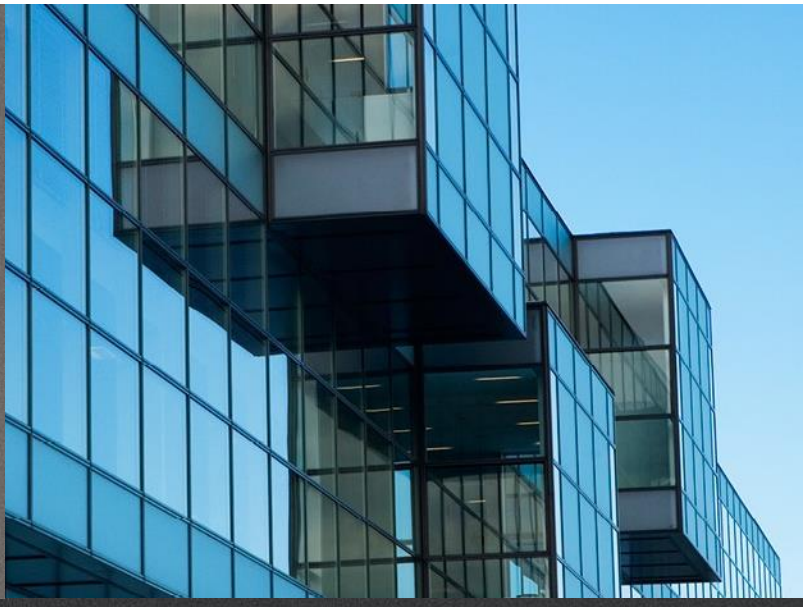
The Behavior of OpenSound Navigator in Complex Environments



Donald J Schum, PhD
Vice President, Audiology

OTICON Audiology

D.Schum@Oticon.com

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Learning Objectives:

1. . . . recognize that different signal processing approaches in high-end hearing aids attack the speech in noise problem in different ways.
2. . . . develop the ability to glean information about dynamic device performance by looking at various advance visual representations (such as spectrographs, waveforms, etc.)
3. . . . recognize that some systems can meet certain performance criteria (such as reduction of noises arising from behind) at the expense of other criteria (such as maintenance of a full gain response).

The Listening Environment

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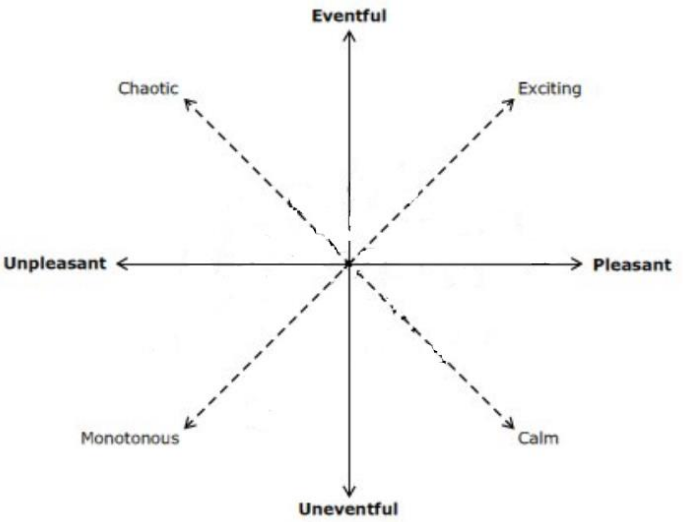

Human Sounds
Technological Sounds
Nature Sounds

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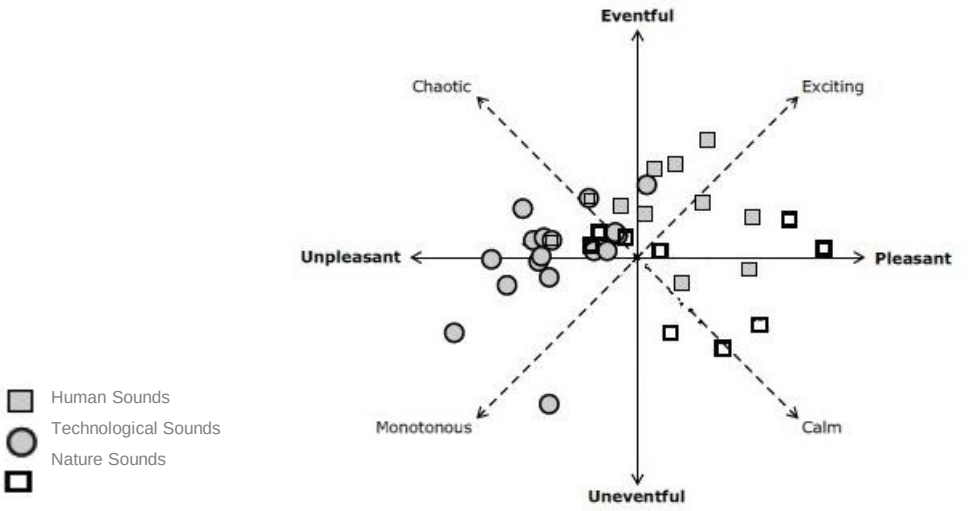

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Stated annoying sound or sound source	*Description*
Verbal human sounds	Sounds produced by people, verbal. An example of these sounds is murmuring.
TV/radio	Sounds emitted from the loudspeakers of TV and/or radio
Vehicles	Sounds produced by vehicles with engines; cars, trains, motorcycles, etc.
Machine tools	Sounds produced by e.g. power saw, drilling-machine
Household appliance	Sounds produced by ordinary household appliances such as washing machine, vacuum cleaner, or electric mixer.

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Åsa Skagerstrand*,‡, Stefan Stenfelt†,‡, Stig Arlinger†,‡ & Joel Wikström*

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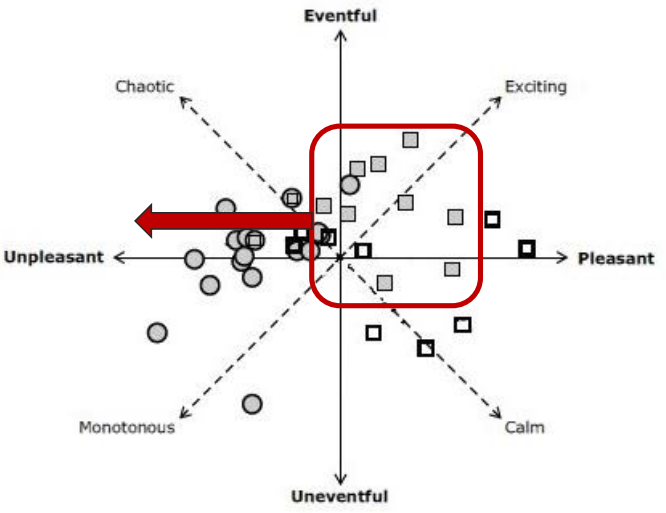

Human Sounds
Technological Sounds
Nature Sounds

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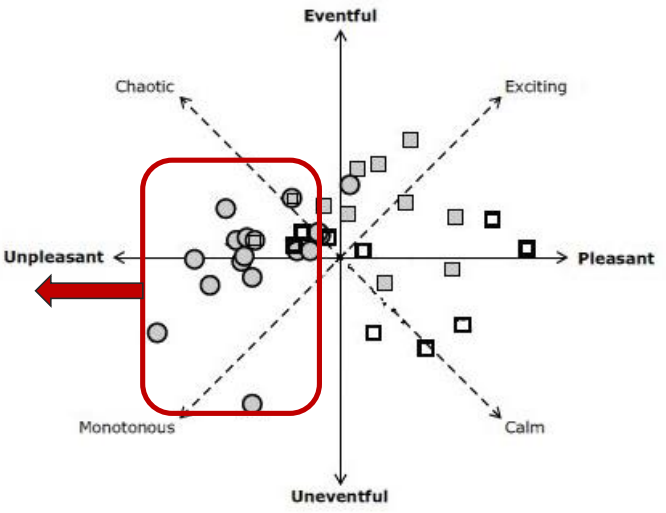

Human Sounds
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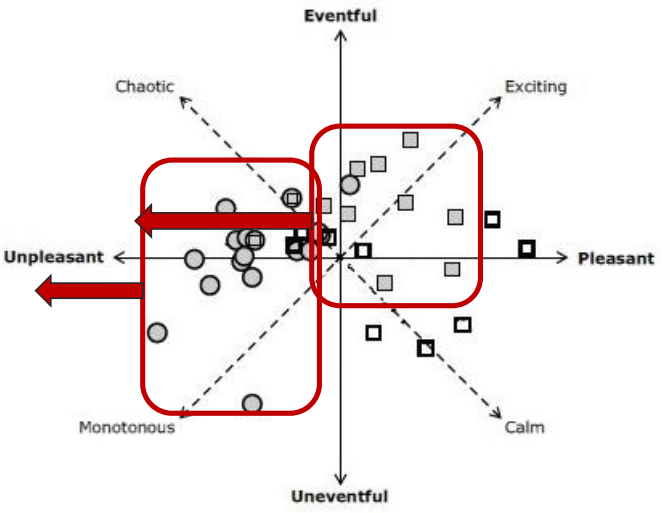

Human Sounds
Technological Sounds
Nature Sounds

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OpenSound Navigator: Design Purpose

- To improve speech understanding performance in complex environments without unduly sacrificing a natural listening experience

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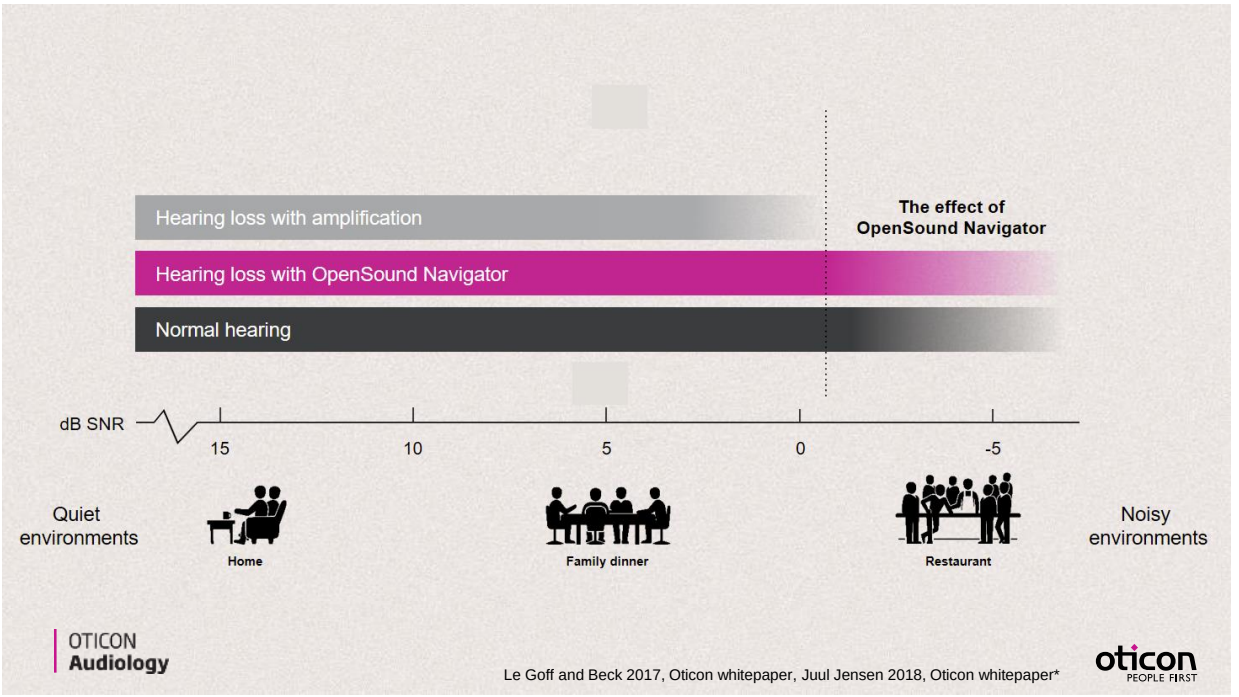
Hearing loss with amplification
Hearing loss with OpenSound Navigator
Normal hearing
The effect of OpenSound Navigator
dB SNR
15
10
5
0
-5
Quiet environments
Home
Family dinner
Restaurant
Noisy environments
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Le Goff and Beck 2017, Oticon whitepaper, Juul Jensen 2018, Oticon whitepaper*
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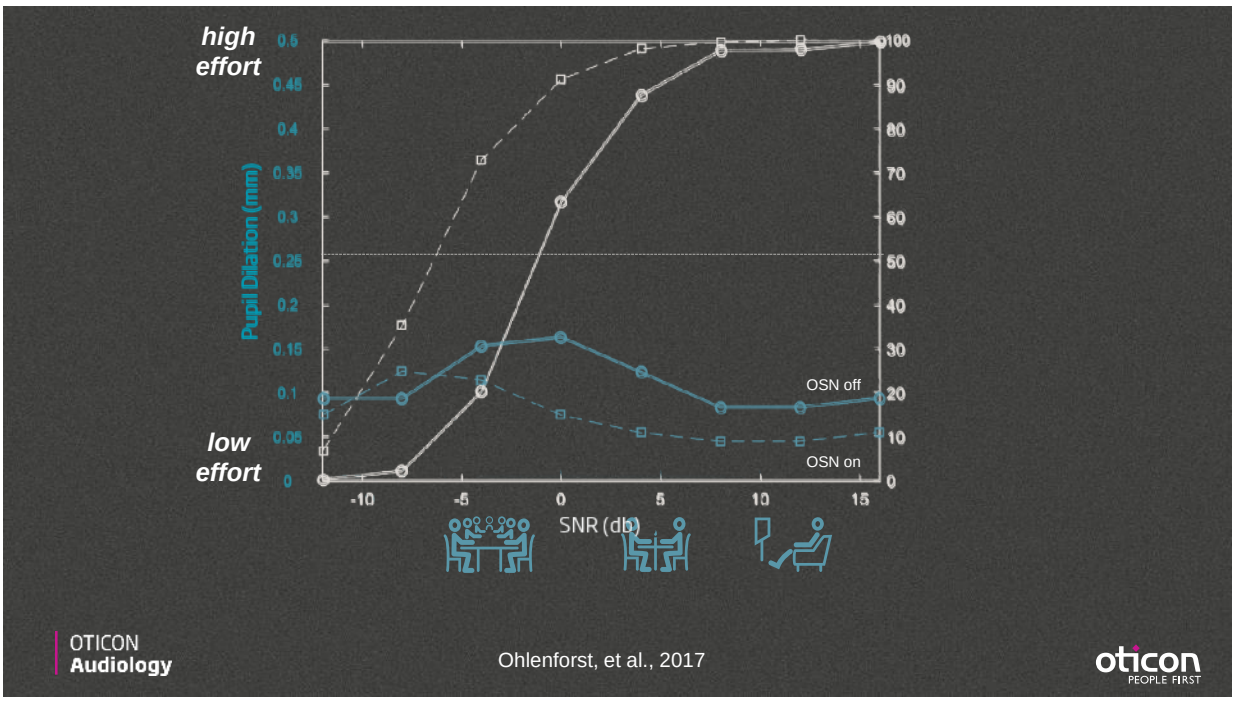
high effort
low effort
Pupil Dilation (mm)
SNR (db)
OSN off
OSN on
OTICON Audiology
Ohlenforst, et al., 2017
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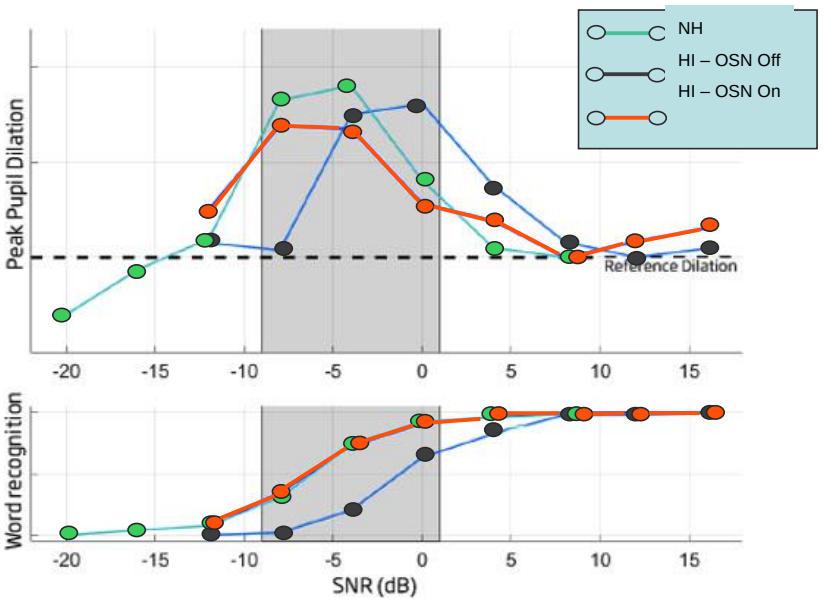

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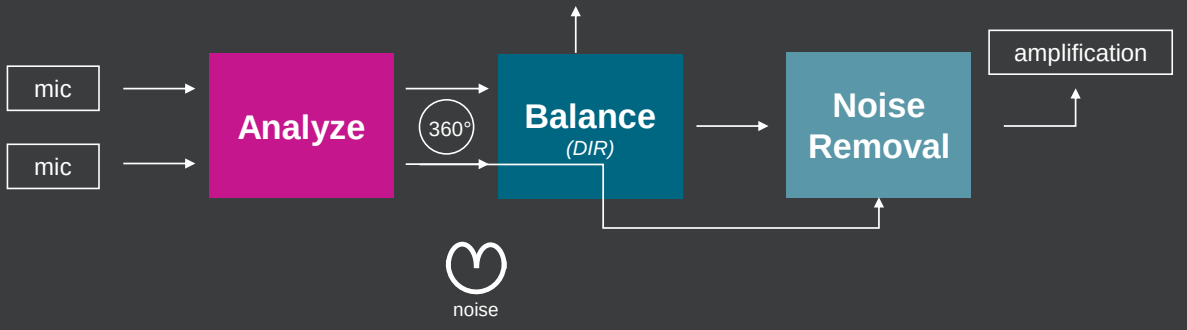
How does it work?



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PEDIATRICS

Data Captured

- Frequency (16 channels)
- Level
- Location
- Speech versus non-speech

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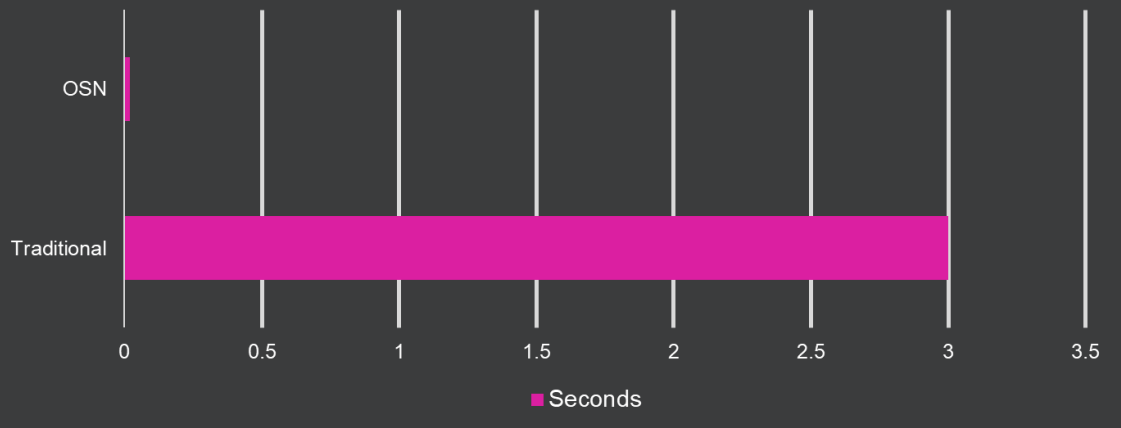
Update speed: 10 msec versus 3 sec



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OpenSound Navigator Compared to:

- Traditional DIR & NR:
  - Analysis Phase
  - Spatially-aware NR
  - Criteria for NR changes
  - Update Speed
- Beamforming:
  - Analysis Phase
  - Update Speed
  - Protection of clearly defined speech sources

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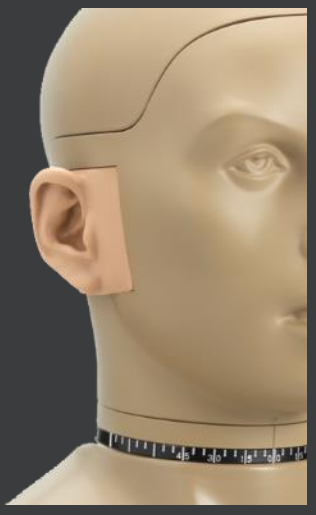
Recordings



- KEMAR recordings
  - Opn 1
  - Beam Former
  - Traditional DIR & NR
- Speech in Speech-shaped Noise (+5 dB S/N)
- Technical Analysis of effect on S/N

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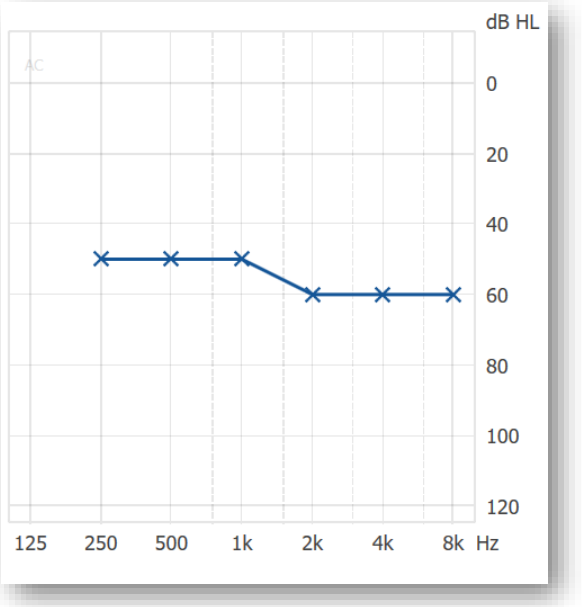
Audiometric configuration:



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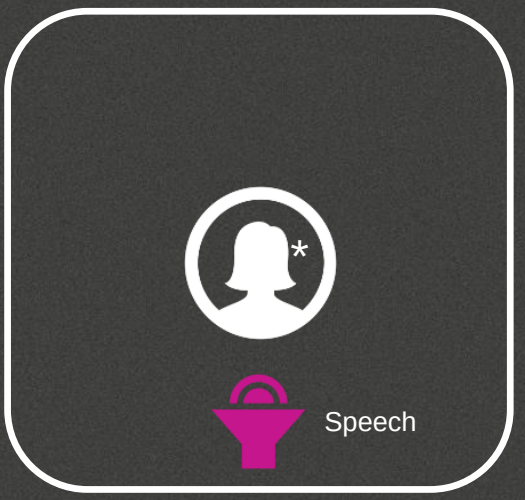
Recordings: Set-up



*Recording Ear

Signal Processing Effect?

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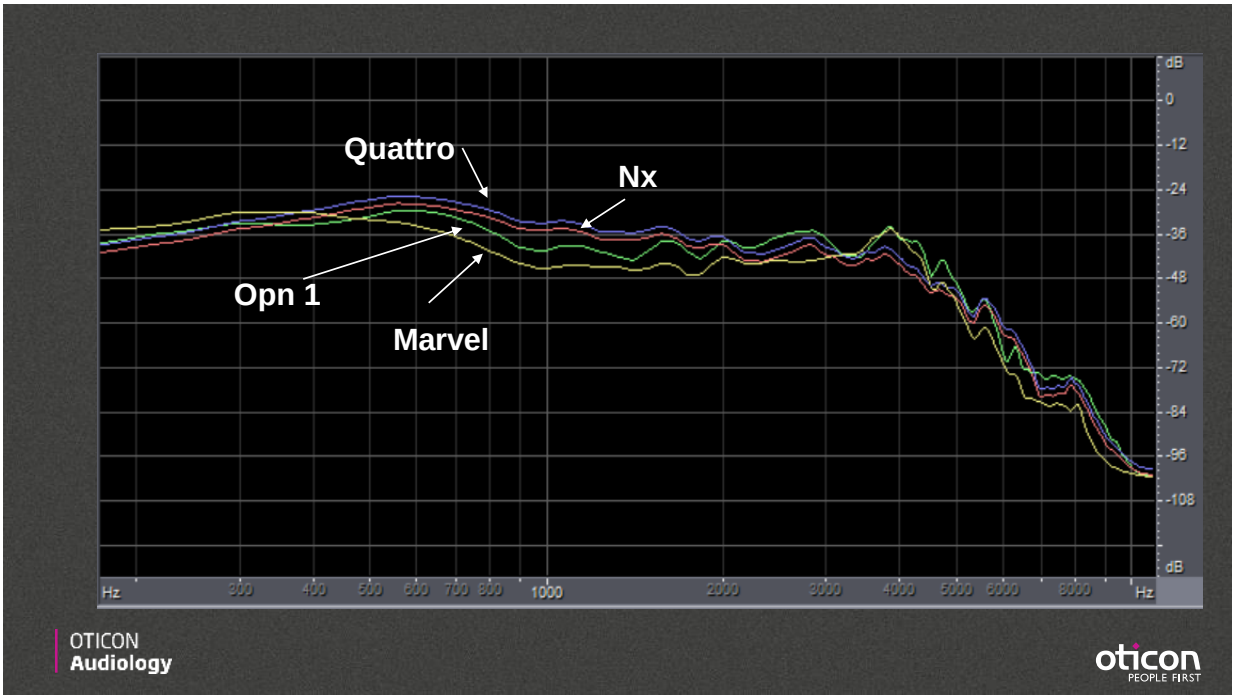
Quattro
Nx
Opn 1
Marvel
dB
0
-12
-24
-36
-48
-60
-72
-84
-96
-108
dB
Hz
300
400
600
700
800
1000
2000
3000
4000
5000
6000
8000
Hz
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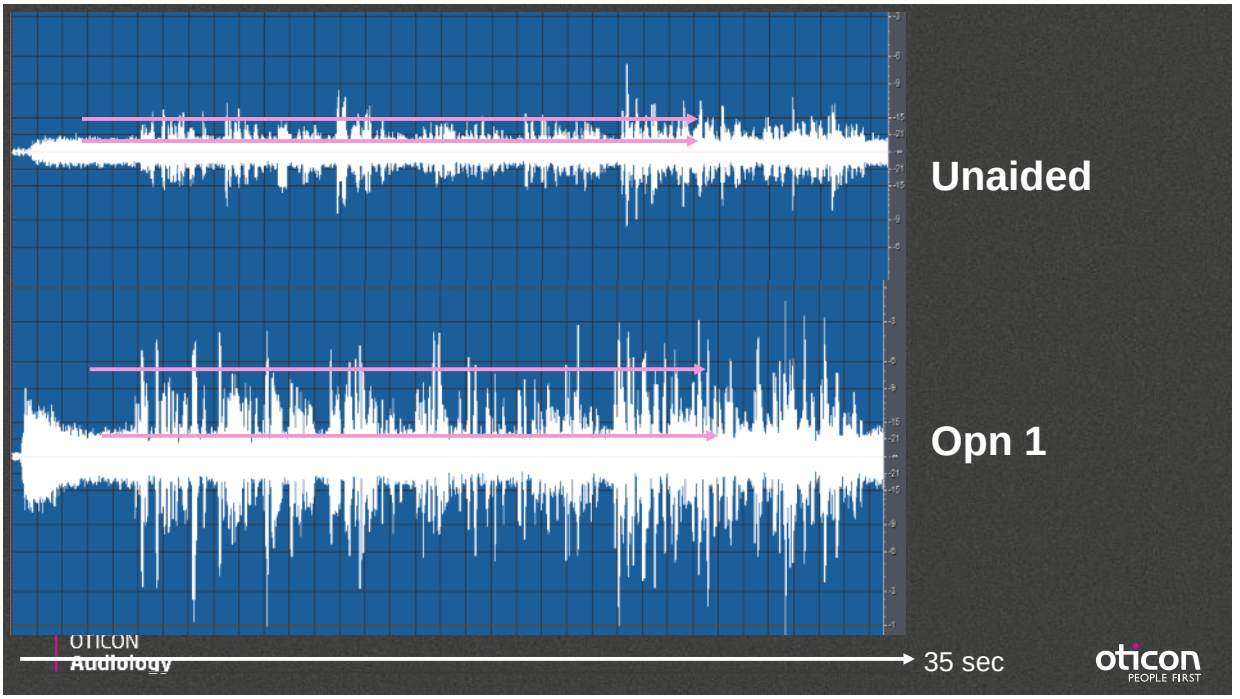
Unaided
Opn 1
OTICON
Audiology
35 sec
oticon
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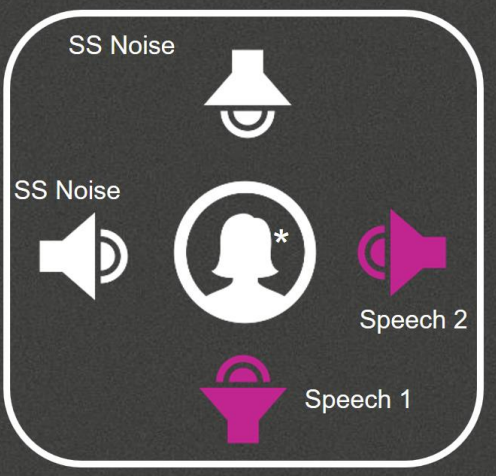
Recordings: Set-up



*Recording Ear

Signal Processing Effect?

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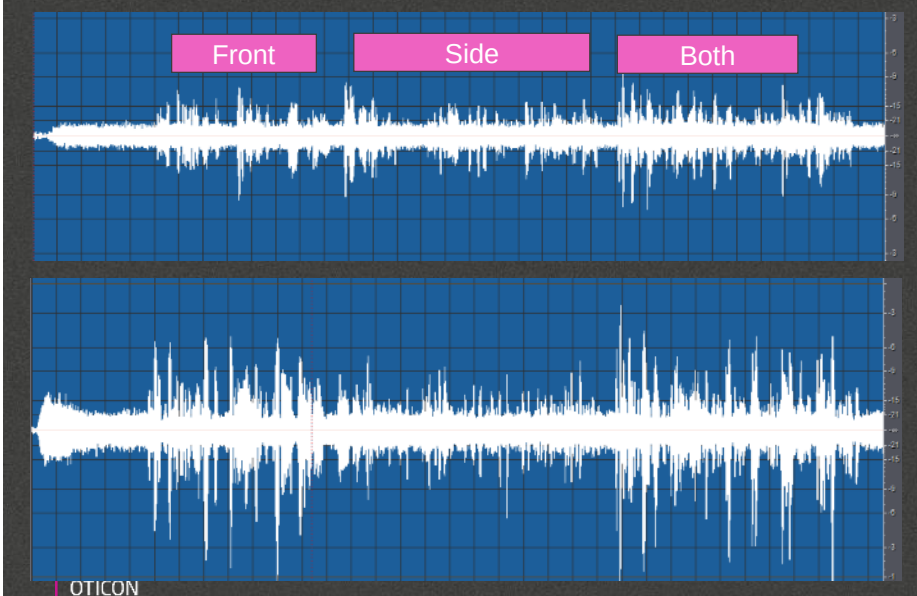


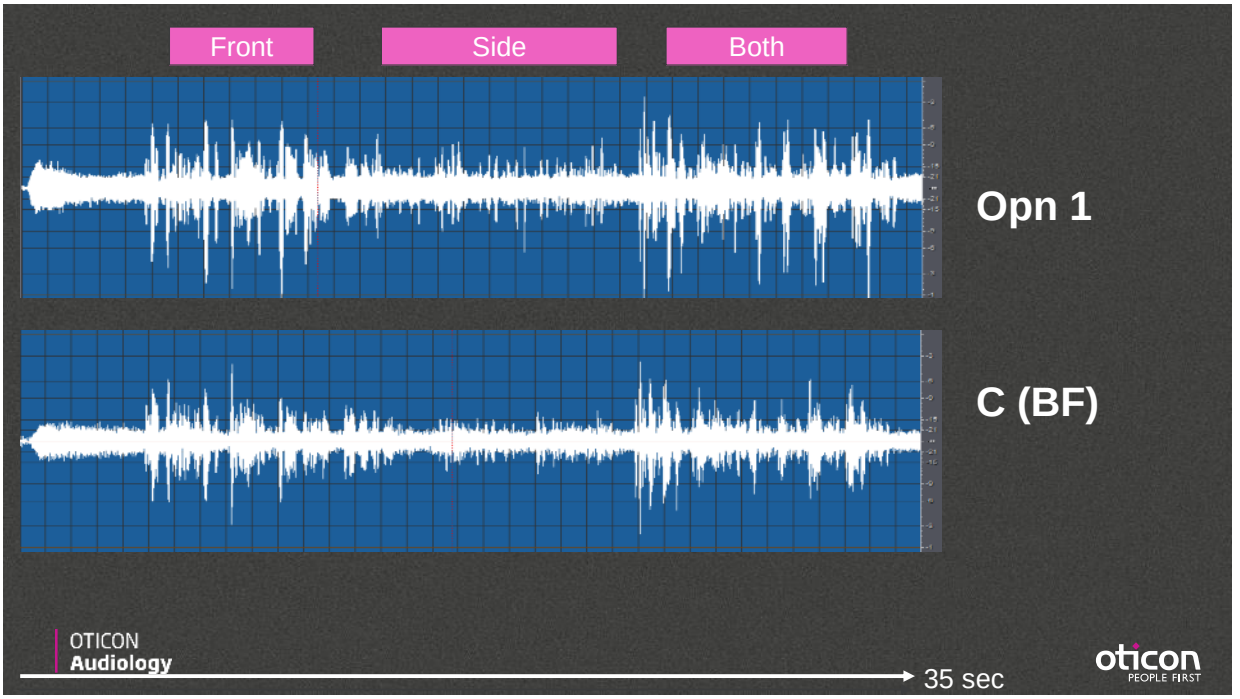
Unaided

Opn 1

OTICON Audiology

35 sec

oticon PEOPLE FIRST


Front
Side
Both
Opn 1
C (BF)
OTICON
Audiology
35 sec
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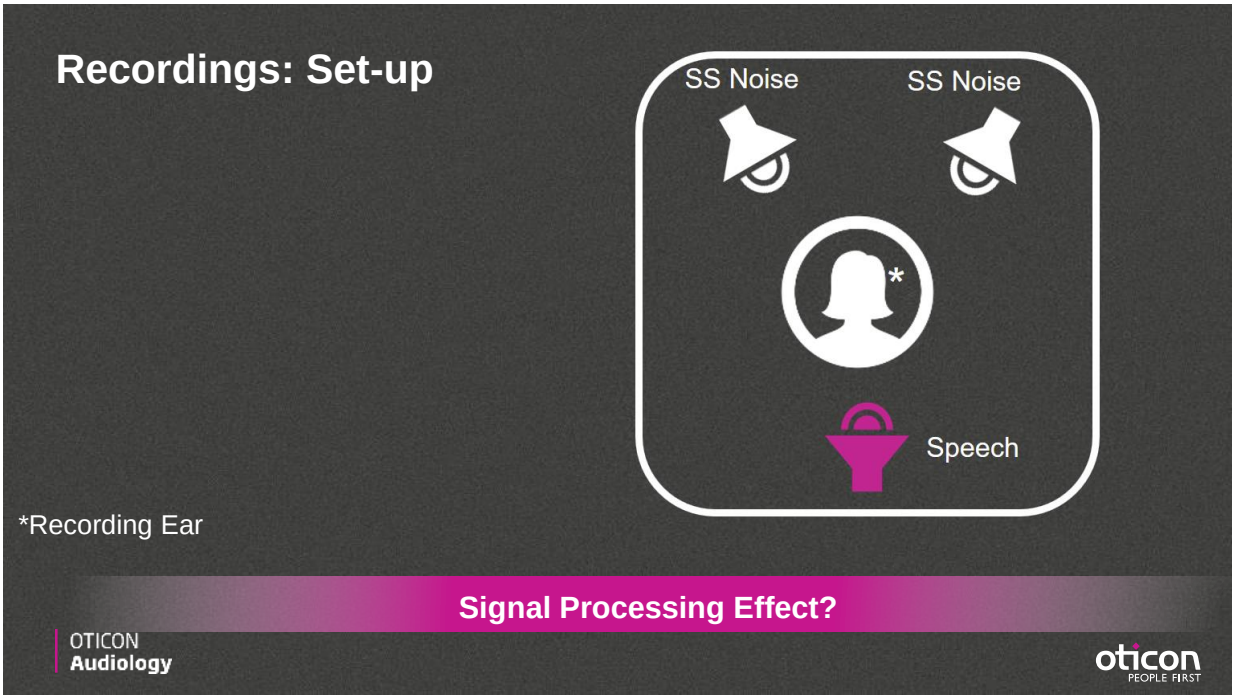
Recordings: Set-up
SS Noise
SS Noise
*
Speech
*Recording Ear
Signal Processing Effect?
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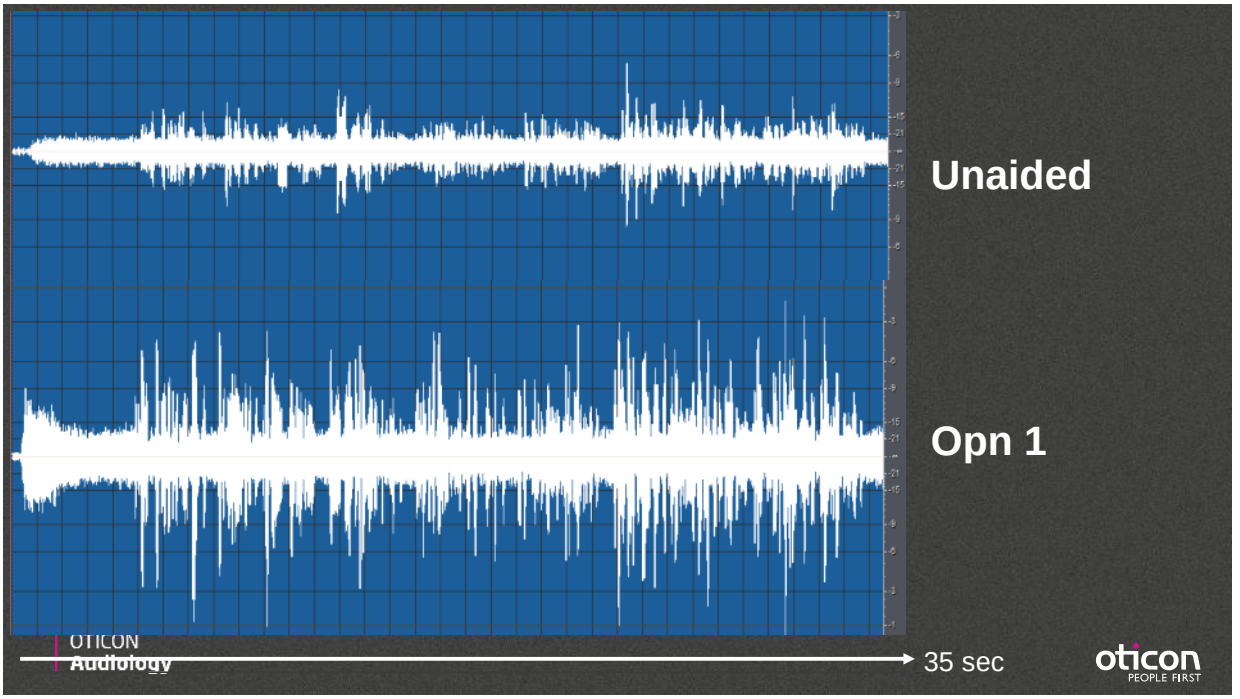
Unaided
Opn 1
OTICON
Audiology
35 sec
oticon
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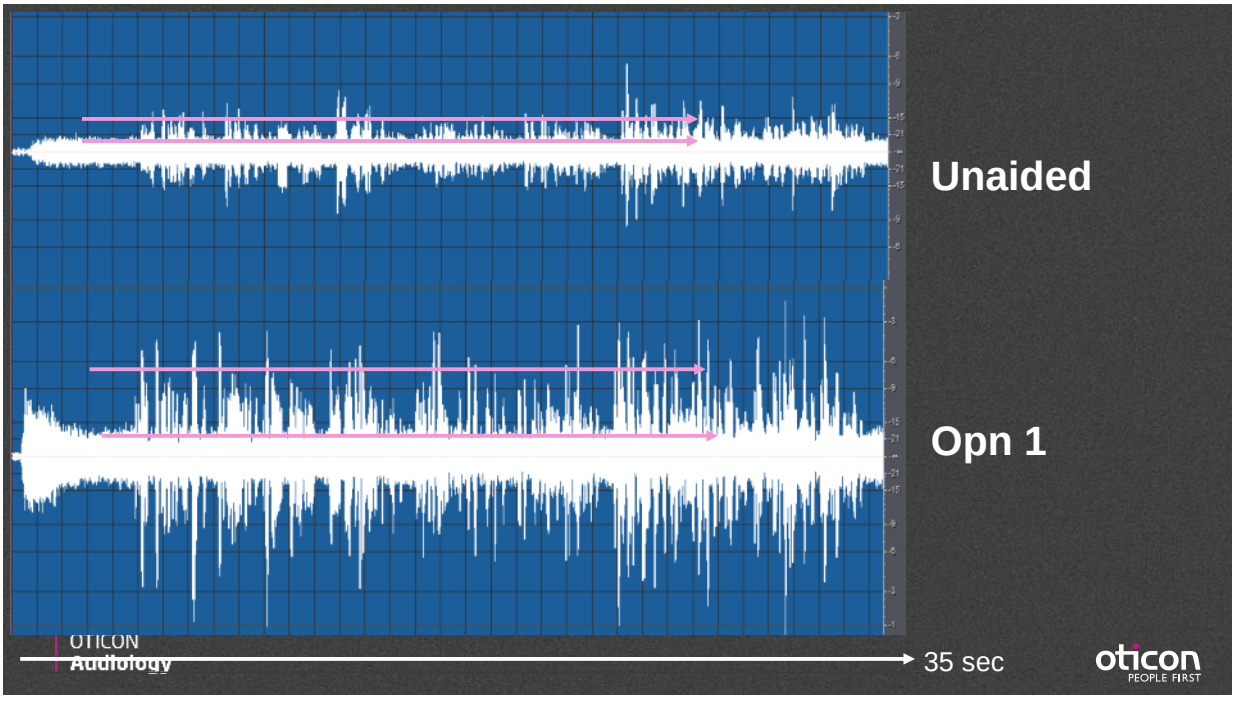
Unaided
Opn 1
OTICON
Audiology
35 sec
oticon
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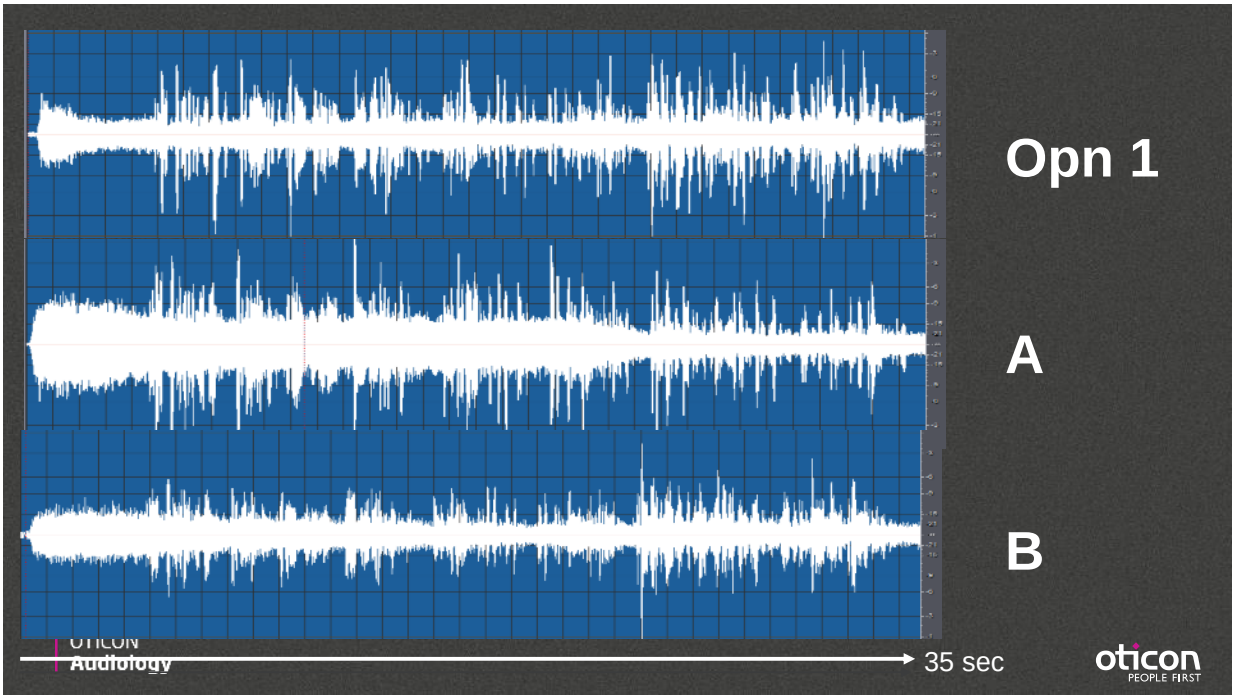
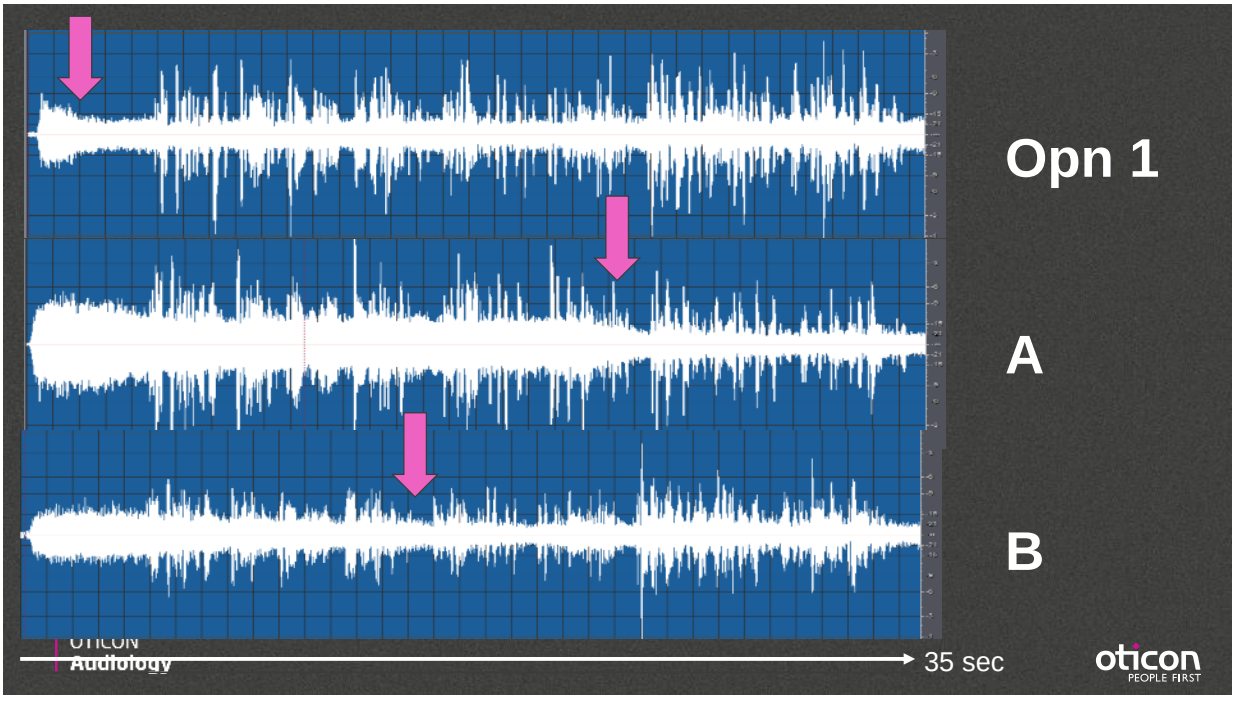

Opn 1
A
B
35 sec
oticon
PEOPLE FIRST


Opn 1
A
B
35 sec
oticon
PEOPLE FIRST

Recordings: Set-up

*Recording Ear

Signal Processing Effect?

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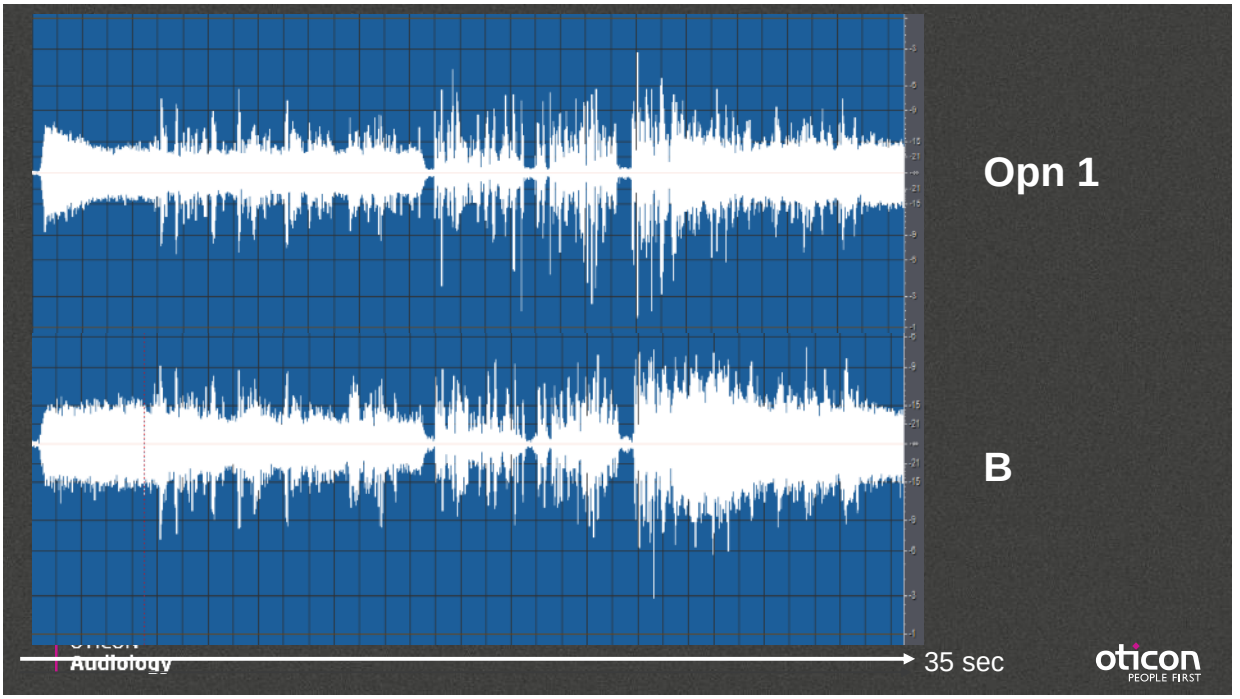
Opn 1
B
35 sec
oticon
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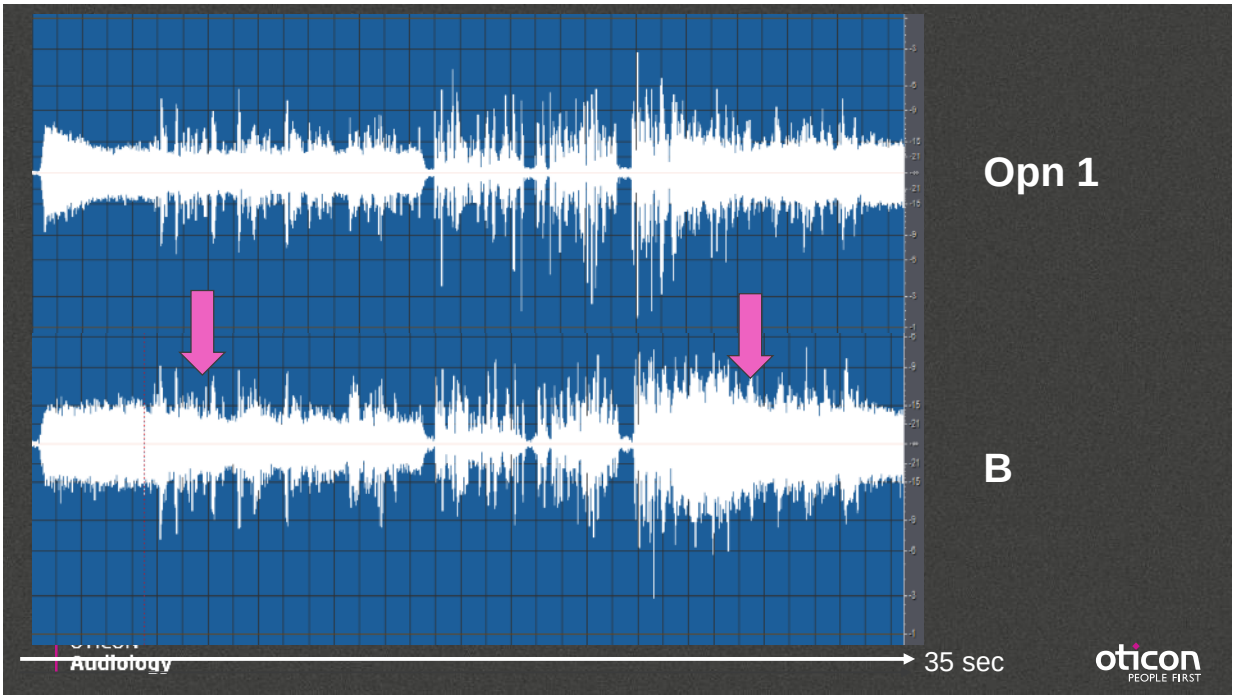
Opn 1
B
35 sec
oticon
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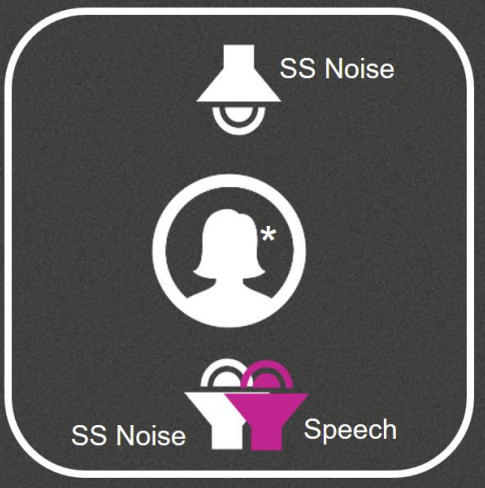
Recordings: Set-up



*Recording Ear

Signal Processing Effect?

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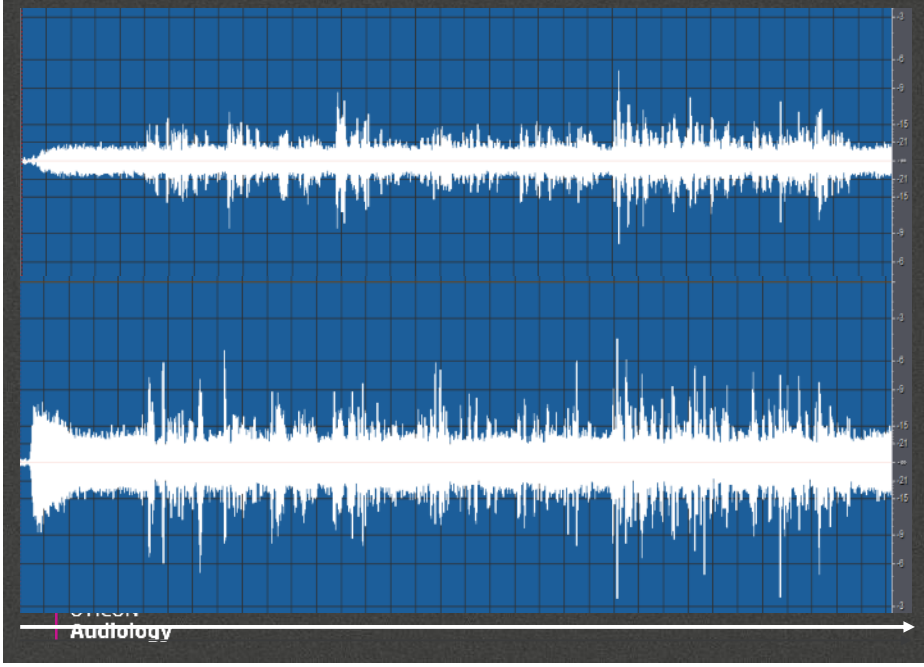

Unaided

Opn 1

35 sec

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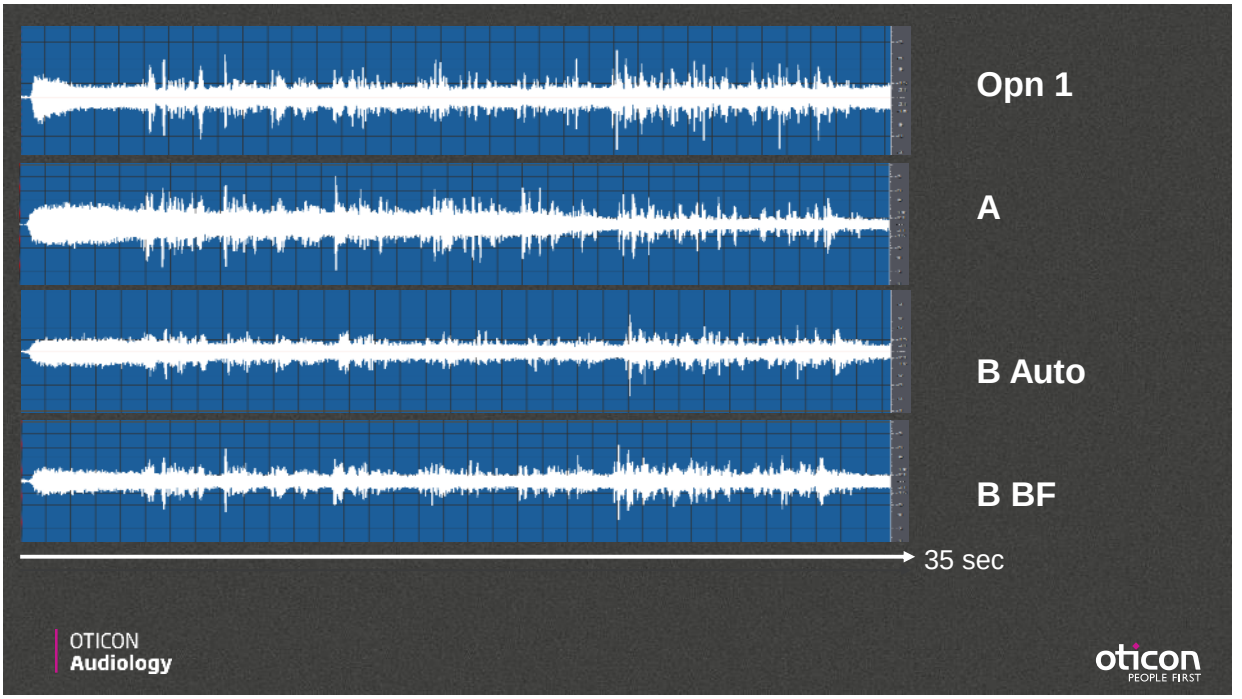
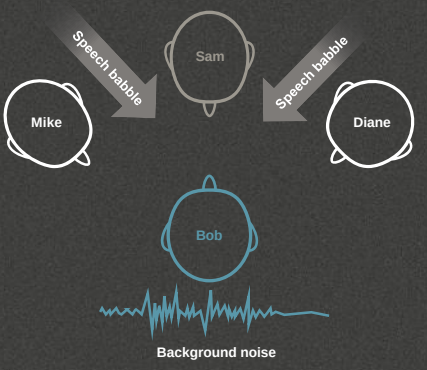


Study: Multiple talkers in noise

- Uncertainty of the target speaker location
- 24 participants
- 3 mRITE HAs with different technologies set to max NR



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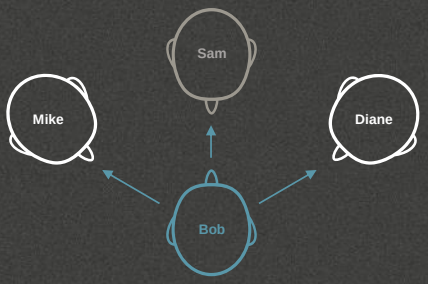
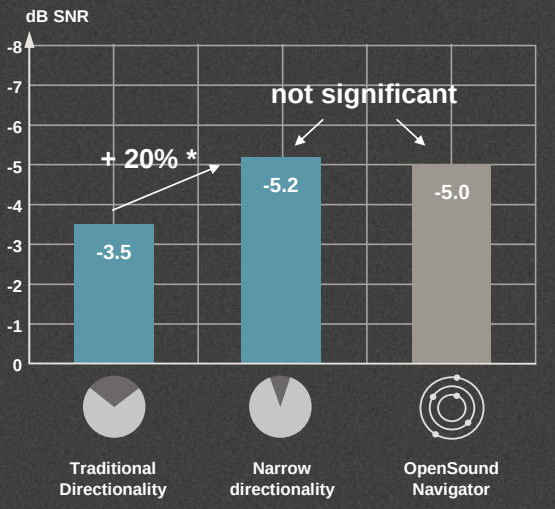
Results

Speech understanding of center speaker (Sam)





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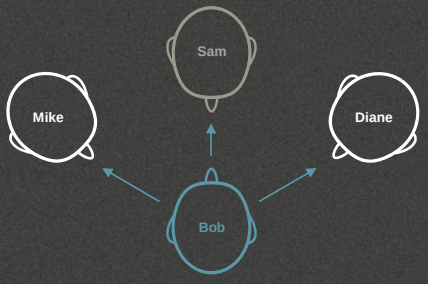
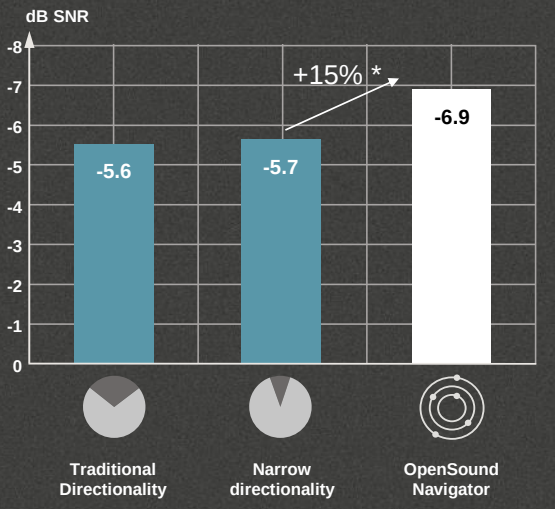
Results

Average speech understanding of speakers from sides (Mike and Diane)





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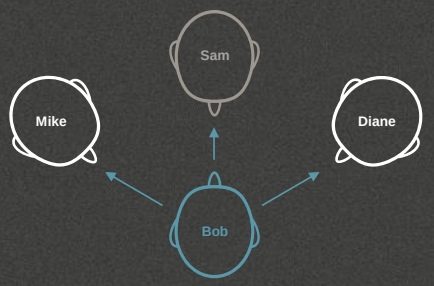
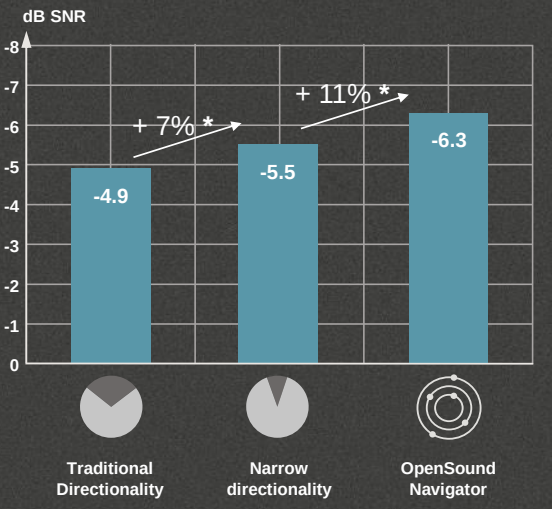
Results

Average speech understanding of 3 speakers





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New in Spring of 2019: The Oticon Opn S family

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Feedback cancellation in action: Two Phases

Fast Phase & *Long-term Phase*

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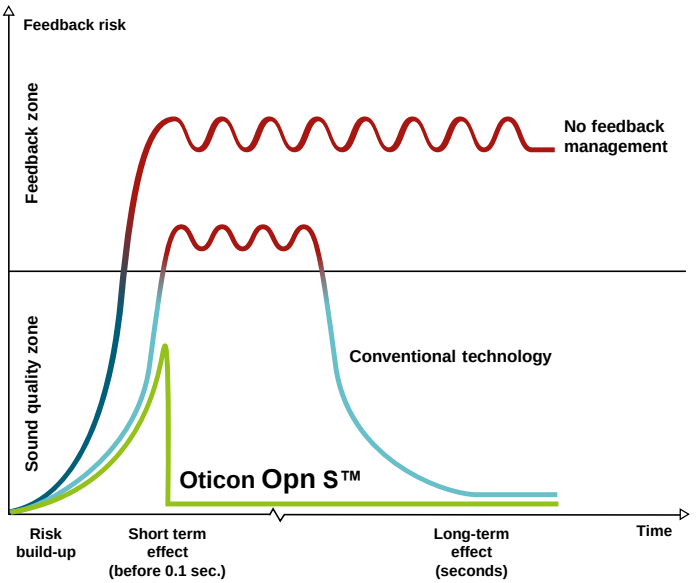
Velox S™ allows significantly faster detection and response



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Two key improvements

- Speed/resolution
- Cancellation technique

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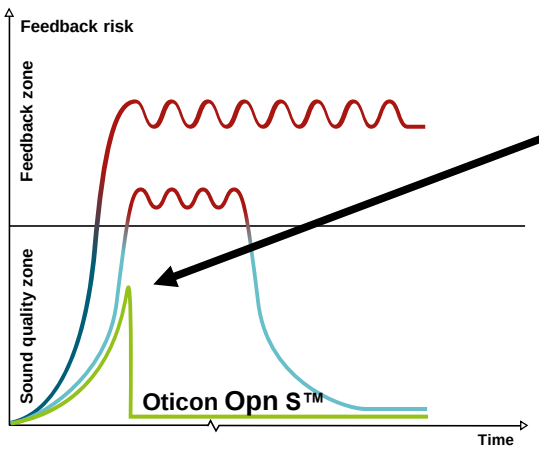

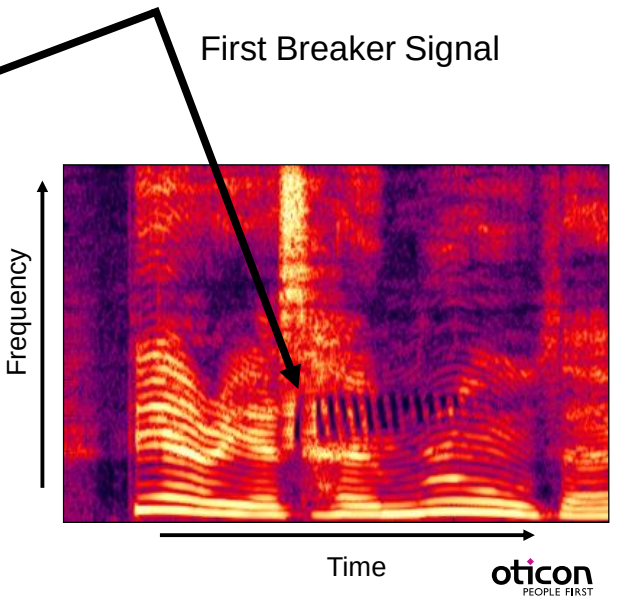

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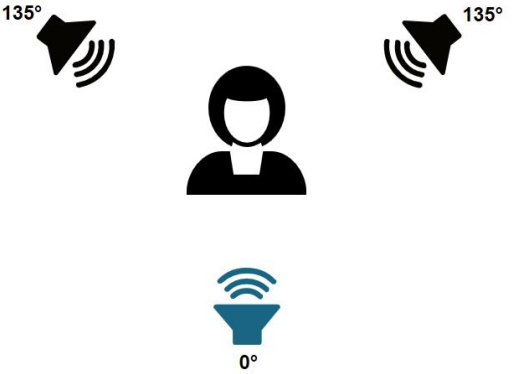
OpenSound Optimizer and OpenSound Navigator

Methods

Test conditions:
- Front: 70 dB speech
- Back: 70 dB speech-shaped noise

Hearing aid fitting:
- Modified S2 audiogram
- Open domes



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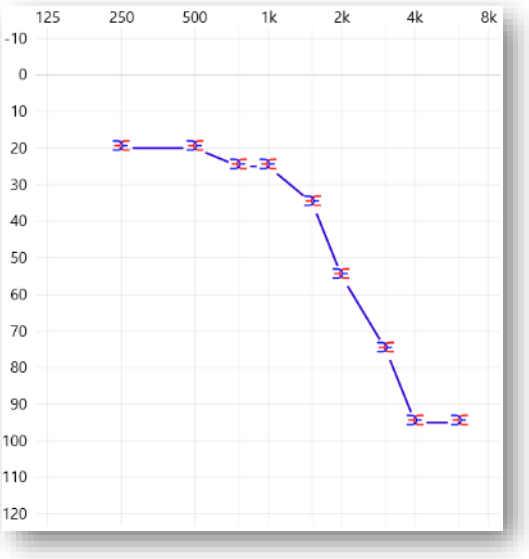
Audiometric configuration:



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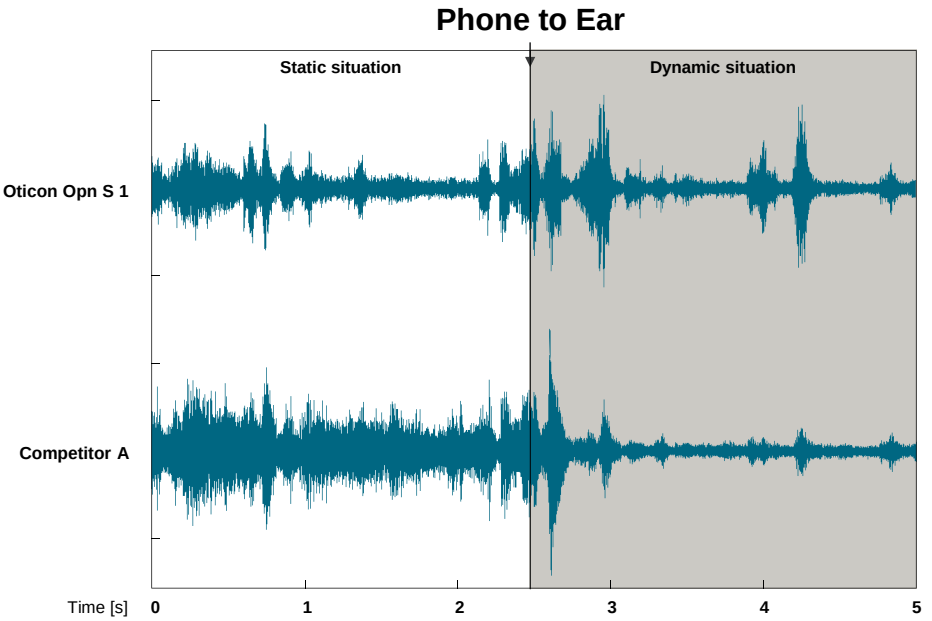

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OpenSound Navigator: Design Purpose

- To improve speech understanding performance in complex environments without unduly sacrificing a natural listening experience

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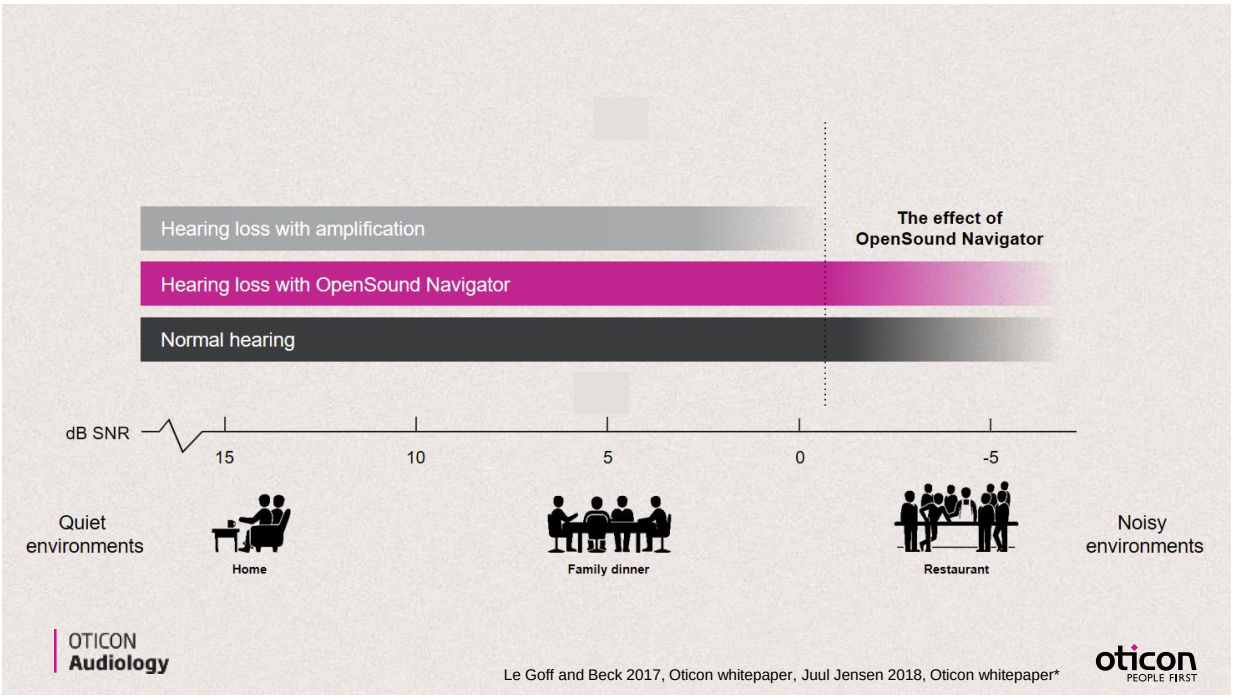
Hearing loss with amplification
The effect of OpenSound Navigator
Hearing loss with OpenSound Navigator
Normal hearing
dB SNR
15
10
5
0
-5
Quiet environments
Home
Family dinner
Restaurant
Noisy environments
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Le Goff and Beck 2017, Oticon whitepaper, Juul Jensen 2018, Oticon whitepaper*
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The Behavior of OpenSound Navigator in Complex Environments
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