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 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

Sound Frequency (Hz)

Typical/normal Hearing
Assistive devices
1600s – early 1800

King John VI of Portugal  1819
Late 1800’s – Early 1900s
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
HARD-OF-HEARING
A REVOLUTIONARY NEW ACCESSORY

**WRIST-EAR**

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 fractional 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.

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1950

**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 illustrations at the left show two attractive ways in which a Paravox may be worn to the hair. Your favorite hair-do style will determine which way will suit you best. Whether you have a hair-chief, set your hair, or not do it yourself, it is surprisingly easy to completely conceal a Paravox "H.E." hearing aid in your hair.

**NOW THE PARAVOX IS HELD IN PLACE ON THE HEAD**
Famous has designed a special garment, with an adjustable elastic band that holds the instrument firmly and comfortably in your hair. 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 at the back of the head as the instructions 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 make little change or affect your hair setting. Your Paravox, light, weight and small, will be hidden from view, even.

**HERE IS IDEAL "HIDDEN HEARING"**
If you wear the air receiver, in the usual manner in the outer ear, you’ll undeniably conceal it by covering your ears with your "hair-do". If you use the newer plastic tube extension, you extend the air receiver, too, in your hair, fastening the receiver to the garment band.
Hearing aid use low: Attitudes - 1952
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 1952, Beltone Hearing Aid Co.
History: Variety/miniaturisation

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

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

$\tau_d = 125\text{ms}$

$\tau_o = 250\text{ms}$

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

Signal processing strategies for: Hearing aids & Cochlear implants

Audio-visual integration

\( \tau_o = 250 \text{ms} \)

\( \tau_d = 125 \text{ms} \)
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
