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Cognitive-Based Assessment of Signal Processing

Donald J. Schum, Ph.D., Vice President of Audiology & Professional Relations, Oticon Inc.

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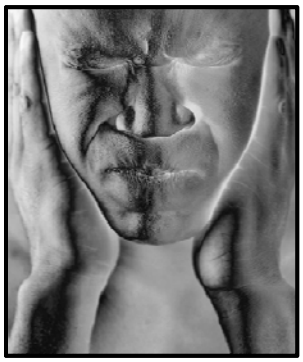

Cognitive-based Assesment of Signal Processing

Donald J. Schum, PhD
Vice President, Audiology & Professional Relations
Oticon, Inc.

Why study cognitive effort?

Effect of cognitive load on articulation rate and formant frequencies during simulator flights

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(Received 31 July 2010; revised 8 November 2010; accepted 18 December 2010)

It was explored how three types of intensive cognitive load typical of military aviation (load on situation awareness, information processing, or decision-making) affect speech. The utterances of 13 male military pilots were recorded during simulated combat flights. Articulation rate was calculated from the speech samples, and the first formant (F1) and second formant (F2) were tracked from first syllable short vowels in pre defined phoneme environments. Articulation rate was found to correlate negatively (albeit with low coefficients) with loads on situation awareness and decision-making but not with changes in F1 or F2. Changes were seen in the spectrum of the vowels: mean F1 of front vowels usually increased and their mean F2 decreased as a function of

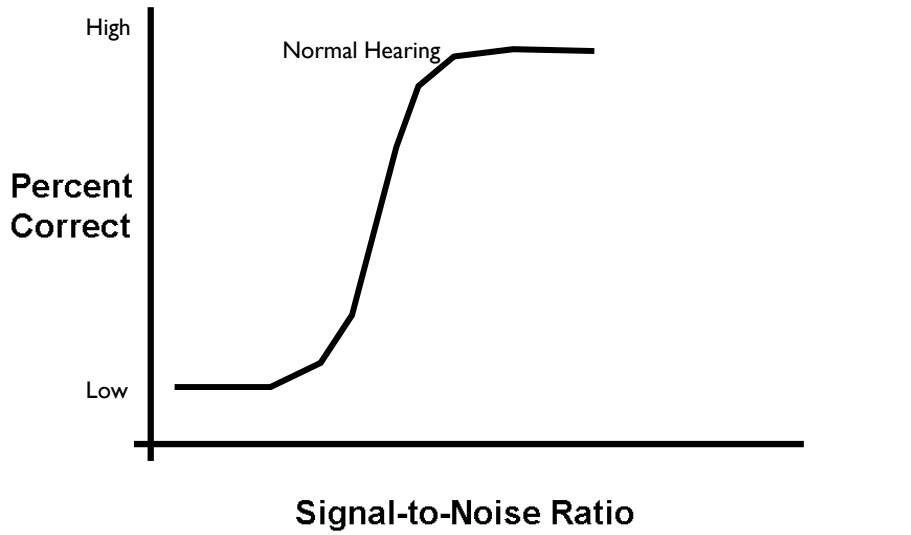
How do patients describe the effects of SNHL?

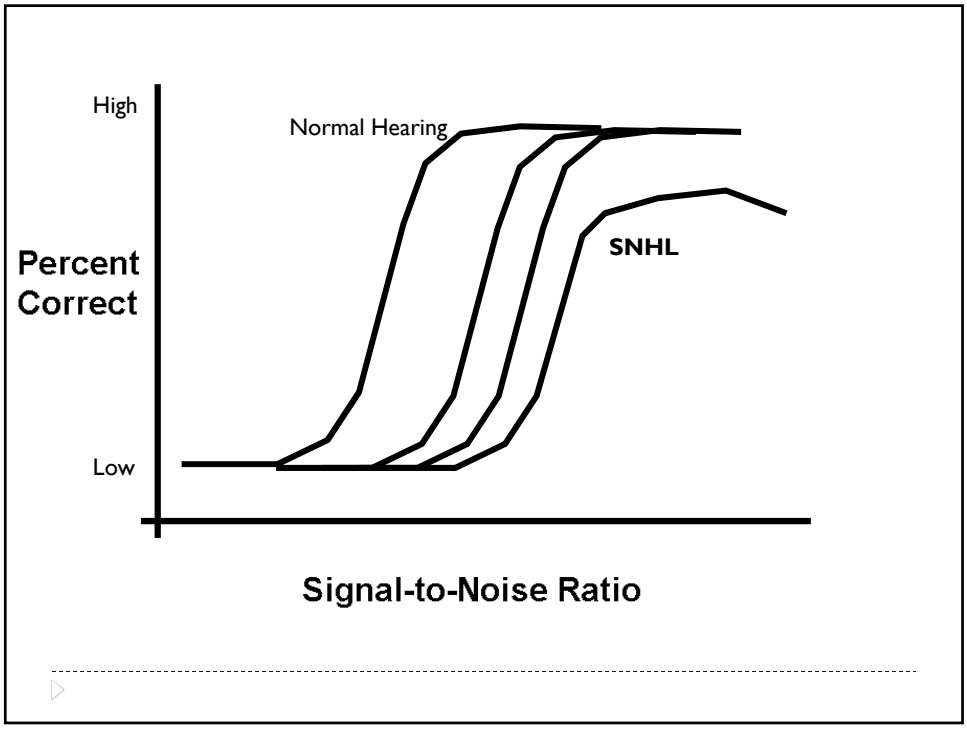
How do parents describe the effects of SNHL on their child?

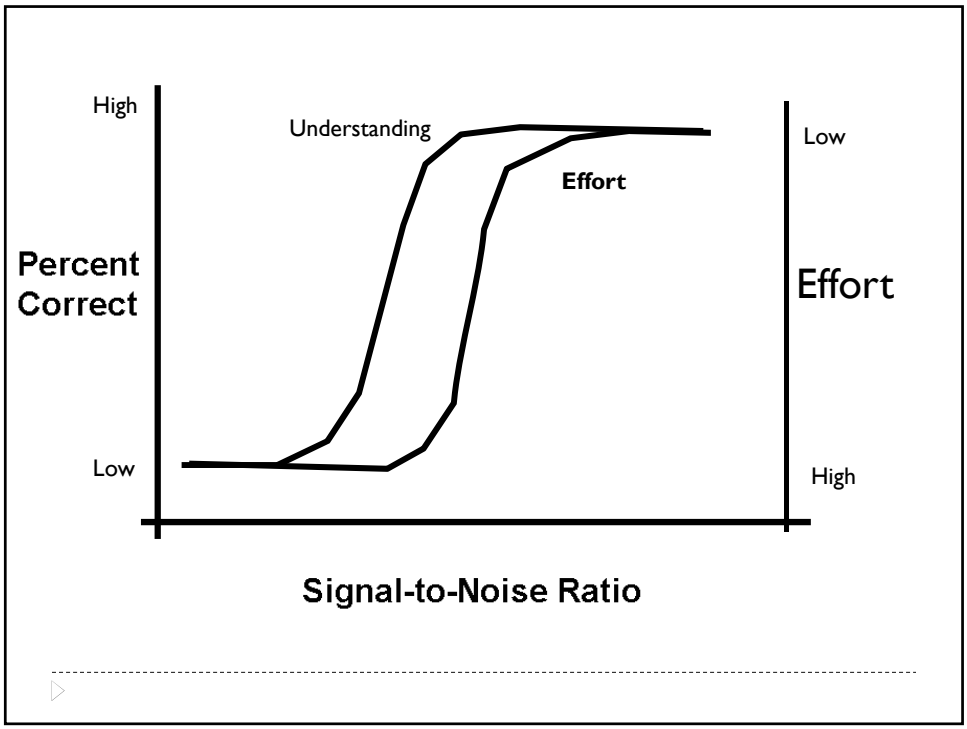
Listening is normally automatic, effortless.

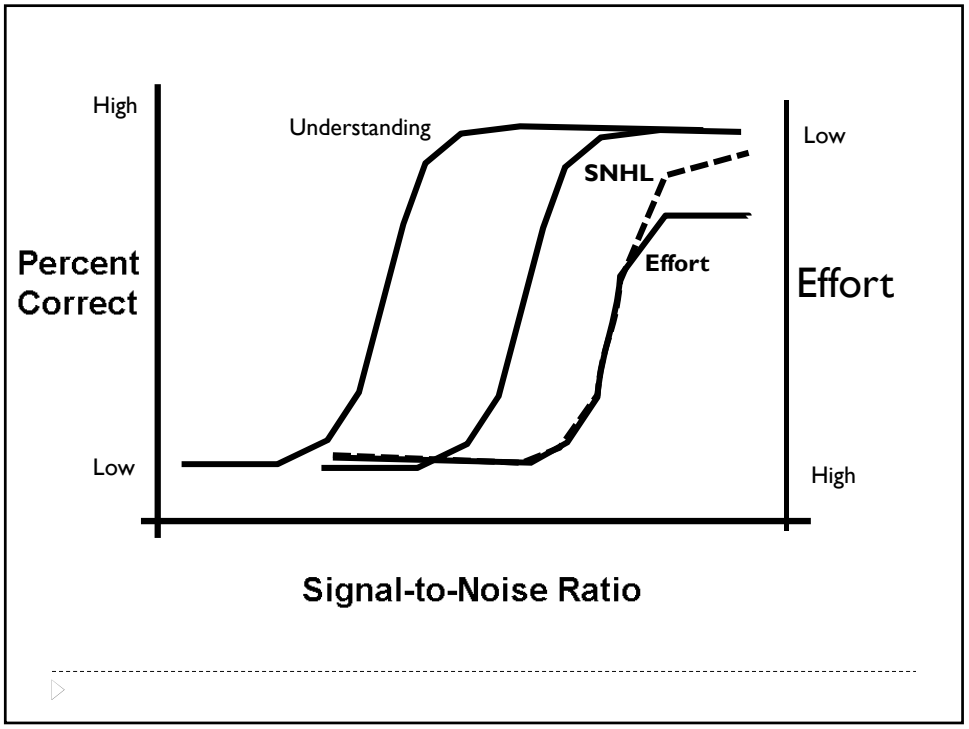
SNHL: many more listening situations require effort to hear and understand

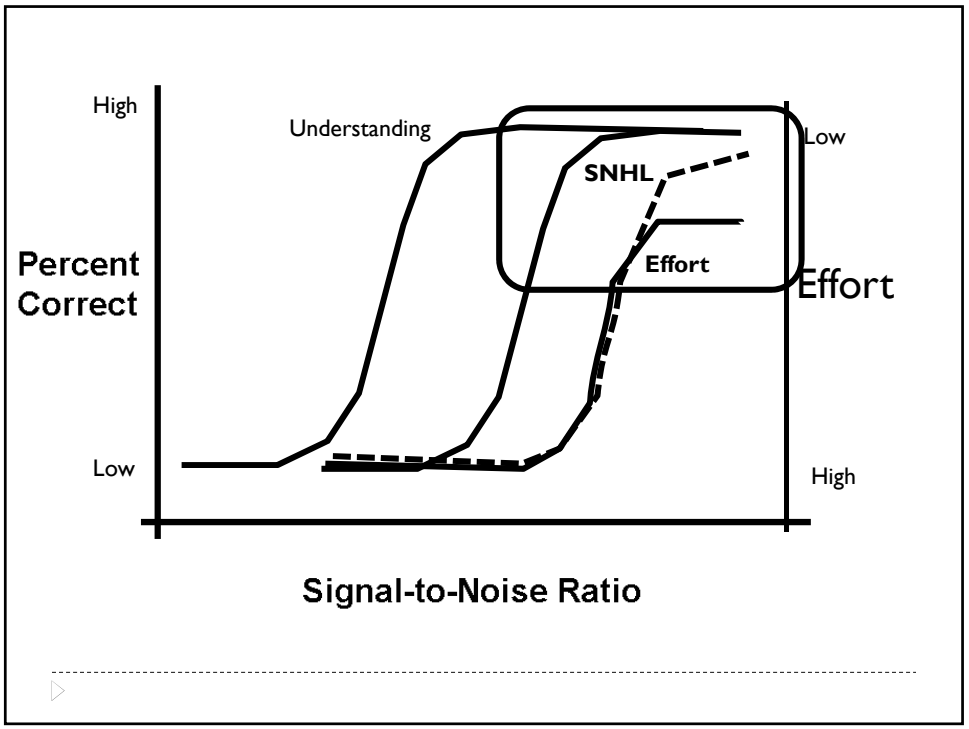
Speech Understanding & Listening Effort




High
Normal Hearing
Percent Correct
SNHL
Low
Signal-to-Noise Ratio


High
Understanding
Low
Effort
Percent Correct
Effort
Low
High
Signal-to-Noise Ratio


High
Understanding
Low
SNHL
Percent
Correct
Effort
Effort
Low
High
Signal-to-Noise Ratio


High
Understanding
Low
SNHL
Percent
Correct
Effort
Effort
Low
High
Signal-to-Noise Ratio

What else can increase the cognitive effort required?

What gets sacrificed?

Speech Understanding: A Cognitive Activity

Finite Cognitive Resources

Listening is active & often purposeful

Speech Understanding as "Meaningful Integration"

-Memory -Interpretation -Evaluation -Reaction

•General processing resources are finite and allocatable

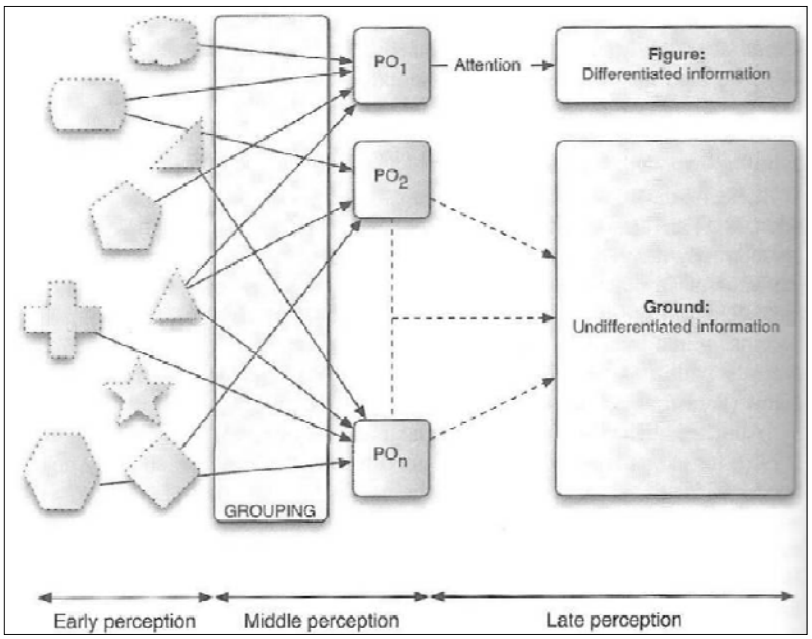
•Identification will be prioritized over memory et al.

Pichora-Fuller, 2003

SNHL = ? ?

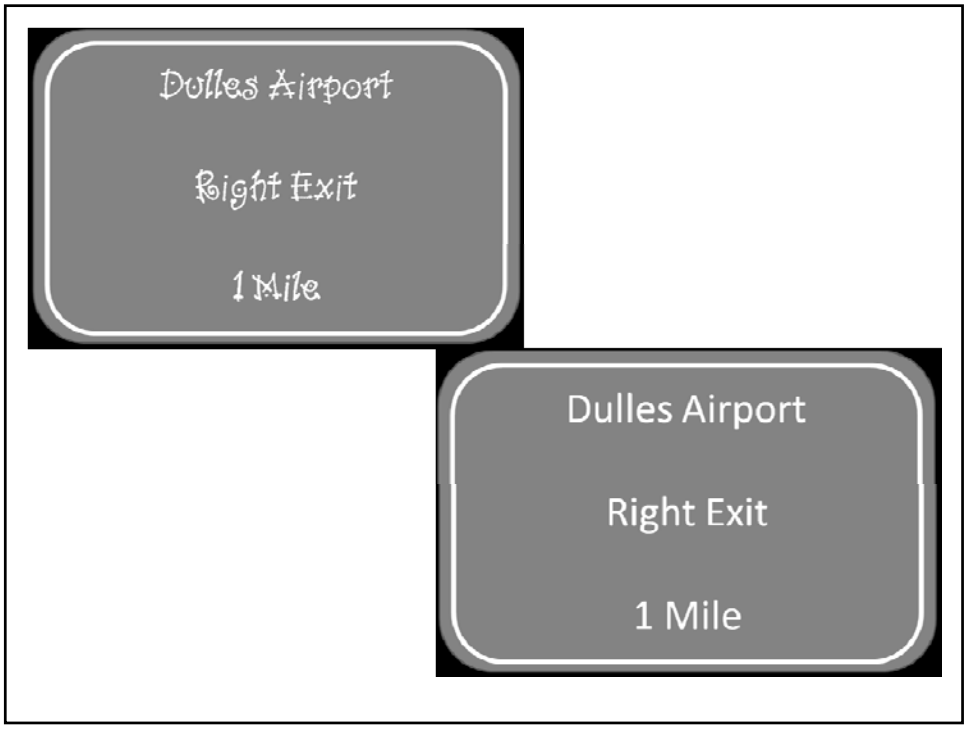
SNHL = ?

Loss of the Ability to Organize Sound



Kubovy & Van Valkenburg, 2001

What does the brain like?


Dulles Airport
Right Exit
1 Mile
Dulles Airport
Right Exit
1 Mile


FHWA Series fonts - Wikipedia, the free encyclopedia - Windows Internet Explorer
Article
Discussion
Read
Edit
View history
Search
FHWA Series fonts
From Wikipedia, the free encyclopedia
The FHWA Series fonts (often informally referred to as Highway Gothic or the copyrighted typeface Interstate) are a set of sans-serif typefaces developed by the United States Federal Highway Administration and used for road signage in the U.S., Canada, Mexico, Australia, Spain, The Netherlands, Brazil and New Zealand. The fonts were created to maximize legibility at a distance and at high speed. Versions known as Highway Gothic or Interstate, which are for sale to the general public, include punctuation marks based on a square shape. However, on signage, the official FHWA Series punctuation is based on a circular shape.
The set consists of seven fonts: "A" (the narrowest), "B", "C", "D", "E", "E(M)" (a modified version of "E" with wider strokes), and "F" (the widest). The fonts originally included only uppercase letters, with the exception of "E(M)", which was used on large expressway and freeway guide signs.
FHWA Series fonts
Highway Gothic
Category
Sans-serif
Designer(s)
Ted Forbes
Foundry
N/A
The Quick Brown Fox Jumps Over The Lazy Dog.
Sample
History
[edit]
The typefaces are officially defined by the FHWA's Standard Alphabets for Traffic-Control Devices, originally published in 1945 (reprinted 1952). Changes to the specifications were published in 1966, 1977, and 2000. The 2000 specifications differ from earlier versions in the shapes of a few letters and in the inclusion of lowercase letters for all alphabet series.
FHWA Series A, B, C, D, E, and F were developed by the Public Roads Administration (which later became FHWA) during World War
Draft versions of these typefaces were used in 1942 for signs on the Pentagon road network.[1] In 1949–50, as part of a research progra
into freeway signing carried out by the California Department of Transportation, Series E Modified was developed from Series E by

The Nature of Competition

What is noise?

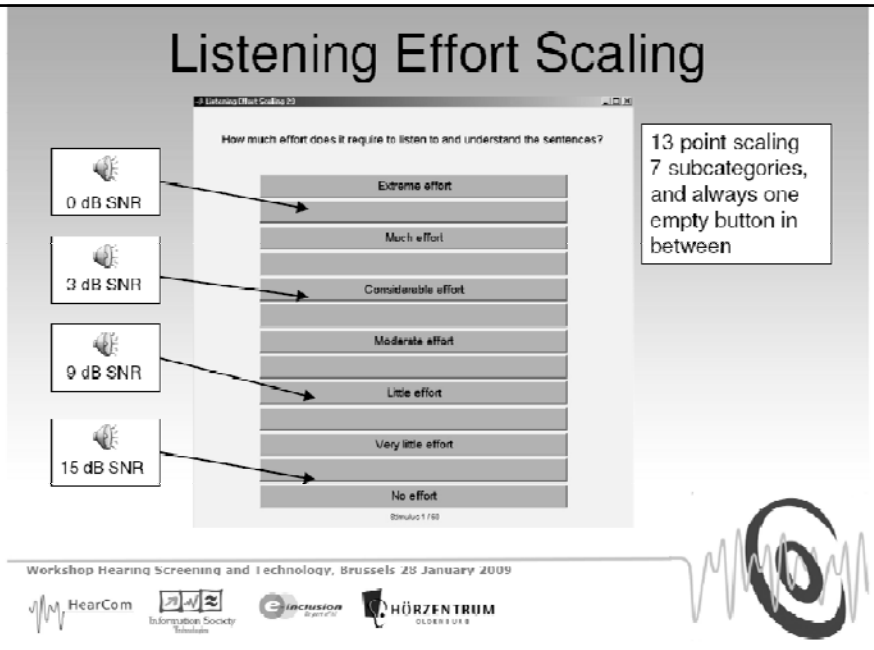
Ignoring takes effort

Measuring Cognitive Effort

Immediate versus Long-term Measures

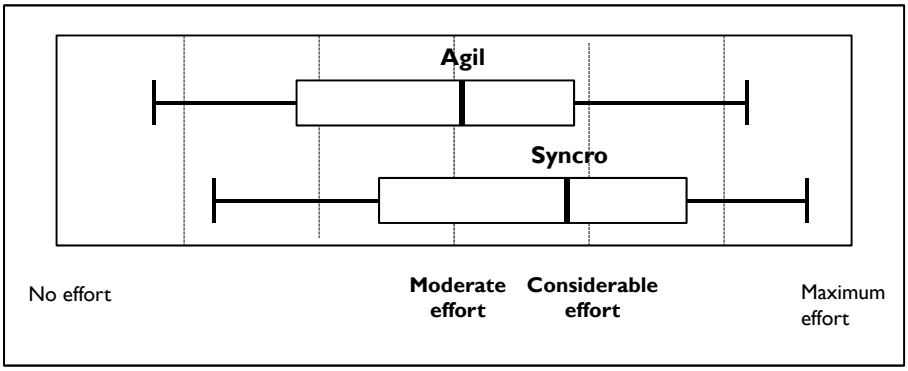
Measuring Listening Effort

- Ratings



34

- International 2-sites study



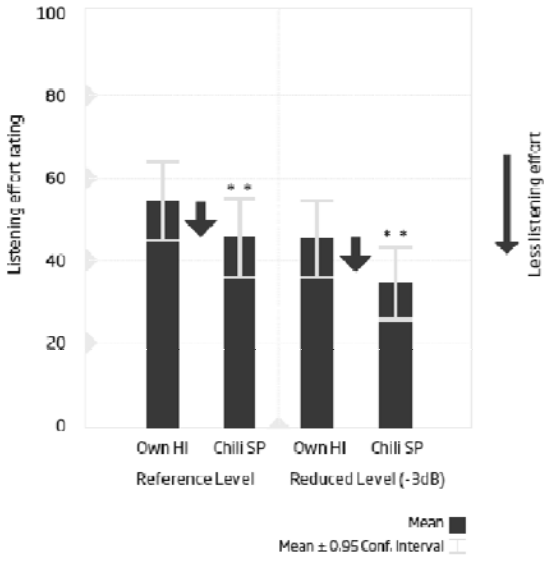
Median
25%-75%
5%-95%

Significantly Less Listening Effort with Agil**

Oticon | Chili

Figure 4

Listening Effort



oticon PEOPLE FIRST

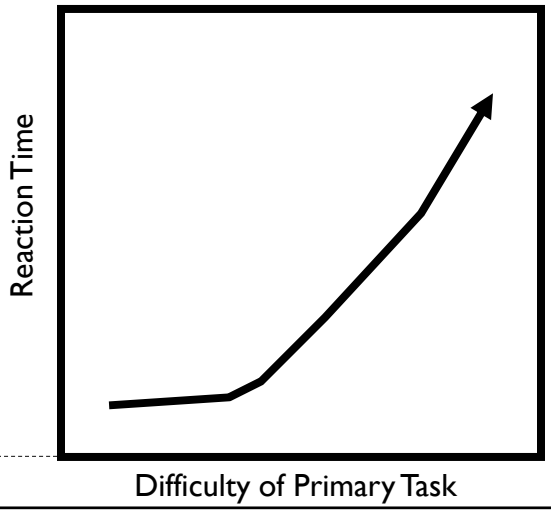
Measuring Listening Effort

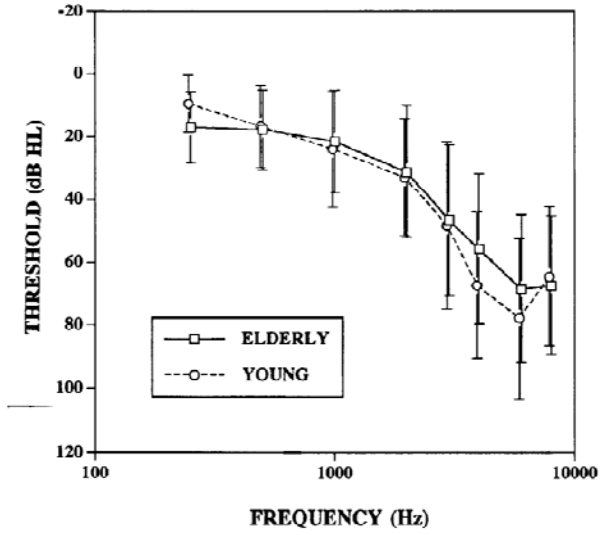
- Ratings
- Dual Task

Two-channel Monitoring
(Schum, 1994)

Primary Task:
"John was talking about the *growl*"

Secondary Task:
Acknowledge screen color change





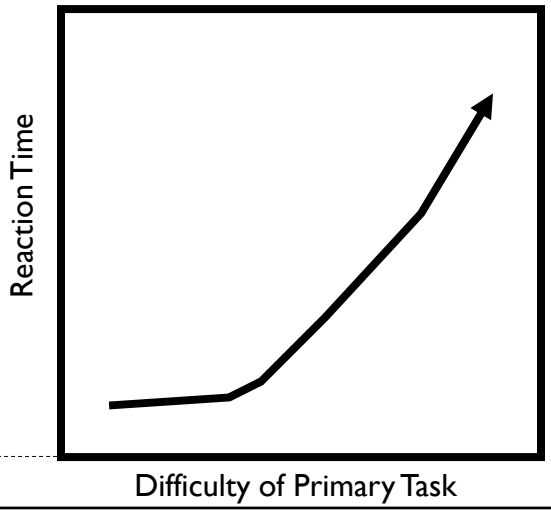
Schum, 1994

Schum, 1994

SPIN Quartets
(Schum, 1994)

Primary Task:
"The watchdog gave a warning *growl*"

Secondary Task:
Remember the last word of the past four sentences



Measuring Listening Effort

- Ratings
- Dual Task
- Physiological

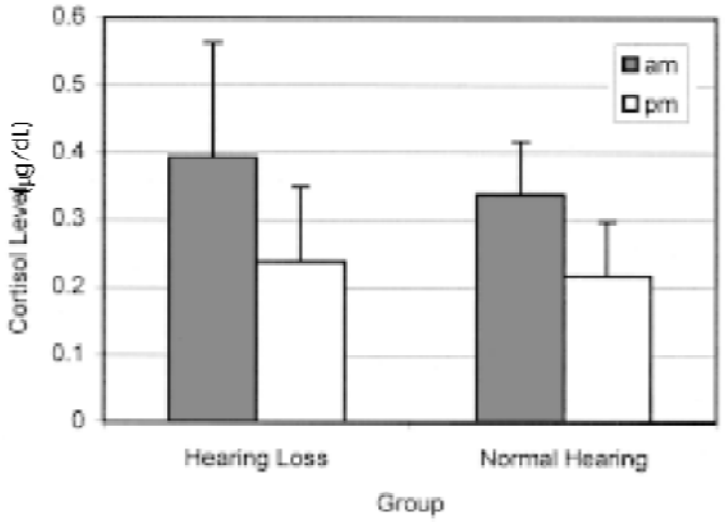
Cognitive Load During Speech Perception in Noise: The Influence of Age, Hearing Loss, and Cognition on the Pupil Response

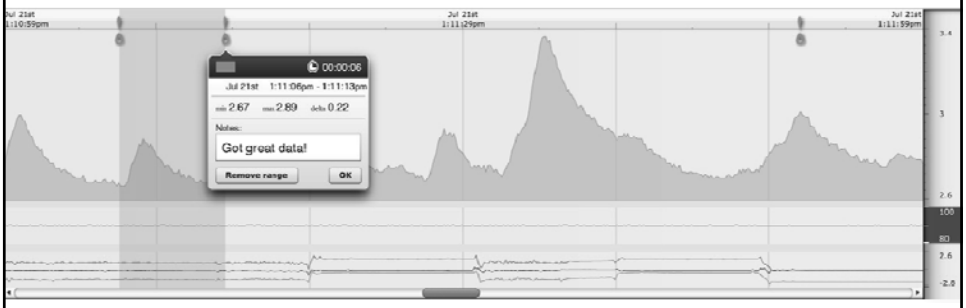
Adriana A. Zekveld, Sophia E. Kramer, and Joost M. Festen

Listening Effort and Fatigue in School-Age Children With and Without Hearing Loss

Candace Bourland Hicks*
Anne Marie Tharpe
Vanderbilt Bill Wilkerson Center for Otolaryngology and Communication Sciences
Nashville, TN

Parents, audiologists, and educators have long speculated that children with hearing loss must expend more effort and, therefore, fatigue more easily than their peers with normal hearing when listening in adverse acoustic conditions. Until now, however, very few studies have been conducted to substantiate these speculations. Two experiments were conducted with school-age children with


0.6
0.5
0.4
0.3
0.2
0.1
0
am
pm
Hearing Loss
Normal Hearing
Group



Examples of Cognitive Effort Research

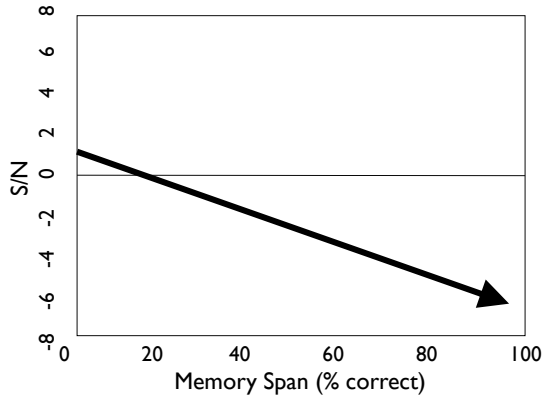
International Journal of Audiology 2003; 42:S49–S58

Thomas Lunner

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

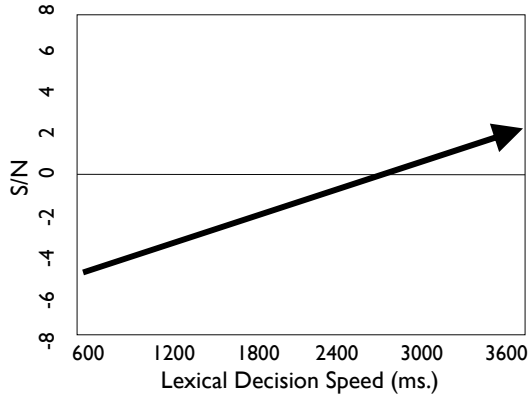
Cognitive function in relation to hearing aid use

Relationship between cognitive abilities and speech understanding in noise



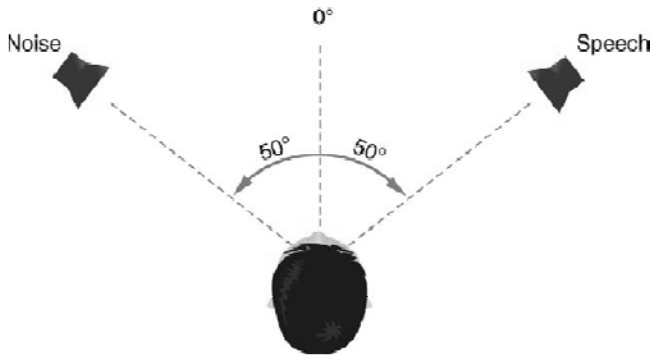
Lunner, 2003

Relationship between cognitive abilities and speech understanding in noise



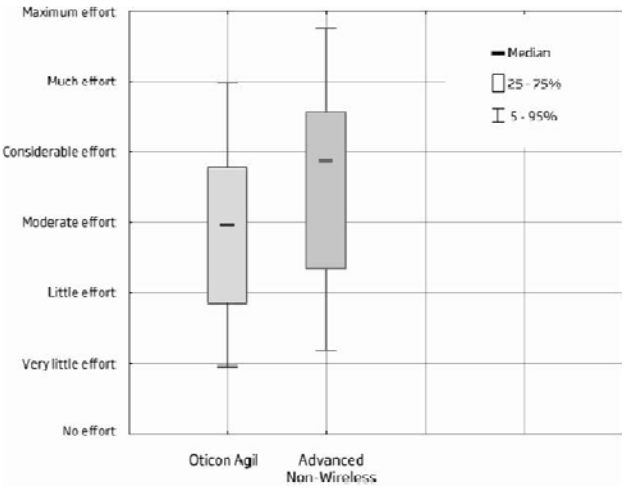
Lunner, 2003

Asymmetric set-up



White Noise, 65 dB SPL

- International 2-site study



- Less* effort required

Relevance in Pediatrics

Ready for Prime Time?

Compensation Strategies

Sender Medium Receiver

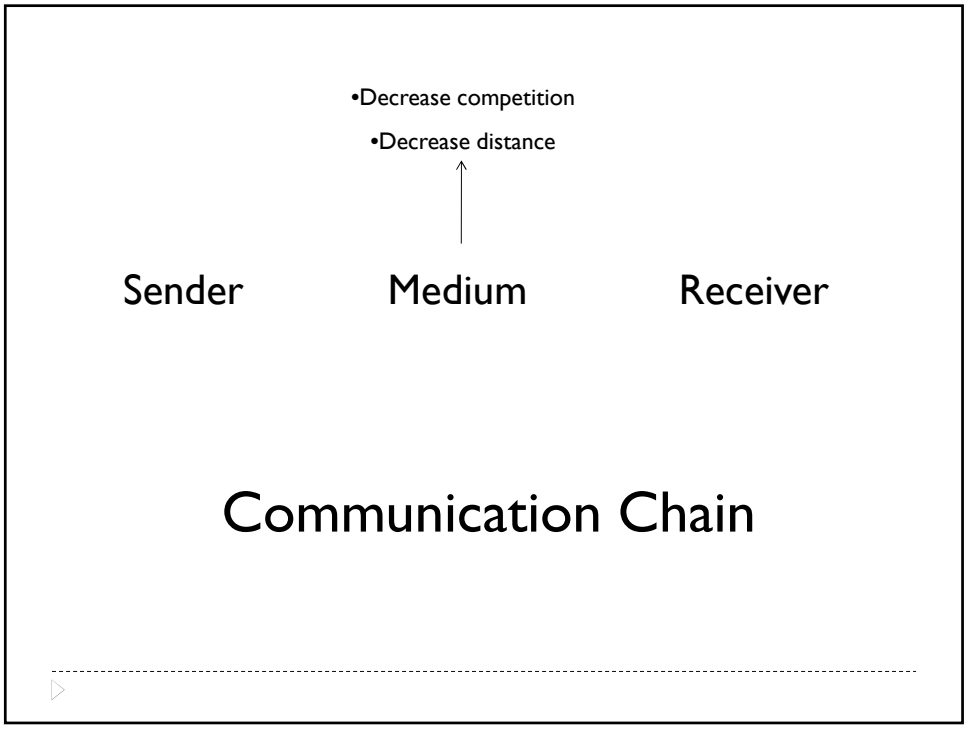
Communication Chain

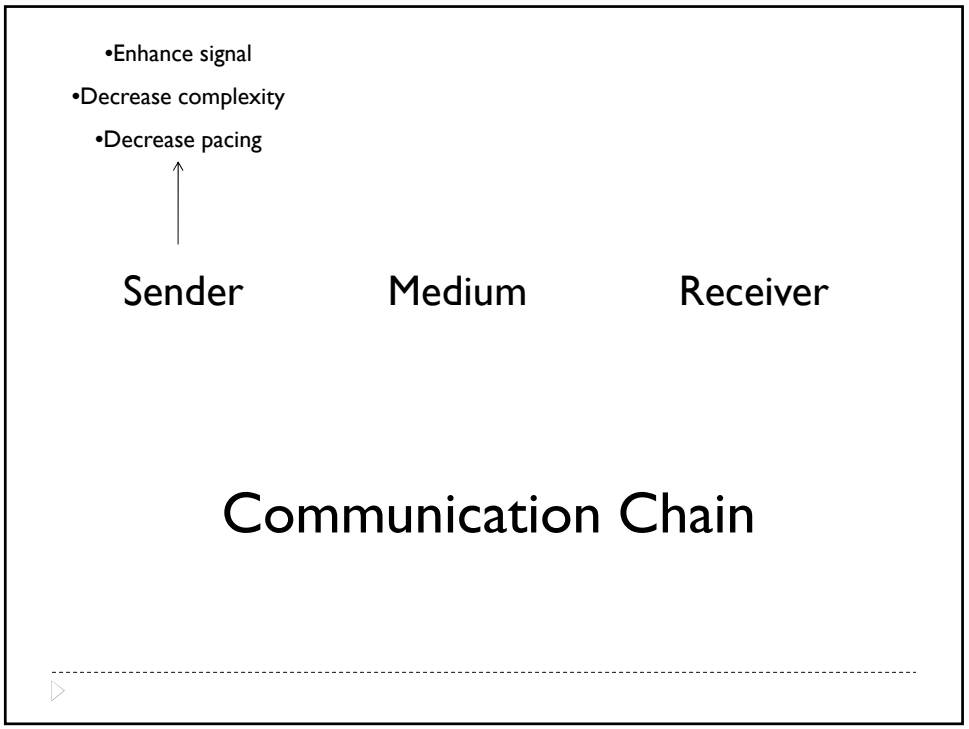
Sender Medium Receiver

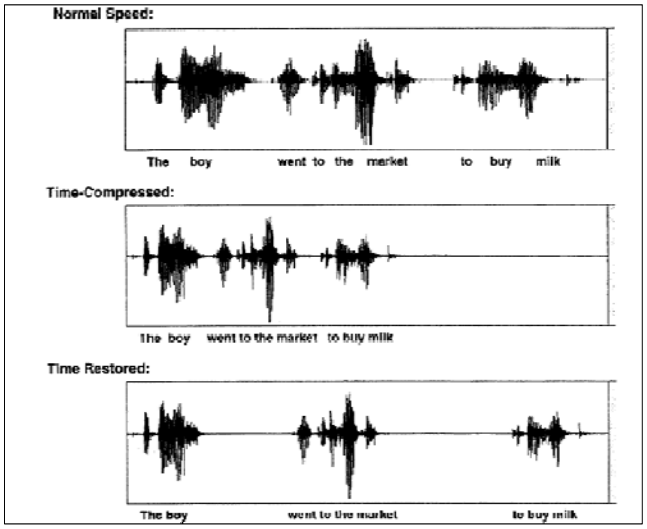
•Improve audibility

•Improve S/N

Communication Chain


•Decrease competition
•Decrease distance
Sender
Medium
Receiver
Communication Chain

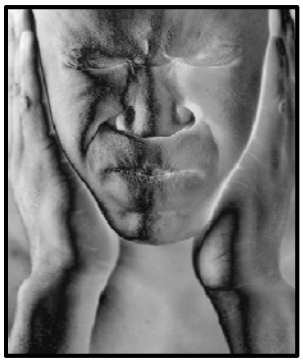

•Enhance signal
•Decrease complexity
•Decrease pacing
Sender
Medium
Receiver
Communication Chain



Wingfield & Tun, 2001

Sender Medium Receiver

Communication Chain



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