6 April 2018

Closing a gap to normal hearing

Evidence

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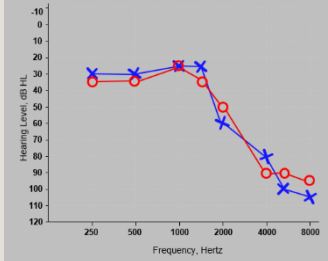
Why is high quality amplification important?

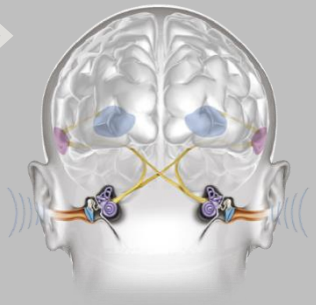
Consequences of an untreated hearing loss*

Hearing loss is more than an audibility problem

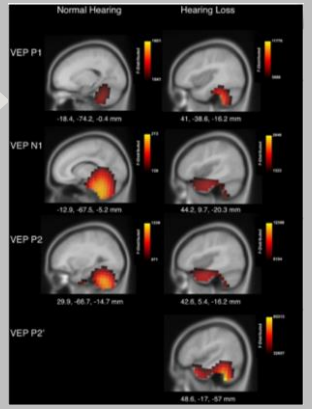
Hearing loss



Signals to the brain have lower quality



The brain will reconstruct and compensate



Campbell & Sharma, 2014

Fatigue and social withdrawal

Acceleration of health problems (e.g. depression and dementia)

*Research in this area is ongoing

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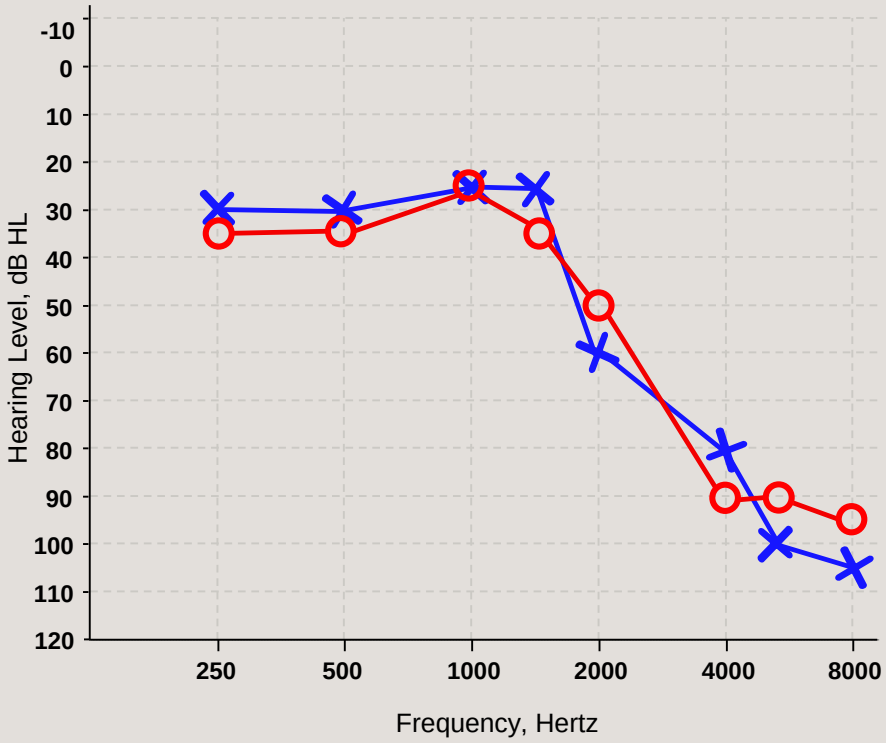
Hearing loss is more than an audiogram

A complex condition associated with changes in the brain



- Auditory nerve synapses changes due to deprivation (Zhuang et al 2017)
- Hidden Hearing Loss - synaptopathy linked to noise exposure (Liberman, 2015)
- Changes to Brain organization (Campbell & Sharma, 2014)
- Changes in Brain Matter (Lin et al., 2014)
- Accelerated cognitive decline (Amieva et al. 2015)

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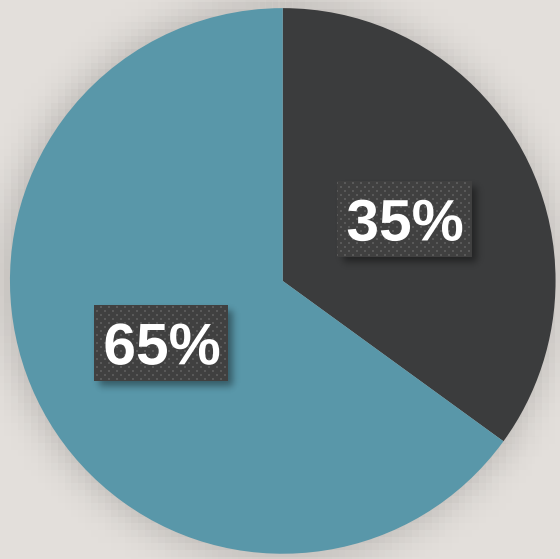
Hearing and health issues

The latest review on Dementia and Causes

Risk factors

- potentially modifiable
- potentially non-modifiable



Livingston et al. 2017

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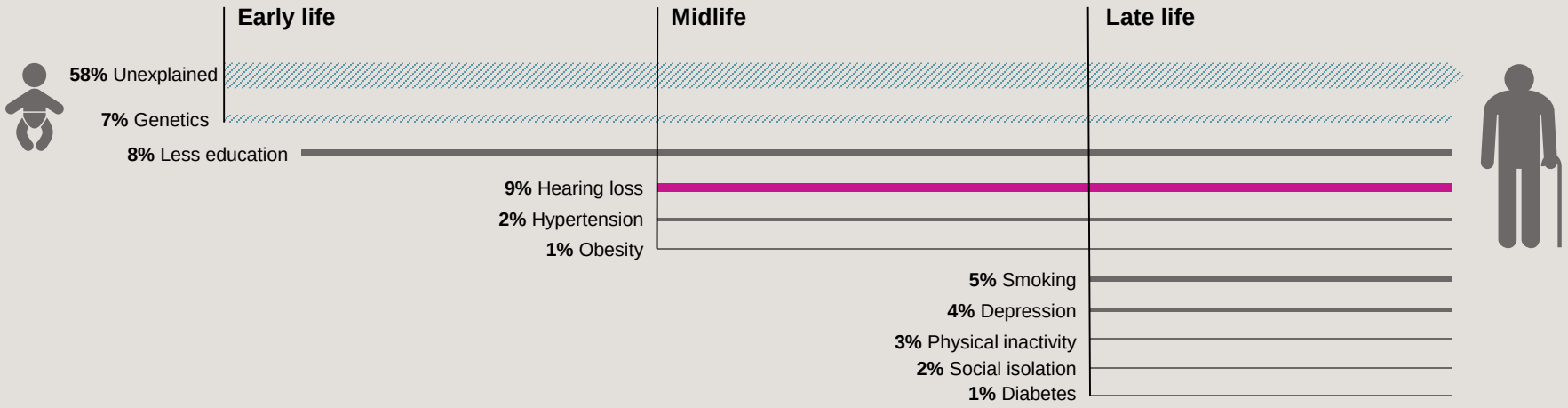
Life-course model of contribution of modifiable risk factors to dementia



Livingston et al. 2017

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So what can we do?

We think brain first

Hearing care is a matter of health

Traditional directionality closes down sounds,

and with them, life

OLD WORLD

NEW WORLD

Directionality as we know it is a thing of the past

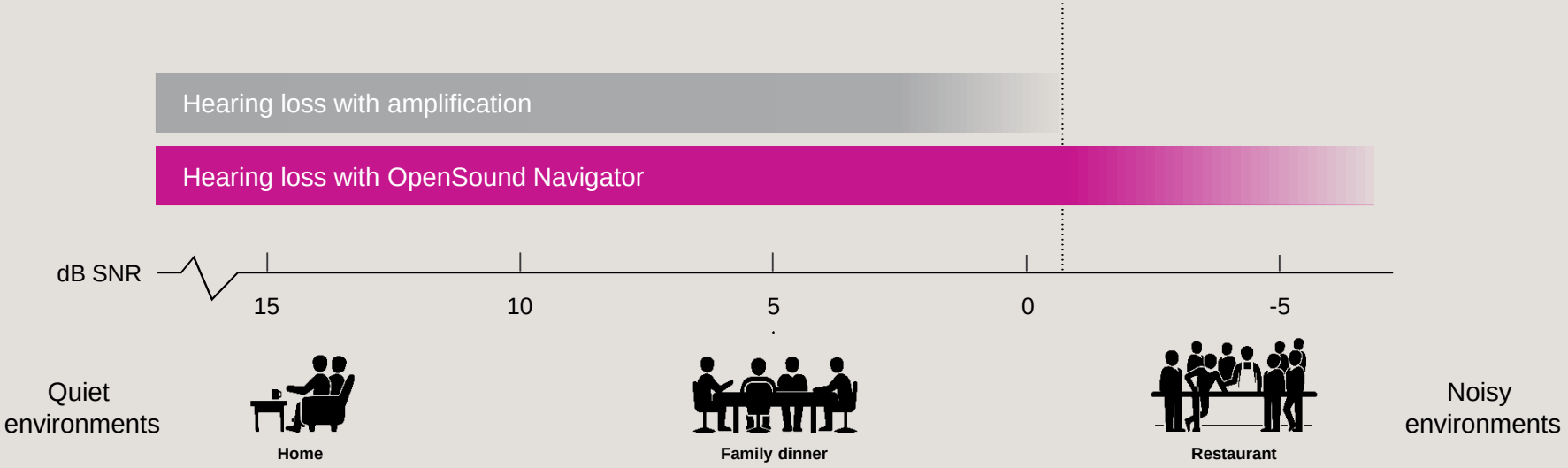
Oticon Opn brings people back into life

OpenSound Navigator™

The most powerful processing technology in Oticon Opn™

Ongoing research documenting BrainHearing benefit

Research from 2017



Le Goff and Beck 2017, Oticon whitepaper

What about normal hearing?

New study: Normal hearing – understanding and effort

Background

Purpose:

Investigate the listening effort and speech understanding in normal hearing listeners

Participants:

- 29 participants with normal hearing
- Mean age of 65.7
- Pure tone average of max. 25 dB HL

Juul Jensen 2018, Oticon whitepaper

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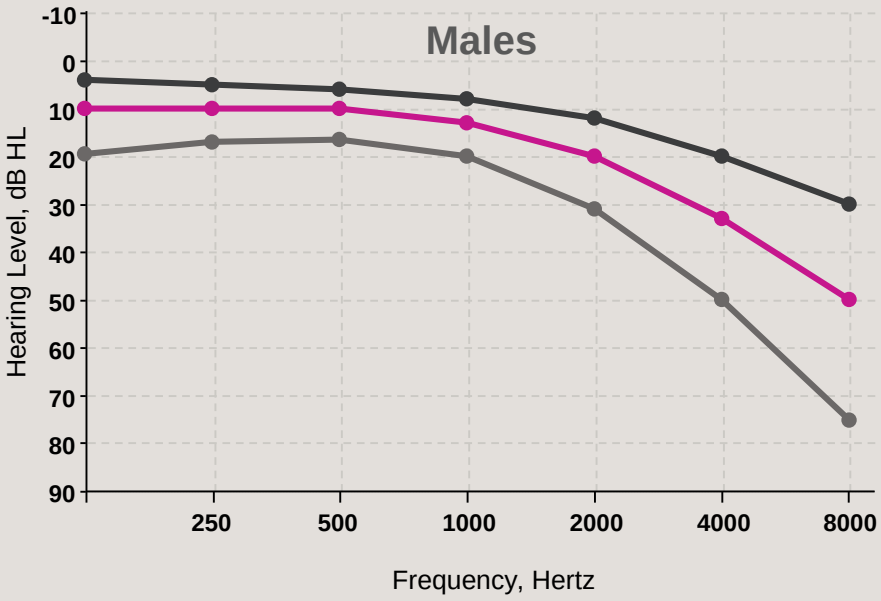
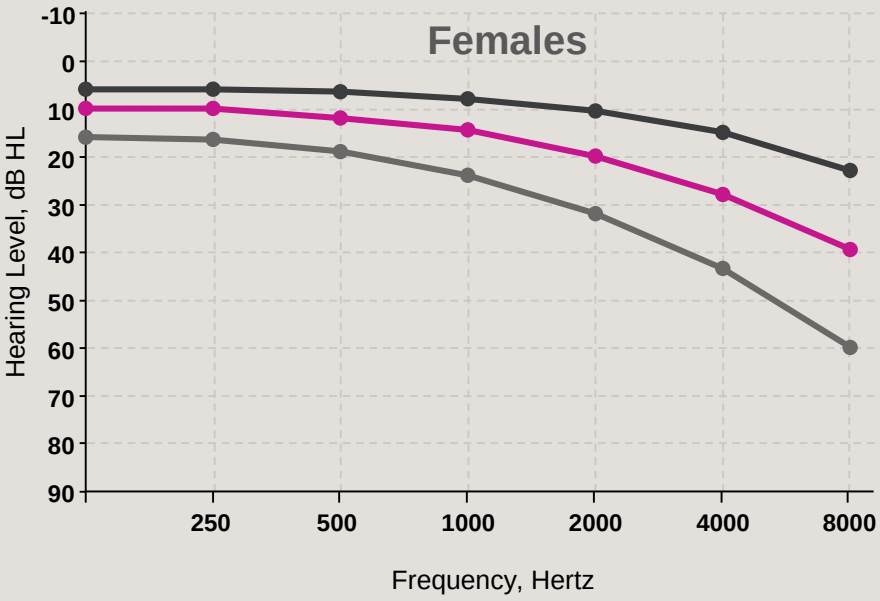
Audiograms

Age-correlated normal hearing





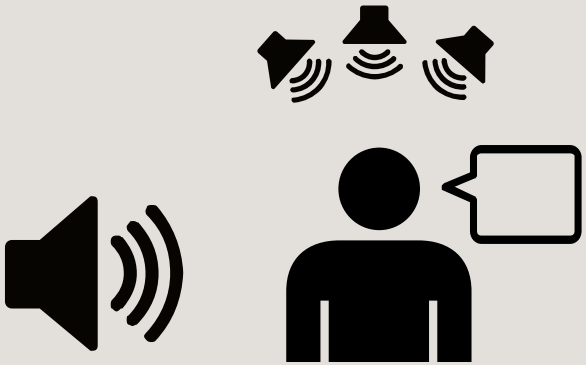
DS/EN ISO 7029:2017

Methods

Looking at the <u>combined</u> effect of two aspects of listening

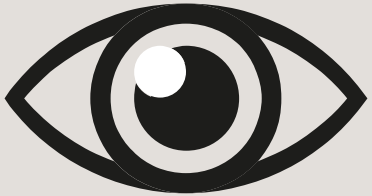
Hearing in noise test (HINT)…

- …to test speech understanding in noise



Pupillometry…

- …to measure of hearing effort
- …to determine when people give up



Pichora-Fuller et al. 2016

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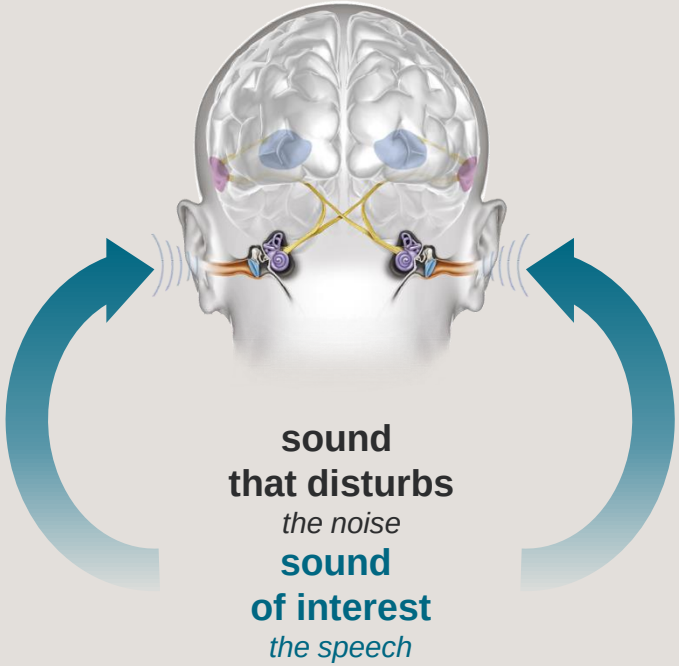
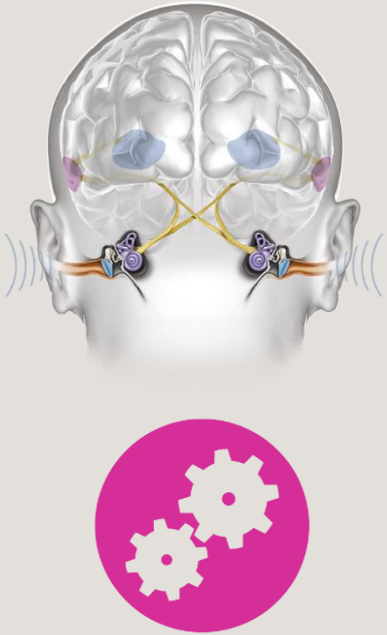
Cognitive effort can be quantified in pupillometry

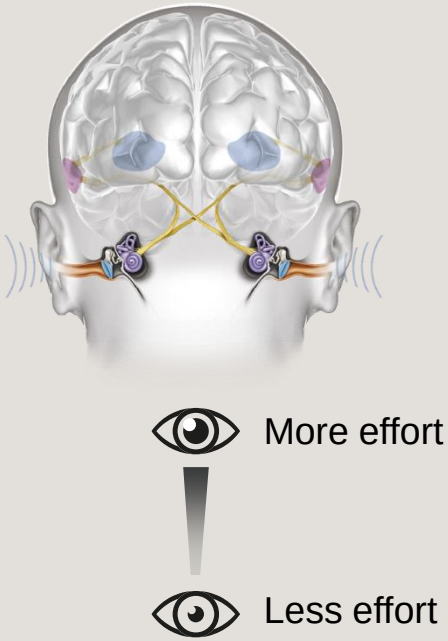
Incoming sound



Understanding



Effort and pupil dilation



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Pupil size can reflect cognitive effort

- Pupil changes are controlled by muscle activity in the iris
- Adaptive response to changes in the environment
- Reflect changes in attention/stress and **effort***

Less effort

More effort

*Kahnemann et al. 1973

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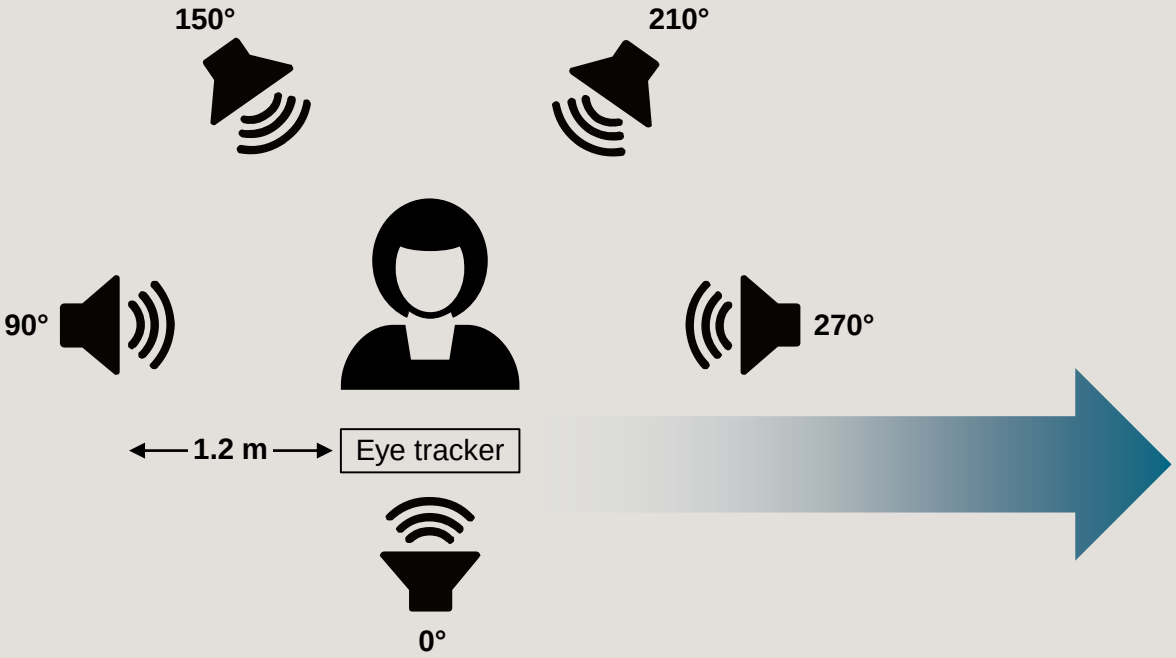
Pupillometry during HINT

A valid and objective measure of listening effort



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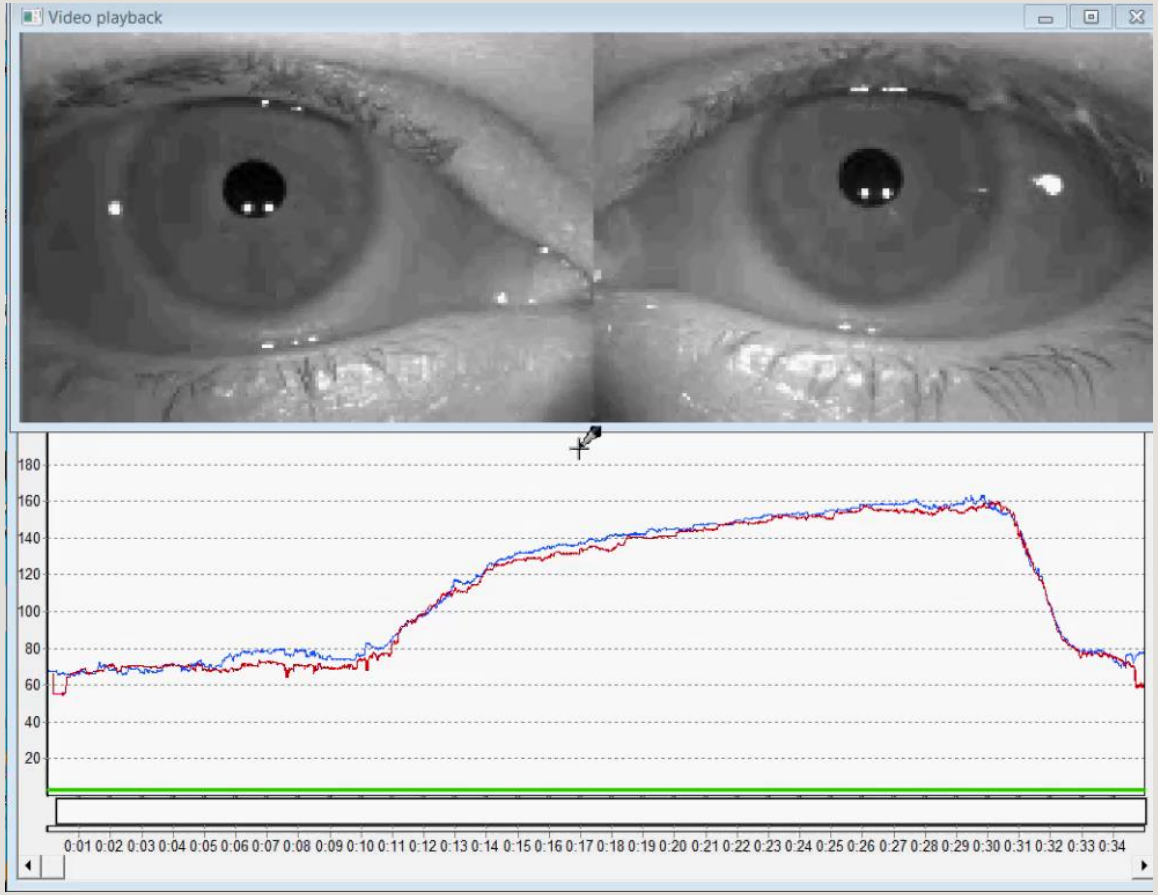
Pupillometry example

A live recording



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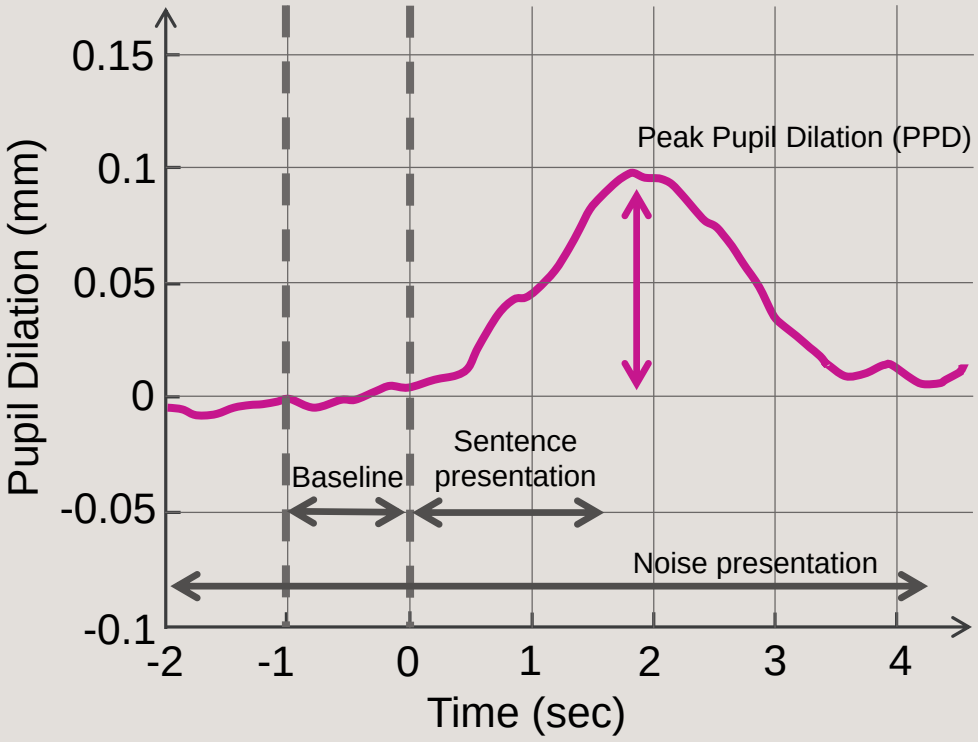
Evidence on pupillometry

Research using pupillometry to measure effort in hearing



- Wendt et al. 2017, *Ear and Hearing*
- Ohlenforst et al. 2017, *Hearing Research*
- McGarrigle et al. 2014, *International journal of audiology*
- Wendt et al. 2016, *Frontier in psychology*
- Zekveld et al. 2010, *Ear and Hearing*
- Kramer et al. 1997, *Audiology*

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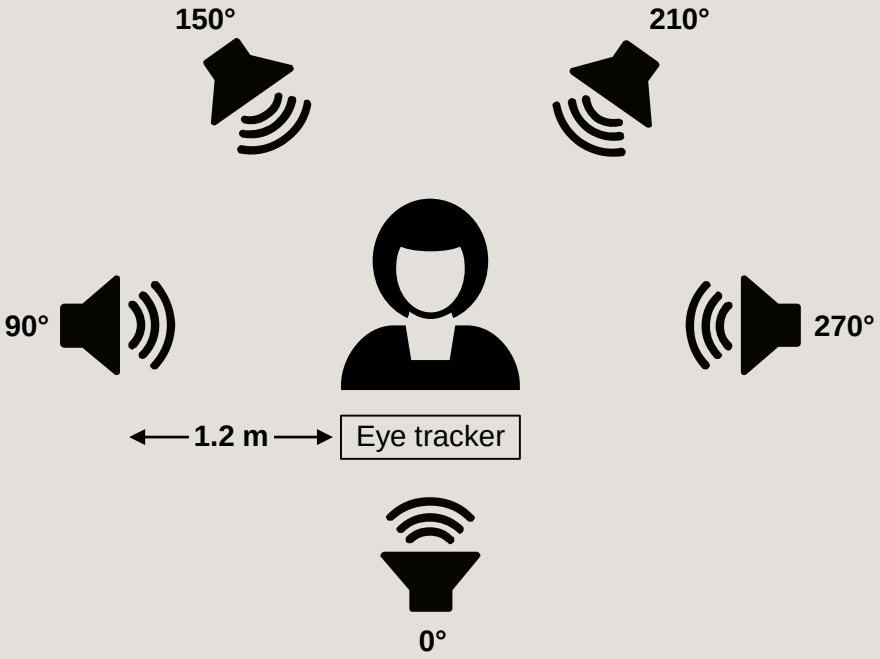
Study: Understanding and effort

Methods

Stimuli in free field:

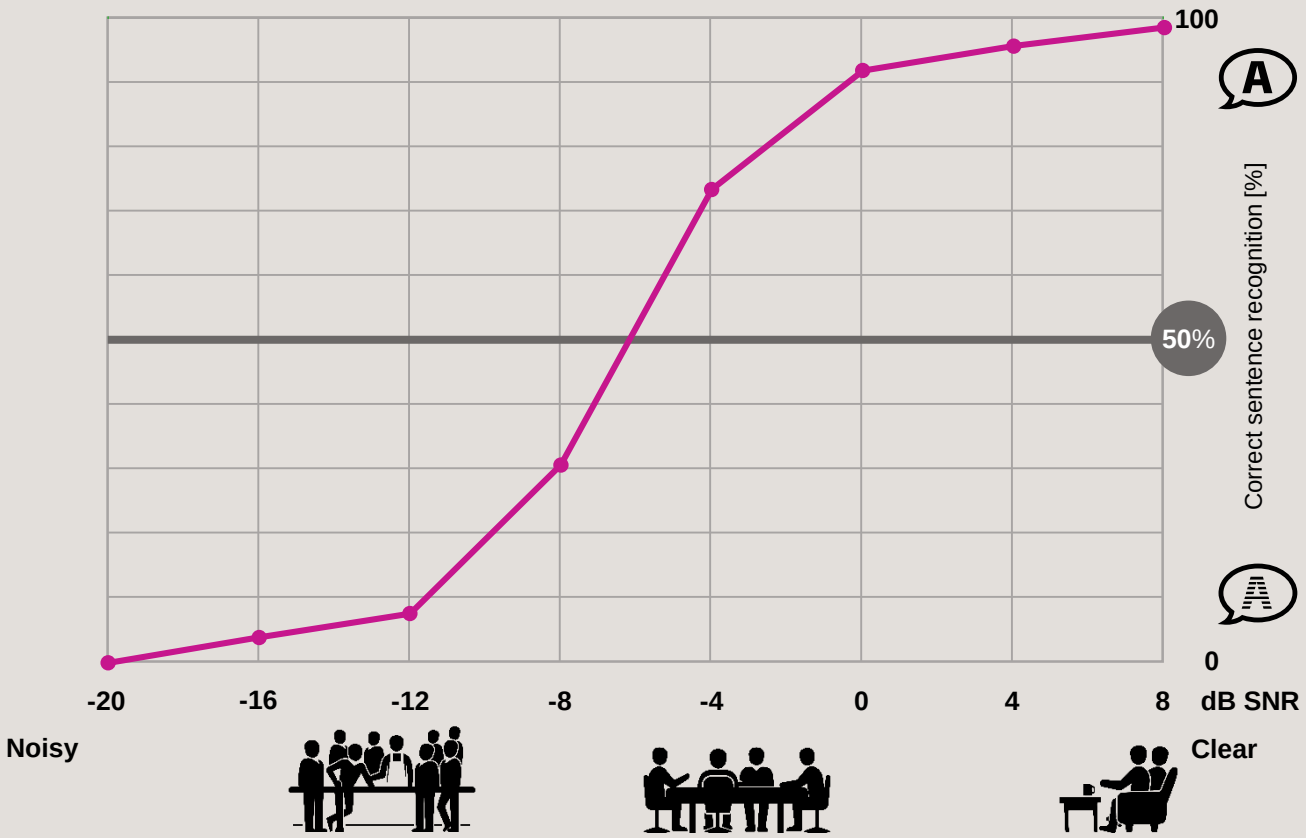
- Danish HINT sentences and pupillometry
- Range of speech understanding from 0% to 100%
- SNR between -20 dB and +8 dB
- Masking noise: 4 talker babble speech and steady-state noise of 70 dB SPL



Results

Speech understanding

Speech recognition for normal hearing listeners



Juul Jensen 2018,
Oticon whitepaper

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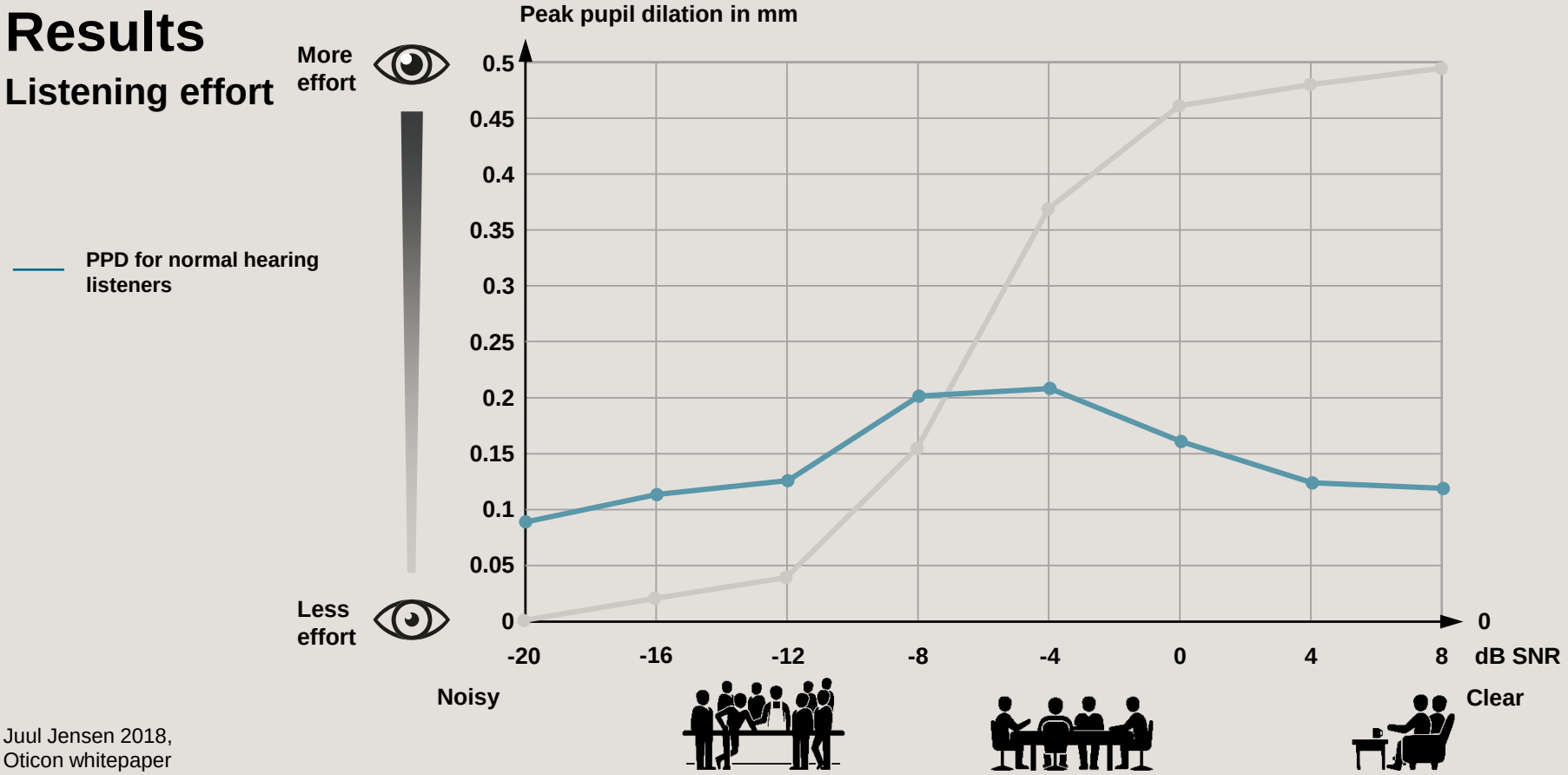
Results

Listening effort



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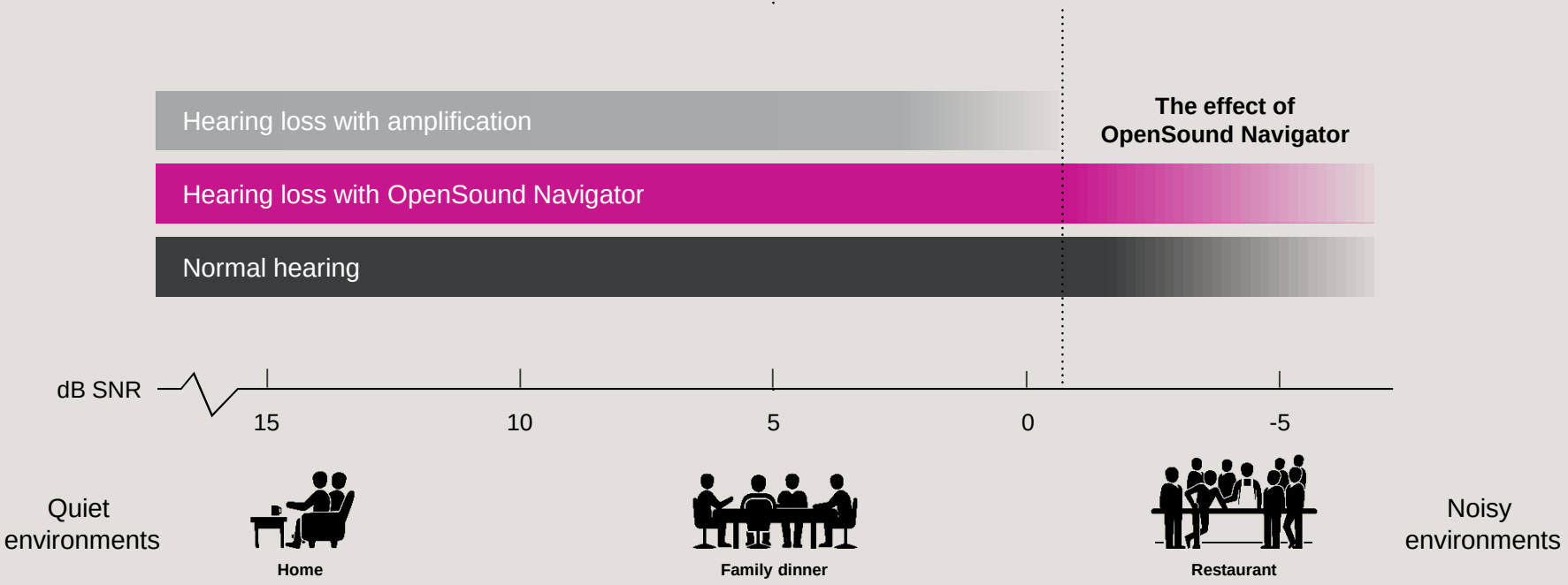
What does it tell us?

Ongoing research documenting BrainHearing benefit

New research in 2018



Le Goff and Beck 2017, Oticon whitepaper
Juul Jensen 2018, Oticon whitepaper

Closing a gap to normal hearing

Oticon Opn overcomes barriers to social participation

Improved speech understanding

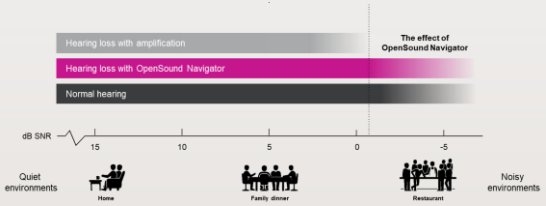
even in the noisiest environments

Reduced listening effort

over a broad range of environments

Motivation and empowerment

to participate and engage in the same environments as people with normal hearing



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Consequences of an untreated hearing loss*

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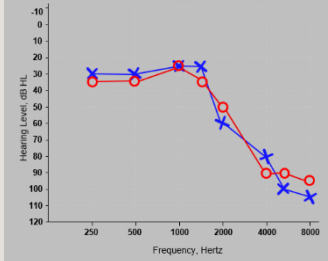

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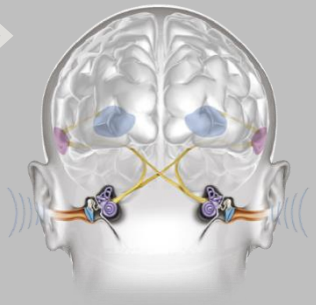

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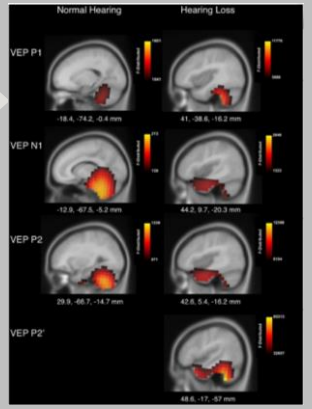

Campbell & Sharma, 2014

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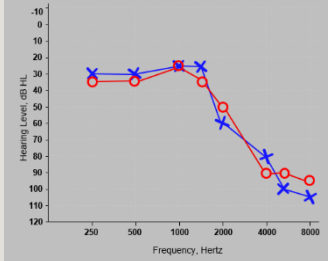
Benefits of treating a hearing loss

Hearing care is health care

Hearing loss



Better signals for the brain

Campbell & Sharma, 2014

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Q&A