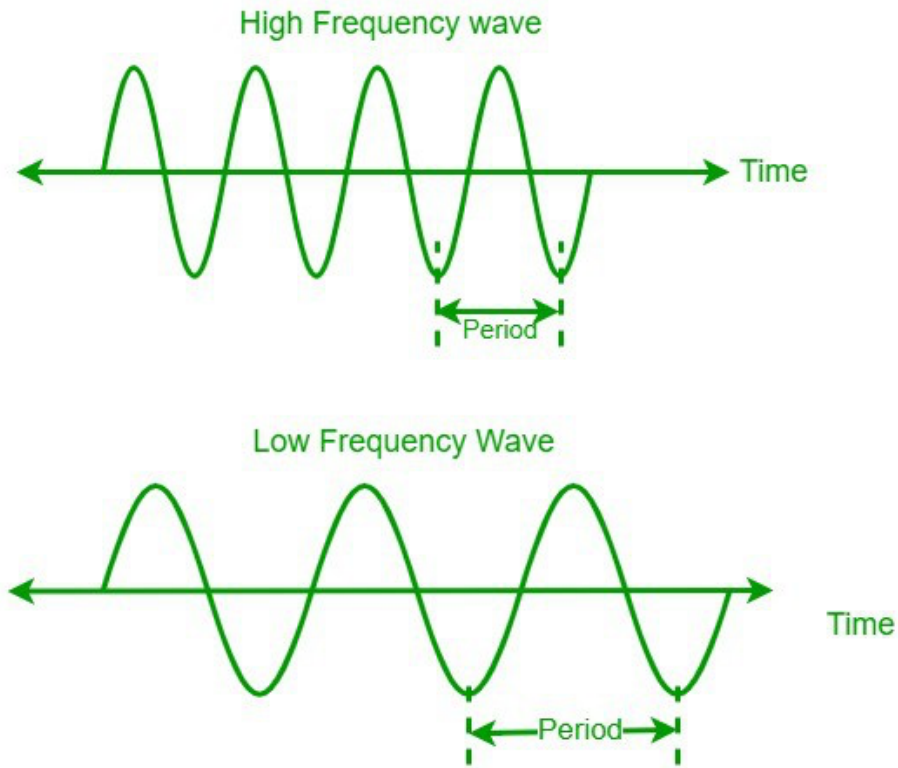
- **Periodic**
  - Wave with a regularly repeating pattern
  - Examples: Bowed string instrument, voiced sounds
- **Aperiodic**
  - No discernible repeating pattern in the wave
  - Can be continuously produced, still without a repeating pattern (e.g. white noise, pink noise, fricatives)
  - A single burst of aperiodic sound is called a transient (e.g. a clap, drum hit, stop burst)

Periodic Waves

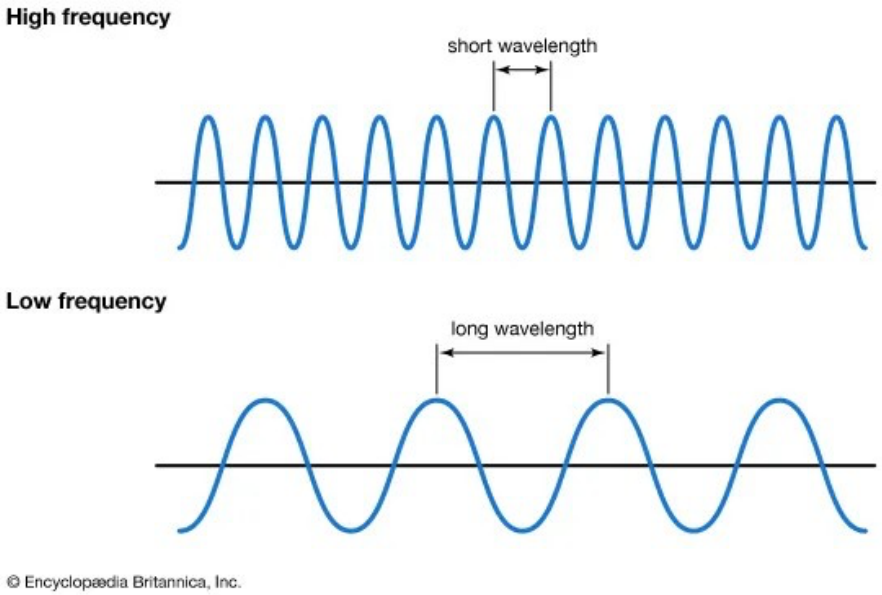
- **Frequency**
  - The rate at which a portion of a wave (a period) repeats in a given time unit
  - Unit of measure: periods (cycles) per second, called **Hertz** (**Hz**)
- **Wavelength** (λ)
  - Distance (in meters) from one period to the next
- **Amplitude**
  - Magnitude of the oscillation, measured in Pascals (absolute), or Decibels (relative)

Frequency

- The rate at which a cycle/period repeats
- More frequent repetitions are perceived as having higher pitch than less frequent ones
- Western (equal temperament) musical tuning and frequency



Wavelength (λ)



$$\lambda = \frac{c}{f}$$

wavelength; speed of sound (m/s); frequency (Hz)

- The distance from one period to another, using the same part of the wave
  - e.g., peak–to–peak, trough–to–trough, positive zero crossing to positive zero crossing
- Represented as the Greek letter lambda (λ)
- Inversely related to frequency (longer wavelength $\rightarrow$ lower frequency)

Amplitude

Break Time!

10 minute break
(stretch, grab a drink, etc.)

To Do:

- Complete the exit ticket for today on Canvas by 12:30pm.
- Complete Homework 2 by Tuesday at 8:30am.