

# Assistive Devices for the Hearing impaired - Past and Present

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# Overview

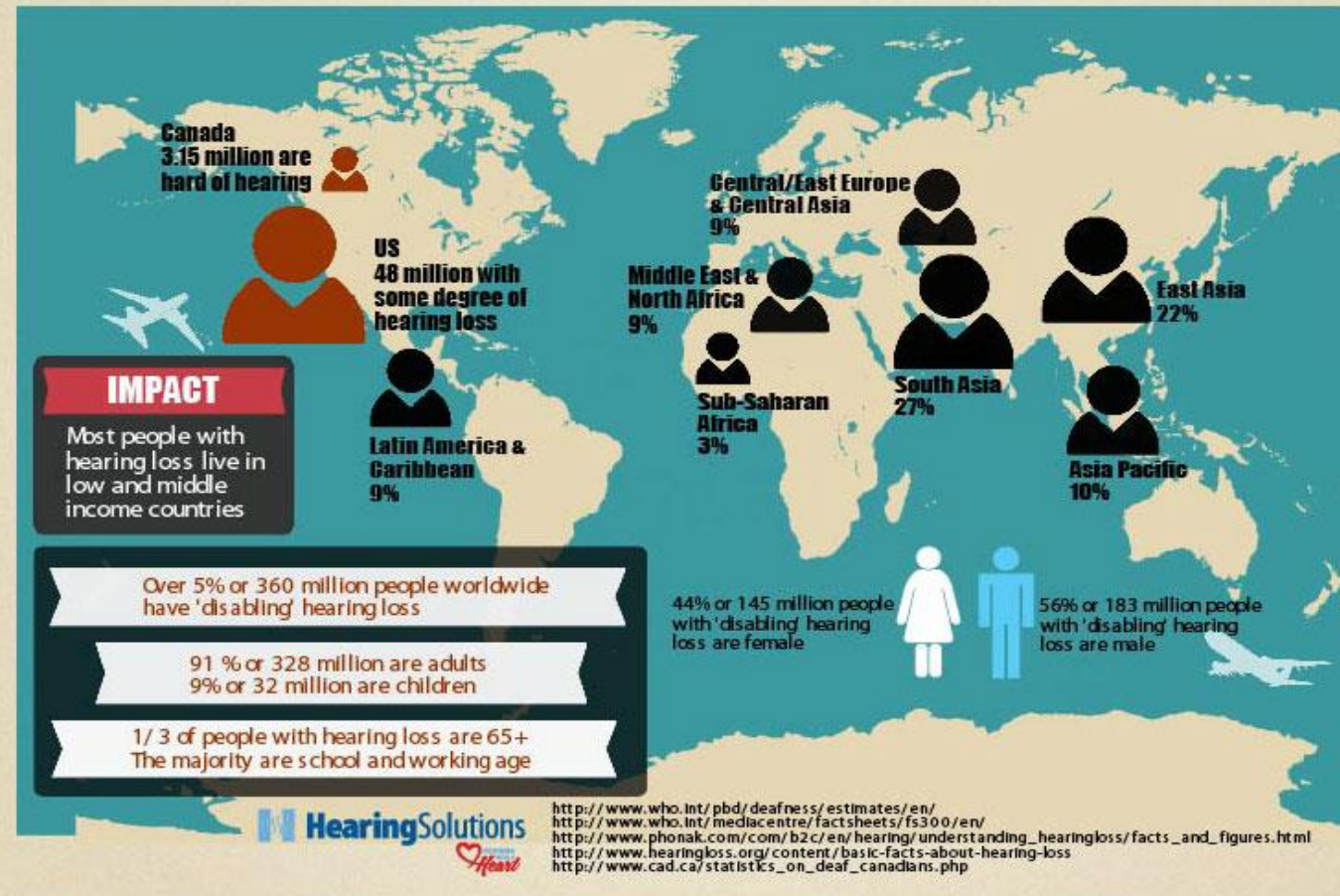
- Hearing
- Intervention/Devices/Assistive Technologies
- Current Challenges
- My research
- Emerging Technologies

Hearing

# World Statistics

## World Stats: Disabling Hearing Loss

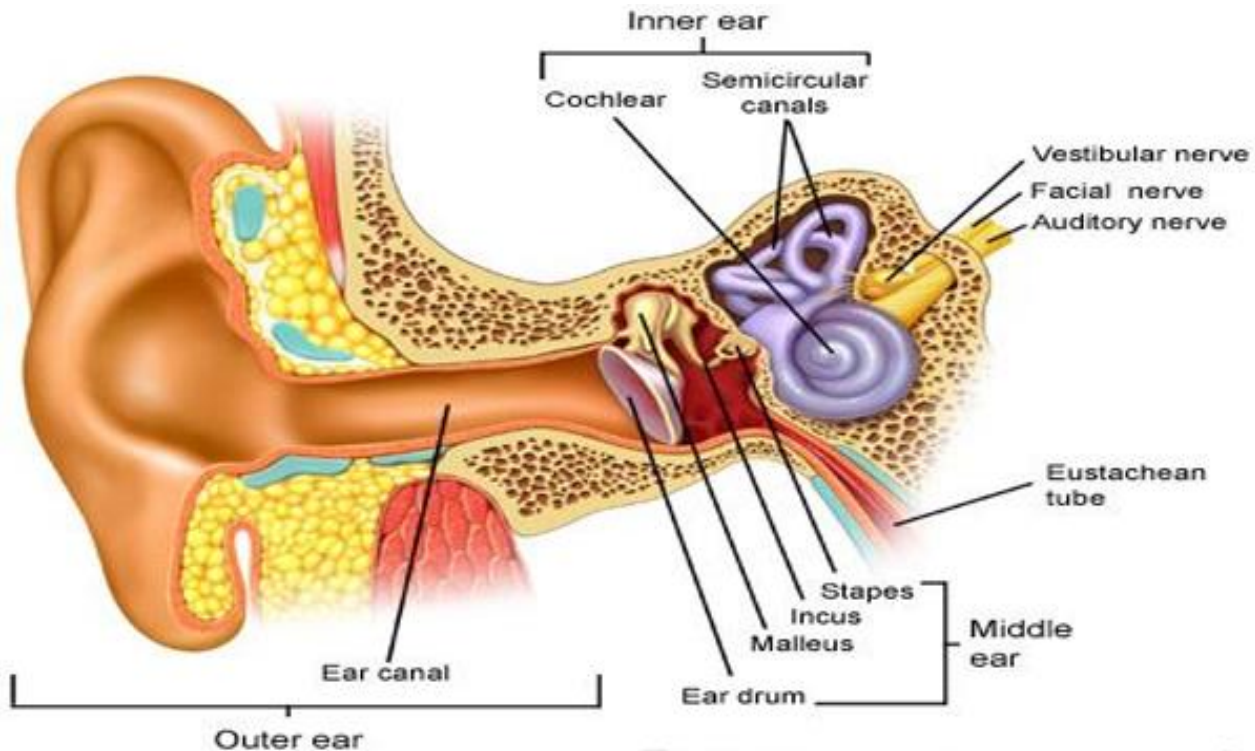
Number of people affected by hearing loss expected to increase from 900 million to 1.1 billion by 2015



World Health Organisation (WHO) Statistics

- will affect most
- even greater problem in developing world

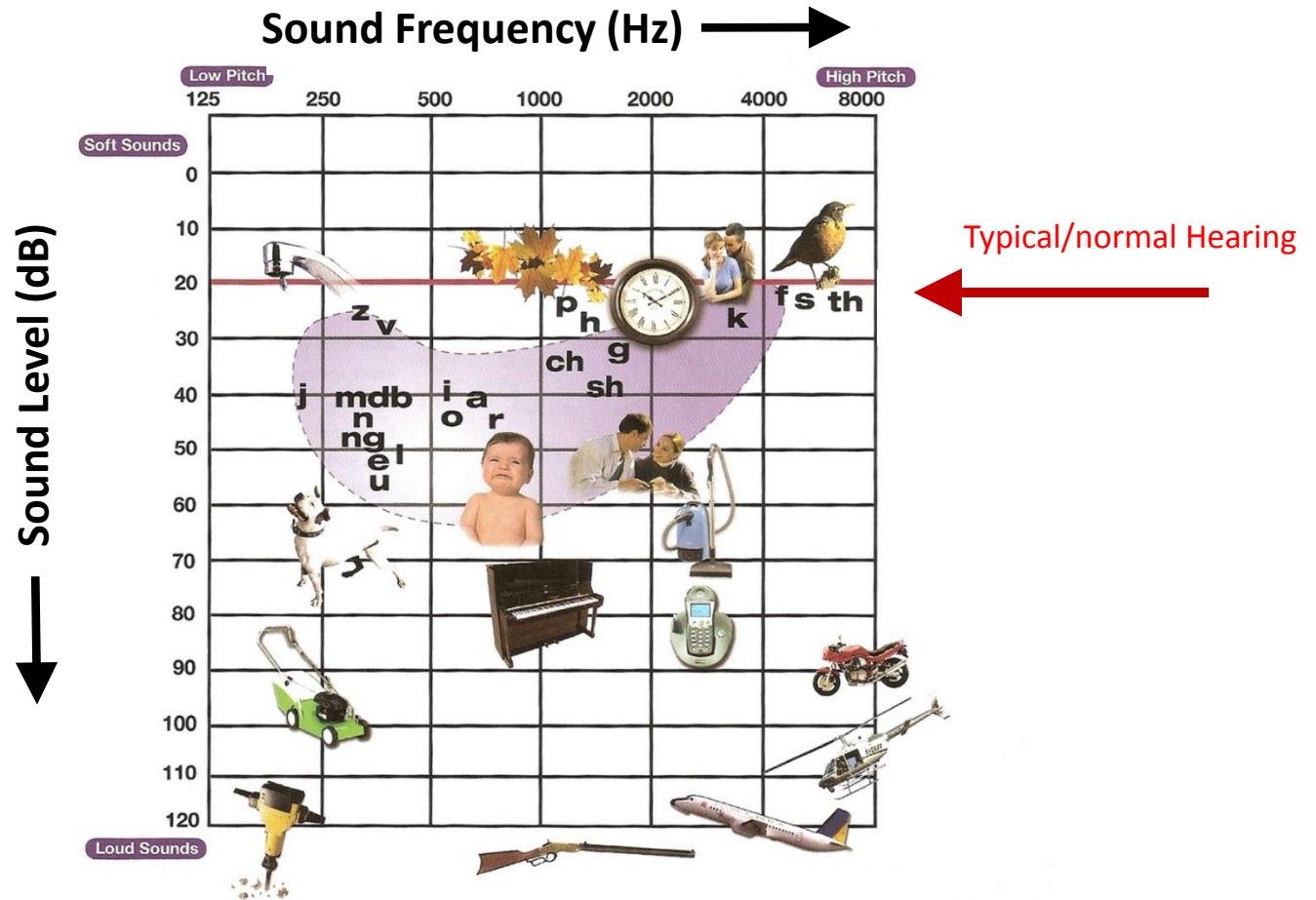
# What is a hearing impairment?



## Possible Loci:

- Outer
- Middle
- Inner
- Neural

# Audiometry -> Audiogram



Assistive devices

# 1600s – early 1800



**King John VI of Portugal 1819**





# Late 1800's – Early 1900s

T. HAWKSLEY. 357, Oxford Street.

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## 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.

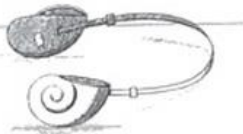


B 92 double



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

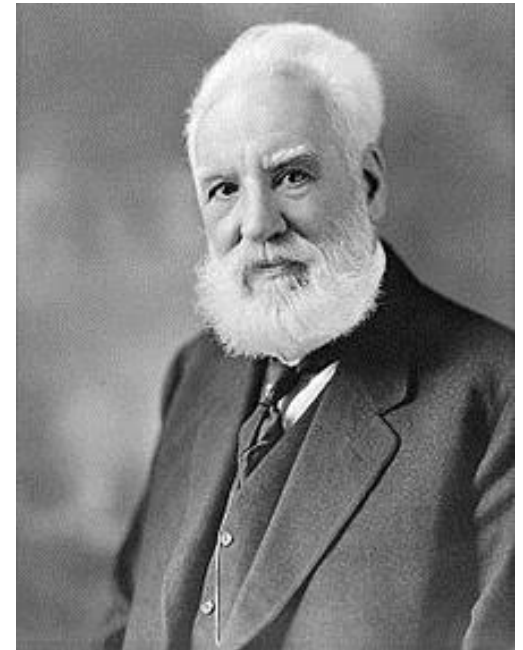
“Blindness separates people from things”

“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.



### THE SECRET of wearing a Paravox in your hair

A new kind of "HIDDEN HEARING"  
... Yours Exclusively with PARAVOX!

### TWO WAYS TO WEAR A PARAVOX IN YOUR HAIR

The two sketches at the left show two attractive ways in which a Paravox may be worn in the hair. Your favorite hair-do style will determine which way will suit you best. Whether you have a hair-stylist set your hair, or you do it yourself, it is surprisingly easy to completely conceal a Paravox "VERI-small" Hearing Aid in your hair.

### HOW THE PARAVOX IS HELD IN PLACE ON THE HEAD

Paravox has designed a special garment, with an adjustable elastic band that holds the instrument firmly, and comfortably to your head. With the hair brushed up and away from the head the garment, holding your Paravox, is placed in position and the band adjusted to fit properly. It can be placed either at the front or the back of the head as the illustrations indicate.

### NOW YOU ARE READY FOR YOUR "SECRET" HAIR-DO

With your Paravox in place on your head, you can bring your hair over the garment and band, and set it in your most attractive "hair-do" style. You'll find that the presence of the aid in your hair will only slightly alter or affect your hair setting. Your Paravox, light weight and small, will be hidden from view, now.

### HERE IS IDEAL "HIDDEN HEARING"


If you wear the air receiver, in the usual manner in the outer ear, you'll undoubtedly conceal it by covering your ears with your "hair-do". If you use the newer plastic tube extension, you conceal the air receiver, too, in your hair, fastening the receiver to the garment band.

Hearing aid use low: Attitudes - 1952



# Eleanor Roosevelt

Eleanor Roosevelt says  
"We should guard against deafness."

A black and white portrait of Eleanor Roosevelt, showing her from the chest up. She has short, curly hair and is wearing a dark jacket and a beaded necklace. The background of the portrait is a solid red color.

## 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.*

Copyright 1932, Bellone Hearing Aid Co.

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# History: Variety/miniaturisation



**1700s**



**1800s**



**1900s**



**1930s**



**1950s**



**1970s**



**1980s**



**Present**

Vs.



**Hearing Aids:  
Software problem**



## Current Challenges

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

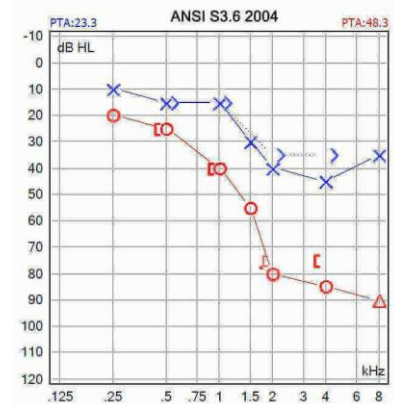
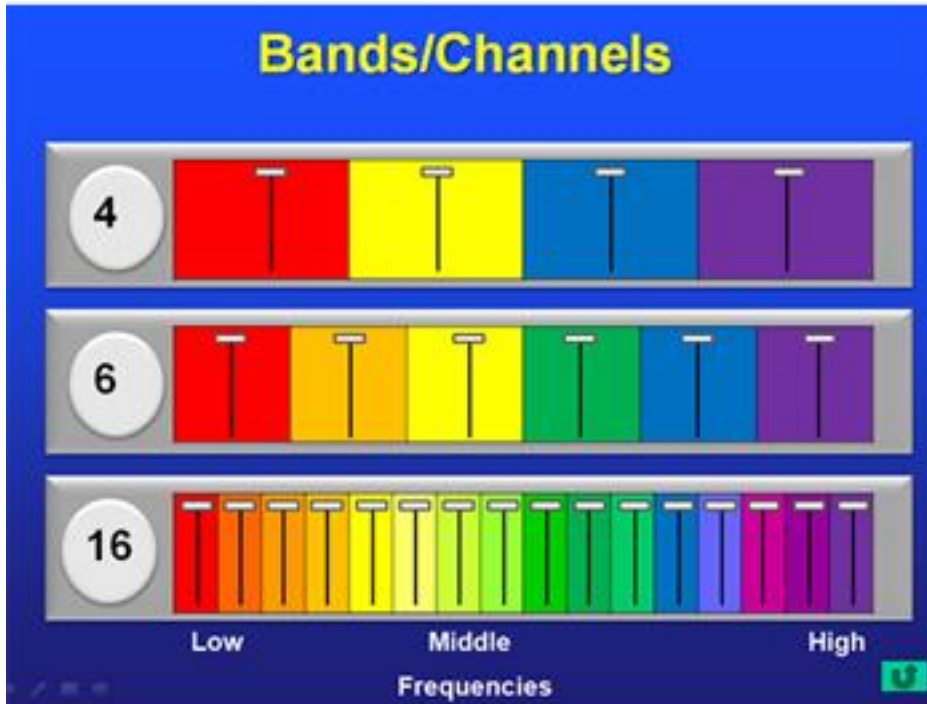


One of the most common problems reported by hearing aid users is that following speech in background noise is difficult.

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?

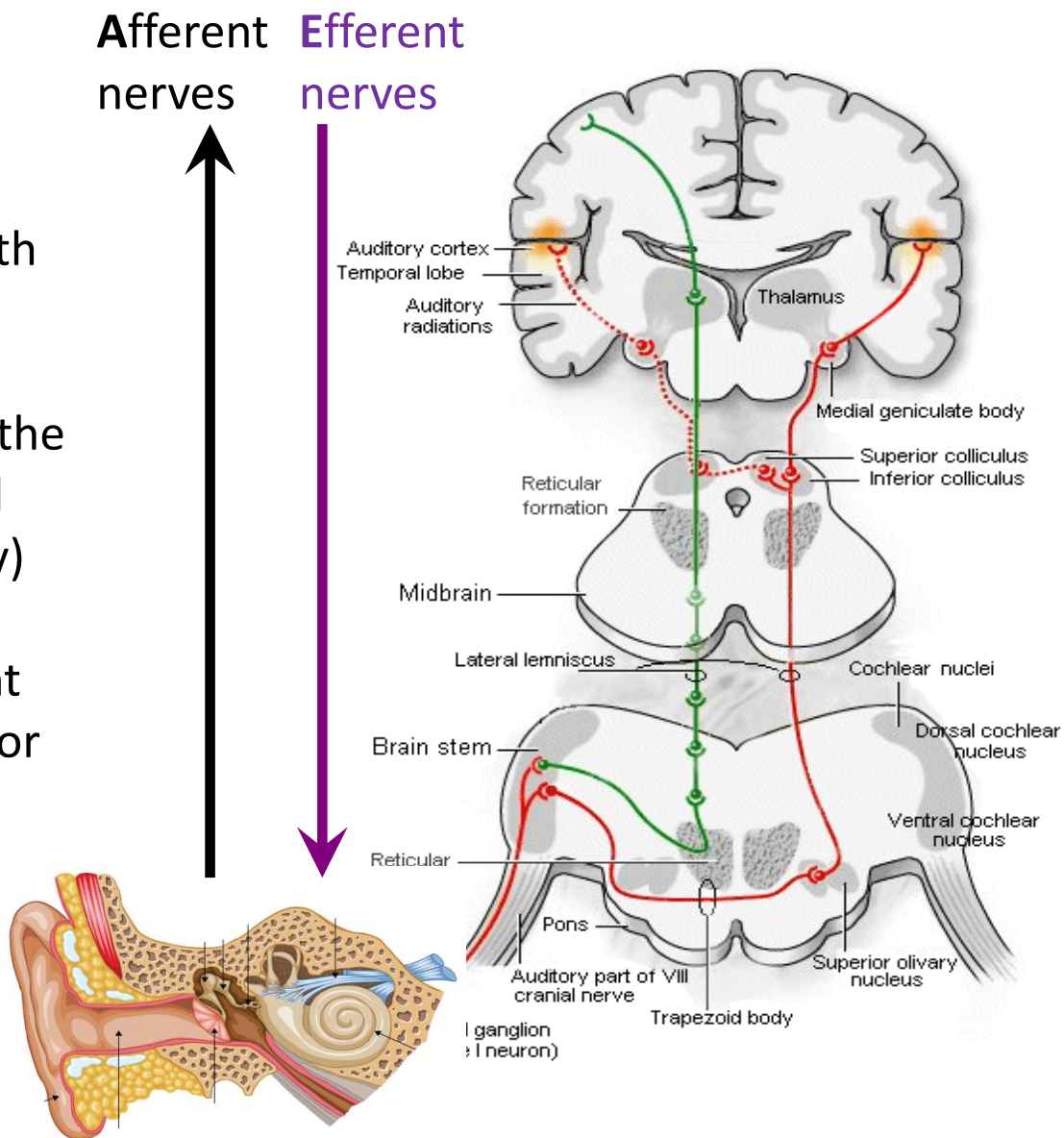
1 or 2 hearing aids?

# Need to think of the whole system: Ear + Brain

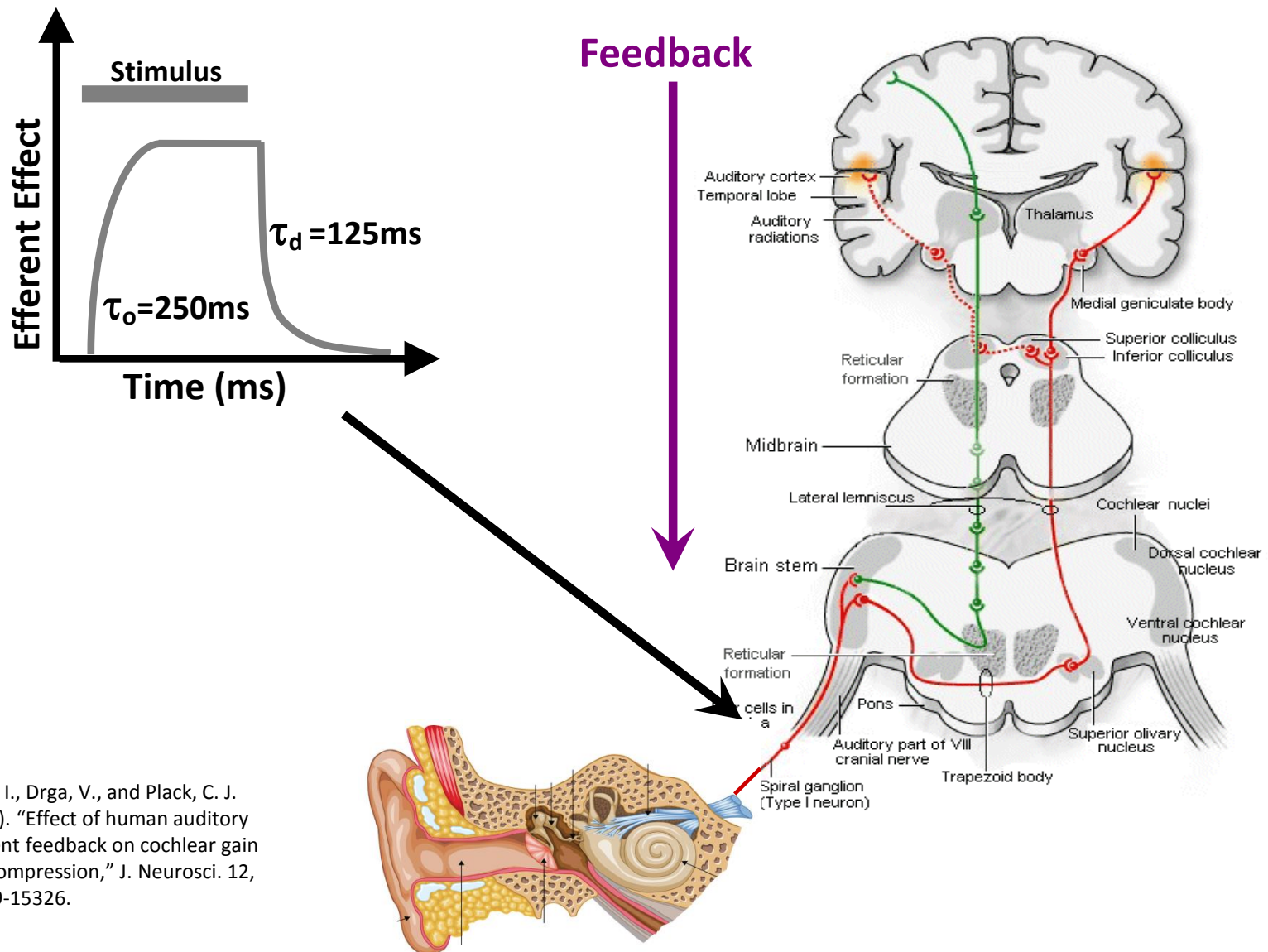
Attention (efferent fibres from higher brain regions)– helps with speech in noise

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

Speech in noise?: Some efferent fibres appear to be important for listening to speech in noise

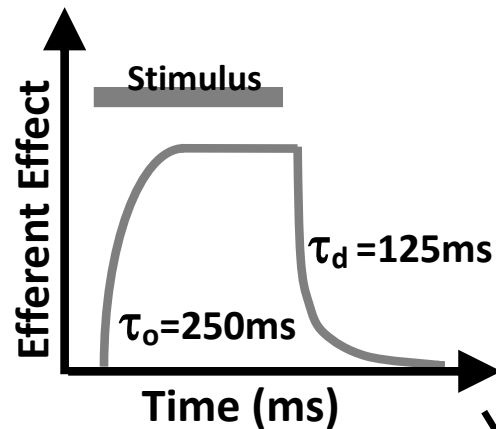


# Auditory psychophysics: time constants associated with auditory neural feedback

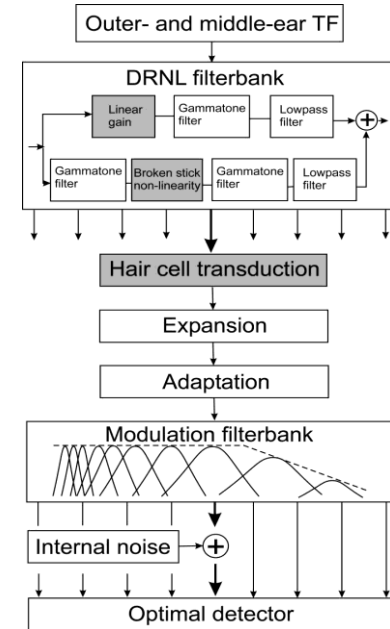


Yasin, I., Drga, V., and Plack, C. J. (2014). "Effect of human auditory efferent feedback on cochlear gain and compression," J. Neurosci. 12, 15319-15326.

# Time constants associated with auditory neural feedback



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



Audio-visual  
integration

Signal processing  
strategies for:  
Hearing aids &  
Cochlear implants

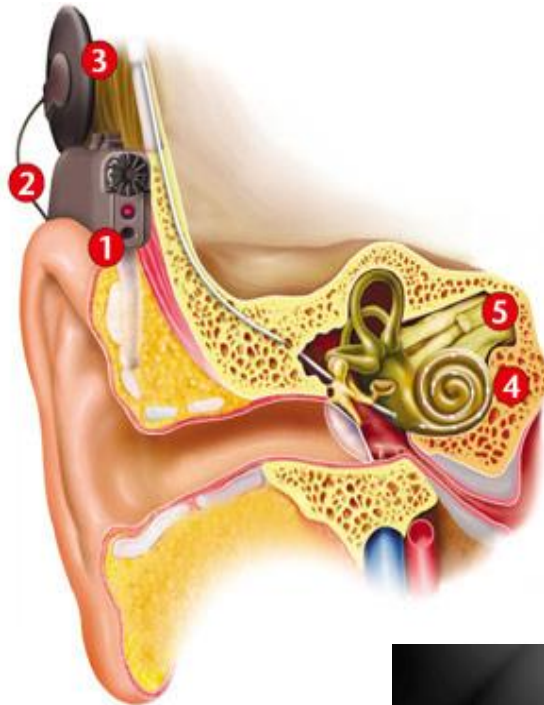
With Automatic Speech  
Recognition (ASR) systems

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.

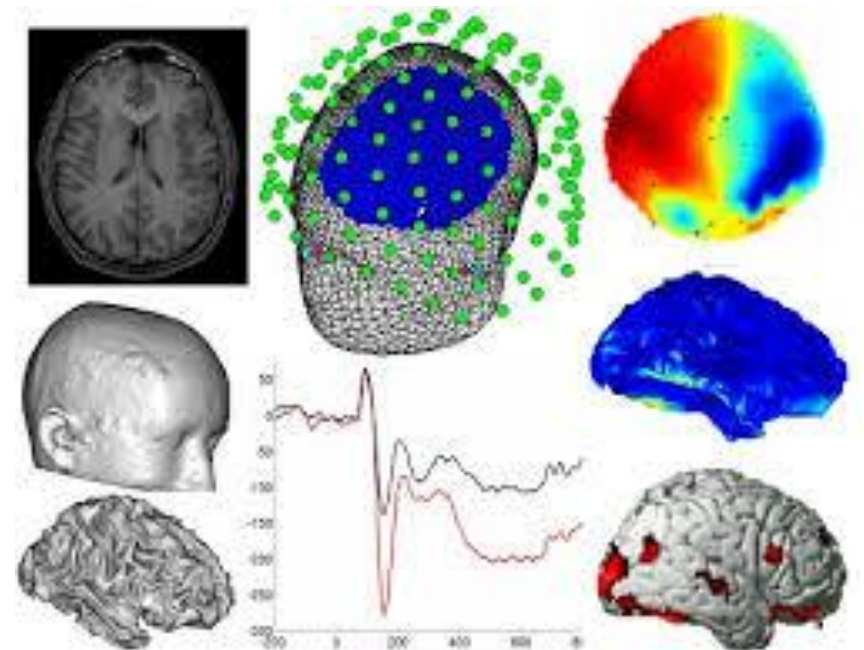


# Intelligent hearing aids

## 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.