

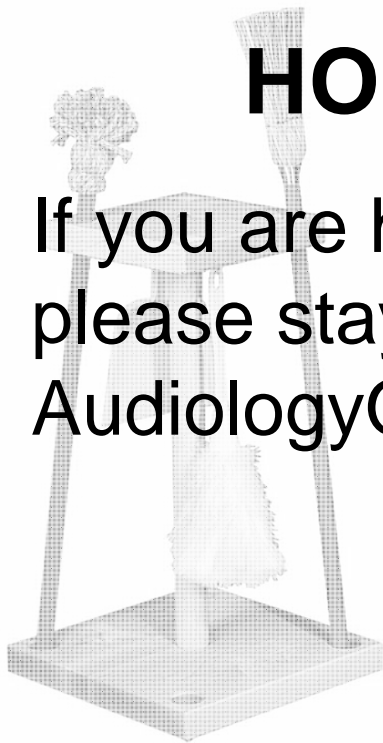
# Anti-Aging for the Auditory System. No Botox Needed!

Jumana Harianawala, Au.D.

Lindsay Prusick, Au.D.

## HOUSEKEEPING

If you are having technical problems,  
please stay logged on and call  
AudiologyOnline at **1-800-753-2160**





# HOUSEKEEPING

This session is available for **1/.1 ceu.**

Must stay **logged** on for the **full** session.

Must successfully **complete** a short **quiz.**



# HOUSEKEEPING

**Pdf.** of presentation is available.

**Questions?** Please use chat box!

# LEARNING OBJECTIVES

- Be able to explain neuroplasticity and the positive impacts cognitive exercises and active engagement can have on the aging brain
- Be able to discuss the relationship between cognition and the auditory system and the implications of hearing loss on this relationship
- Be able to identify the potential positive effects of auditory training for individuals with normal or impaired hearing







## **COGNITIVE SKILLS + AGING=**

A certain amount of cognitive decline is a normal part of aging.

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

**“Crystalized” intelligence  
stable**

**“Fluid” intelligence  
declines**

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

**Stored memories or  
recall of past events  
remains relatively  
preserved**

**Recent or new memories  
more vulnerable**

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

**Simple or focused  
attention preserved**

**Difficulties may occur  
when divided attention  
required**

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

**Verbal abilities  
preserved**

**Changes or difficulty  
with word retrieval or  
production**

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

**Traditional solutions  
maintained**

**New problems may take  
more time to figure out**

# COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

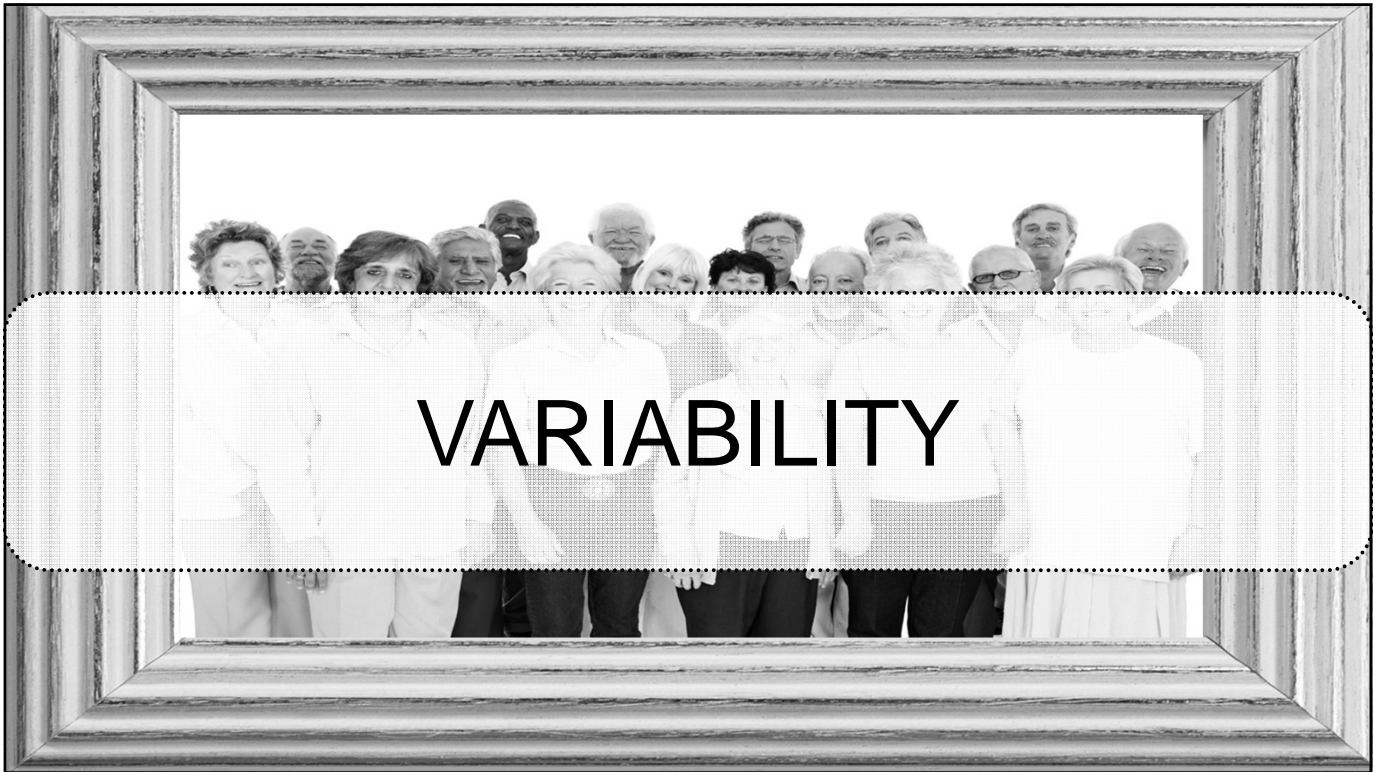
Language

Reasoning & Problem Solving

Speed of Processing

**Cognitive and motor  
processing speed  
increases**





# FACTORS AFFECTING COGNITIVE AGING

Medications

Sensory changes

Health related changes

Changes in mood

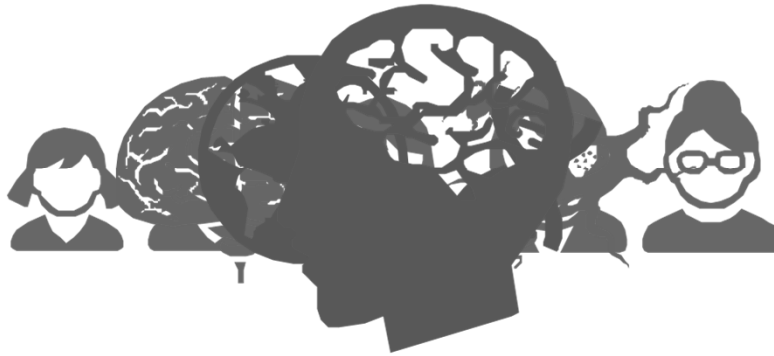
# COGNITIVE SYSTEM + AGE...



**HOW?!?!**

**NEUROPLASTICITY**





## NEUROPLASTICITY



FUNCTIONAL= PHYSIOLOGY



STRUCTURAL= ANATOMY



## MACAQUE STUDY

Functional Neuroplasticity

Brain areas were considered silent from lack of sensory input after a severe hand injury

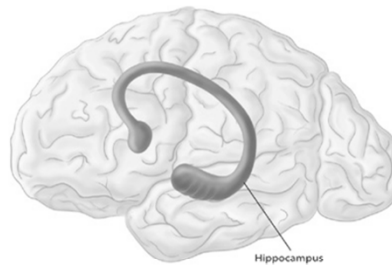
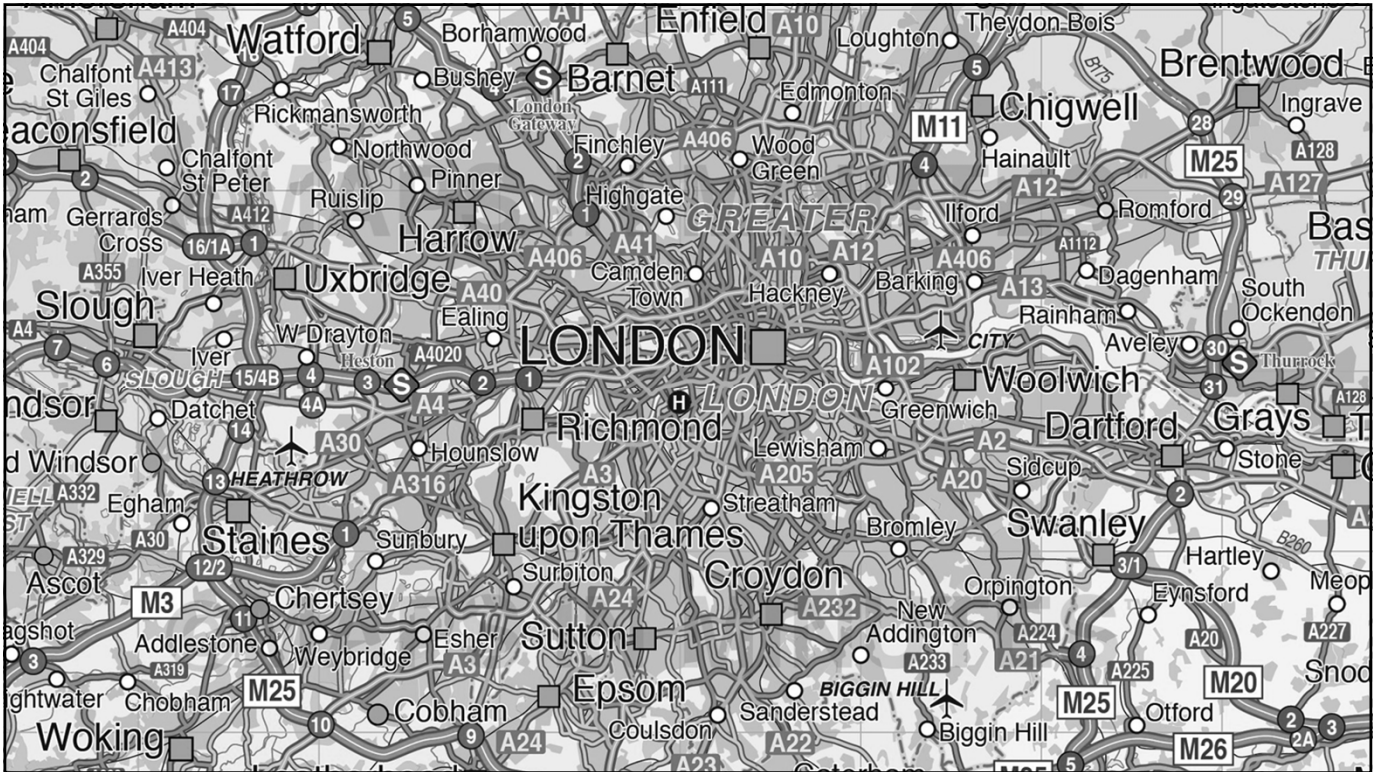
Neighboring areas in the brain expanded into the vacant territory

Merzenich et al., 1968

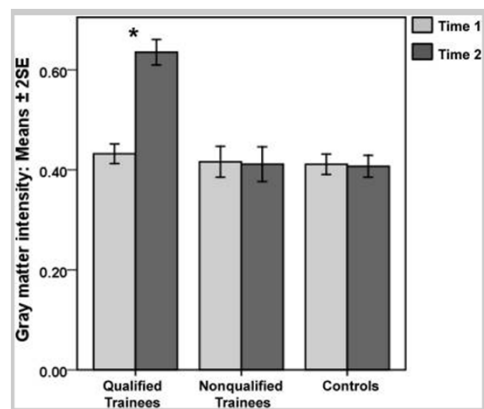


Maguire, Woollett & Spiers, 2006





Consolidation of information  
from short-term memory to  
long-term memory and spatial  
navigation

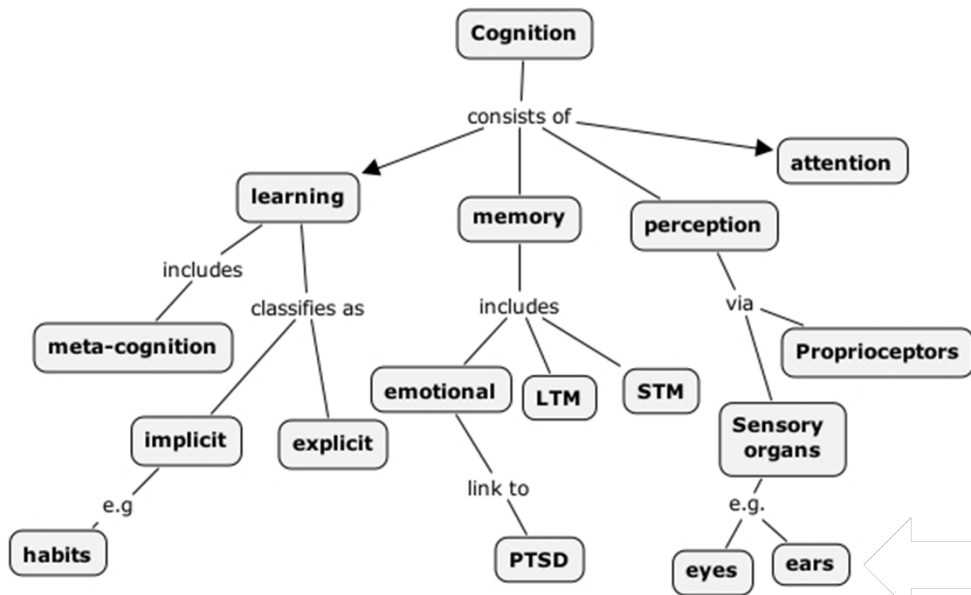
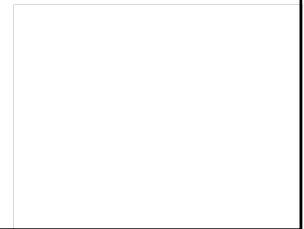


Plot of Gray Matter Intensities across Groups and Time

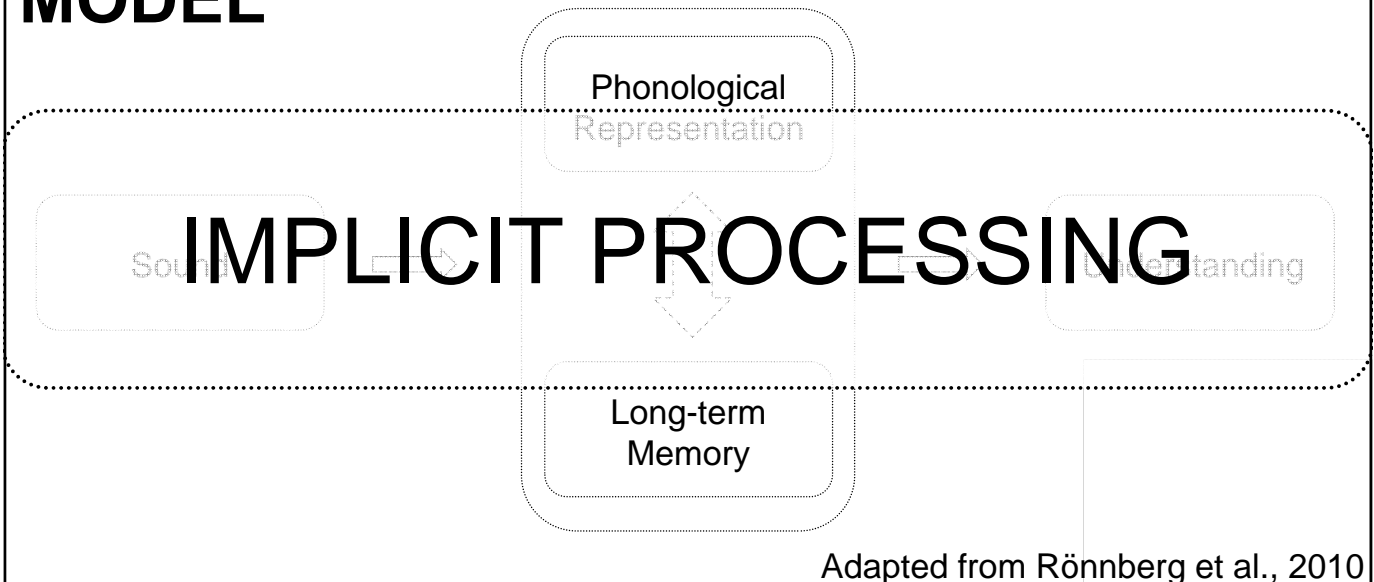
Woollett & Maguire, 2011



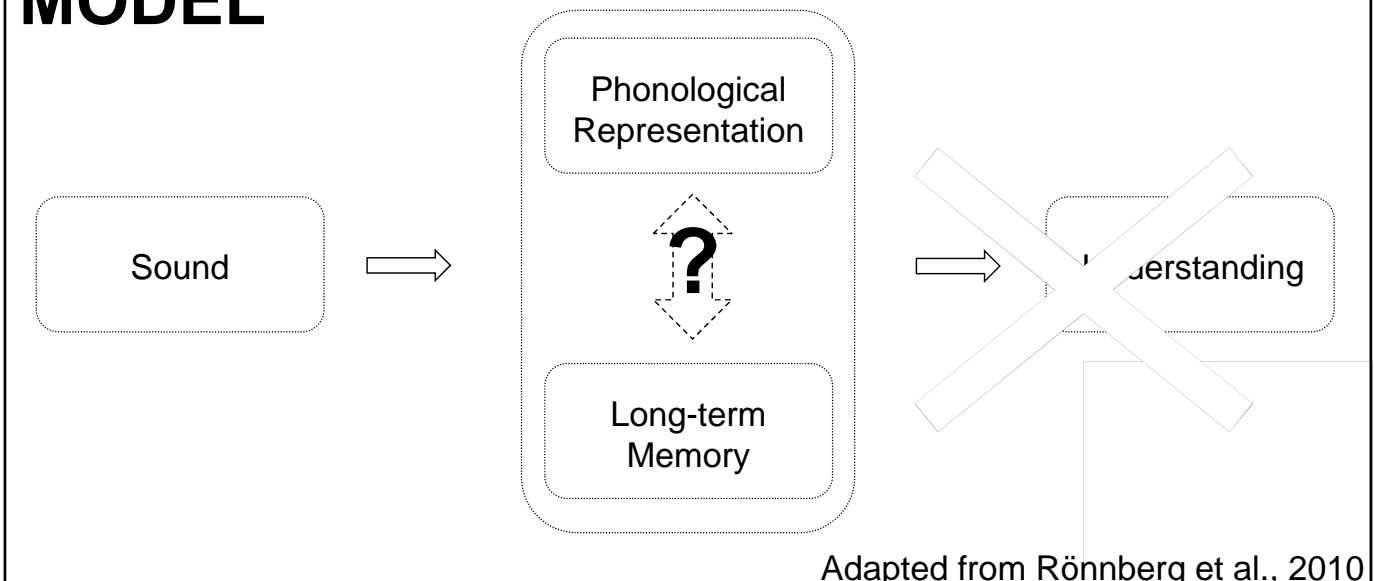
# NEUROPLASTICITY & AUDITORY SYSTEM???



# EASE OF LANGUAGE UNDERSTANDING MODEL



# EASE OF LANGUAGE UNDERSTANDING MODEL





# EASE OF LANGUAGE UNDERSTANDING MODEL

Phonological  
Representation

INCREASED PROCESSING

Long-term  
Memory

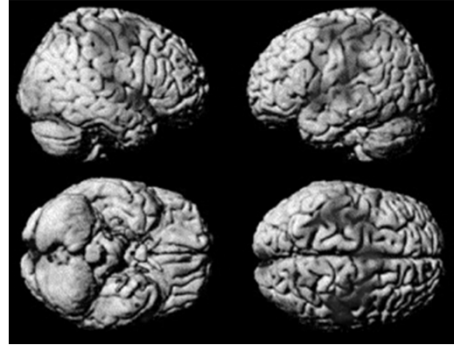
Adapted from Rönnberg et al., 2010



## COGNITIVE SKILLS & AGING

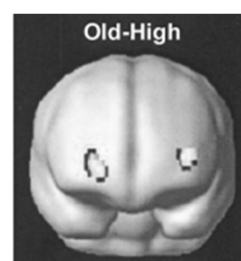
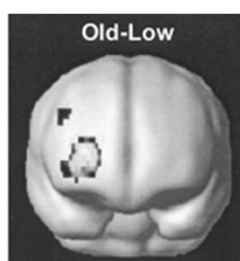
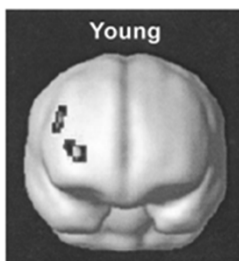


Younger Brain  
Activity Lateralized



Older Brain  
Activity Distributed  
*Compensatory Strategies*

## COGNITIVE SKILLS & AGING



Cabeza et al., 2002

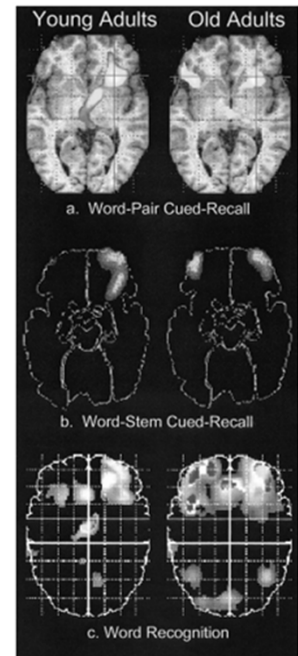
## COGNITIVE SKILLS & AGING

“I can’t keep up.”

Increasing listening effort has deleterious effects on cognitive measures.

Difference between older and younger individuals is minimal when one equates for listening condition.

- Pichora-Fuller, 2006



Cabeza et al., 2000

## COGNITIVE SKILLS & AGING

Intelligence

Memory

Attention

Language

Reasoning & Problem Solving

Speed of Processing

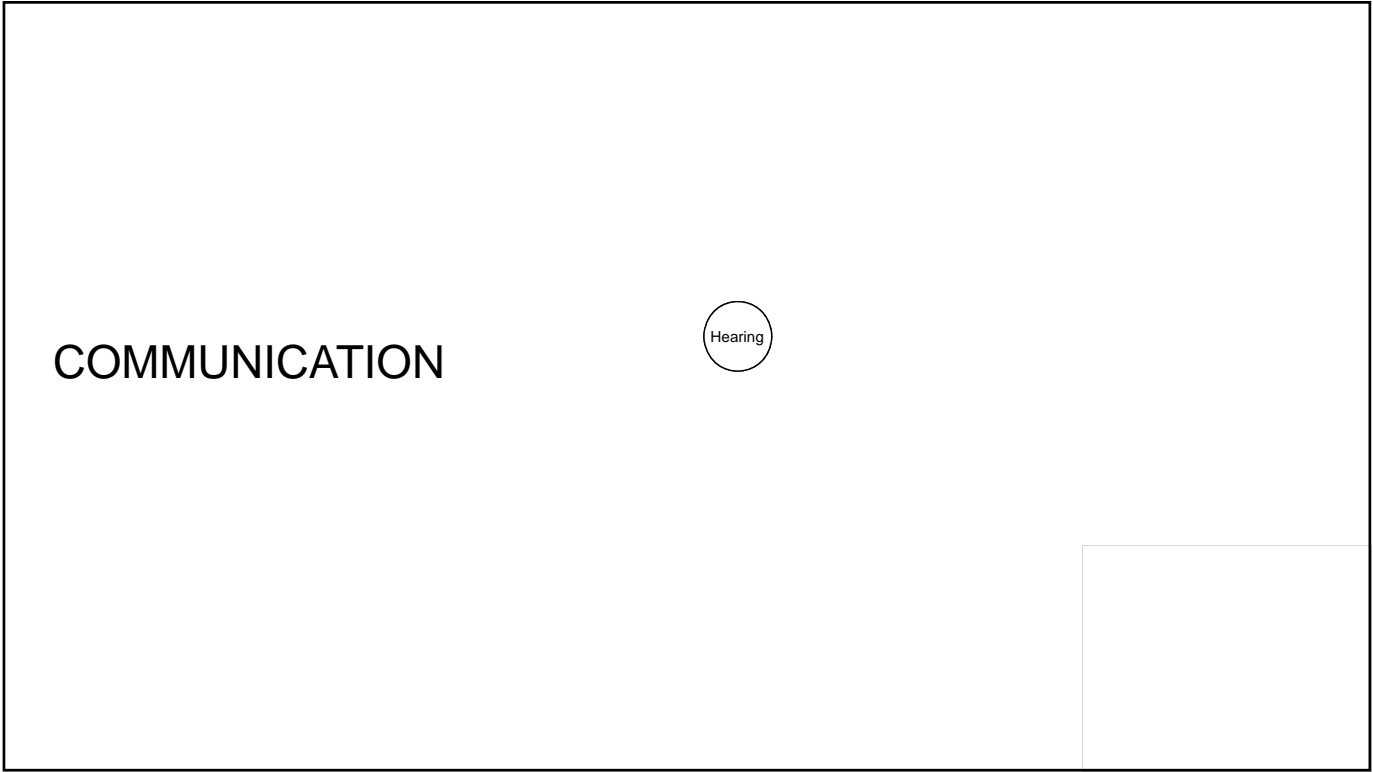
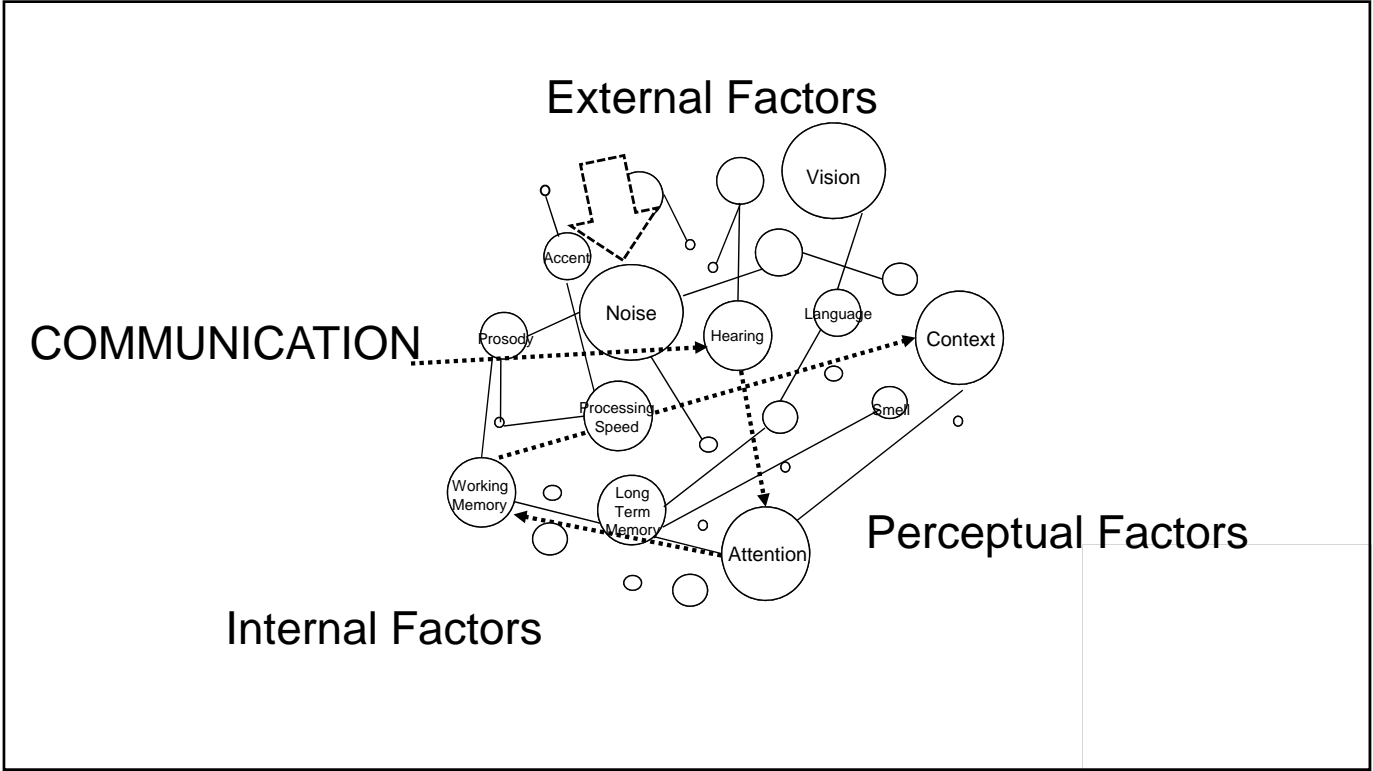
ADD  
HEARING  
LOSS???



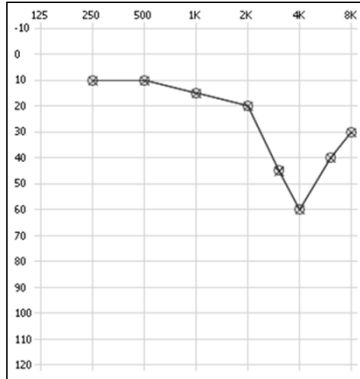
## **COGNITIVE SKILLS & AGING**

**HEARING LOSS** INCREASES  
COGNITIVE LOAD  
**ACCELERATES**  
**COGNITIVE DECLINE**

Lin et al., 2013



# HEARING EVALUATION



PERIPHERAL AUDITORY  
FACTORS DOMINATE

REHAB DECISIONS  
BASED ON THESE  
FACTORS

PHONED A.M. P.M.	PROMISED	DELIVER	WILL CALL
------------------------	----------	---------	-----------

FOR \_\_\_\_\_

ADDRESS \_\_\_\_\_

**R<sub>x</sub>**

*For hearing loss:  
Hearing aids  
Accessory  
Aural rehab tips*

DR. \_\_\_\_\_ DR. \_\_\_\_\_  
SUBSTITUTION PERMITTED DISPENSE AS WRITTEN

DEA NO. \_\_\_\_\_ REFILL \_\_\_\_\_ TIMES

DATE \_\_\_\_\_ ADDRESS \_\_\_\_\_

ITEM #52945



# WHAT EXACTLY IS AUDITORY TRAINING?

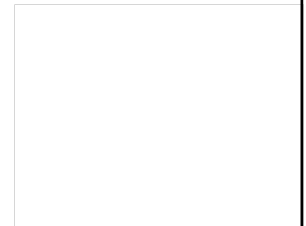
A PROCESS THAT  
INVOLVES  
TEACHING THE  
BRAIN TO LISTEN.



/beet/

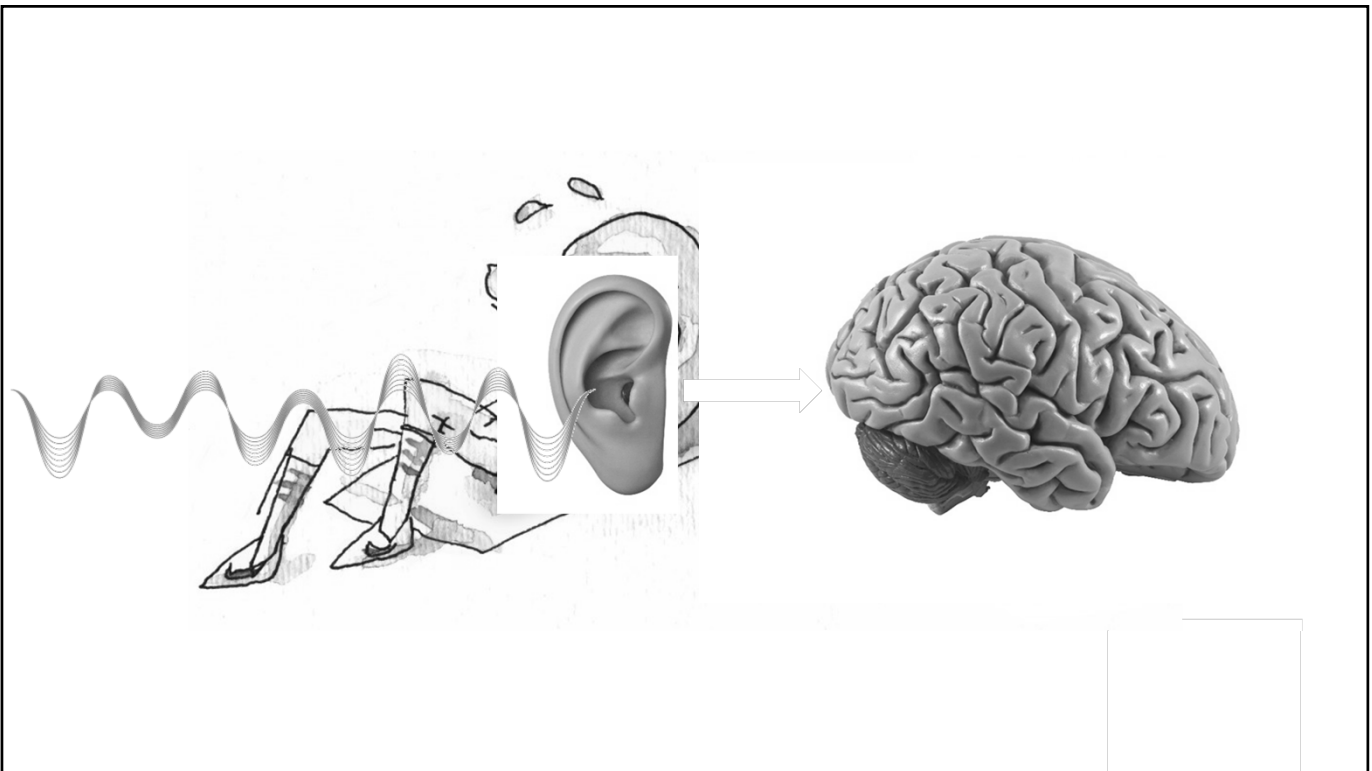
/boot/

/bat/





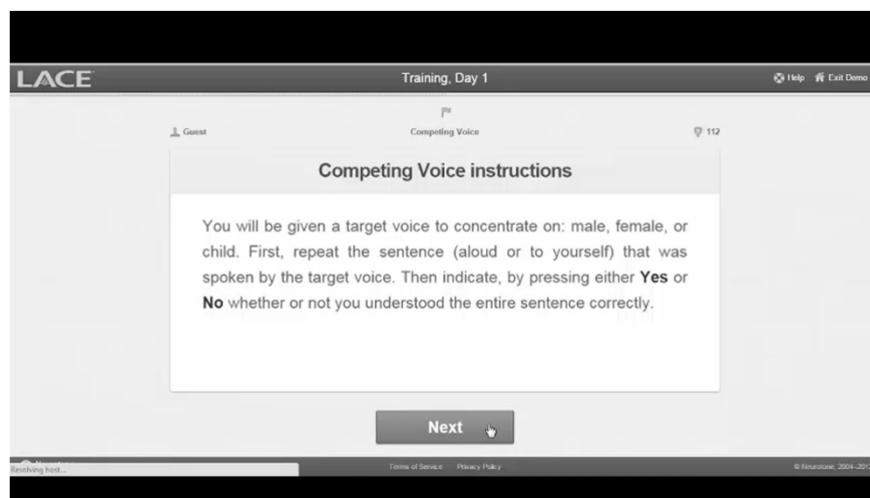
**WOULD YOU LIKE  
THE BEET SALAD?**



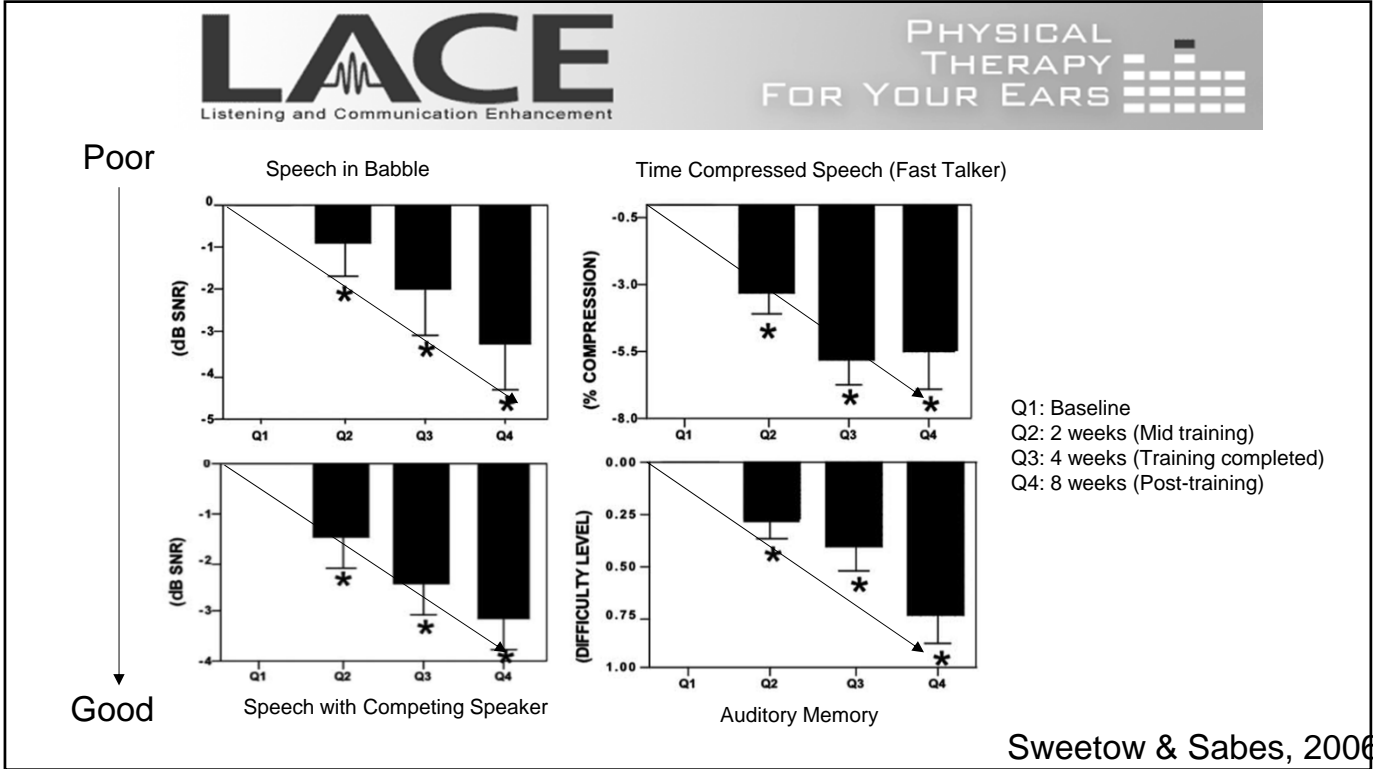
**AUDITORY TRAINING IS COGNITIVELY CHALLENGING!** TAKES ADVANTANGE OF THE NEUROPLASTIC NATURE OF THE BRAIN.

**LACE**  
Listening and Communication Enhancement

PHYSICAL  
THERAPY  
FOR YOUR EARS

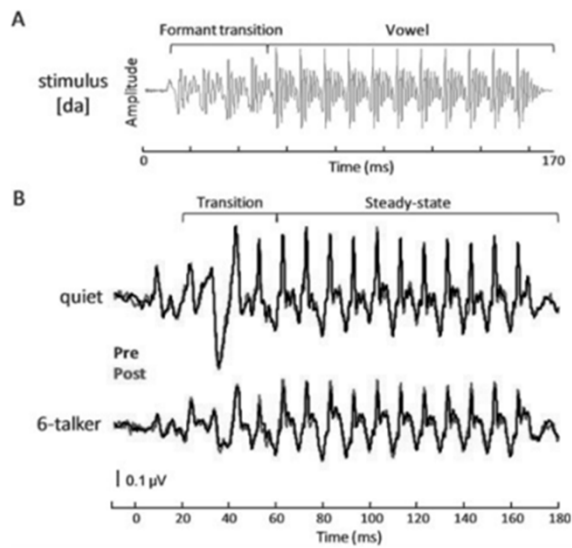


**LACE Demo**



# AUDITORY TRAINING DATA

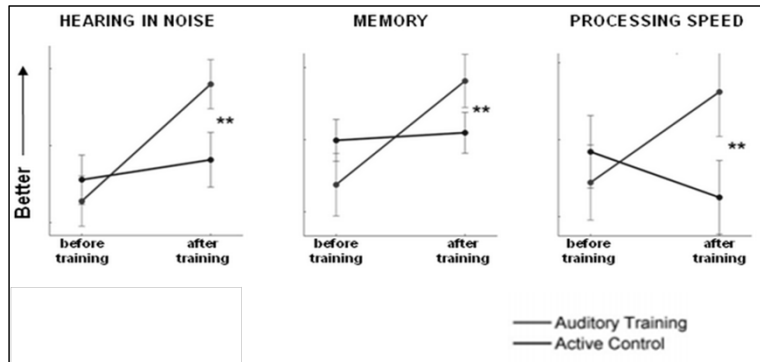
## Normal Hearing Young Adults



Song et al., 2012

# AUDITORY TRAINING DATA

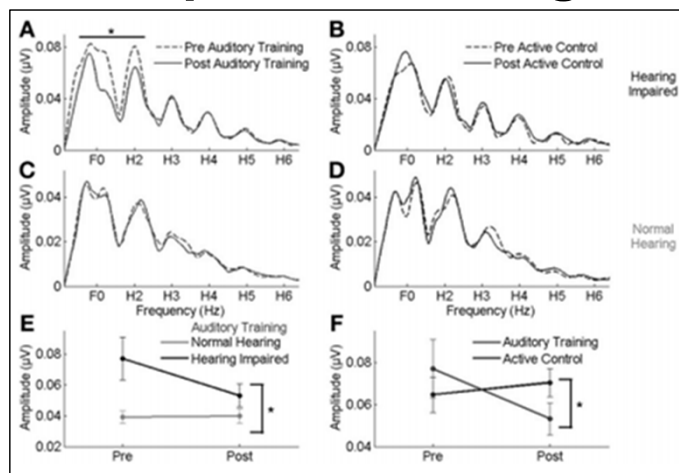
## Older Adults with Normal & Impaired Hearing



Anderson et al., 2013

# AUDITORY TRAINING DATA

## Older Adults with Normal & Impaired Hearing



Anderson et al., 2013



# GAMIFICATION

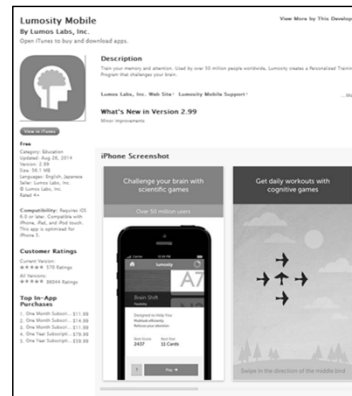
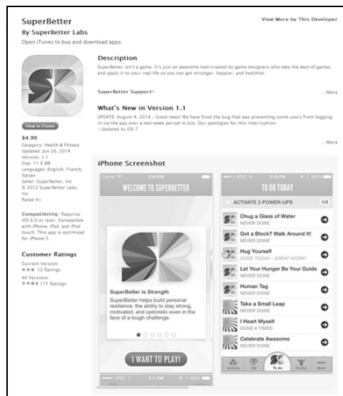
gam·i·fi·ca·tion  
/gāmifə'kāSHən/

*noun*

using game thinking and design techniques for non-gaming contexts to engage users to solve problems or change behaviors in a fun, competitive or rewarding way



# GAMIFICATION





# GAMIFICATION

It makes the hard stuff in life fun...  
...like auditory training!

The screenshot shows a web browser window with the URL [www.sensesynergy.com](http://www.sensesynergy.com). The page features the Sense Synergy logo and navigation links: TRY IT | PURCHASE | LOGIN/REGISTER | ABOUT US | CONTACT. Below the logo are tabs for WELCOME, PRODUCT INFO, FOR PROVIDERS, and SUPPORT. The main content area is titled "One of the most exciting innovations in speech comprehension" and features the "ReadMyQuips" logo with a "Patent Pending" tag. A sub-headline reads "Train Your Brain" and Understand Again". The text describes the product as an audio-visual home training system designed to help users understand speech in noisy environments. A "FREE TRIAL" button is visible. On the left side, there are social media sharing icons for Twitter, LinkedIn, Facebook, and a Like button. At the bottom, there are two columns of text: "For the Hearing Impaired" and "For Hearing Professionals", each with a small image and a right-pointing arrow. The footer contains copyright information and social media follow links.



# RMQ Demos

Acting is all about honesty.

(George Burns)

iPad 6:58 AM 100%

Stats

ReadmyQuips

Help

Level: 7

Trial 1

Score: 69

If you can fake that, you've got it made

whose office plants have died

never learn anything from experience.

SENSE SYNERGY

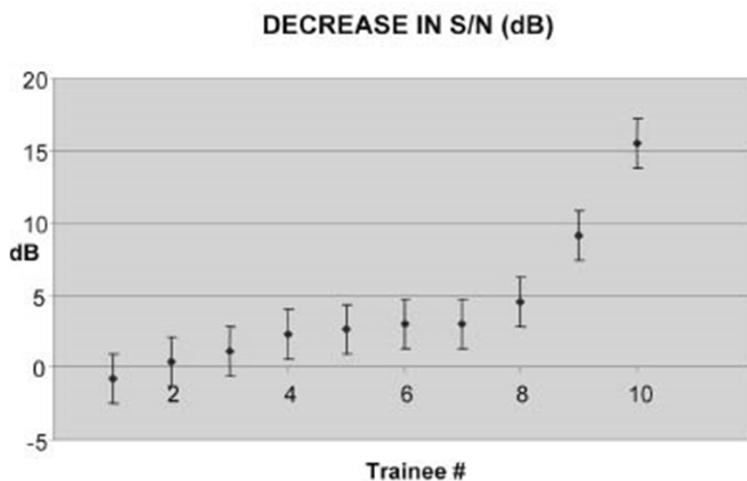
Puzzle 1/10

## MULTI-TASKING...

**SELECTIVE ATTENTION** FOCUS ON RELEVANT SOUNDS, SUPPRESS IRRELEVANT SOUNDS

**WORKING MEMORY** TEMPORARILY MAINTAIN, STORE, PROCESS INFO

## RMQ DATA



Significant improvements in speech recognition

Average improvement for the 9 experienced hearing-aid users was 2.8 dB

Subjects enjoyed the system and felt their speech-in-noise ability had improved

Leavitt, H. et al., 2011



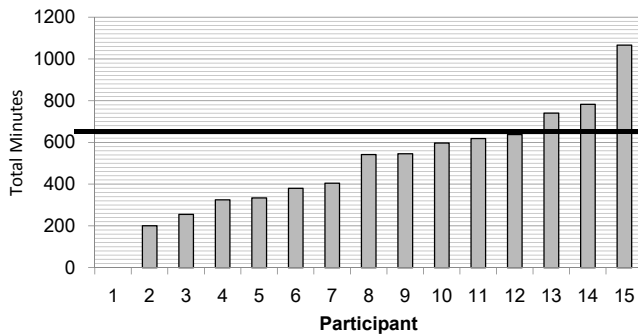
# RMQ DATA

	Daily Use	% Directional	% Noise	%Speech in Noise
RMQ	9.6 hours	19.16%	1.4 %	41.3%
CTRL	8.4 hours	17.6 %	1.2 %	41.2%

29 new hearing aids users

Randomly assigned to RMQ & control group

**Self-Reported RMQ Time**

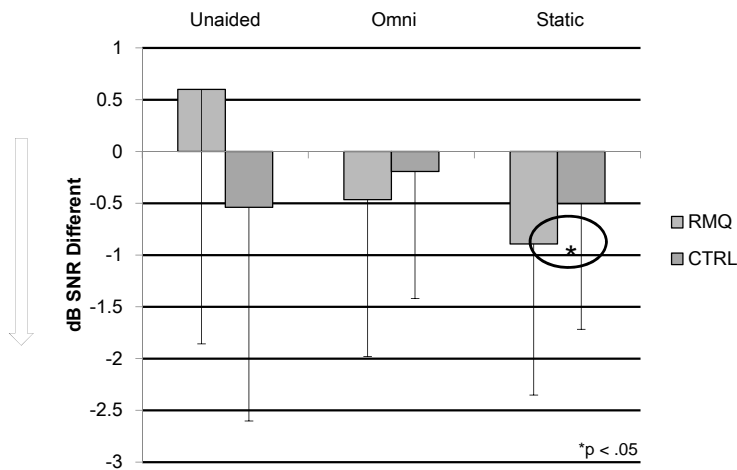


Variety of test measures given pre & post including HINT & WIN

Bock & Abrams, 2013

# RMQ DATA

**HINT Differences**

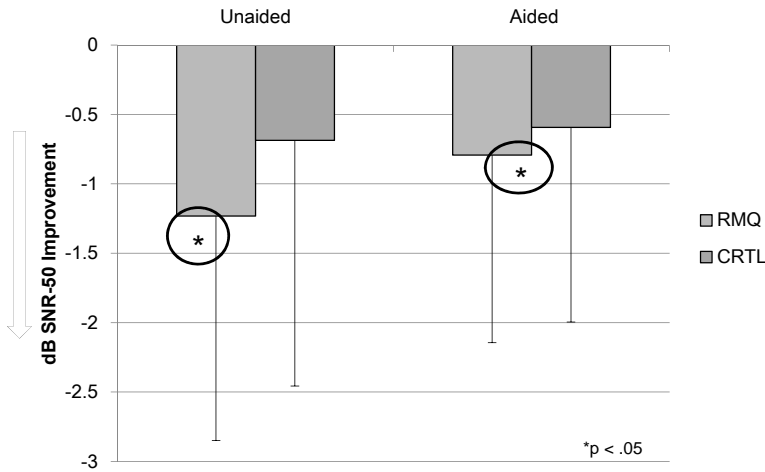


Significant improvement seen for the RMQ group on the HINT test in the static directional condition

Bock & Abrams, 2013

# RMQ DATA

## WIN Differences



Significant mean improvement seen for the RMQ group on the WIN test for both aided and unaided conditions

Bock & Abrams, 2013

**Massachusetts Eye and Ear**  
sense life. experience life.

**Press Releases 2014**

**Game Technology Teaches Mice and Men to Hear Better in Noisy Environments**

Audiogames may provide the hearing impaired with an improved ability to reconnect to the auditory world.

Contact: [Mary Leach](#)  
617-573-4170

BOSTON (June 9, 2014) – The ability to hear soft speech in a noisy environment is difficult for many and nearly impossible for the 48 million in the United States living with hearing loss. Researchers from the Massachusetts Eye and Ear, Harvard Medical School and Harvard University programmed a new type of game that trained both mice and humans to enhance their ability to discriminate soft sounds in noisy backgrounds. Their findings will be published in PNAS Online Early Edition the week of June 9-13, 2014.

In the experiment, adult humans and mice with normal hearing were trained on a rudimentary 'audiogame' inspired by sensory foraging behavior that required them to discriminate changes in the loudness of a tone presented in a moderate level of background noise. Their findings suggest new therapeutic options for clinical populations that receive little benefit from conventional sensory rehabilitation strategies.

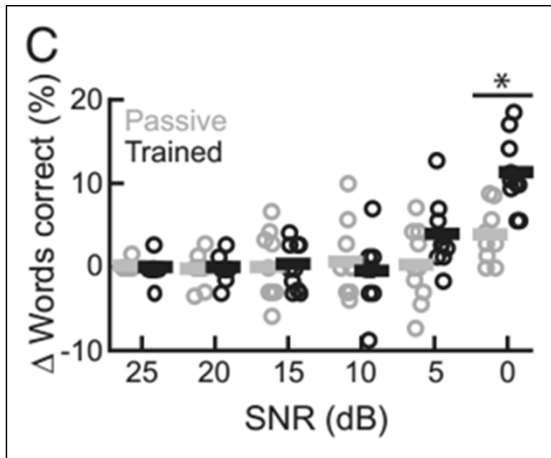
Daniel Polley in the Amelia Peabody Neural Plasticity Unit of the Eaton-Peabody Laboratories

"Like the children's game 'hot and cold', our game provided instantaneous auditory feedback that allowed our human and mouse subjects to hone in on the location of a hidden target," said senior author Daniel Polley, Ph.D., director of the Mass. Eye and

## Foraging "Audiogame"

Subjects learned adaptive search strategies that allowed them to more efficiently convert noisy dynamic audio cues into actionable information for finding the target

Whitton, J. et al, 2014



Change in words correctly recognized for the speech in noise task (Post-Pre) according to target speaker SNR

**Auditory foraging task transferred to an untrained speech perception task!**

Generalized improvement in ability to understand speech in noisy conditions

On average, a **12% improvement** at 0dB SNR

Whitton, J. et al, 2014



PositScience®

Why BrainHQ World Class Science Brain Resources Partners

Think faster Focus better Remember more

memory navigation attention

intelligence

Keys

people skills brain speed



Press the left arrow on your keyboard if the figures match as described below. Otherwise press the right arrow. You'll have a limited time to respond. Click START to begin.


Same color











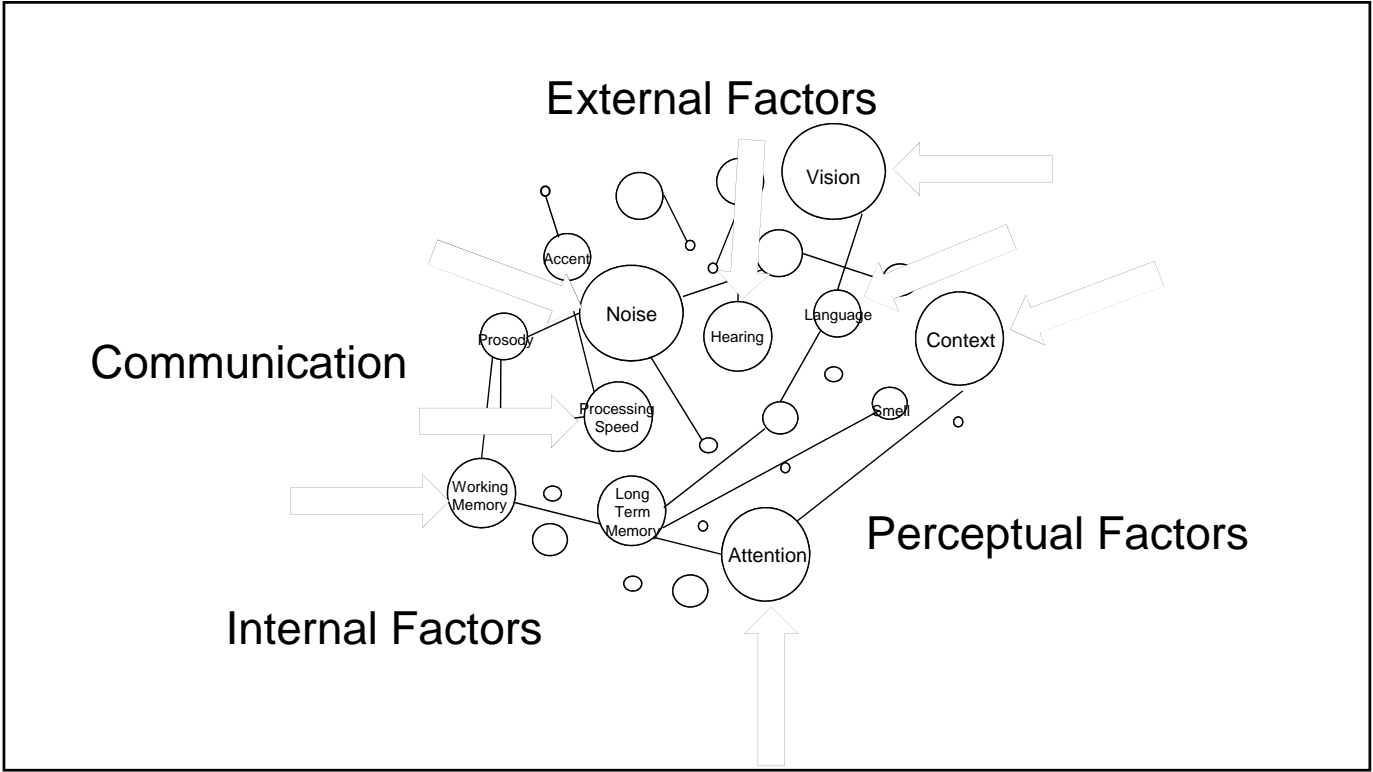
**BrainHQ Demo**

[Click to see another example](#)





<b>Sound Sweeps</b>  PLAY >	<b>Fine Tuning</b>  PLAY >	<b>Auditory Ace</b>  PLAY >	<b>Mixed Signals</b>  PLAY >
<b>In the Know</b>  PLAY >	<b>True North</b>  PLAY >	<b>Rhythm Recall</b>  PLAY >	<b>Syllable Stacks</b>  PLAY >



**AUDITORY TRAINING IS  
ANTI-AGING FOR THE BRAIN**

**NO BOTOX  
NEEDED!**

**Thank you!**

Jumana\_Harianawala@starkey.com.

Lindsay\_Prusick@starkey.com