HEARING ENHANCEMENT TECHNOLOGY: THE 30,000 FOOT VIEW

Current and future technologies
Applications
Barriers to Use
Suggestions for Removing Barriers
There are many true statements about complex topics that are too long to fit on a PowerPoint slide ~ Edward Tufte
Conductive, mixed, single-sided deafness

HEARING AIDS

COCHLEAR IMPLANTS

HYBRIDS (Mild low frequency hearing loss/severe-to-profound HFHL)

BONE ANCHORED HEARING SYSTEM (BAHA)*

MIDDLE EAR IMPLANTS (MEI)

*Conductive, mixed, single-sided deafness
Why hearing aids/implants may not be enough

Because microphone is worn on the head, speech understanding can be negatively influenced by the synergistic effect of room acoustics.

* Determined by intensity of target signal, vocal effort of talker, distance, hearing loss.
Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.

FOUR UNIVERSAL LISTENING NEEDS

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  - Media

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  - Warning/cueing signals

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- In addition, HAs/implants alone do not always provide good reception for:
  - Media
  - Telephone
  - Warning/cueing signals
- We all have four receptive communication needs
- **FULL ACCESS REQUIRES ALL FOUR NEEDS TO BE MET** – at home, work, play, school, volunteer work.

That takes the improvement in communication that modern hearing aids and implants make possible...and extends it even further.
Hearing Assistance Technology Types

- 4 Needs
- Ownership: Personal/Public
- Portable vs. Stationary
- Hardwired vs. wireless
Hearing Assistance Technology Types

- 4 Needs
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- Hardwired vs. wireless
Concept Behind ALDs for Face-to-Face Communication and the Reception of Media

Sound is picked up and transmitted directly to the listener, thus overcoming deterioration due to distance and room acoustics.

“BINOCULARS FOR THE EARS”
HARDWIRED BODY STYLE AMPLIFIER

- Affordable; Mild to profound
- Applications:
  - Face-to-face, media, phone
  - At home, work, car, hospitals
- Examples: Williams Sound, Comfort Audio, Bellman Symfon, etc.

1. Acoustic Coupling
2. Inductive Coupling
3. Direct Audio Input (DAI)
Radio Waves

1. Infrared (IR)
2. Frequency Modulation (FM)
3. Induction (Hearing Loop)

“CLASSIC” WIRELESS HAT (IR, FM, loop)

Face-to-face, media

- CATCH
- CARRY
- COUPLE

Microphone or Electrical Connection

Transmitter

Receiver

Coupling to Ears/Hearing Aid/Implant
Wireless HAs

CATCH

CARRY

COUPLE

Face-to-face, media (as well as phone, remote control)

NORMAL  MILD  MODERATE  SEVERE  PROFOUND

Wireless hearing aids with accessories for “connectivity”

Proprietary 2.4 GHz or 900 MHz

Mic TV

Neck/Lapel-worn Streamers (Transceivers)

Proprietary NFMI

Wireless HAs

Bluetooth

Proprietary 2.4 GHz or 900 MHz
Things can become complicated if more than one employee has a hearing loss and each uses a different wireless hearing aid system.
Infrared (IR): Home/Office

AC-powered IR Transmitter

1. Acoustic Coupling
2. Inductive Coupling
3. DAI

Receivers must always be used
FM: Home/Office

Battery-powered Transmitter
Neck-worn, Clip-on, Hand-held

One or more mics

TV, etc.

1. Acoustic
2. Inductive
3. DAI (corded or BTE Receiver)
Induction Loop: Home/Office

Loop Amplifier
Connected to
Back of TV/Sound System

Loop of Wire Around Room

Hearing Aids (or Implants)
with Telecoils
2. Acoustic Coupling

2. Inductive Coupling

LOUDSPEAKER

HARDWIRED MICROPHONE

MIXER/AMPLIFIER

FM Transmitter

WIRELESS MICROPHONE RECEIVERS

WIRELESS MICROPHONES

PERMANENTLY INSTALLED PUBLIC SYSTEMS

LOUDSPEAKER
LOUDSPEAKER
HARDWIRED MICROPHONE
MIXER/AMPLIFIER
WIRELESS MICROPHONE RECEIVERS
WIRELESS MICROPHONES
IR Transmitter
1. Acoustic Coupling
2. Inductive Coupling
PERMANENTLY INSTALLED PUBLIC SYSTEMS
LOUDSPEAKER
The Loop is the Transmitter

Induction Coupling: Receiver = telecoil inside the listener’s HA/CI

Consumer’s Telecoil-equipped Streamer

Venue-supplied Under-chin or Neck-worn Telecoil Receiver used with Earphones
Accessibility Scenarios

**FM/IR SYSTEMS**

- Buy ticket
- Ask for ALD receiver
- Hand over ID
- Given receiver with earphones

- You ask for neckloop
- Manager finds neckloop
- Receiver dead
- Manager finds new battery
- Receiver intermittent
- "We are in compliance"
- He returns your ID and money
- You feel unhappy

**TELECOIL IN HA/IMPLANT OR STREAMER**

A RECEIVER IS ALWAYS NEEDED WITH FM OR INFRARED SYSTEMS

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[Diagram showing a flowchart of scenarios involving FM/IR systems, including steps like buying tickets, asking for ALD receivers, handling IDs, and receiving new equipment, along with various outcomes such as a receiver being dead or intermittent, and the manager returning ID and money.]
Accessibility Scenarios

FM/IR SYSTEMS
Accessibility Scenarios

HEARING LOOP

1. Buy ticket
2. Walk into theater
3. Set HA/implant to telecoil mode
4. Enjoy the show
5. You feel happy

TELECOIL IN HA/IMPLANT OR STREAMER
Accessibility Scenarios

HEARING LOOP
Accessibility Scenarios

**FM/IR SYSTEMS**

**HEARING LOOP**
Newer Digitally Modulated Technologies
Spread Spectrum/Frequency Hopping 2.4 GHz

- **Portable** 1:1 or group conversations at home, office, public venues.
- Same coupling options as FM
- Encrypted; pass-code protection
- **MULTI-MIC OPTIONS: 1-WAY OR 2-WAY**
- Customized solutions for ADA ACCESS
Newer Digitally Modulated Technologies
Spread Spectrum/Frequency Hopping 2.4 GHz

- TOURS
- PROFESSORS WITH HEARING LOSS
- BOARD MEETINGS
- OPERATING THEATERS
- TRAINING TIPS:
  - Change seating configuration
  - Proper lighting
  - Rules of communication

Normal hearing and/or HOH Audience enjoying the narration without negative effects of distance, noise, echo
Face-to-face/Media Takeaway

1. Cacophony of coupling options for private and public venues/too many systems
2. Incompatibility among systems
3. Each person’s system must be adjusted to achieve the best signal.
4. Systems requiring receivers require maintenance
5. HA/implant users need telecoils for access to public ALDs
Telecommunications

Many options available for access to all telecommunications platforms: with or without HAs/implants:

- Amplified phones; add-on amplifiers
- Hands-free interfaces
- Speech-to-text services
Binaural Listening: Mobile Landline, VoIP, HDDWIRED

Tecear T-Link with Telecoils
Clearsounds CLAv2 Amplified Neckloop
Plantronics Vista M22 Mic/headset w/ Clearsounds Neckloop

WIRELESS

Captioning

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**Landline**
- Clarity Ensemble
- Caption Call
- Hamilton CapTel

**Smart Phone Apps**
- Used w/ hands-free
  - Hamilton, Sprint
- IOS/Android, 4G or Wi-Fi
- Register for special number.
- Missed calls go to built-in captioned voicemail

**Web-based**
- Use any phone
- But receive captions on web browser of a computer/smartphone
- Captioning for teleconferencing

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## Captioning

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Other Text Services

• Email
• Instant messaging
• **Automatic voicemail transcription services** that convert voicemail to text and send it via texts or email.
  – SimulScribe ([www.simulscribe.com](http://www.simulscribe.com))
  – CallWave ([www.callwave.com](http://www.callwave.com))
  – Spinvox ([www.spinvox.com](http://www.spinvox.com))
  – Gotvoice ([www.gotvoice.com](http://www.gotvoice.com))

• Remote transcription
• More info: [http://tap.gallaudet.edu/](http://tap.gallaudet.edu/)
Amplified/Visual Stethoscopes

http://www.cardionics.com/pdffiles/CatalogE-Scope.pdf


Alerting Systems
(Home, Office, Public Areas)

• Used with or without HAs/Implants
• Normal hearing people
• Stand-alone or integrated w/ hearing aids – e.g. Unitron, iPhone?

ALERTS/CUES:
- Alarm clock
- Doorbell
- Phone ring
- Baby cry
- Appliance alerts
- Weather alerts
- Movement
- Smoke/CO
- Security

PICKUP:
- Microphone
- Electrical connection
- Infrared beam
- Pressure mat
- Bluetooth
- Wi-Fi
- Cell network

TRANSMISSION:
- Hardwired
- Wireless

STIMULUS:
- Auditory
- Visual
- Vibration
- Combination

Face-to-Face
Receptive Communication Access
Phone
Media
Alerting
Fire Safety and Hearing Loss

• Individuals age 65+ have a fire death rate of > twice national average. (Geiman & Gottuk, 2006).

• Most current smoke detectors peak at 3100 Hz, right where older people have hearing loss (Cruickshanks, et al., 1998.)

• ~ 40 dB difference between detecting a signal when awake vs. asleep; thus, many older adults may possibly sleep through a standard high-pitched alarm (Bruck, 2001).

• People w/ hearing loss incorrectly assume that they will be alerted to their smoke detector with HAs off (Compton-Conley and West, 2008).

• For more info on fire safety: soundstrategy.com/tutorials/how-alerting-technology-can-keep-you-and-your-family-safe-and-add-convenience-your-life
Disruptive Technology
Leaping to Change the Paradigm
First Generation Streaming From Smartphone to Wireless HAs

Bluetooth Phone → Bluetooth → Proprietary 2.4 GHz → ReSound 2.4 GHz Wireless Hearing Aids
Second Generation Streaming From Smartphone to Wireless HAs

iPhone/iPad with 2.4 GHz Radio

Bluetooth 4.0

Voice calls, Music, Navigation, Podcasts, Audio Portion of Face time, Remote Mic

ReSound LiNX 2.4 GHz Wireless Hearing Aids

http://www.reuters.com/article/2013/11/24/us-denmark-hearingaids-idUSBRE9AN05M20131124
Lo and behold!
It’s the holy grail!

Wait a minute.  Don’t I still need a telecoil at the movies?
Envisioning the Future

- Public venues would transmit audio directly to smartphones (or HAs), avoiding receiver maintenance and coupling issues.
- TV chips for audio transmission directly to the hearing enhancement device (home, nursing homes, etc.)

Apple/ReSound partnership illustrates the critical role that smartphones, and their hosted applications, will play in the future.
One “total communication” device?

- One device w/ smartphone hub, programmable via an app/multiple apps
- Default settings used when you don’t have your mobile device
- Meets all 4 needs, in changing venues/environments
- Hearing protection device
- Self fitting
Self-fitting Devices?

- Research Being Done at National Acoustics Laboratories (Trends in Amplification 2011 15: 155)

- Self-fitting hearing aid:
  - Measures hearing thresholds in situ.
  - Creates a “prescription.”
  - Fine-tunes over time to meet each person’s listening demands.

- Software to enable CI users to optimize processing
Smartphones as Hardwired Hearing Enhancement Devices

• 25 - 30 apps

• With an app, good earphones and a high fidelity add-on mic, phone becomes a body aid or hard-wired ALD.

• “Social” iPhone/hearing aid system?
  – Users save settings that work well for certain environments/activities.
  – Settings shared w/ friends via phone.

http://appleinsider.com/articles/12/07/19/filings_detail_apples_plans_to_improve_support_for_hearing_impaired_users.html
1. What do consumers with hearing challenges want/need?

2. How do we meet their needs?
1. FULL receptive communication access— for a lifetime.

2. Employing a holistic systems-engineering approach that:
   1. Carefully assesses residual hearing using best practices
   2. Focuses on individual needs based
   3. Considers full range of technologies & training
   4. Verifies, validates.

**NEED INFLUENCES TECHNOLOGY . . . TECHNOLOGY SERVES NEED**
<table>
<thead>
<tr>
<th>CHALLENGES</th>
<th>SOLUTIONS</th>
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<tr>
<td>Lack of information on technology and full access in general. In 2009, only 34% of consumers were aware they had a telecoil in their hearing aid. Kochkin, S (2010) HJ 63(1).</td>
<td>ADA places onus on the consumer. Massive informational campaign (TV, internet, print) ; consumer checklist</td>
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<tr>
<td>Lack of a variety of price points for hearing enhancement solutions. Consumers want more choice and more input into their hearing health care.</td>
<td>Continued R &amp; D of self-fitting, self-adjustable, open platform devices. Open market to both prescribed/non-prescribed products for hearing enhancement.</td>
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Thank You

Some resources for unbiased information on hearing enhancement technology

- http://soundstrategy.com/
- http://tap.gallaudet.edu/
- http://www.hearingloss.org/
- www.hearingloop.org

“It’s a special hearing aid. It filters out criticism and amplifies compliments.”