

Hearing and Hearing Loss in Aging Adults

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October 26, 2011
31st Annual Arkansas Aging Conference
Hot Springs, AR



Learning Objectives

1. Participants will be able to describe the impact of hearing-related changes in aging adults
2. Participants will be able to identify barriers to communication to change with low-tech solutions

What Do We Mean By "Hearing"?

Hearing

- The process, function, or power of **perceiving** sound ; *specifically* : the special **sense** by which noises and tones are received as stimuli (Webster)
- Hearing is the **sense** that obtains information about the world around us using the pressure fluctuations in the air (sounds) that are produced by vibrating objects. (Plack, 2005)

Hearing Includes Processing

(Central) Auditory Processing includes the auditory mechanisms that underlie the following abilities or skills:

- *sound localization and lateralization;*
- *auditory discrimination;*
- *auditory pattern recognition;*
- *temporal aspects of audition;*
- *temporal ordering;*
- *temporal masking;*
- *auditory performance in competing acoustic signals (including dichotic listening);*
- *and auditory performance with degraded acoustic signals*

Information Processing is Bi-Directional

Bottom-Up Factors

- Basic Acoustic Processing
 - Intensity
 - Frequency
 - Duration
 - Phase, etc.

- Speech and Background Noise?
- Hearing Loss?

Top-Down Factors

- Higher-Order Functions
 - State of Arousal
 - Attention
 - Working Memory
 - Linguistic Competence, etc.

- Falling Asleep During Presentation?
- Perceptual and Cognitive Declines?

Top-Down Processing: Example 1

- McGurk Effect

From www.YouTube.com

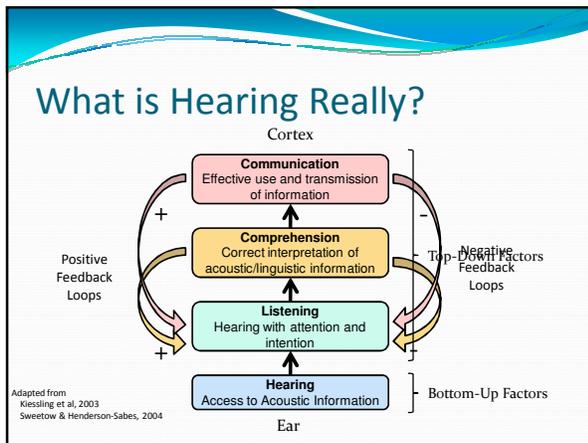
<http://www.youtube.com/watch?v=aFPtc8BVdJk>

Top-Down Processing: Example 2

- We use our linguistic knowledge to "guess" what a word is within its context
- Listen to this: 🎧

What was actually said:

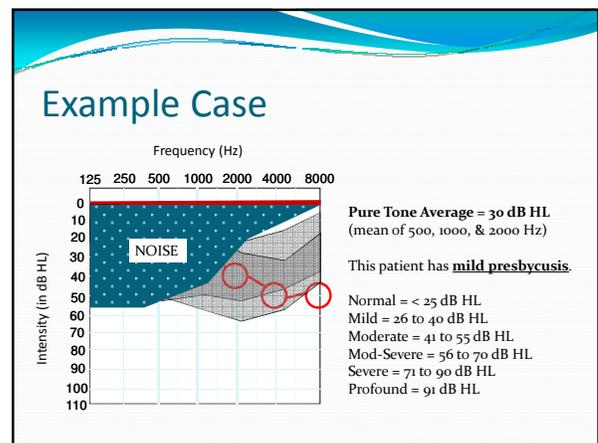
"Last week, my grandfather went failing on the lake."

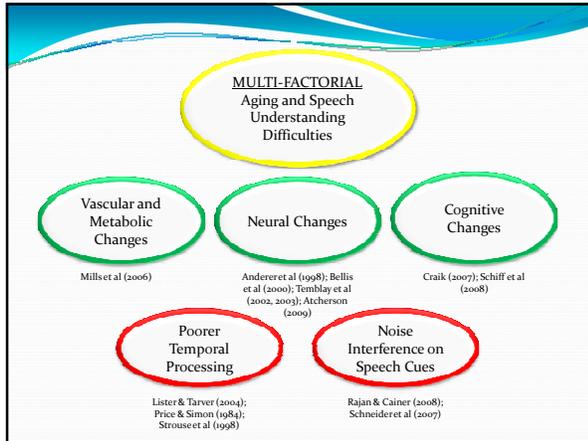


Hearing Loss and Aging

Helen Keller, 1880-1968

*"Blindness separates people from things.
Deafness separates people from people."*





Simulations

Hearing Loss?	No Hearing Loss	Mild Noise-Induced Hearing Loss	Moderate Noise-Induced Hearing Loss	Mild Presbycusis	Moderate Presbycusis
Audiogram					
Sound File	Quiet	Quiet	Quiet	Quiet	Quiet
	Noise	Noise	Noise	Noise	Noise

From <http://facstaff.uww.edu/bradleys/radio/hlsimulation/>

High-Frequency Hearing Loss

In looking at a mapping of common hearing conditions by frequency and decibel level, it can be seen that even a mild hearing loss means the individual loses the sounds.

From Davis & Atcherson (2007)

Hearing Loss Impacts Communication

- Loss of Audibility – most debilitating
- Loss of Frequency Resolution
- Loss of Temporal Information
- Loss of Binaural Hearing Skills

- ### Common Causes of Hearing Loss
- Presbycusis/ Genetics
 - Otitis Media/ Excess Cerumen
 - Vocation and/ or Recreation
 - High noise levels (e.g., farming, hunting, etc.)
 - Personal music devices; stereo systems
 - Pharmacologics/ Ototoxicity

- ### Common Barriers to Communication
- Noise and Reverberation
 - Signal-to-Noise Ratio Issue
 - Distance
 - Sound and Vision Issue

Noise and Reverberation

HERE IS THE DIFFERENCE!

THE CHILD GRABS THE TOY

Adapted from Bess and Tharpe (1986) Ear Hear 7(1)

Signal-to-Noise Ratio (SNR)

Noise

Speech

-10 dB Impossible!

0 dB Difficult!

+10 dB Better!

+20 dB Best!

Determination of Signal-to-Noise Ratio

- If speech is 70 dB and noise is 60 dB, then SNR is +10 dB
- If speech is 60 dB and noise is 70 dB, then SNR is -10 dB
- Common SNRs
 - Urban: +9 to +14 dB
 - Outdoors: +5 to +8 dB
 - Parties: -2 to +1
 - Classrooms: -7 to +5

Distance

- Crandell & Bess (1986)
 - Effect of distance, noise, and reverberation
 - 20 children with normal hearing (5-7 y/o)
 - SNR of +6 dB
 - Reverberation time of 0.45 s
 - Distances were 6, 12, and 24 ft
 - Sentences presented:
 - 89% at 6 ft
 - 55% at 12 ft
 - 24% at 24 ft

What about people with hearing loss?

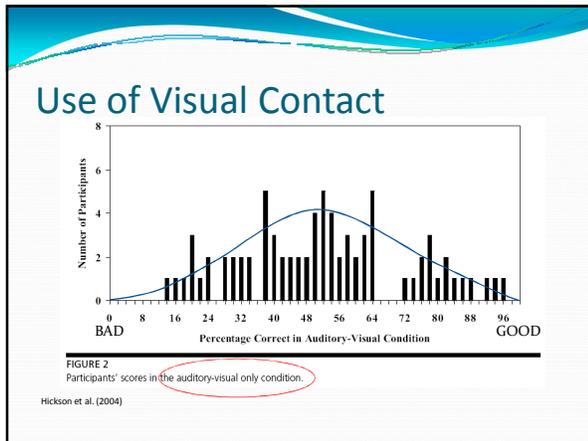
Other Barriers to Communication

- Poor lighting, and backs to windows
- Poor visual contact (e.g., not looking at patient, surgical mask, facial hair)
- Exaggerated Speech
- Poor or no conversational repair strategies
- Telephone issues

Poor Visual Contact

FIGURE 1
Participants' scores in the auditory only condition.

Hickson et al. (2004)

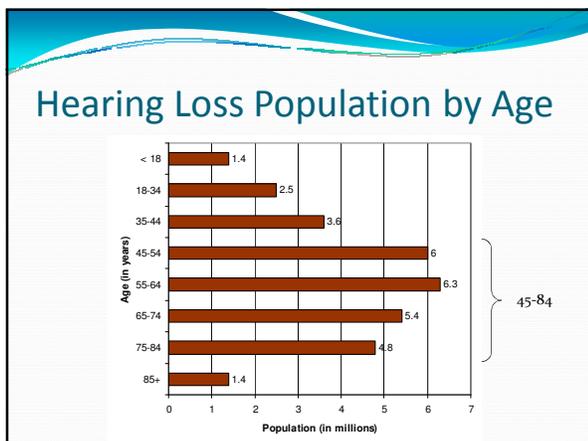


Hearing Loss Impacts Health

- Reduced psychosocial functioning leading to:
 - Increased feelings of **isolation, depression, loneliness, fear, frustration, and disappointment** (Crandall et al., 1998; Bess et al., 1989)
 - Poorer physical health (Lichenstein et al., 1998; Mulrow et al., 1990)
- **HOWEVER**, improvements seen with hearing aids and cochlear implants (Cohen et al. 2004; Mo et al., 2005)

Some information from the MarkeTrak VII data by the Better Hearing Institute (Kochkin, 2005)

<http://www.betterhearing.org/index.cfm>

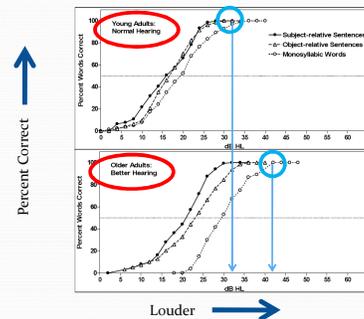


Hearing and Aging

Impact of Aging on Speech Perception

- Even in the absence of hearing loss, older subjects require **3-5 dB greater SNR** than young listeners (Schneider, Daneman, & Murphy, 2005)
- Perhaps the problem isn't that older people have true cognitive differences than young. Rather, the need for greater SNR places a greater strain on the cognitive resources. This creates more **effortful listening**. (Pichora-Fuller, 2006)

Louder is Better (Stewart & Wingfield, 2008)



On Auditory Tests Robust Against Hearing Loss

- Performance on the battery of auditory processing measures by elderly hearing-impaired listeners was systematically **related to individual differences in cognitive function rather than auditory function**, especially for stimuli not affected by peripheral hearing loss. (Humes, 2005)

What Can We Do?

Pearl of Wisdom

*"Hearing loss may be an **individual's** problem, but...*

*Communication is **everyone's** problem."*

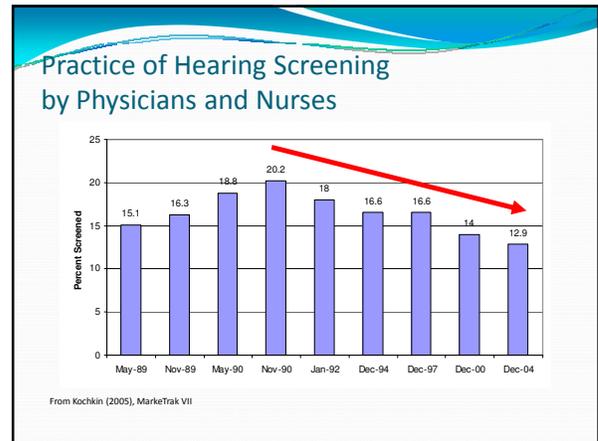
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Things We Need More Efforts In

- Health Promotion and Hearing Loss Prevention
- Awareness and Acceptance of Hearing-Related Problems (Cognitive issues included)
- Frequent Hearing Screenings (at least annually)
- Research

Things We Can All Do

- **Screening** for hearing difficulties
- Slow down and speak *clearly*, and **use conversational repair strategies**
- Face our patients when talking to them
- Consider ways of minimizing noise sources or increasing the "signal"
- Avoid "Elderspeak"



Quick In-House Screening

5-Minute Hearing Loss Questionnaire

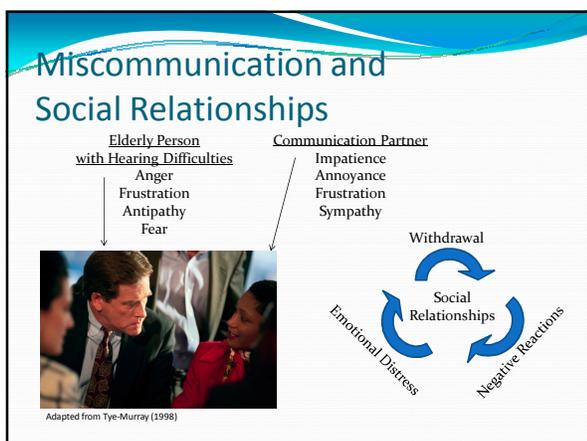
- Quick assessment and compare results to 2,304 other adults with hearing loss

A Single Question

- Simply asking "Do you have a hearing loss?" has a sensitivity of 0.71.

Conversational Repair Strategies

- Ask what patient did and did not understand
- Ask patient to repeat instructions, or write them down following instruction
- Instead of repeating word-for-word, revise or paraphrase



Amplifiers Help to Increase Signal-to-Noise Ratio

From Davis & Atcherson (2007)

	No Amplifier	With Amplifier
No Noise	DO YOU SEE ME?	DO YOU SEE ME?
↑ ↓	DO YOU SEE ME?	DO YOU SEE ME?
	DO YOU SEE ME?	DO YOU SEE ME?
	DO YOU SEE ME?	DO YOU SEE ME?
High Noise	DO YOU SEE ME?	DO YOU SEE ME?

Telecoils and Loops

The Hearing Loop Process

1. Start with the source, for our example (shown below) lets make the source a TV.
2. The source (TV) signal is sent to the "loop specific" amplifier.
3. From the amplifier a wire is run around the perimeter of the room and brought back to the amplifier to create a complete loop.
4. Lastly, the hearing aid user turns their hearing aid to the t-coil mode and a clear sound is picked up by the t-coil thanks to the magnetic field created by the loop!

Not to Scale

Personal Amplifiers for TVs

Telephone

- How well does one understand on standard phone? (Impacts scheduling, phone consults, requests for help, etc.)
- What alternate telecommunication options are available?
 - TTY to TTY
 - TTY to voice, or voice to TTY (Relay)
 - Voice-Carryover, or similar (e.g., Captel)

I-LINE CAPTEL

The voice conversation and the captions are both carried on one phone line. I-Line Captel requires a standard analog telephone line, or DSL. Use with an analog filter.

PEOPLE WHO CALL YOU	CAPTIONING SERVICE	CAPTTEL USER
 I want the speaking part of my school.	 Voice	 Captions
Callers must first dial the Captioning Service in order for you to get captions.	The Captioning Service transcribes their voice into captions for you to read, and transmits the captions on the same telephone line.	 I want the captioning part of my school.

Your outgoing calls are automatically routed through the Captioning Service so that you get captions during the call.

Ultratec

Bluetooth Technology

What to Look For

- Frequent need to have things repeated
- Turning head to one side (the better ear)
- Misunderstandings and bluffing
- Excuses for not hearing
- Patient's speech seems to be "different"

Related Considerations

- Hearing loss can be mistaken for dementia
- Inactivity can lead to excess cerumen production
- Caregivers may not always know how to keep hearing aids functioning
- Lost opportunities to refer for critical cases

Resources for Hearing Loss

- AR Vocational Rehabilitation - <http://www.arsinfo.org/>
- AR Telecomm. Access Program (TAP) - <http://www.arsinfo.org/pdf/TAP.pdf>
- UALR Technology Access Center - <http://www.uams.edu/chrp/audiospeech/>
- Hearing Loss Association of America - <http://www.hearingloss.org/>
- Association of Late Deafened Adults - <http://www.alda.org>
- Healthy Hearing (Consumer Info) - <http://www.healthyhearing.com/>
- DeafMD (Consumer Info in ASL) - <http://www.deafmd.org>

Parting Quote

"It is more important to know what sort of patient has a hearing loss, than what sort of hearing loss a patient has."

Sir William Osler, M.D., 1849-1919



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