Measuring the Effect of a Hearing Aid

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VP, Audiology

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Why?

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Learning Objectives:

- … develop a patient-oriented mindset when assessing the effect of a new fitting
- … identify situations in which benefit may not be reflected in speech-in-noise measures
- … recognize how more complex testing paradigms can reveal the cognitive effects of fittings

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Initial Observations

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Clinical versus Experimental

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Big Question:

Why are you assessing the impact of the hearing aids?

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Big Question:
Why are you assessing the impact of the hearing aids?

- Institutional/payor compliance
- Standardization/consistency of database
- Tracking over time
- Comparison of Options
- Go/No-Go decision
- Documentation of benefit (?)
  - HCP reassurance
  - Patient/family reassurance
  - Counseling input

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One Patient at a Time

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Patient-centered Care

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Patient-centered Care:

What does it take to ensure daily usage of devices?

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What does it take to ensure daily usage of devices?

- Perceived Need
- Motivation & Confidence
- Functional
- Ease of Use
- Perceived Benefit/Value*

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An observation about baby boomers:

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Technical versus Behavioral Performance

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What does real-ear tell you?

What does it miss?

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Traditional Speech-in-Noise Measures

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Speech-in-noise testing - Positives

- Reliable & standardized
- Readily available
- Relatively time efficient
- Matches typical equipment set-up
- Reasonably simple to perform for both HCP & patient
- Useful spread in the results – it tells you something

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Speech-in-noise testing - Observations

- Primarily testing peripheral integrity
  - Speech Recognition versus Spoken Language Understanding
  - Simple task
  - Simple constructions
  - No time demands
- Artificial sound environments
  - Location of sound sources
  - Predictability / stability of competition
  - Type of competition
  - Low reverberation
  - Style of the talker / single talker

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Is it truly patient-centered?

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Subjective Approaches

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"How do they sound?"

"How are things going for you?"

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Time course of useful feedback (FTUs):

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Time course of useful feedback (FTUs):

- Loudness / discomfort
- Sound quality
- Performance
  - in Quiet
  - in Noise

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Questionnaires

- Alphabet soup

HAPI / HANA

SADL

HHIE

APHAB

HAPQ

CPHI

CPHI

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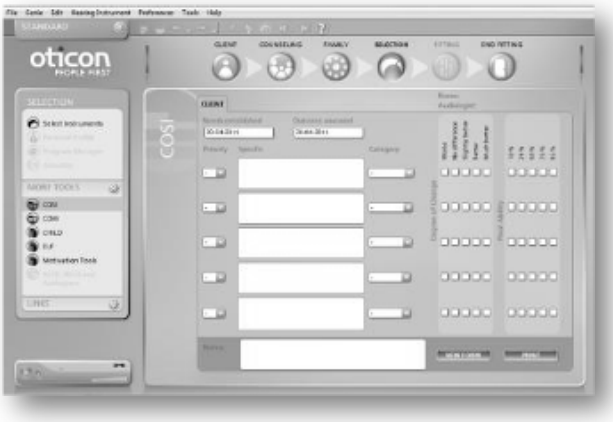
Questionnaires

- Alphabet soup
- COSI



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Deeper Level Assessment

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What does the brain do well?

- Recognizes voices
- Streams (tracks) voices over time
- Predicts & fills in
- Shifts focus

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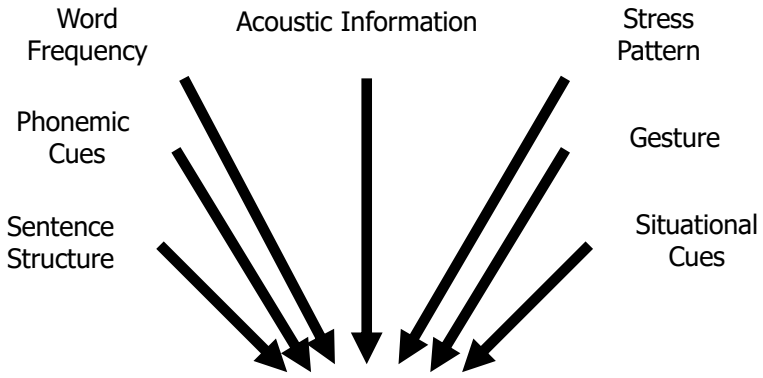
Multiple Sources of Information



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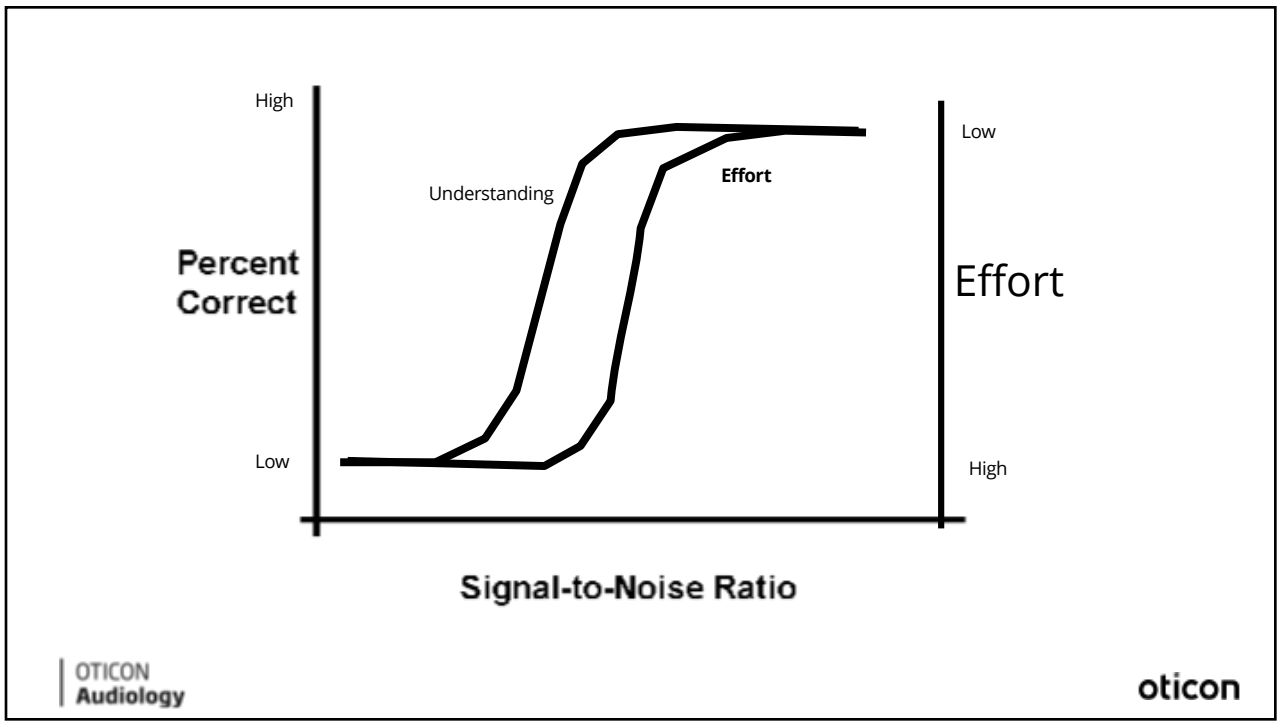
High
Low
Understanding
Effort
Percent Correct
Low
High
Effort
Signal-to-Noise Ratio
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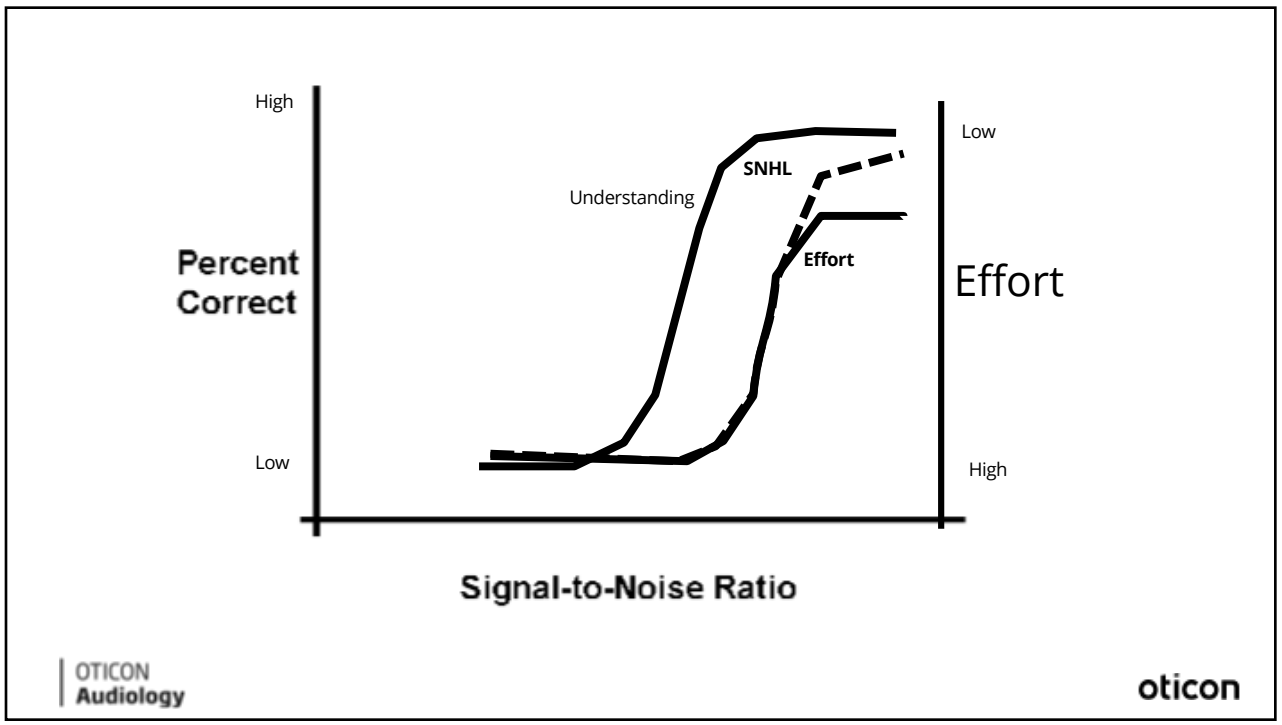
High
Low
SNHL
Understanding
Effort
Percent Correct
Low
High
Effort
Signal-to-Noise Ratio
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Finite Cognitive Resources

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What gets sacrificed?

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Measuring Cognitive Effort (processing demands)

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Two Considerations:

1: Immediate versus long-term measures

2: Effort is under the control of the listener

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Measuring Processing Demands

- Ratings
- Physiological
- Reaction Time
- Dual Task
  - Immediate (resource allocation)
  - Recall (depth of processing)

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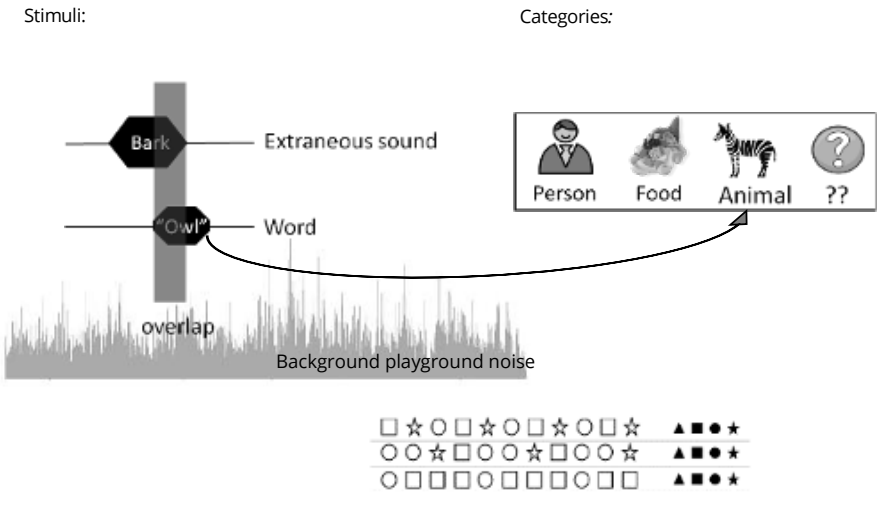
Andrea Pittman et al. 2014 (JAAA): Fast, slow and Adaptive Amplitude Compression



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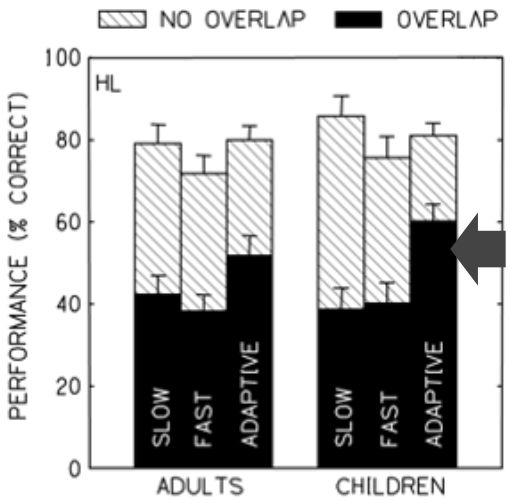
Andrea Pittman et al. 2014 (JAAA): Fast, slow and Adaptive Amplitude Compression 43

Word categorization performance



Strong statistical difference

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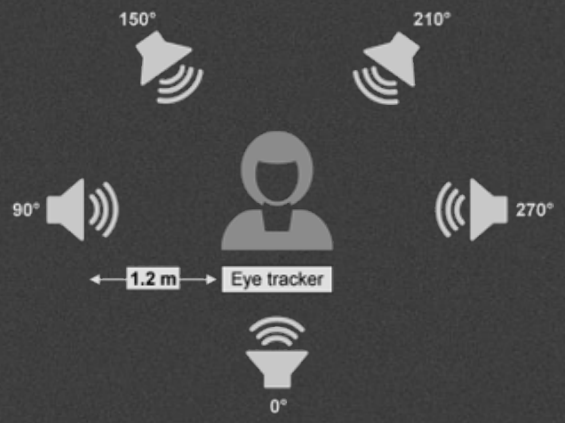
Pupilometry as a measure of effort

Method:

- 24 participants
- 4-talker babble speech masker
- OSN On/Off



Ohlenforst, et al., 2017

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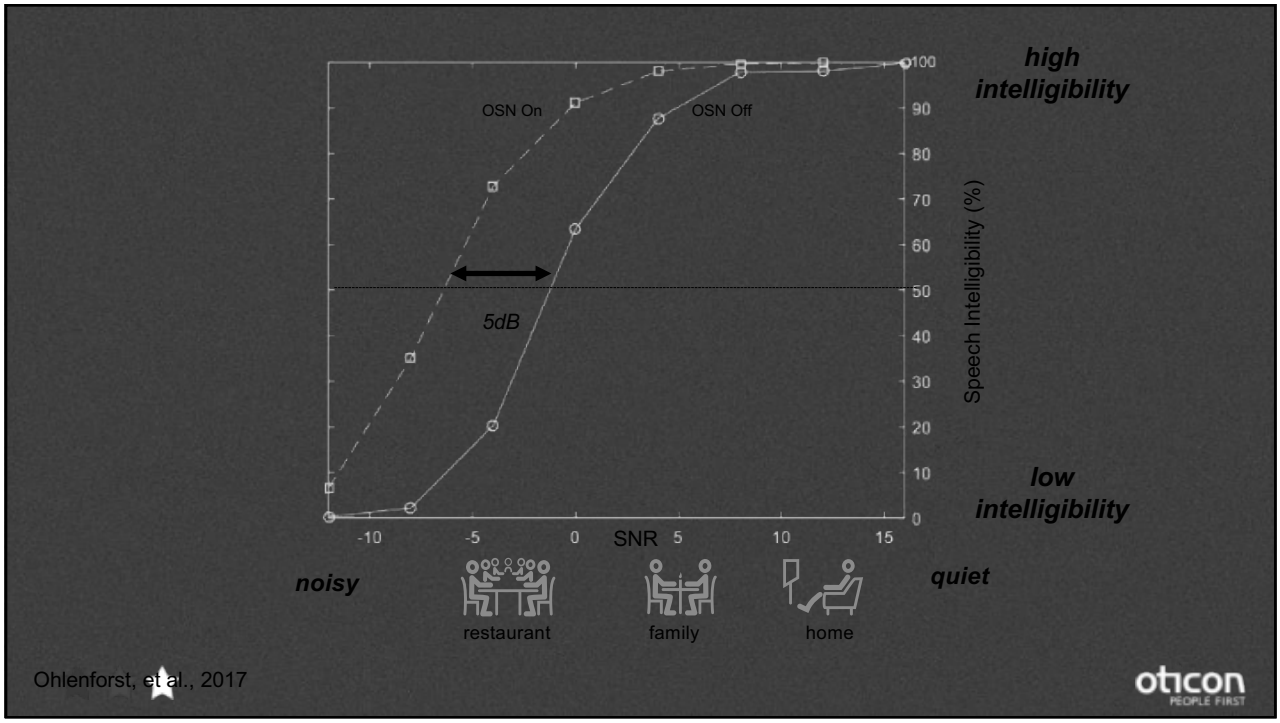
high intelligibility
OSN On
OSN Off
5dB
Speech Intelligibility (%)
low intelligibility
SNR
noisy
quiet
restaurant
family
home
Ohlenforst, et al., 2017
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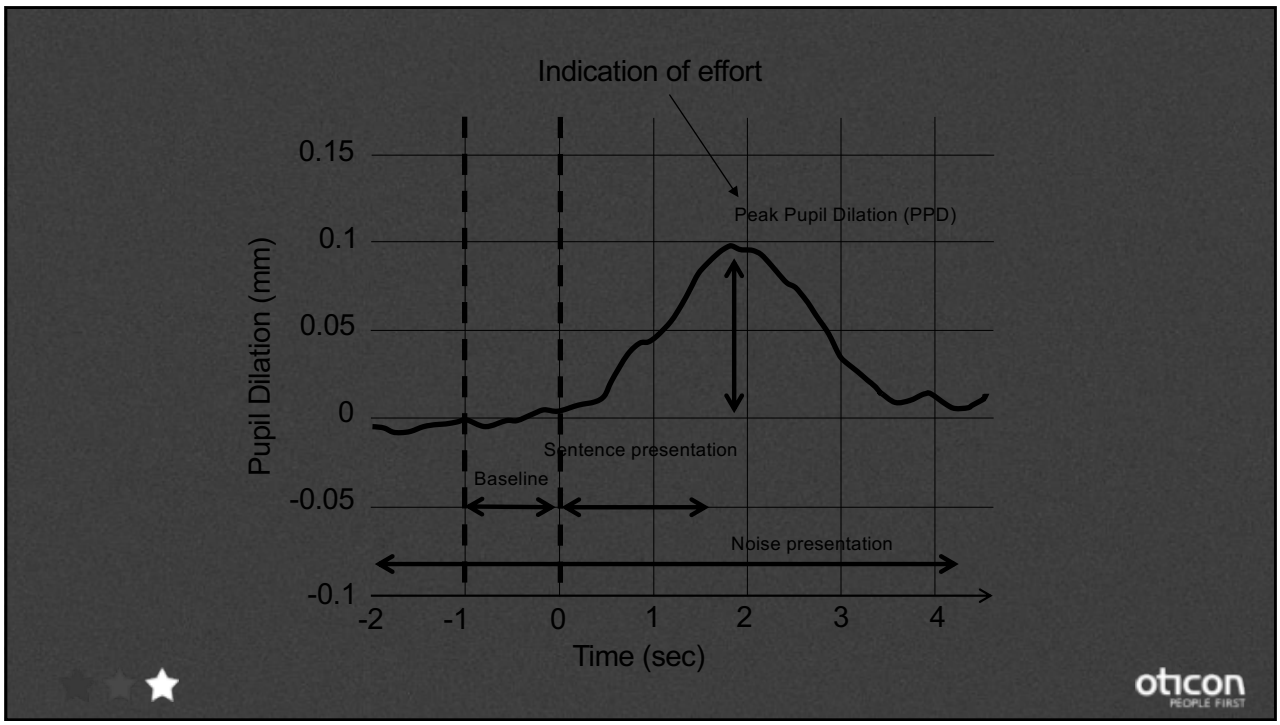
Indication of effort
Peak Pupil Dilation (PPD)
Pupil Dilation (mm)
Sentence presentation
Baseline
Noise presentation
Time (sec)
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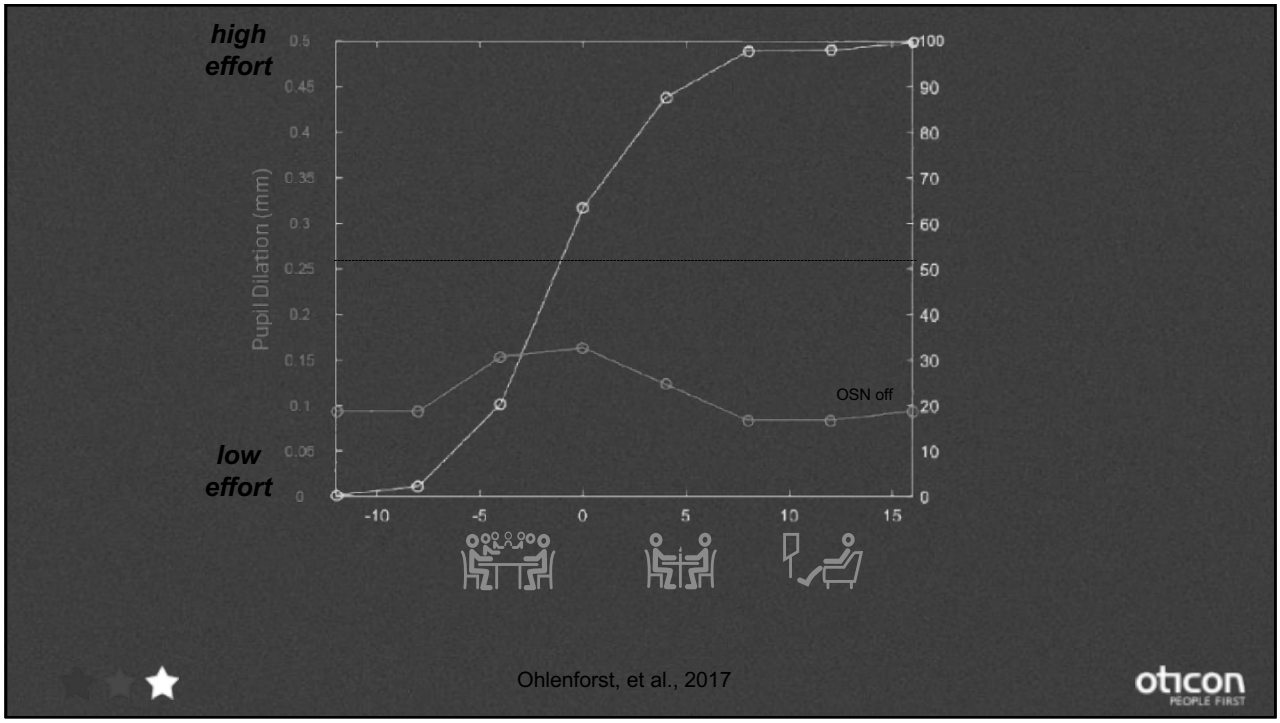
high effort
low effort
Pupil Dilation (mm)
OSN off
Ohlenforst, et al., 2017
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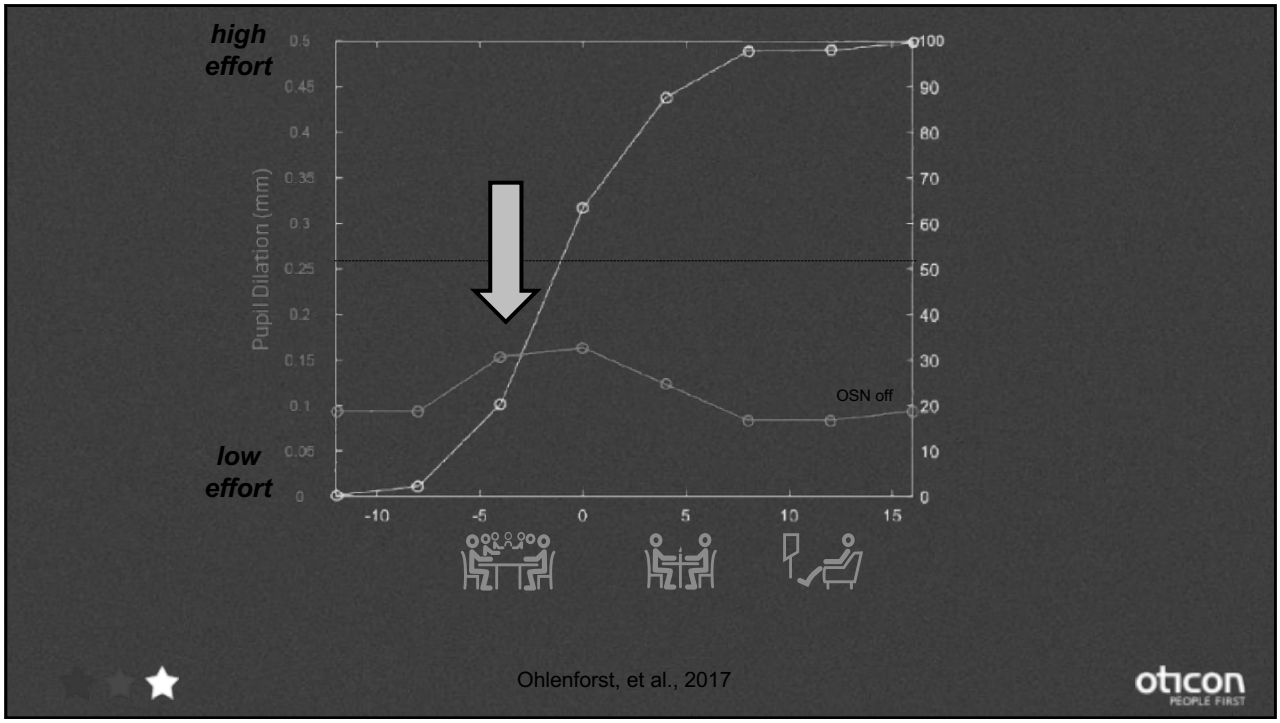
high effort
low effort
Pupil Dilation (mm)
OSN off
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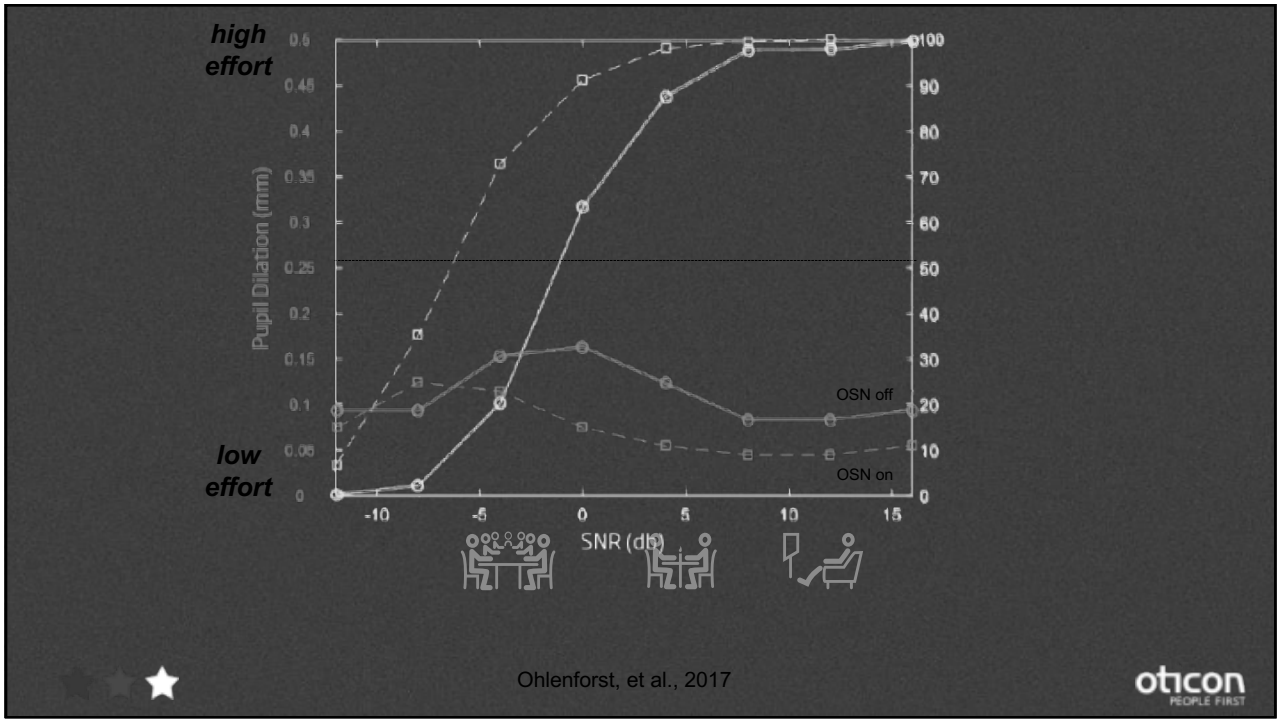
high effort
low effort
Pupil Dilation (mm)
SNR (dB)
OSN off
OSN on
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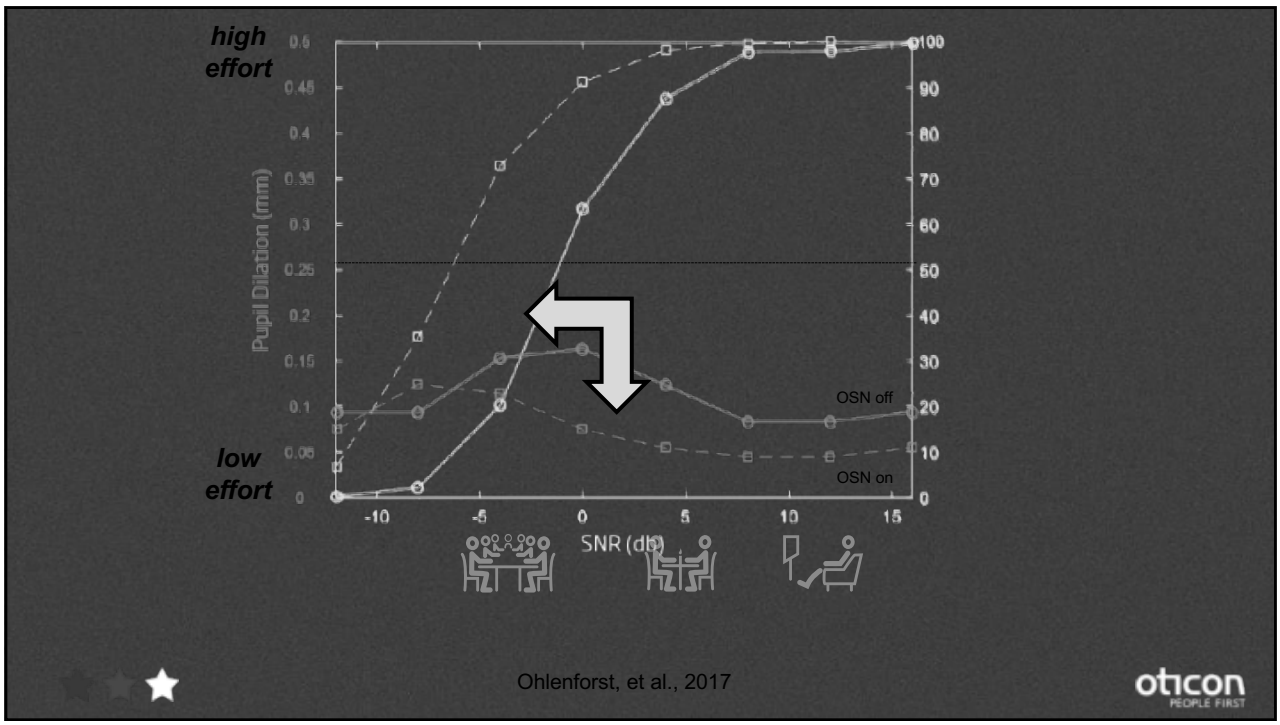
high effort
low effort
Pupil Dilation (mm)
SNR (dB)
OSN off
OSN on
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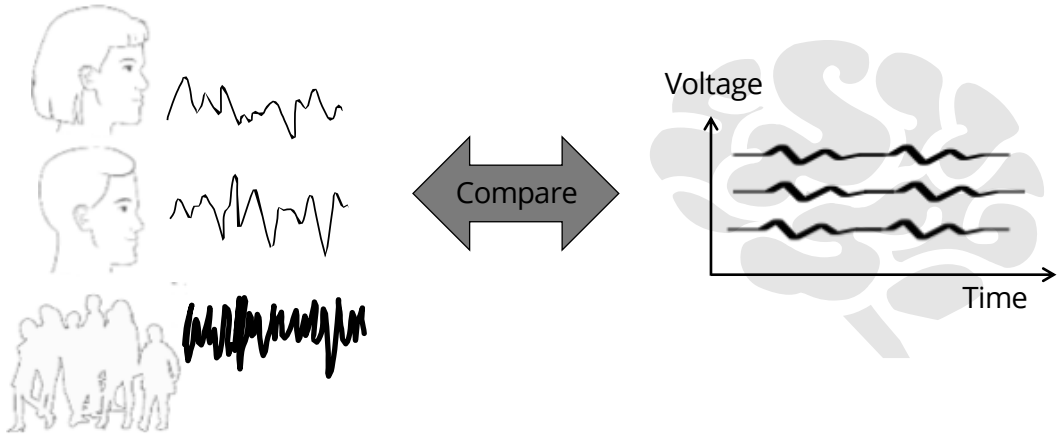
Stimulus reconstruction

Comparing the acoustical signal to the voltage recording in the brain



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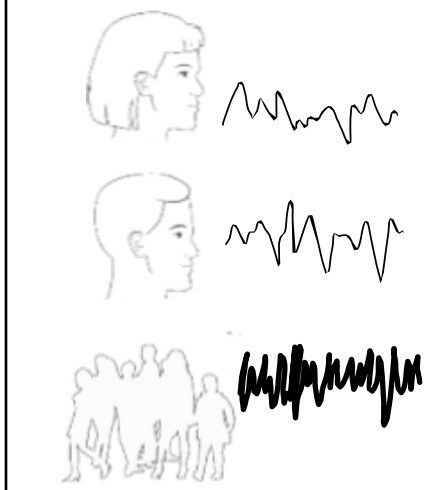

What is normal conversation like?

What is the natural behavior of the cognitive system?

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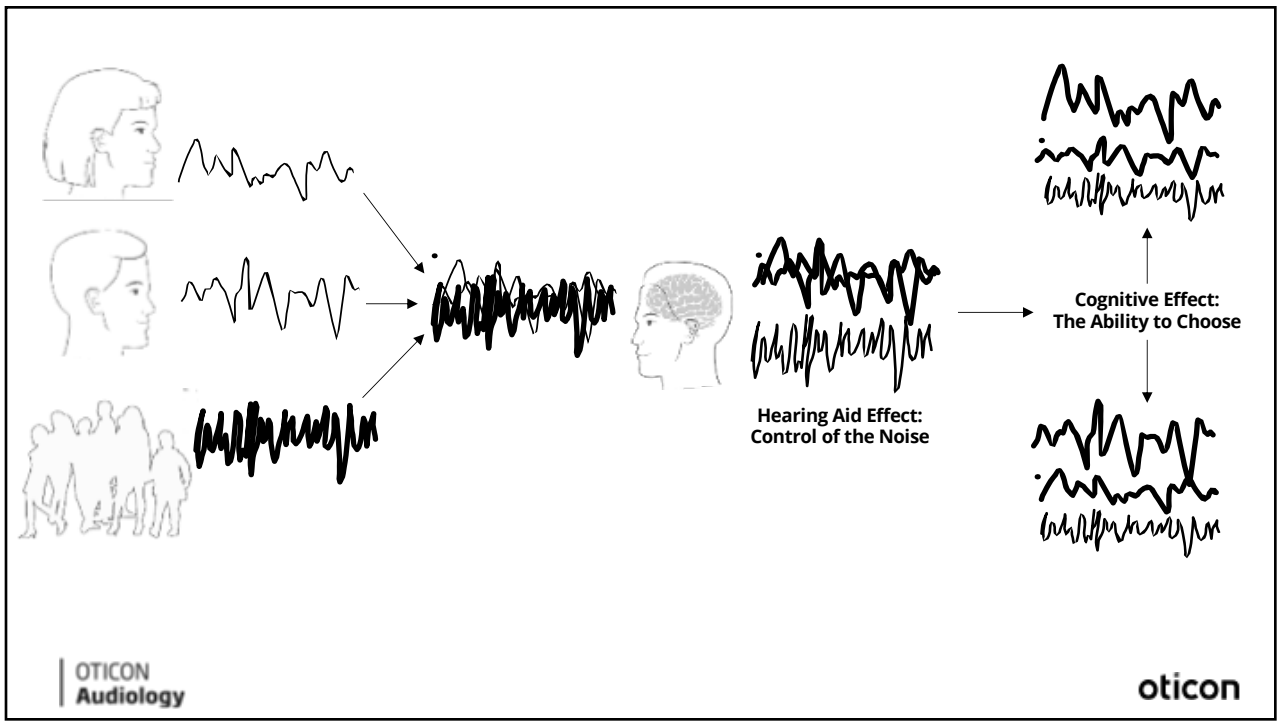

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Procedural Issues

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Procedural Issues:

- Know your device
- Automatic or fixed?
- Speaker position in relation to you question
- Activation levels

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Final Thoughts

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