Assistive Devices for the Hearing impaired - Past and Present

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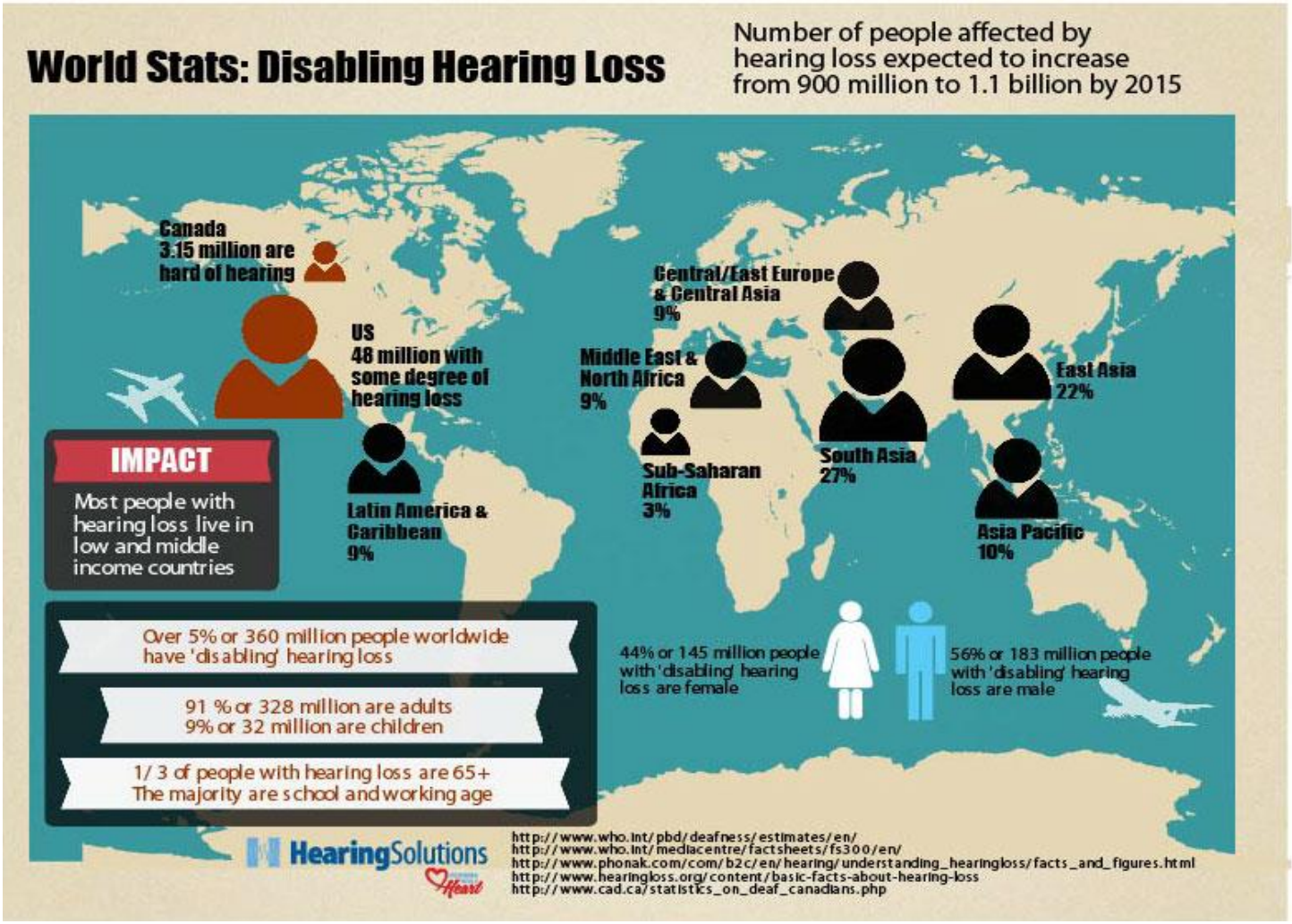
Overview

- Hearing
- Intervention/Devices/Assistive Technologies
- Current Challenges
- My research
- Emerging Technologies

Hearing

World Statistics

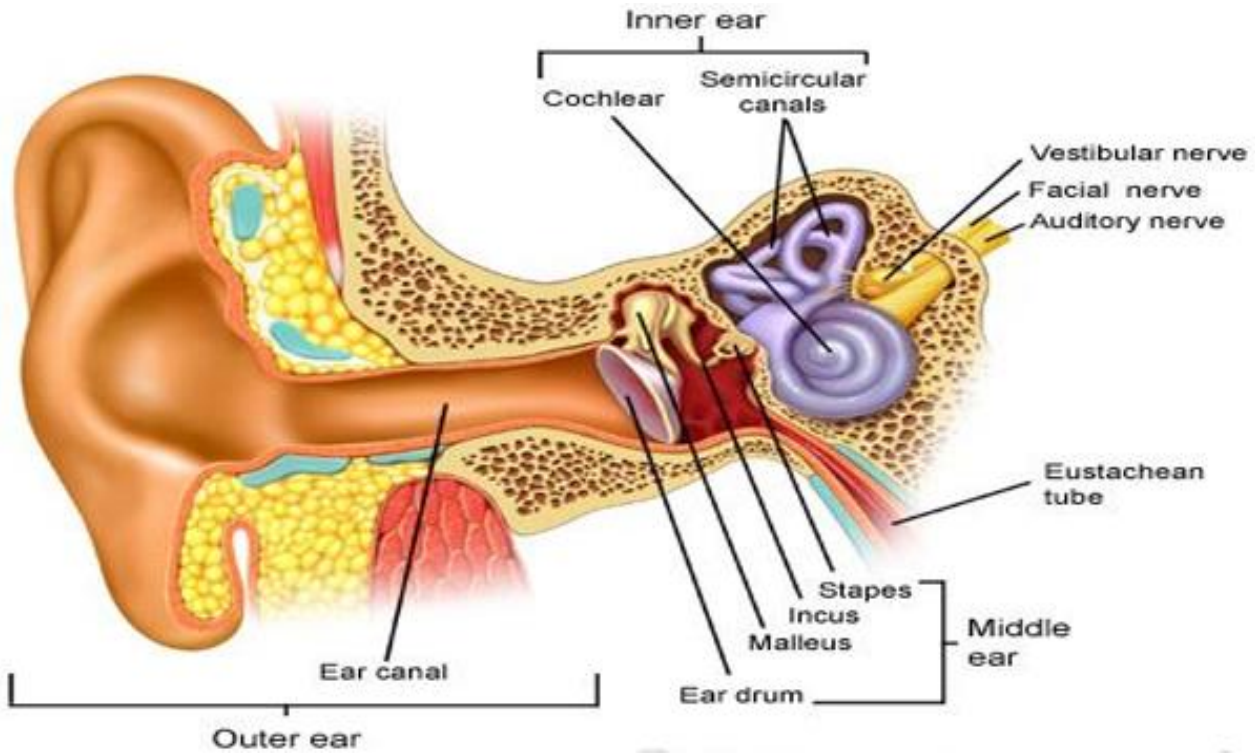


World Health Organisation (WHO) Statistics

- will affect most

- even greater problem in developing world

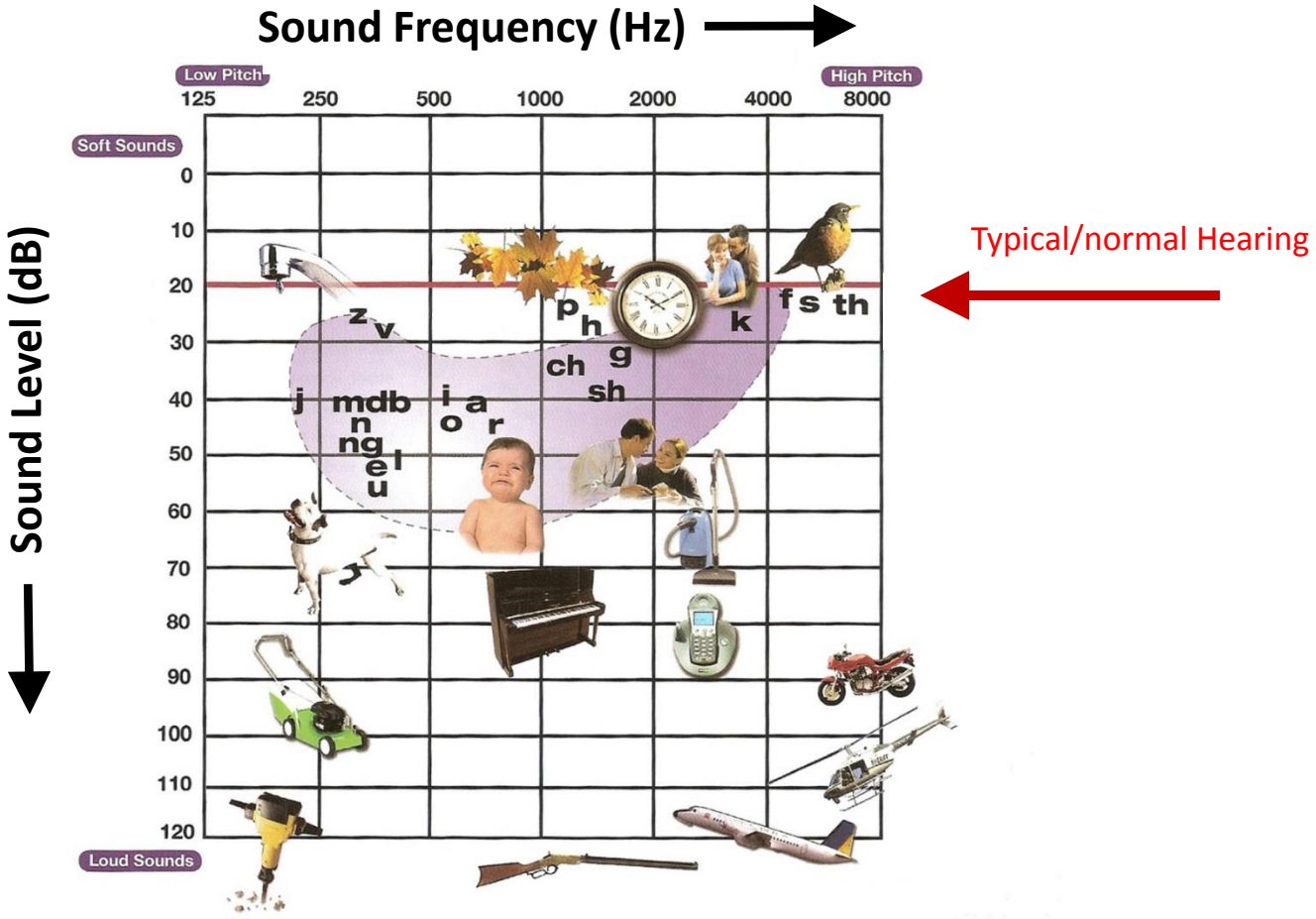
What is a hearing impairment?



Possible Loci:

- Outer
- Middle
- Inner
- Neural

Audiometry -> Audiogram



Assistive devices

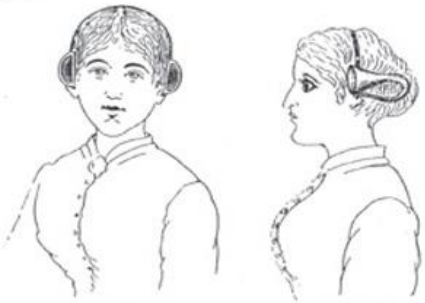
1600s – early 1800

King John VI of Portugal 1819

Late 1800's – Early 1900s

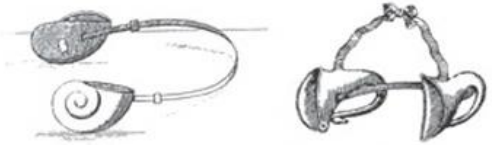
CLASS B.—AURICLES.

The AURICLE is a very powerful form of hearing instrument. The principle is a metal cone having a large sound-collector doubled on itself. They are covered in silk or japanned, and attached by an adjustable spring, going over or behind the head; they require to be carefully fitted to the ears so as to avoid undue pressure; are light in weight and easily concealed by the hair, wig, &c.



B 92 double B 92 single

When only one auricle is required the spring attaching it to the ear must pass over the head; those with a spring at the back of the head are in all cases double. The advantage of the spring being at the back of the head is that the weight of the auricles is sustained by the soft ribbon which alone passes over the head, and the spring keeps the nipples in contact with the ears.



B 900 B 92

(For prices see next page.)

THE AUDIPHONE.

Helen Keller (1880 –1968)

- Blind & hearing impaired from 19 months
- Author
- Activist
- Lecturer
- Attitudes, schooling, sign language

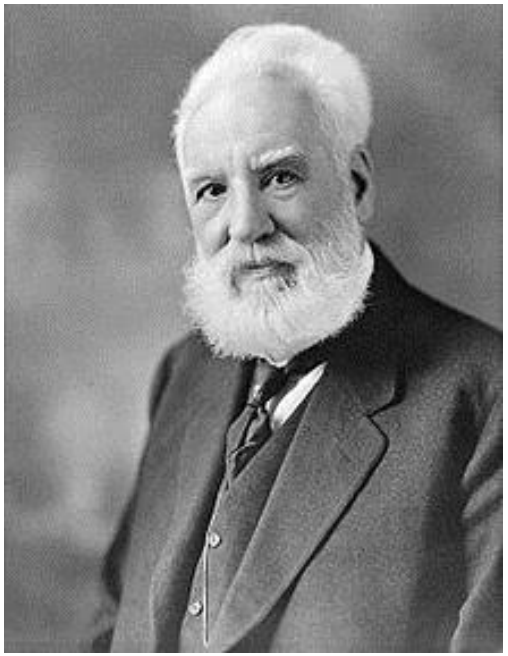
“Blindness separates people from things”

“Deafness separates people from people”

Alexander Graham Bell

Inventor of the telephone patented 1876 ……

- Bell's father, grandfather, brother- work on speech production for hearing impaired
- Bell's mother and wife were profoundly hearing impaired
- Bell's experiments with a hearing device for his wife ⟶ Telephone



1930s

1950

HARD-OF-HEARING
A REVOLUTIONARY NEW ACCESSORY

MAKES IT POSSIBLE TO WEAR AN ACOUSTICON LIKE A WRIST WATCH

Wear it on your wrist like a watch! *Now* —

- You can have directional hearing . . .
- Maximum clarity and ease in your phone conversations . . .
- Great reduction in frictional clothing noise...
- You can carry on confidential conversations . . .
- Hear without strain in church, theaters, or auditoriums . . .

This new Acousticon "Wrist-Ear" gives you increased volume and provides flexibility in hearing that has never before been possible, *because you wear it on your wrist!*

Come in — at the earliest moment you can — for a free try-out. You'll be amazed and delighted.

Or if you can't come in, send coupon now for complete information.

Acousticon

580 Fifth Avenue, New York 19, N. Y.

ACOUSTICON 580 - 5TH AVE., DEPT. V
NEW YORK 19, N. Y.

☐ Please send me complete information about the new "Wrist-Ear".

☐ Without obligation, I would like a home try-out of "Wrist-Ear". The best time to see me is:

(hour) (day)

Name

Address

City State

Figure 4. *The Penfone at left and the Telex 300 were both hearing aids designed to look like fountain pens.*

Hearing aid use low: Attitudes - 1952

Eleanor Roosevelt

ELEANOR ROOSEVELT
stresses the importance of
HEARING AIDS

"An unusual award was given to America's elder statesman, Bernard B. Baruch . . . because of his leadership in encouraging the hard of hearing to use and seek hearing problem advice. He wears his aid with distinction, and it certainly makes a difference not only to himself but to his family and friends. That could be true of anyone who is deaf.

"I would have to wear a hearing aid in my work at the United Nations if we didn't have earphones, which magnify the sound as well as permit us to hear the translations. Each one of us has a little microphone in front of us and we talk into it. The minute anyone forgets and does not talk into the microphone I am completely lost, for I hear nothing.

* * *

"I will acknowledge that for a woman a hearing aid is a little more trouble to carry about than it is for a man . . . But when the day comes when I can't hear people around me I certainly will not make my family shout at me. I will wear a hearing aid no matter what inconvenience I may find in carrying the paraphernalia."—*Reprinted from Mrs. Roosevelt's famous newspaper column by permission of United Feature Syndicate.*

History: Variety/miniaturisation

Vs.

Hearing Aids: Software problem

Image accessed (28/2/17): http://www.besthearingaidguide.com/h_history.html

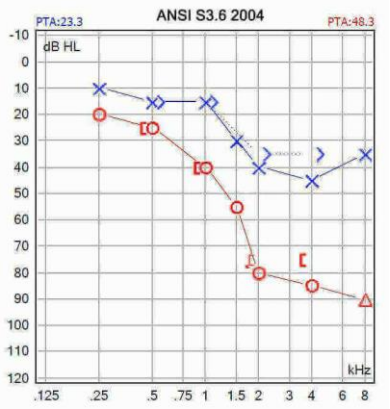
Current Challenges

With a hearing aid: Listening to speech in noise can still be difficult

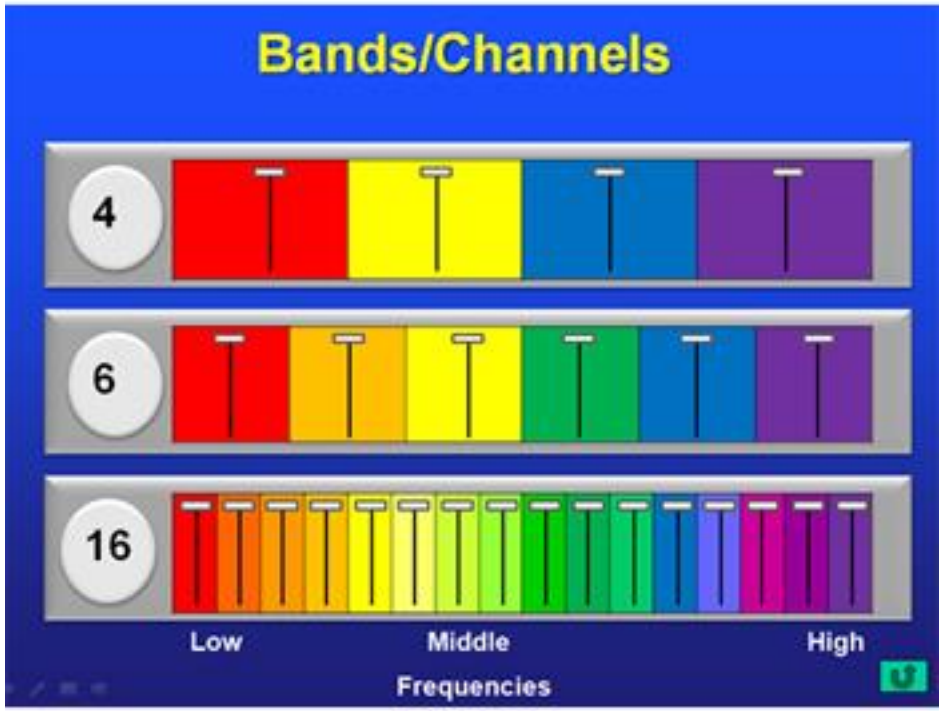
One of the most common problems reported by hearing aid users is that following speech in background noise is difficult.

My Research

Hearing aid design



Hearing aid: Input acoustic input can be separated into frequency bands (channels) for further processing



Factors affecting Speech perception in noise:

How many channels?

Type of Microphone?

Algorithms?

Signal Processing?

Limiting the output?

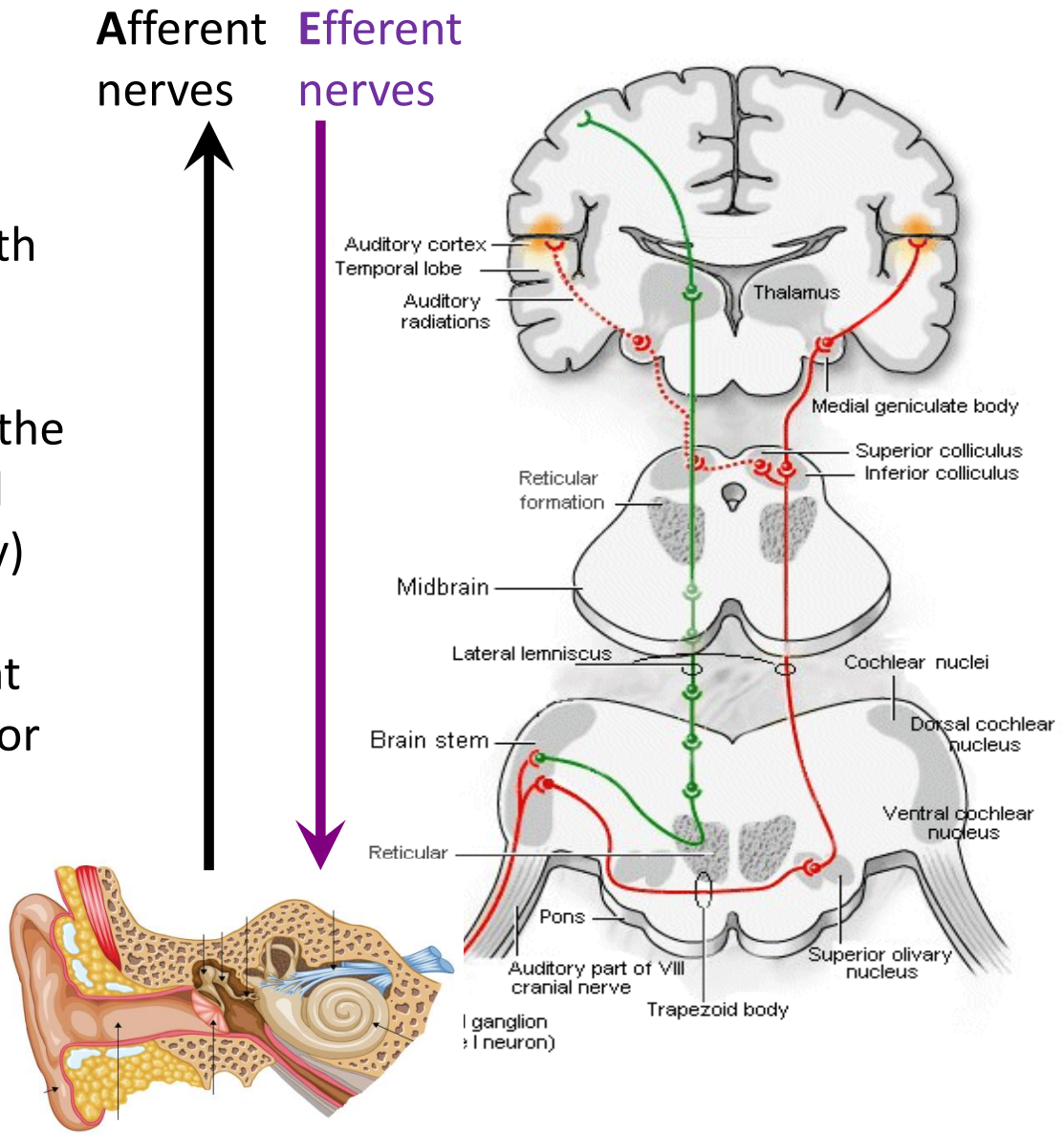
1 or 2 hearing aids?

Need to think of the whole system: Ear + Brain

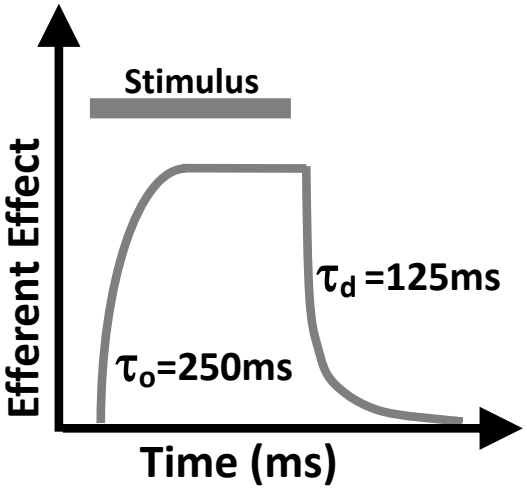
<u>Attention</u> (efferent fibres from higher brain regions)– helps with speech in noise

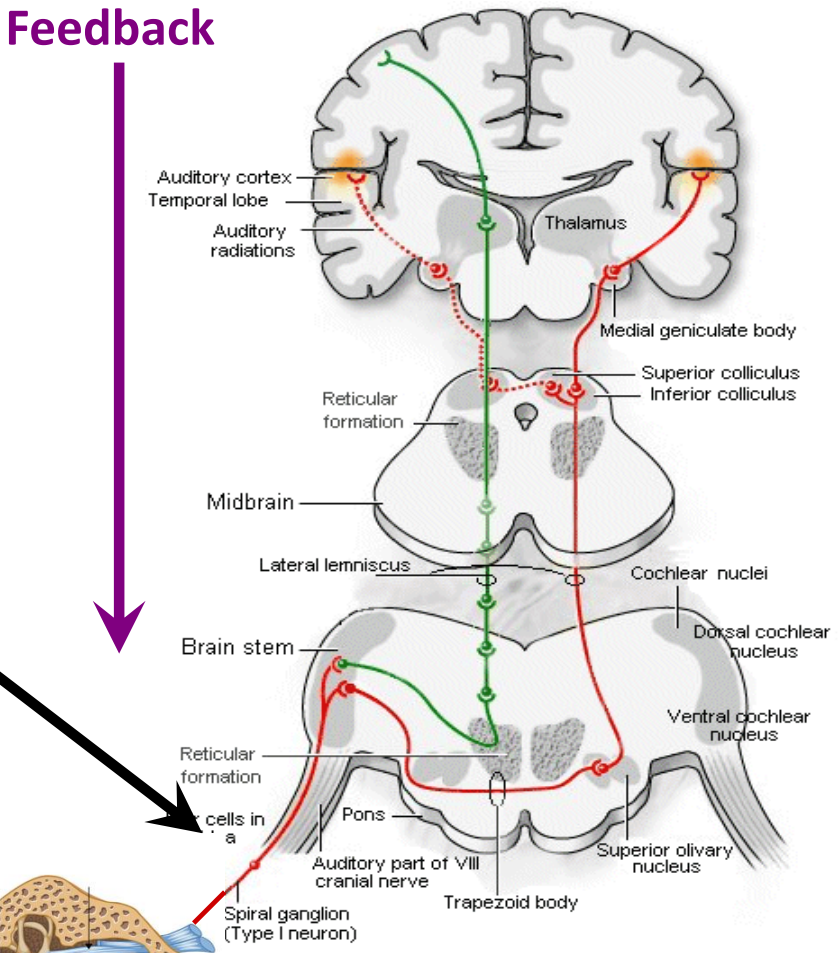
<u>Acclimatisation</u>: takes time for the brain to re-learn with amplified input (related to brain plasticity)

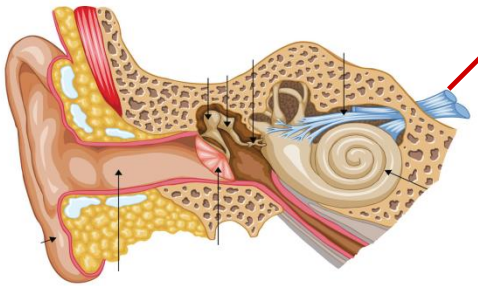
<u>Speech in noise?</u>: Some efferent fibres appear to be important for listening to speech in noise



Auditory psychophysics: time constants associated with auditory neural feedback

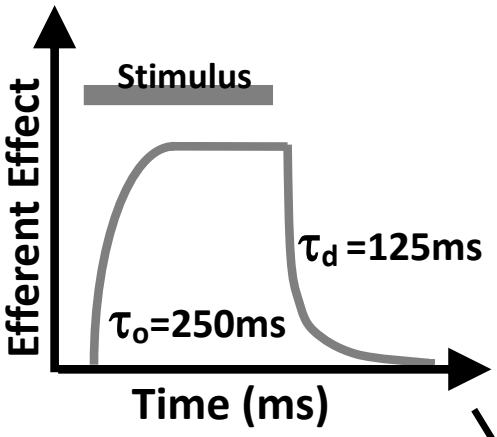




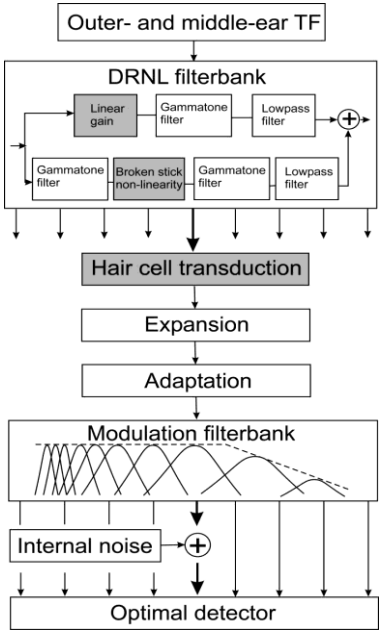


Yasin, I., Drga, V., and Plack, C. J. (2014). "Effect of human auditory efferent feedback on cochlear gain and compression," J. Neurosci. 12, 15319-15326.

Time constants associated with auditory neural feedback



The computational auditory signal processing and perception (CASP) model (Morten and Jepsen, 2011)



With Automatic Speech Recognition (ASR) systems

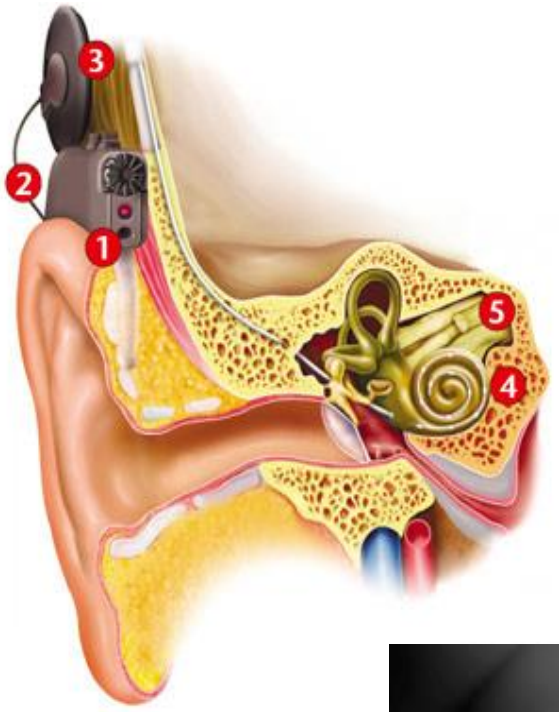
Audio-visual integration

Signal processing strategies for: Hearing aids & Cochlear implants

Emerging technologies

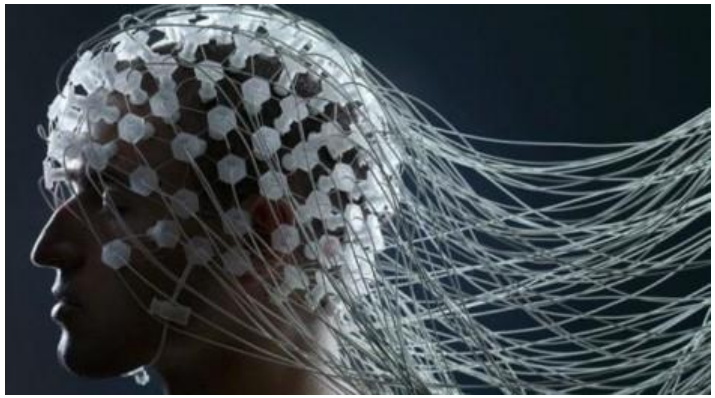
Cochlear Implants – “Bionic ear”

1. Sounds are picked up by the microphone.
2. The signal is then “coded” (turned into a special pattern of electrical pulses).
3. These pulses are sent to the coil and are then transmitted across the skin to the implant.
4. The implant sends a pattern of electrical pulses to the electrodes in the cochlea.
5. The auditory nerve picks up these electrical pulses and sends them to the brain. The brain recognizes these signals as sound.

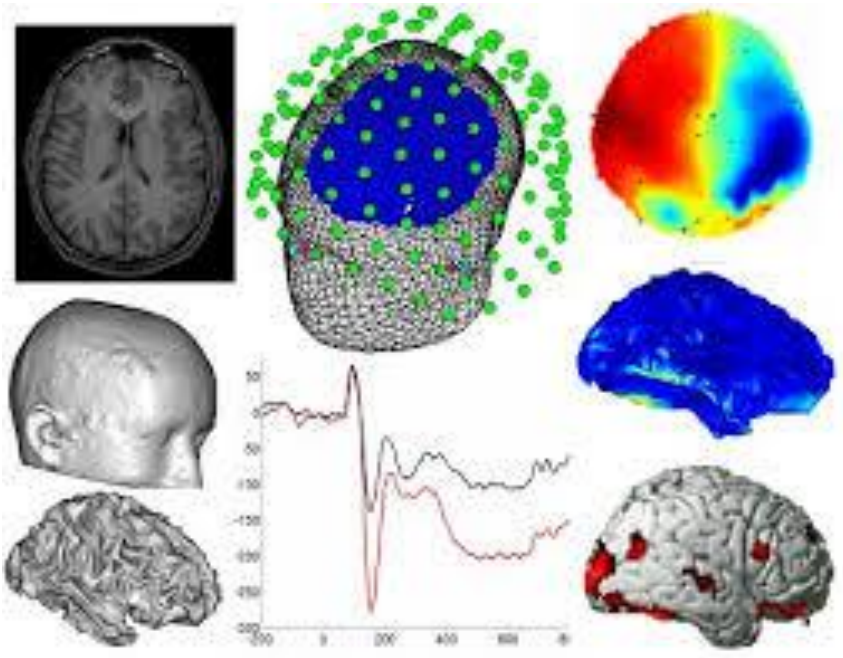


Intelligent hearing aids

Electroencephalography (EEG)



Communication between hearing aid and brain



References/Factsheets/Videos:

World Health Organisation: Deafness and Hearing Loss (factsheet 300):
http://www.who.int/mediacentre/factsheets/fs300/en/

World Health Organisation: Millions live with Hearing Loss (2013):
http://www.who.int/pbd/deafness/news/Millionslivewithhearingloss.pdf

Edwards, B. (2007). “The future of hearing aid technology”, Trends in Amplification, 11, 31-45.

Yasin, I., Drga, V., and Plack, C. J. (2014). “Effect of human auditory efferent feedback on cochlear gain and compression,” J. Neurosci. 12, 15319-15326.