

Baycrest

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Mind Your Hearing: The link Between Our Ears, Brain and Dementia



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is fully affiliated with the
University of Toronto.



Do any of you have trouble hearing?

If you...

- Can hear people talking but can't understand the words
- Blame others for mumbling!
- Find that people speak too quickly
- Often need to ask people to repeat what was said
- Have difficulty hearing when you can't see the speaker's face
- Hear better with your glasses on!
- Are told that you have the TV, radio or stereo turned up too loud

...then you may have some hearing loss

Prevalence of Age-related Hearing Loss

- Highly prevalent among older adults
- Third most common chronic disability in N. America, after arthritis and hypertension
- Prevalence increases with age
- 30-40% population over 65yrs and 50% those over 75yrs have a hearing loss
- 80-90% elderly living in care facilities have hearing loss

Complaints of Older Listeners

More related to changes to the way our brains process sound than simply not hearing loud enough:

- “I can hear people talking, but I can’t make out the words.”
- “I can’t hear in background noise.”
- “I can’t hear that fast!”

Age-Related Hearing Loss



Our brains as well as our ears become hard of hearing

Inner ear changes:

- loss of sensitivity, especially for high frequencies

Central auditory system changes:

- distortion, slowing of processing speed, difficulty focusing on signal in noise, difficulty with localization (comparing signals from both ears)

Cognitive changes:

- problems with memory and attention

The ears & brain work together



Being able to understand conversation depends on:

- **Hearing** (passive)
- **Listening** (active)
- **Comprehending** (making sense of info reaching the brain)
- **Remembering** (storing & retrieving)

Attend to a single talker in presence of energetic and informational masking

Interpret distorted signal (reverberation, distance)

Process and store rapidly varying information

Integrate visual and auditory cues

Switch attention between auditory streams

3. Role of cognition in listening

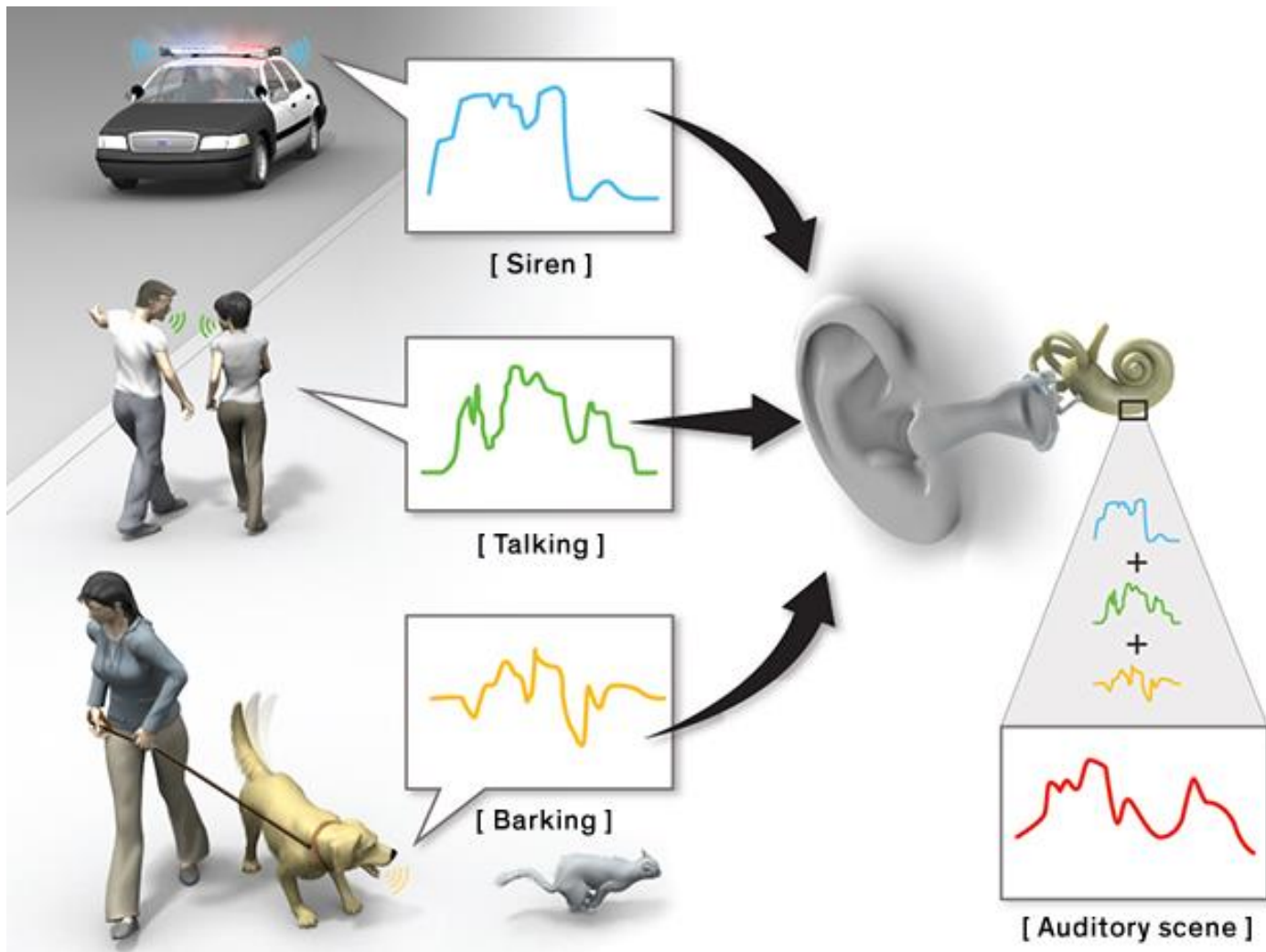


LISTENING IN NOISY ENVIRONMENT: WHAT RESEARCH CAN TELL US?

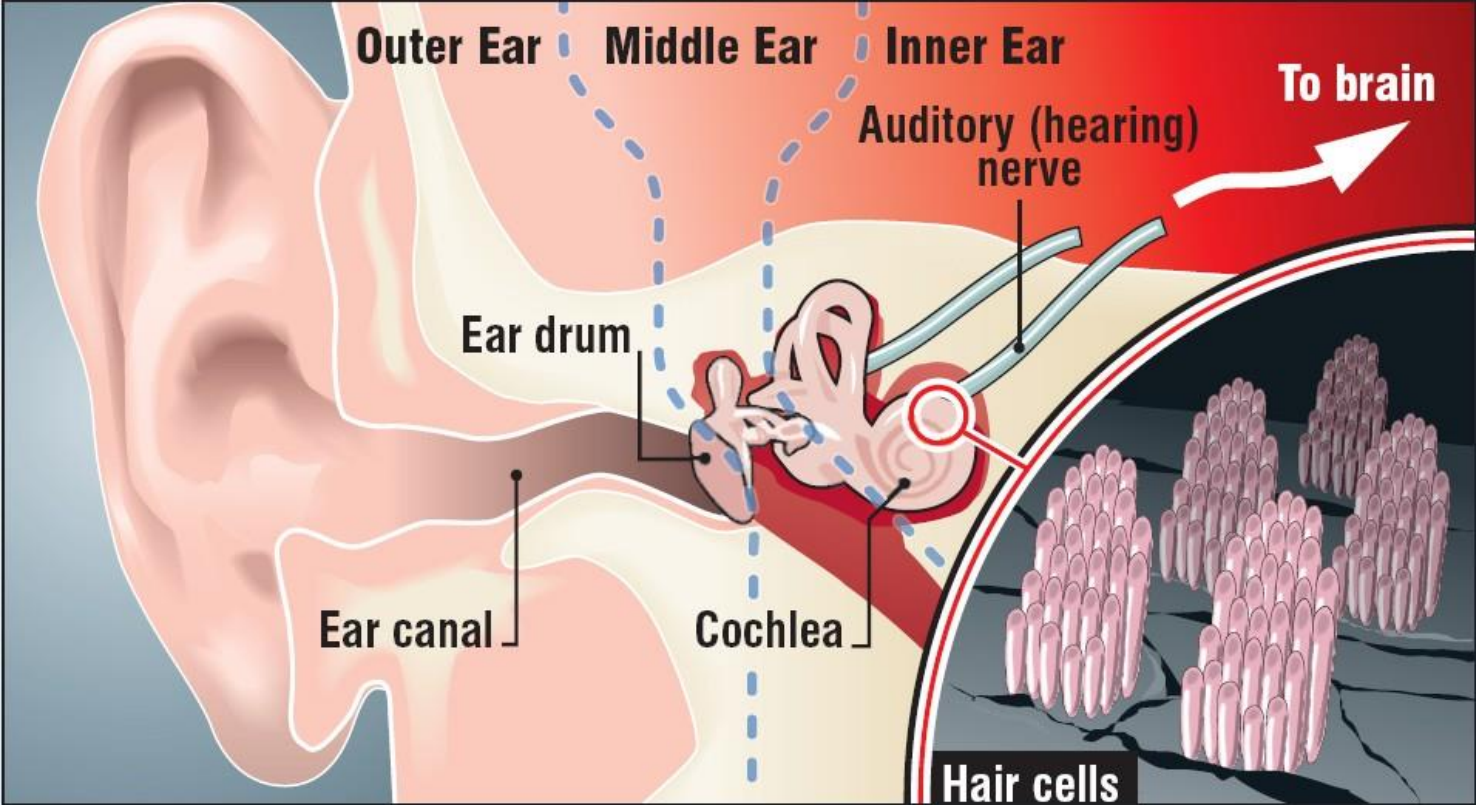


Auditory Scene Analysis (ASA)

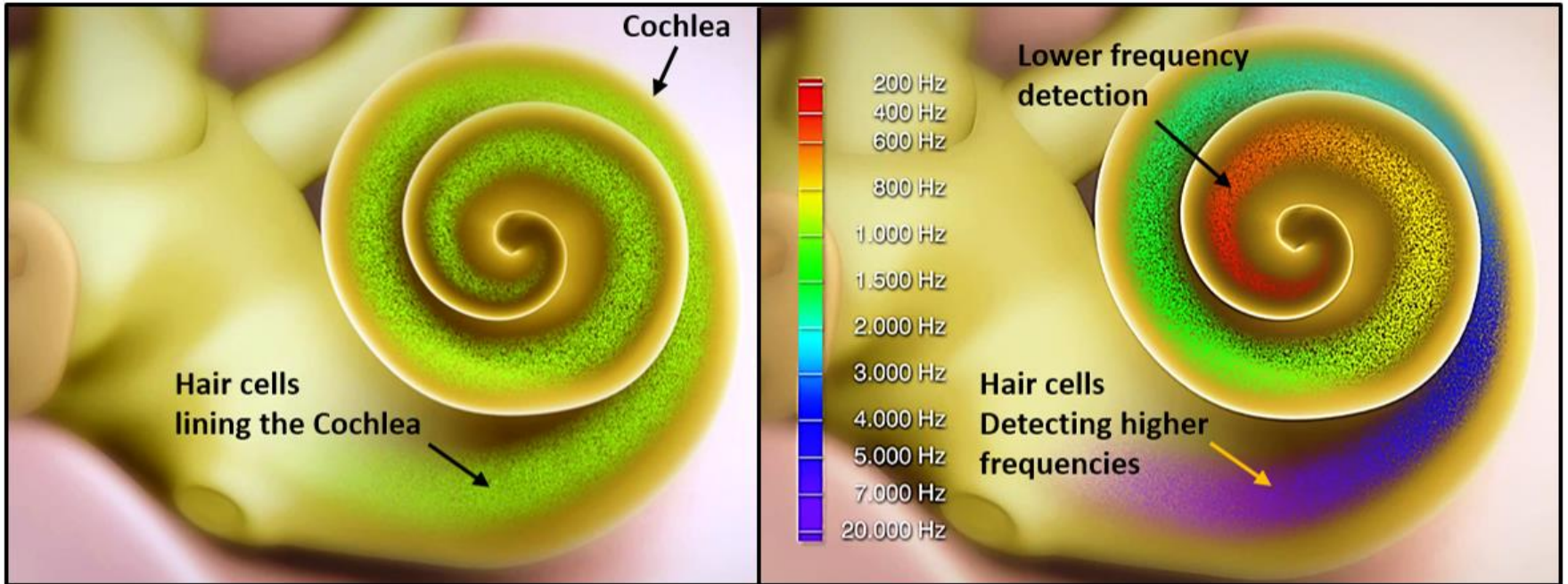




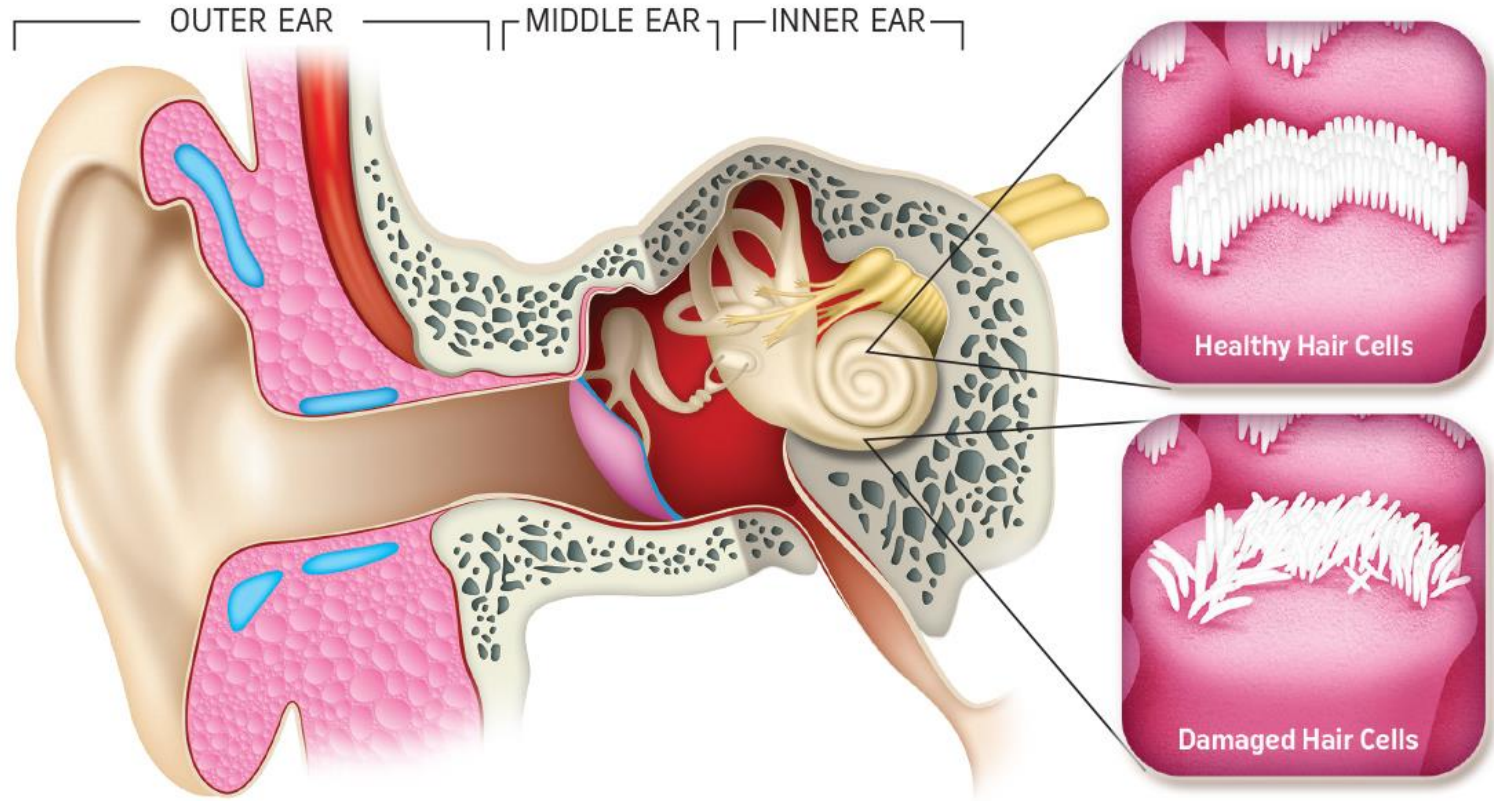




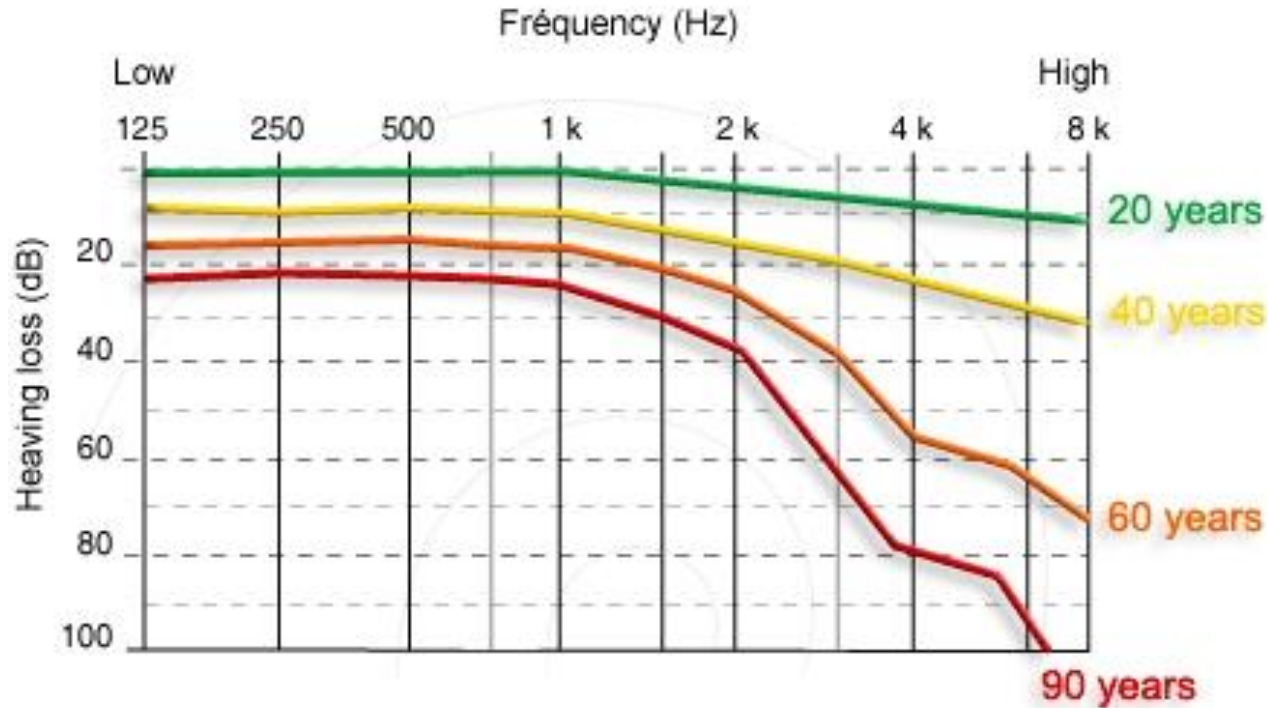
Difference pitch (e.g., voices) activates different place on the basilar membrane



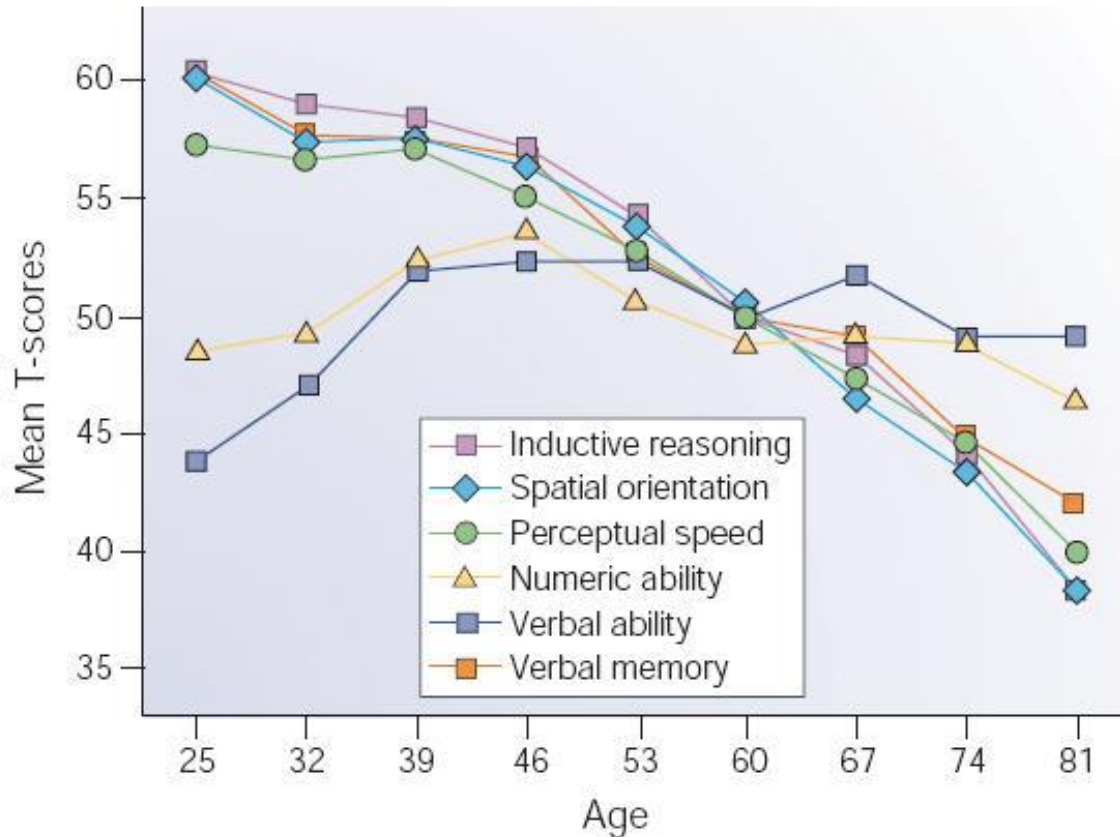
Effects of Age and Noise Exposure



Effects age on Hearing Sensitivity



Cognitive Function and Aging



Hearing & Cognition

- Research shows strong evidence of association between hearing loss and cognitive impairment
 - While prevalence of both HL and CI increases with age = disproportionately high amount of HL in AD patients (>90%)
- Older adults with untreated hearing loss are more likely to develop dementia
- The more severe the hearing loss, the greater the risk
 - For every 10dB of HL over 25dBHL, there was a 20% increase in risk of developing dementia
(Frank Lin et al, recent study at Johns Hopkins)

What's the link?

Same cause?

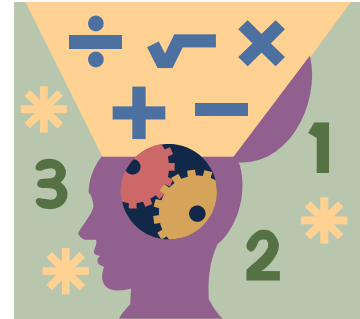
- Shared underlying pathological process

Cause-and-effect relationship?

- Cognitive load theory:
 - effort used in hearing exhausts resources needed for other things like memory, attention and comprehension
 - the better you hear something, the more likely you are to understand and remember it!
- Lack of sensory stimulation leads to brain atrophy
- Social isolation from hearing loss can lead to depression (risk factor for dementia)

Memory and Hearing

- How can you remember what you did not hear?
- Working memory (WM) = aspect of cognition most closely related to speech understanding in noise
- Assumed to have limited WM capacity that must be shared between processing and storage
- Ability to store & manipulate info in WM declines with age



Evidence

- People with poor WM have more difficulty understanding speech in noise than those with good WM
- Older adults with HL can't remember as many words as those with normal hearing

How do you know if it's hearing or memory loss?

- Hearing problems can be disguised as memory problems
- Symptoms are similar for both:
 - Decreased understanding
 - Responding inappropriately

***In collaboration with Toronto Rehabilitation Institute,
we are currently developing new hearing tests that may
help separate hearing from memory problems in
patients with Alzheimer Diseases***

Neuroimaging techniques used to uncover how do we perceive, attend to, and remember sounds

Magnetoencephalography (MEG)



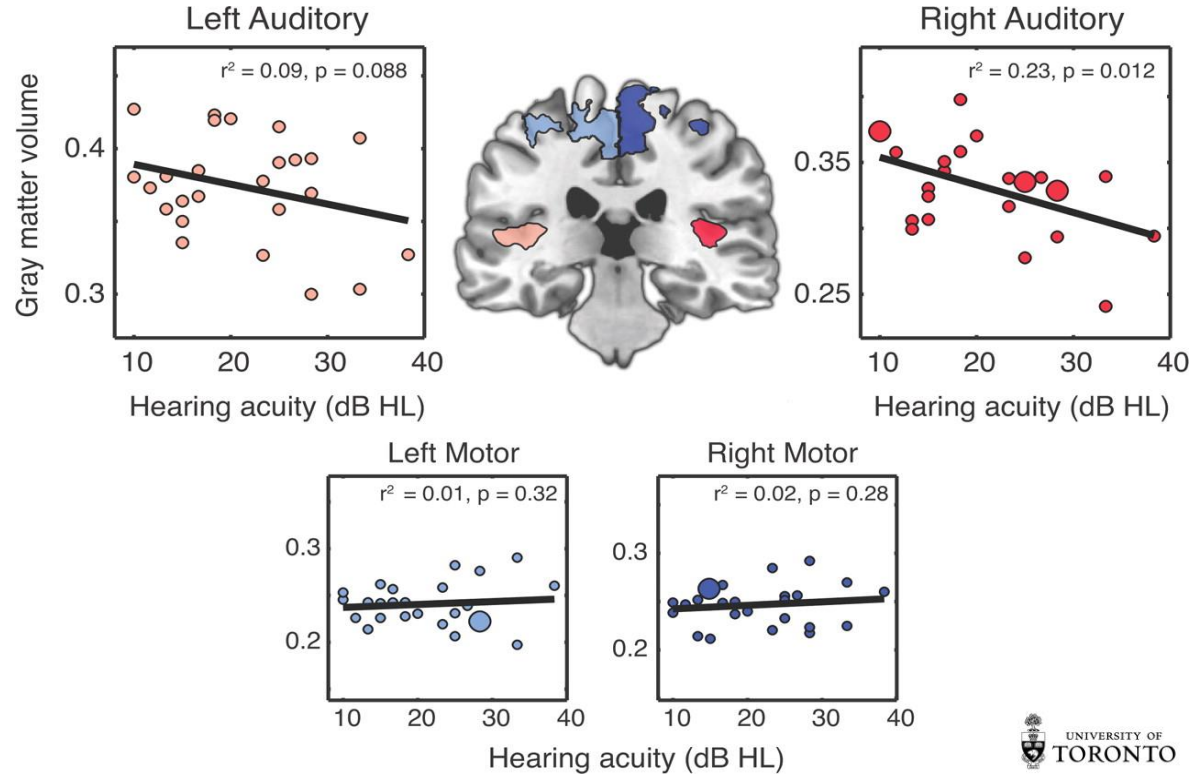
Electroencephalography (EEG)



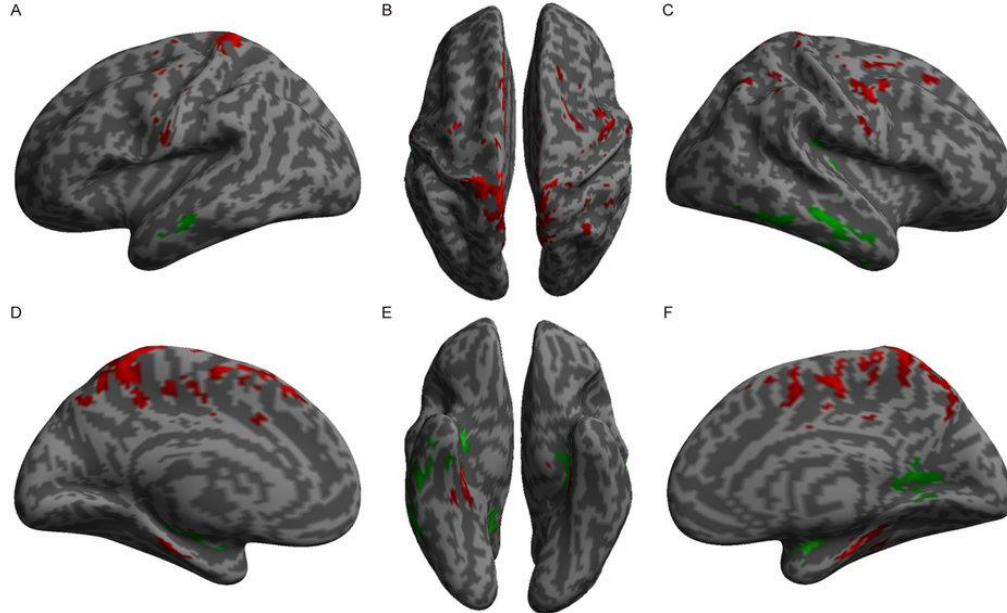
Functional magnetic resonance imaging



Relationship between Regional Gray Matter Volume and Hearing Ability



Brain atrophy in middle-aged adults with unilateral hearing loss



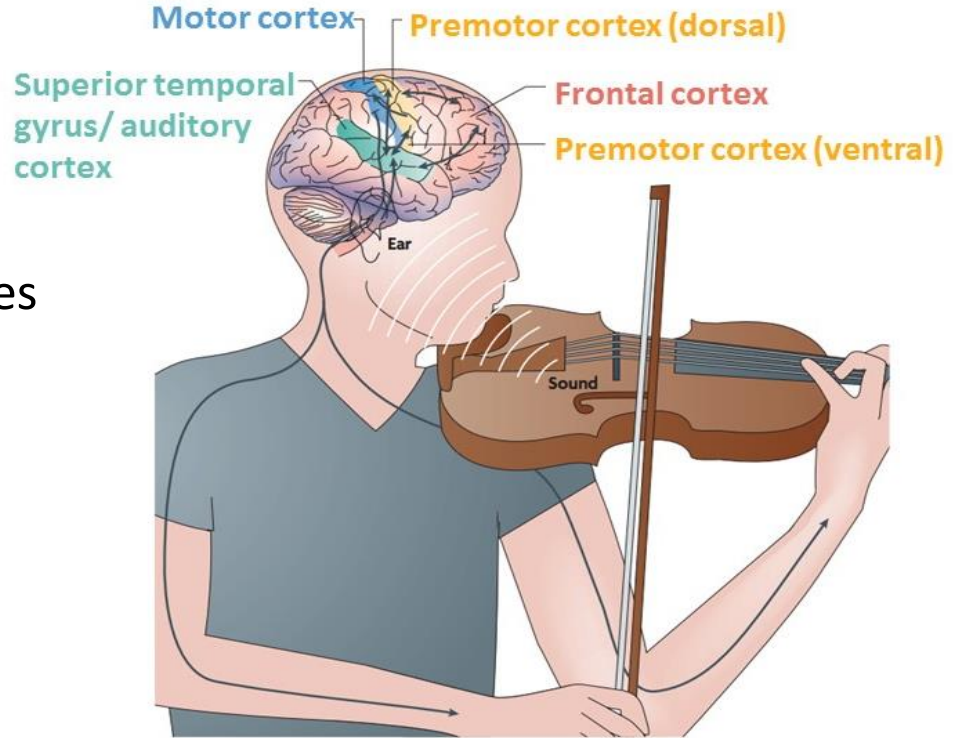
- Decreased gray matter volume
- Increased gray matter volume



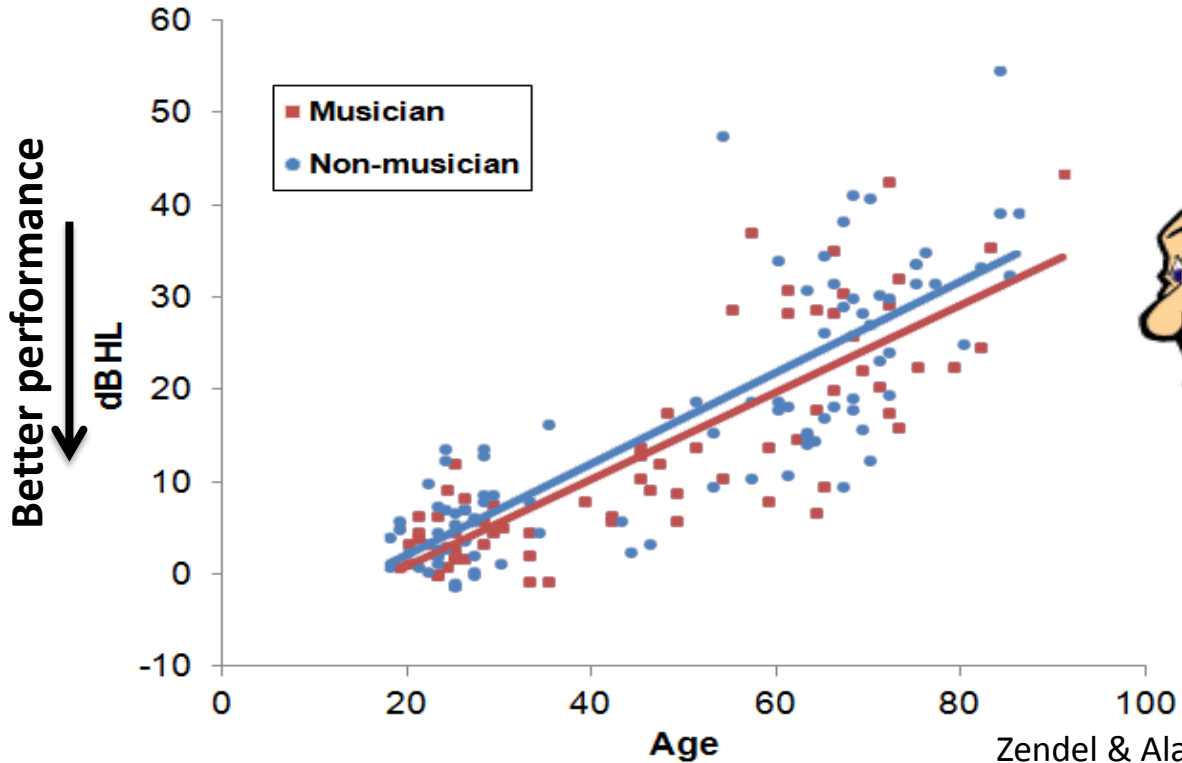
Music: The ultimate brain workout

- Involves numerous cognitive processes such as learning, memory, and affect
- It has cognitive, physical and social components, so it engages many brain networks
- Learning a “new language” -- implicit and/or explicit “rules” that govern the musical system

Brain Areas Involved in Playing Music

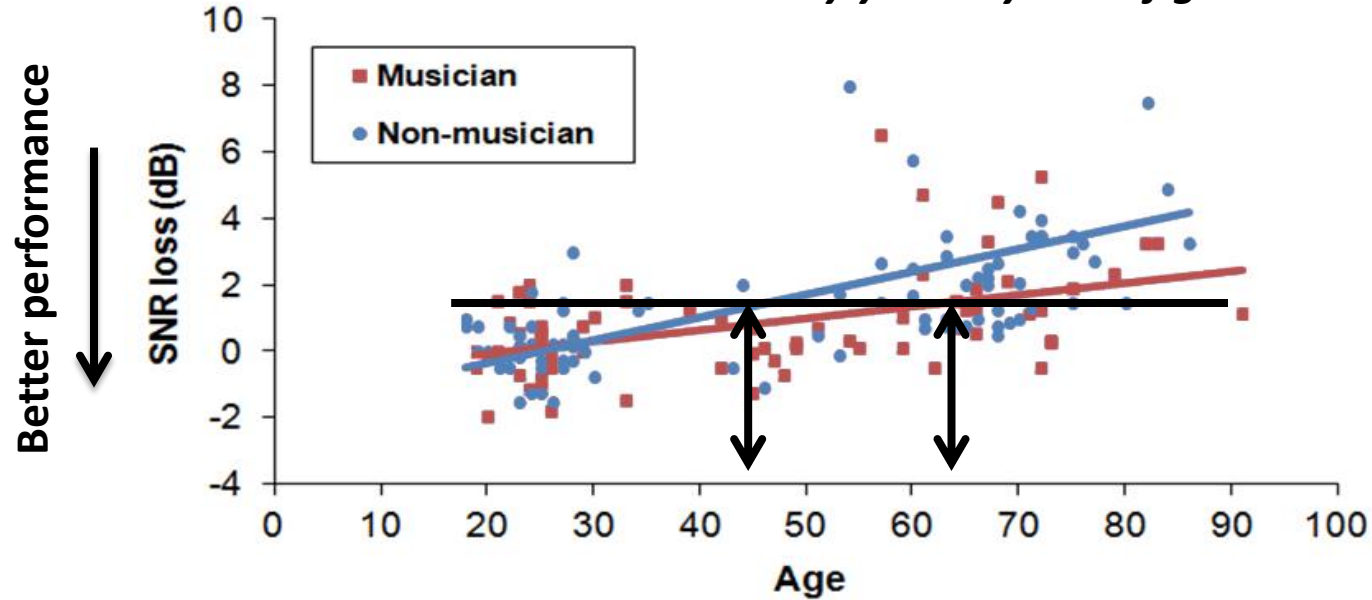


Life long musicianship and auditory cognition

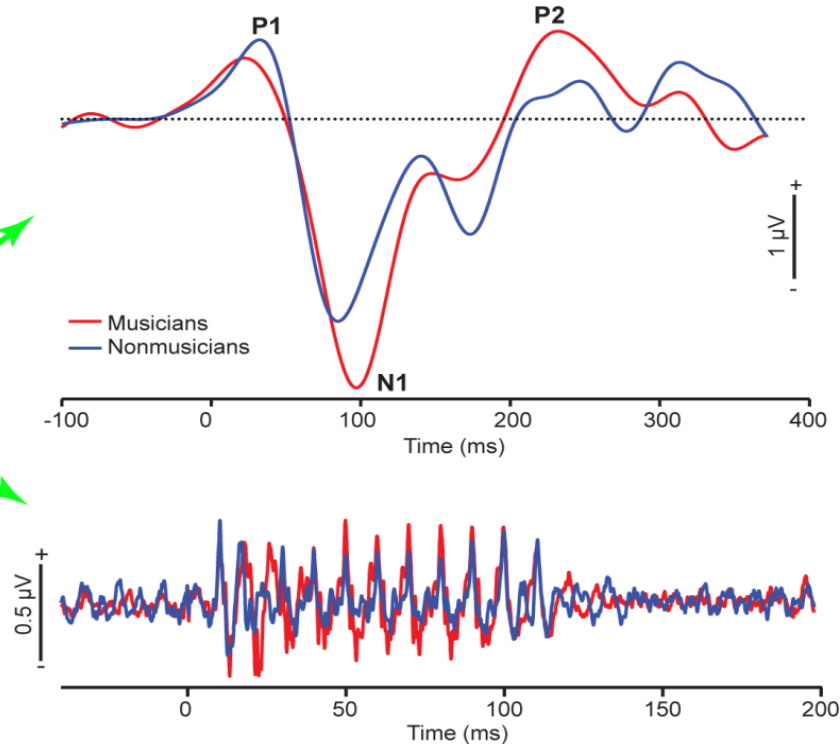
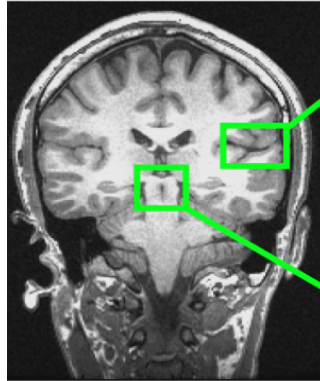


Lifelong musicianship improves speech in noise comprehension

Playing a music instrument throughout adulthood can buy you 20 years of good listening skills!



Older musicians have stronger responses to speech sounds than non-musicians



Lifelong musicianship protect against difficulties understanding speech in noisy environment

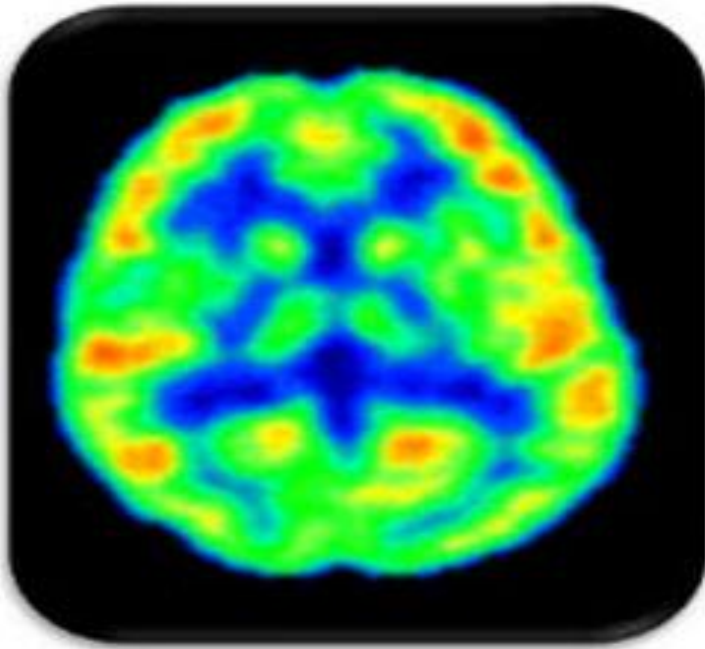
Musicians are less susceptible to age-related degenerations in the brain, presumably as a result of their daily musical activities

From music making to music listening

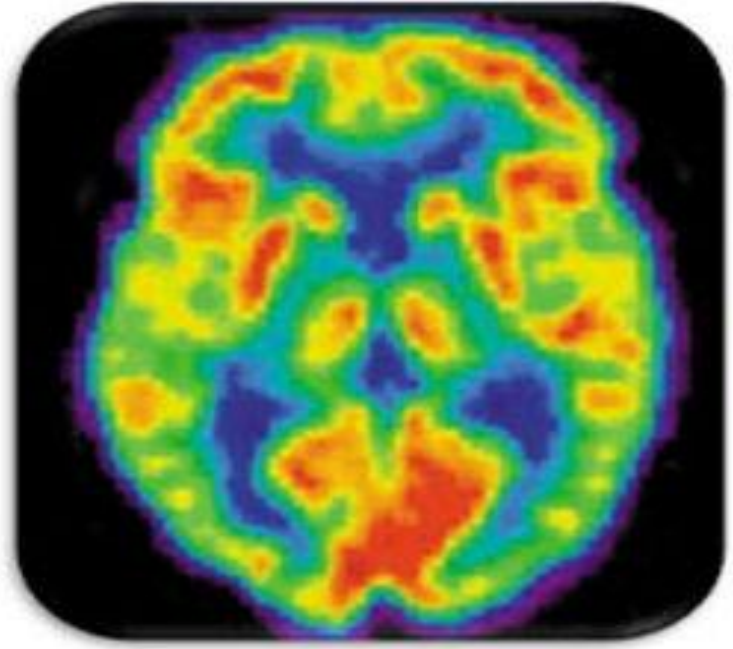
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The brain at rest



The brain's reaction to music

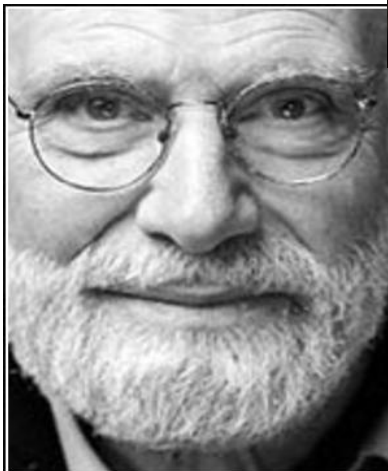


All it takes is 1 song to bring back a 1000 memory

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Music evokes emotion and emotion
can bring it's memory.

— *Oliver Sacks* —

AZ QUOTES

Music making can help maintain a healthy auditory brain

Music listening stimulates and engages many different part of the brain, enhance memory and improve emotional state

Music may also help by enhancing social interaction



Maintain Social Interaction

- Older adults with active lifestyles and strong social networks maintain higher cognitive abilities and have reduced risk of developing dementia
- Individuals with dementia show improvement following participation in physically and mentally stimulating activities
- **Good hearing is necessary for staying socially involved**



Why are seniors so reluctant to do something about hearing loss?

- Many seniors put off doing something about hearing loss – average delay by 10 years
- Only 20% adopt hearing aids
- Why?
 - Denial of hearing loss
 - Stigma attached to hearing aids
 - Myths and negative attitudes about hearing aids
 - Poor motivation from depression re. general health and aging
 - High cost of devices and limited means
- OTHERS complain = nuisance -> seek help
 - Family unable to contact parent living alone by phone,
 - Gets tired of repeating & raising voice
 - T.V. is so loud it bothers others, etc.

Getting help for hearing loss

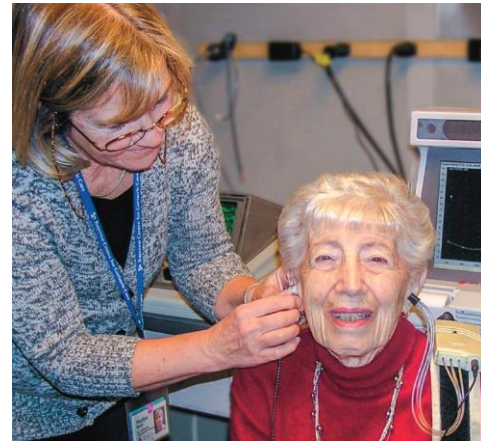
- See your **doctor** (GP, ENT) for medical clearance
 - wax, infection, other pathology that may need investigation/treatment
- See an **Audiologist** for assessment and management of hearing loss:
 - Hearing test battery
 - Hearing aid/assistive device evaluation and prescription
 - Dispensing of device(s)
 - Ongoing follow-up and counseling
- Hearing aid dispenser (Audiologist or HIP)

People with AD are less likely to get help with HL, even though effective management may actually help to reduce symptoms and facilitate care, reducing caregiver burden.

Baycrest Audiology Clinic

Services include:

- comprehensive hearing assessments
- hearing aid evaluations and prescriptions
- hearing aid sales, fittings, repairs
- hearing aid orientation and counselling for clients and caregivers
- assistive listening devices (telephone and TV amplifiers, visual alarm systems, etc.)
- ear mold impressions and fittings
- hearing aid accessories and batteries
- loaner hearing aids and Pocket Talkers
- education and counselling with communication tips and tricks for clients and their families, individually and in groups



What Can Be Done?

Options:

- **Technology**
 - hearing aids
 - assistive devices (PSAPS, amplifying phones, TV devices, etc.)
- **Environmental modifications** reduce noise and reverberation
 - ensure good lighting, etc.
- **Behavioral communication strategies**
 - counseling re. coping strategies
 - use of visual cues & speech reading training
 - optimizing audition and listening skills
 - assertiveness training

Hearing Aids Can Help the Brain

- Hearing aids can reduce listening effort by improving the quality of the signal reaching the brain, through:
 - Restoring audibility of important high frequency speech sounds
 - Improving hearing in noise with directional microphones, noise reduction techniques and wireless accessories
- Hearing aids **cannot** give you a younger auditory system or brain!



Hearing Help Classes

- Teach strategies that help where hearing aids can't:
 - use of visual cues; speech-reading
 - optimising audition; paying attention
 - manipulating environment
 - being assertive
- Hearing help classes at Baycrest

Communication Strategies

Optimizing Hearing:

- Speak slowly and clearly, slightly louder than normal
- Keep sentences short and simple
- Paraphrase sentences you have to repeat
- Ensure there is no background noise or music where possible (turn off TV/radio)
- One speaker at a time!!

Communication Strategies

Use of Visual Cues:

- Ensure your face is clearly visible to facilitate speech reading.
- Stand in a clear light facing the person to whom you are speaking
- While speaking, keep hands and other objects away from your face; do not chew gum or eat

Communication Strategies

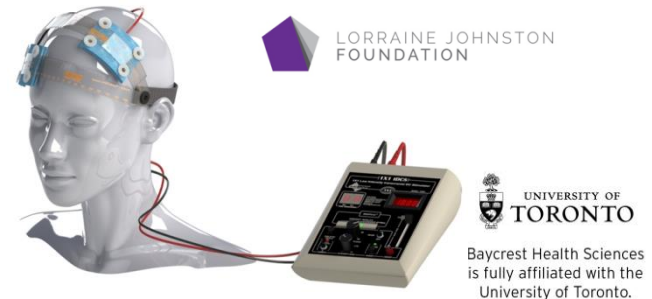
- Attract the person's attention before speaking
- Inform the listener of the topic of conversation
- Ensure the information has been heard correctly
- In restaurants or social gatherings, chose seats away from noisy areas
- When in doubt, ask the person how you can facilitate communication

What else can we do for clients with cognitive impairment?

Clinical research to find out what works:

Developing, implementing and evaluating new intervention programs for seniors with both hearing loss and cognitive impairment and their caregivers

- Auditory training: improving listening and attention skills
- Interventions combining hearing and memory training
- Interventions providing social interaction
- Music-based interventions
 - Combining music and brain stimulation to improve memory



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Summary of Recommendations

- Have a hearing test to establish a base line
- Have your hearing monitored annually
- Protect your hearing
- If you have hearing loss, do something about it!
- Improving your hearing will
 - Free up mental resources to improve your memory capacity
 - Improve your ability to communicate and interact with others, allowing you to reap the many health benefits of social engagement!

Thank You!

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