Hearing

Image https://pxhere.com/en/photo/1428401 by mbpogue

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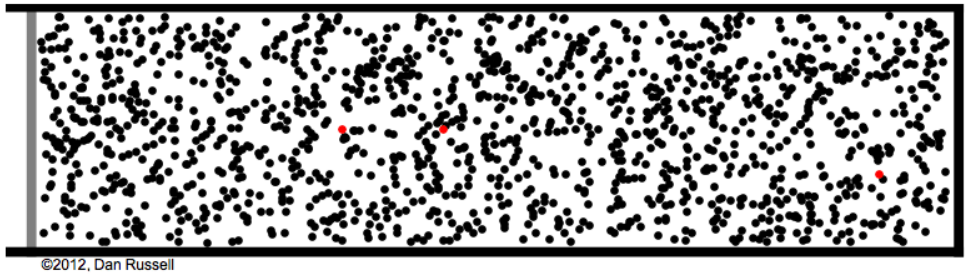
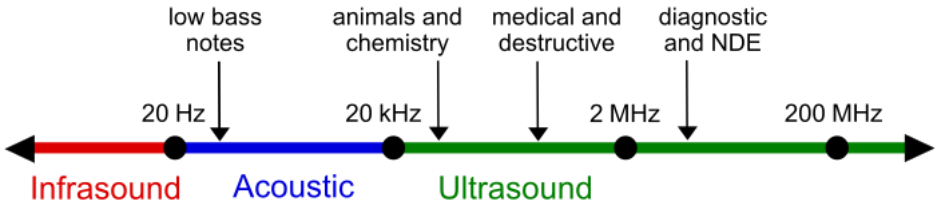
Learning Goals

- Sound
- The ear
- Spatial hearing
- Sound filtering

Sound





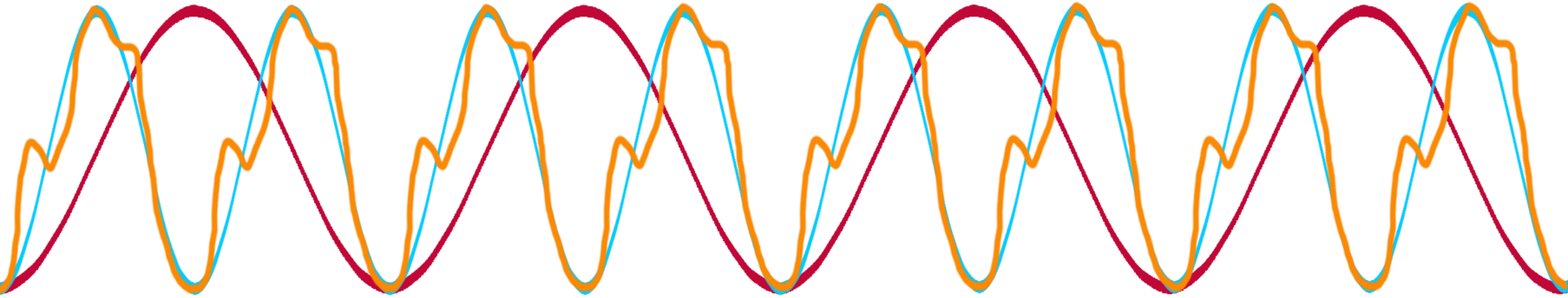
- Hearing: sensory perception of sound
- Sound: changes of air pressure in the perceivable frequency range

Image Source https://commons.wikimedia.org/wiki/File:Standing.gif by Daniel A. Russell & https://commons.wikimedia.org/wiki/File:Ultrasound_range_diagram.svg by Mikhail Ryazanov

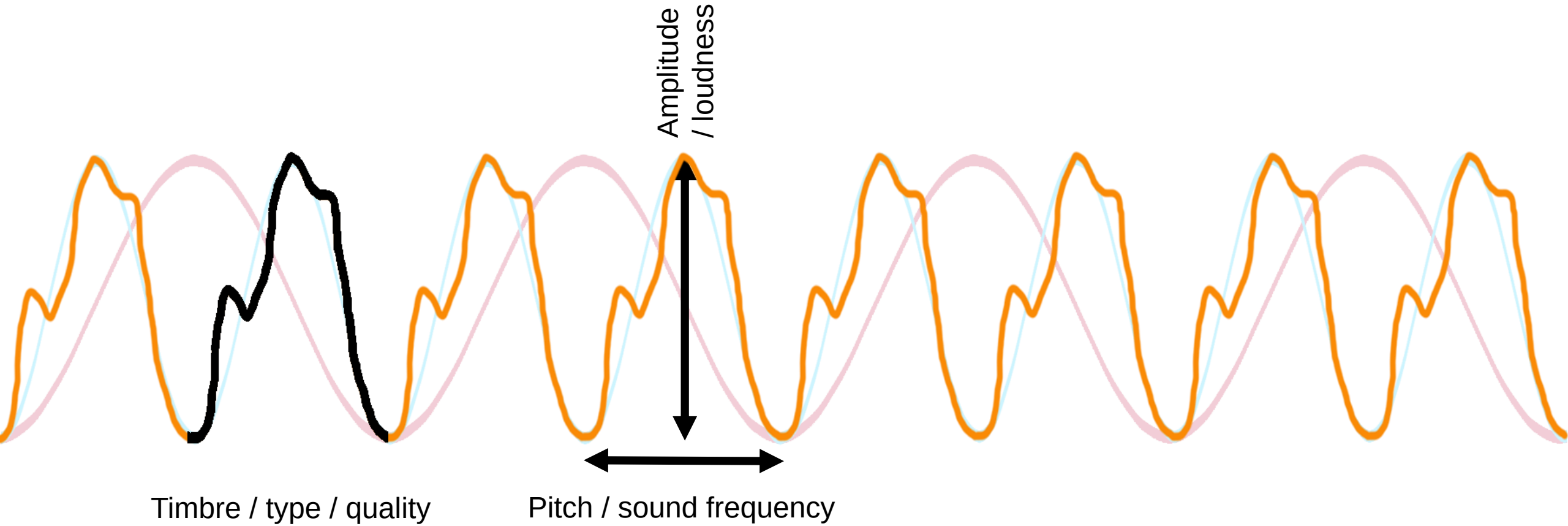
Slide adapted from Tonja Machulla

Sound

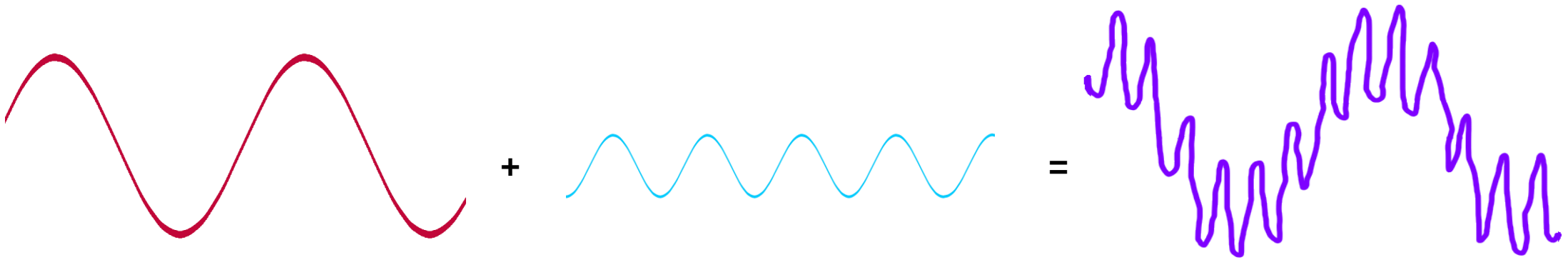
- C note 220Hz



Sound


Amplitude
/ loudness
Timbre / type / quality
Pitch / sound frequency

Sound



Sound

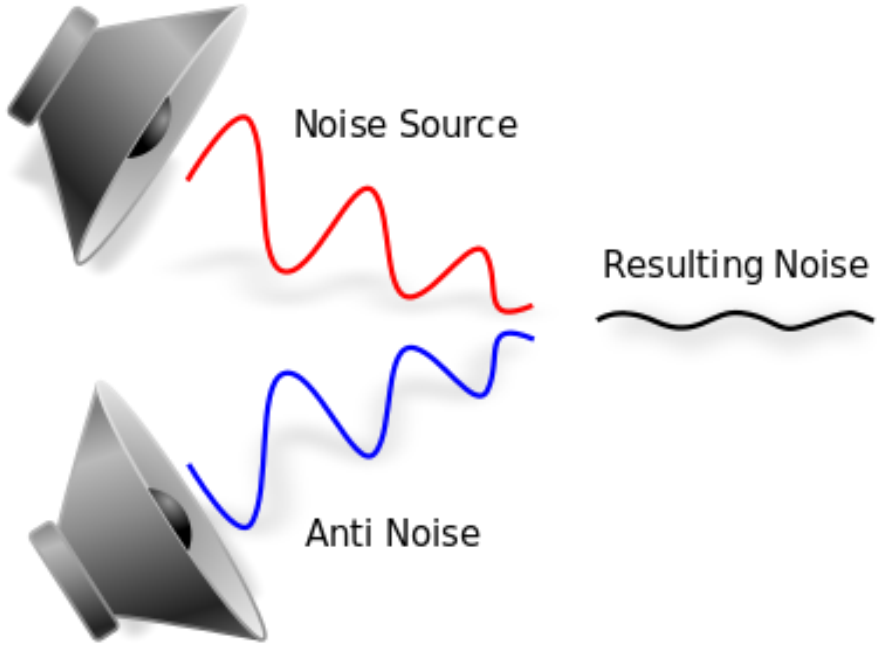
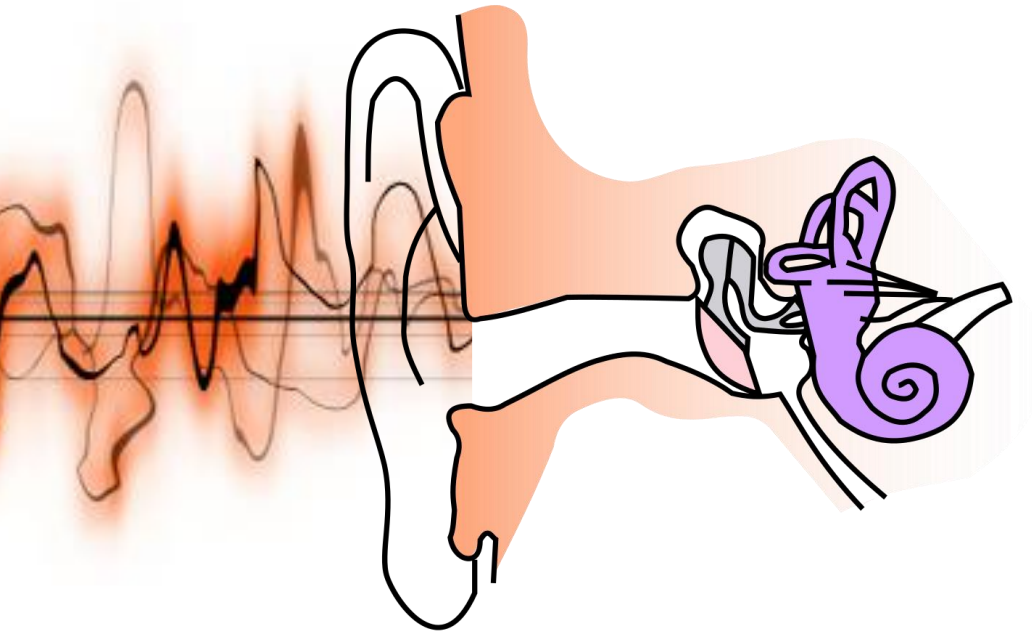


Image Source https://commons.wikimedia.org/wiki/File:Active_Noise_Reduction.svg by Marekich

Image Source https://pixnio.com/de/media/schwarz-und-weis-ohr-brillen-hut-altmodisch

The ear



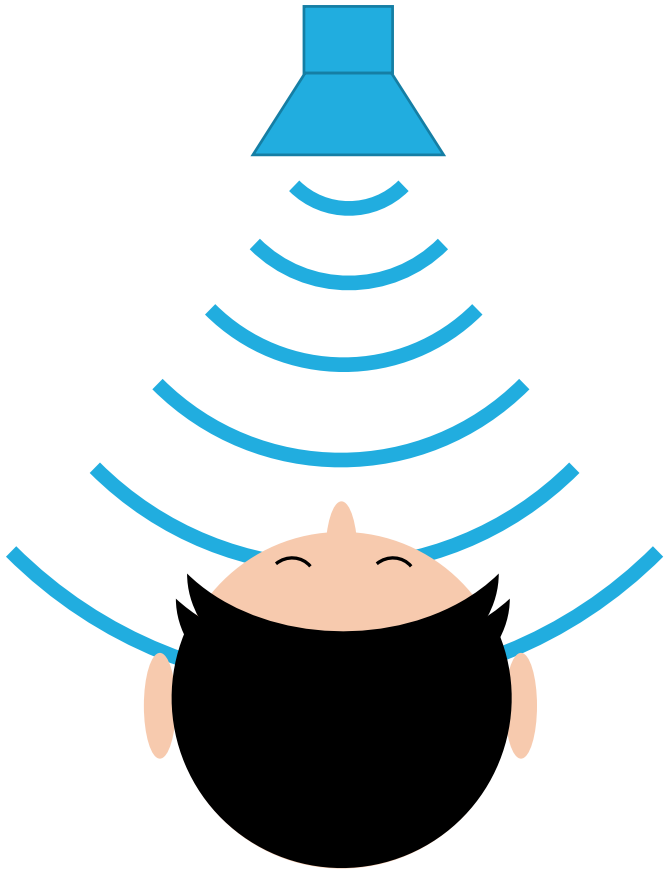
- outer ear: protects inner ear & amplifies sound
- middle ear: transmits sound waves as vibrations to inner-ear
- inner ear: chemical transmitters are released and cause impulses in auditory nerve

Image Source https://de.wikipedia.org/wiki/Datei:Ear-anatomy-notext-small.svg by Surachit

Image https://www.pexels.com/photo/crowded-street-with-cars-passing-by-708764/ by suzukii xingfu

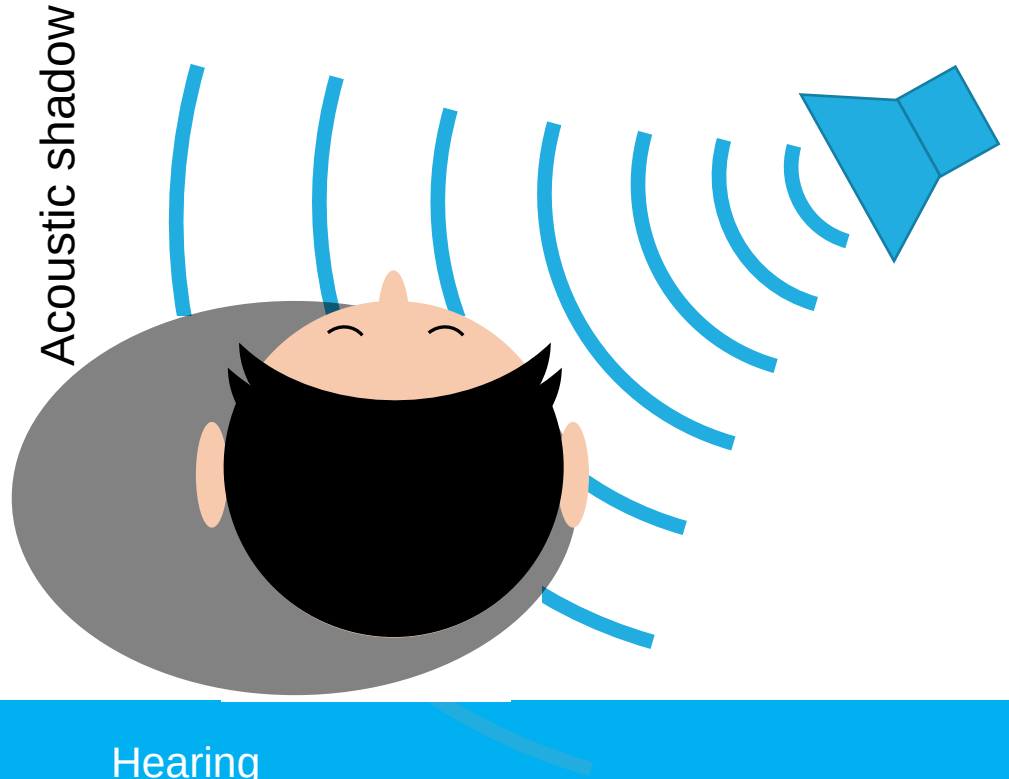
- Information about the environment
- Type of sound source
- Distance and direction through spatial hearing

Spatial Hearing



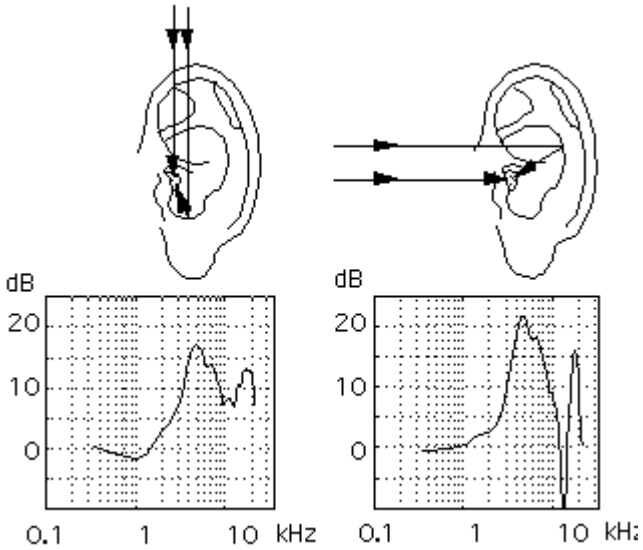
- Time:
  equal
- Amplitude:
  equal
- Sound wave form:
  equal

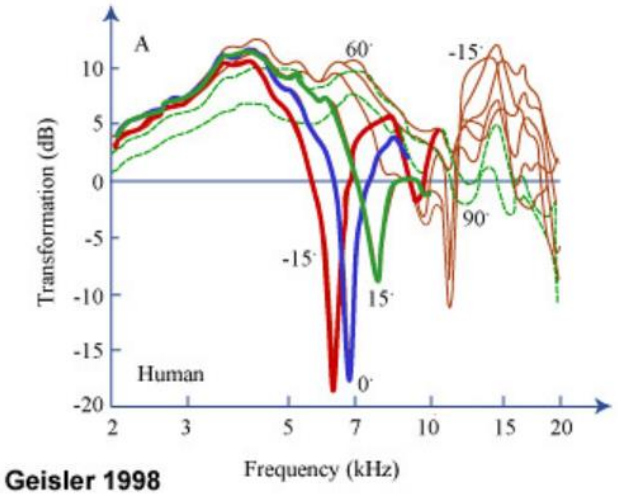
Spatial Hearing



- Interaural time difference (ITD)
- Interaural intensity difference (IID)
- Head related transfer function (HRTF)
- Works better for high frequencies

Head related transfer function





Geisler 1998

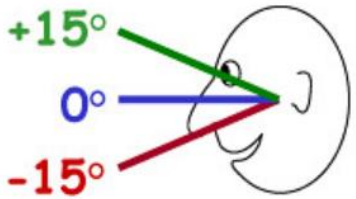


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Image Source https://www.pexels.com/de-de/foto/20-25-jahre-alt-cocktail-stunde-cocktails-coole-party-2788687/ by Vanessa Pardo

Auditory Information Filtering

- Examples:
  - Focusing on a conversation at a party
  - Listening in the neighbor conversations at a party
  - Recognizing when somebody speaks out your name

- The auditory system filters incoming information and allows selective hearing
  - Selectively hearing sound in environment with background noise
  - Spotting keyword, e.g. cocktail party phenomenon

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