The Aging Perceptual System

Donald J Schum, PhD
VP, Audiology

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Why?

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Learning Objectives

1. … … recognize the cognitive basis of spoken language understanding under realistic communication conditions
2. … recognize how age-related hearing loss can compromise the coded neural signal sent to the brain
3. … identify the effects of normal aging on central perceptual processes

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The Cognitive Nature of Speech Understanding

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Speech Understanding vs Spoken Language Understanding

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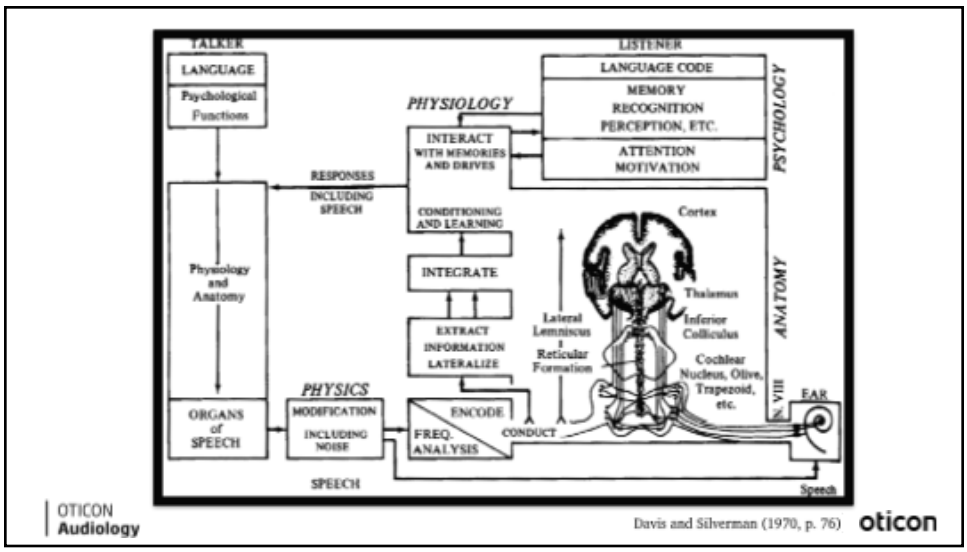
TALKER
LISTENER
LANGUAGE
Psychological Functions
LANGUAGE CODE
MEMORY
RECOGNITION
PERCEPTION, ETC.
ATTENTION
MOTIVATION
PSYCHOLOGY
PHYSIOLOGY
INTERACT WITH MEMORIES AND DRIVES
RESPONSES INCLUDING SPEECH
CONDITIONING AND LEARNING
INTEGRATE
EXTRACT INFORMATION LATERALIZE
Physiology and Anatomy
ANATOMY
Cortex
Thalamus
Inferior Colliculus
Lateral Lemniscus
Reticular Formation
Cochlear Nucleus, Olive, Trapezoid, etc.
N. VIII
EAR
PHYSICS
ORGANS of SPEECH
MODIFICATION INCLUDING NOISE
ENCODE
FREQ. ANALYSIS
CONDUCT
SPEECH
Speech
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Davis and Silverman (1970, p. 76)
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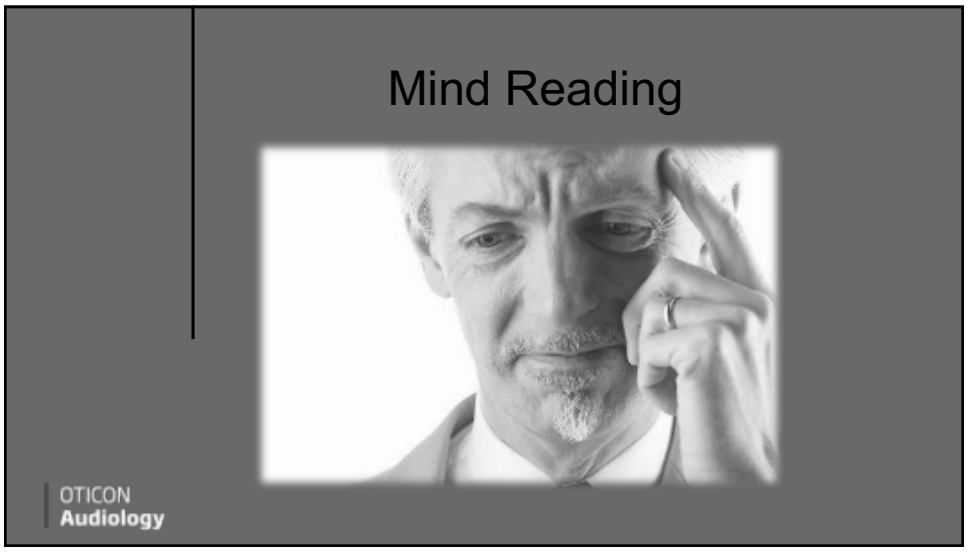
Mind Reading
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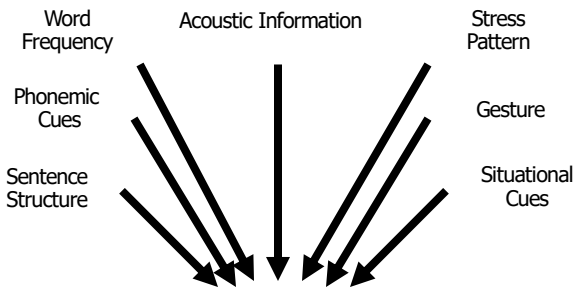
Multiple Cue Processing



Spoken Language Understanding

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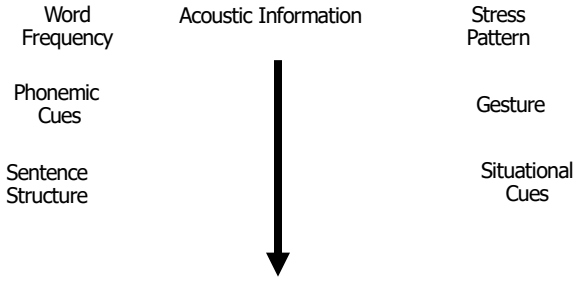
Multiple Cue Processing



Spoken Language Understanding

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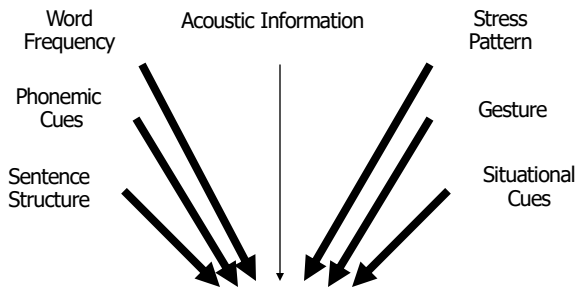
Multiple Cue Processing



Spoken Language Understanding

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"You never REALLY listen to me!"

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Peripheral Changes

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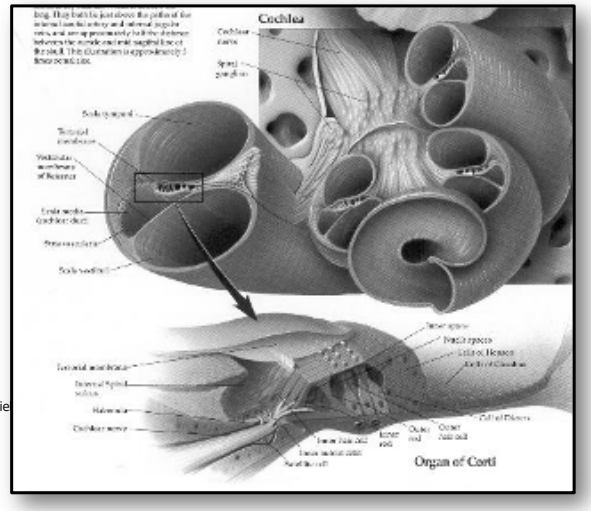

Yost & Nie

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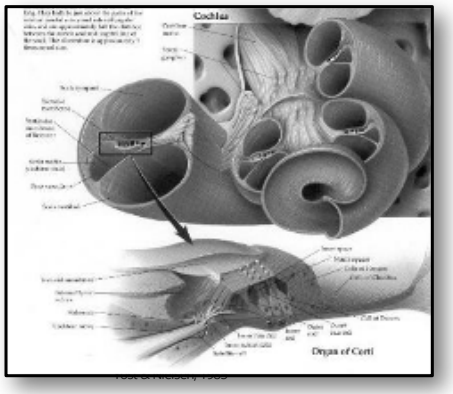

Four Types of Presbycusis

(Schuknecht, 1974)

- Sensory
- Neural
- Metabolic
- Mechanical

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Psychoacoustic Performance

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Age-Related Changes in Temporal Processing: Implications for Speech Perception

Bruce A. Schneider, Ph.D.,[1] and M. Kathleen Pichora-Fuller, Ph.D.[2]

Seminars in Hearing, 2001

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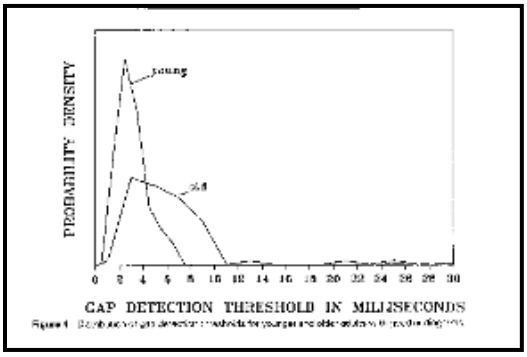

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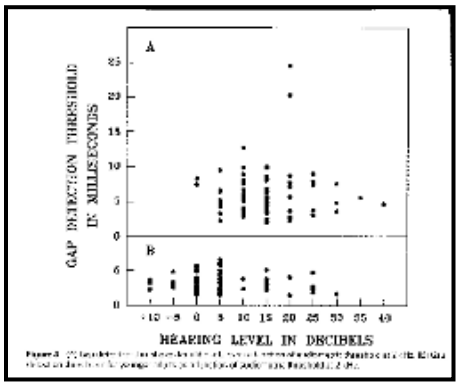

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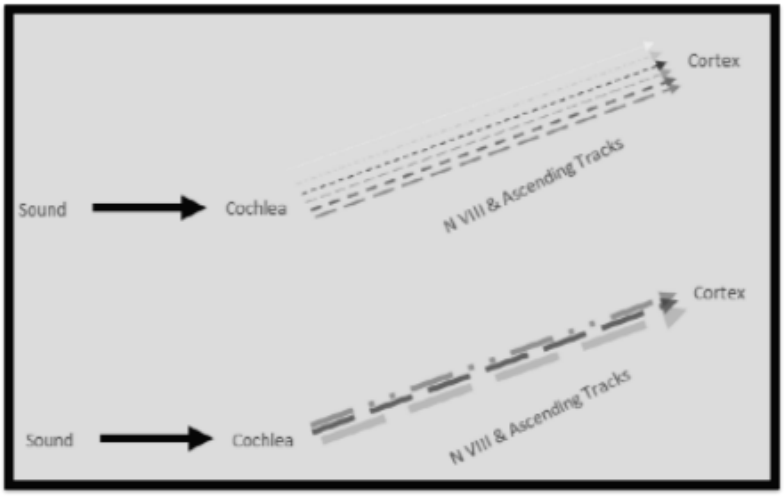

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Central Changes

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"Speech is a cognitive process …

… it happens in the brain."

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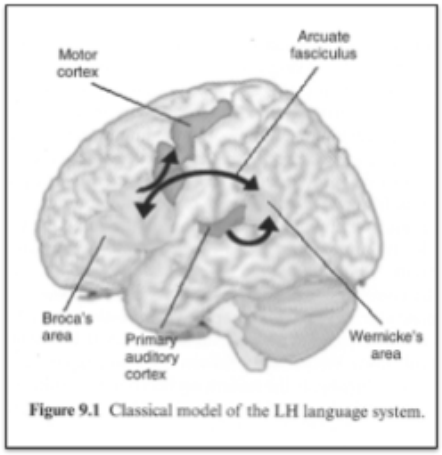

Figure 9.1 Classical model of the LH language system.

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Tyler & Marslen-Wilson, 2009

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Age-related Brain Changes

- Brain dependent on other body changes / status
- *It is all about feeding the brain!*

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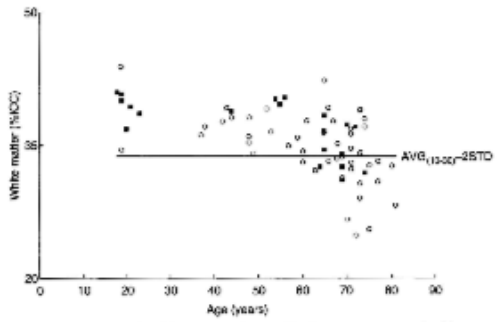

Figure 7.5 Differences in white matter volume with advancing age among healthy older individuals are shown as an example of the variability that can be seen in measures of brain structure among healthy individuals. The white matter measure is presented as a percent of intracranial cavity volume (%ICC) for each subject (circles = females; squares = males). A horizontal line is drawn 2 SD below the mean for the 20-year-old subjects. Note that only subjects 60 and older fall below this horizontal line, but there remain many older individuals who fall above the line.

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Albert & Killiany, 2001

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Age-related Brain Changes

- Physical changes do not necessarily equate to functional changes
- Compensation happens
- Aging: loss of adaptive capacity

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Normal Aging

- **Which Skills Are Affected?**
  - motor skills
  - sensory sensitivity & acuity
  - short term memory
  - sensory-motor reaction time
  - processing & decision speed
  - selective attention
- **Which Skills are Retained?**
  - Long-term memory (recall)
  - intelligence
  - linguistic skills

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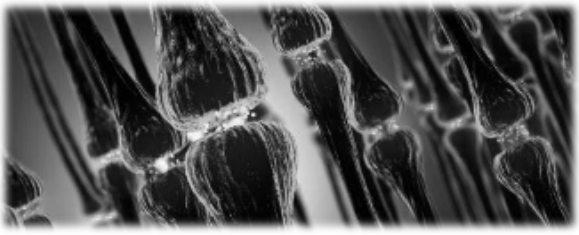
- Neurological Slowing …
  - All neurological events just take longer to happen



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Complex Tasks

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Complex tasks get more of the brain involved (especially frontal lobe)

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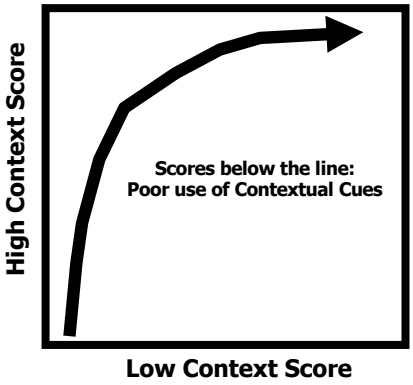
Use of Context by the Elderly
(Schum & Matthews, 1992)

High Context:
"The watchdog gave a warning *growl*"

Low Context
"John was talking about the *growl*"



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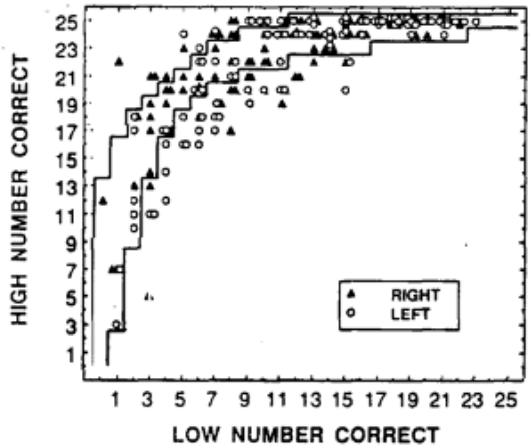

Schum & Matthews, 1992

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Spoken Language Comprehension in Older Adults: Interactions between Sensory and Cognitive Change in Normal Aging

Arthur Wingfield, Ph.D.,[1] and Patricia A. Tun, Ph.D.[1]

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Seminars in Hearing, 2001

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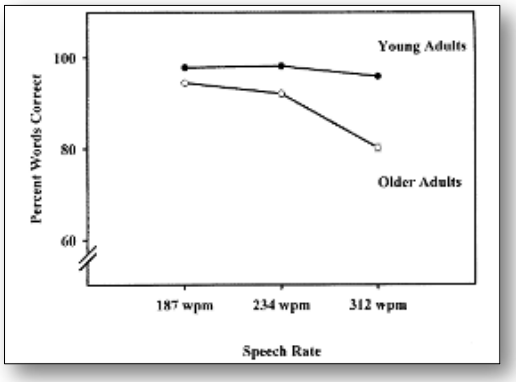

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Wingfield & Tun, 2001

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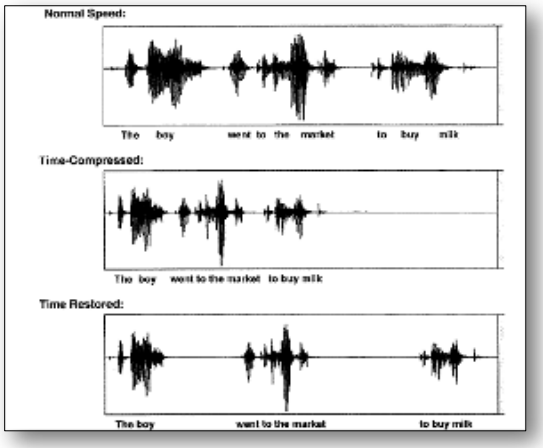

Wingfield & Tun, 2001

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Types of Attention:

- Sustained
- Selective
- Divided
- Working Memory

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Types of Attention:

- Sustained
- ***Selective***
- Divided
- Working Memory

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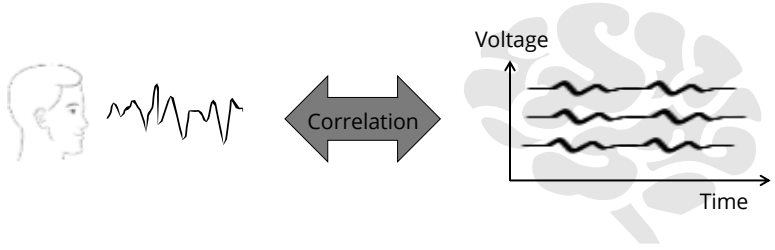
Can you see the brain tracking the speech signal?



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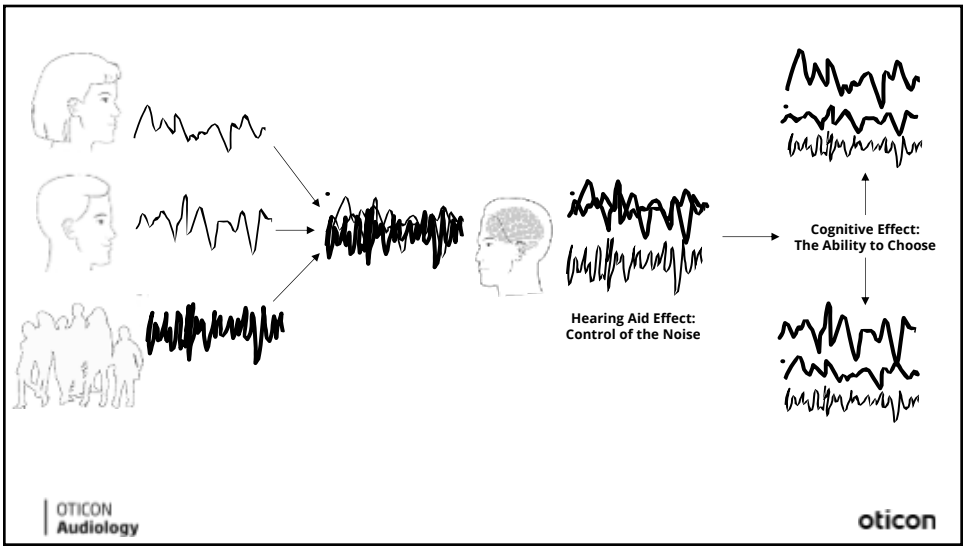

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Does cognitive decline affect basic speech understanding?

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International Journal of Audiology 2003; 42:S49–S58

Thomas Lunner

Oticon A/S, Research Centre Eriksholm, Snekkersten, Denmark, and Department of Technical Audiology, Linköping University, Linköping, Sweden

Cognitive function in relation to hearing aid use

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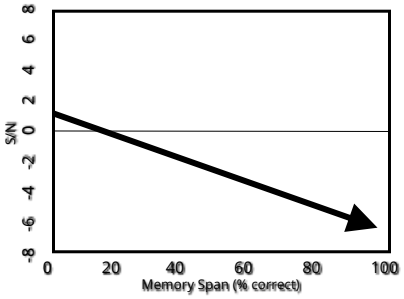
Relationship between cognitive abilities and speech understanding in noise



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Lunner, 2003

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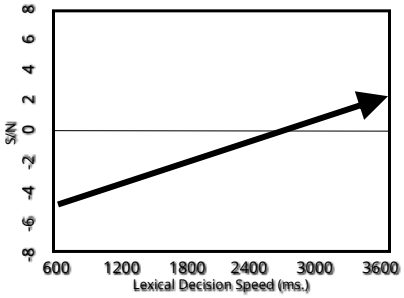
Relationship between cognitive abilities and speech understanding in noise



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Lunner, 2003

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Speech Understanding in Noise:

- Audible?
- Above the noise?
- How sensitive to noise? (distortional component)
- Where does the noise come from?
- What constitutes the “noise”?
- Who is the talker?
- Support cues?
- How much effort is the listener investing?
- How good is the patient at piecing together a partial signal?

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Speech Understanding in Noise:

- Audible?
- Above the noise?
- How sensitive to noise? (distortional component)
- Where does the noise come from?
- What constitutes the “noise”?
- Who is the talker?
- Support cues?
- How much effort is the listener investing?
- ***How good is the patient at piecing together a partial signal?***

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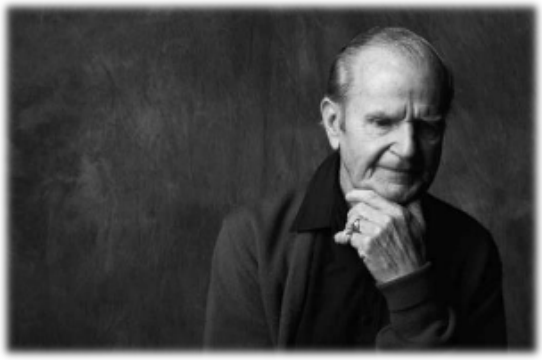

Loss of the ability to *organize* sound

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Can we tease apart the effects?

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OK …

… then what can I do about it?

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Hearing Loss, Aging & Speech Understanding

Presented by Don Schum, PhD

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Course: #32314 | Level: Intermediate | 1 Hour

★★★★☆ 296 Reviews

View CEUs/Hours Offered

Effective speech understanding, especially in complex environments, requires both a well-functioning auditory system and a cognitive system that can efficiently and accurately process information, but our older patients can be challenged on both…

Aging | Hearing and Hearing Loss

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Final Thoughts

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The Mind-Body Connection

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The Aging Perceptual System

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