Auditory Phonetics: Ear and Brain

Dra. Isabel Balteiro
Introduction

- The importance of the brain

- The importance of the ear
  - 3 major functions:
    - to collect stimuli
    - to transmit stimuli
    - to analyse stimuli
The Ear

- Outer ear
- Middle ear
- Inner ear

(image taken from: http://biblia.com/maravillas/oido.)
The Outer Ear

- The *outer ear*
  - what we can see + the canal (which leads to the *ear-drum*).
  - It amplifies some frequencies and rejects some frequencies and intensities.

- The canal
  - a short tube full of air, which acts as a resonator and causes some amplification of frequencies near its resonant frequency.
The Middle Ear

- A small air-filled cavity in the skull which contains a chain of three tiny bones connected to the ear-drum at one end and the *inner ear* at the other.

- Connected to the nose by the Eustachian tube.
  - This ensures that the air pressure in the enclosed middle air can be equalized with outside air pressure quickly and easily if they become very different.
The Inner Ear

- The main part of the inner ear is the **cochlea**.

- **Cochlea:**
  - a completely enclosed gallery with rigid walls, filled with fluid, coiled round itself like a snail-shell.
  - its broad end connects with the middle ear.
  - Two openings from the middle ear into the cochlea:
    - the oval window
    - the round window
From the cochlea to the brain ....

- The ear canal amplifies some frequencies.
- The eardrum rejects some frequencies and intensities.
- The middle-ear bones amplify slightly the vibrations of the ear-drum.
- The difference in size between the ear-drum and the oval window makes the pressure at the latter very much greater than at the former.
- The cochlea analyses the component frequencies of the complex wave.
The perception of sound

- We hear speech sounds in terms of:
  - pitch
  - loudness
  - quality
  - length.
Our hearing is most sensitive in the region below 1,000 cps.

We can perceive a difference of pitch between two notes which are as little as 3 cps.

We do not use a very great range of vocal pitch in speech.

It varies quite widely from person to person.
Loudness

- When we reach a level of about 140db pain begins to be felt in the ear.

- We can distinguish 250 or more degrees of loudness of a pure tone.

- At a fixed loudness we may be able to hear more than 1,000 differences of pitch.
Sound or voice quality

- Voice quality is affected by:
  - differences in size and shape of the individual’s vocal cavities
  - structure of vocal cords and control of their vibration
  - air-flow characteristics

- Voice quality is also related to the higher formants of voiced sounds.
Feedback

Feedback mechanism:

The ear acts as a monitor of what we ourselves say or are saying.

Deafness and deaf-mutism.

*Delayed feedback.* It makes people stammer.
Ear training

To discriminate sounds.

How?

- Alternating the sounds and drawing attention to the relevant auditory and articulatory factors.
- Dictating nonsense words.