

AutoSense OS 3.0

Understanding the
Automatic System
Behind Phonak
Audeo Marvel
Technology



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Phonak Clinical Trainer

A Sonova brand

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Learning Outcomes

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- Participants will be able to describe the benefits of AutoSense OS 3.0
- Participants will be able to describe adaptive compression speed
- Participants will be able to describe how AutoSense OS 3.0 supports top rated streamed sound quality
- Participants will be able to describe how AutoSense OS 3.0 supports reduced listening effort in noise

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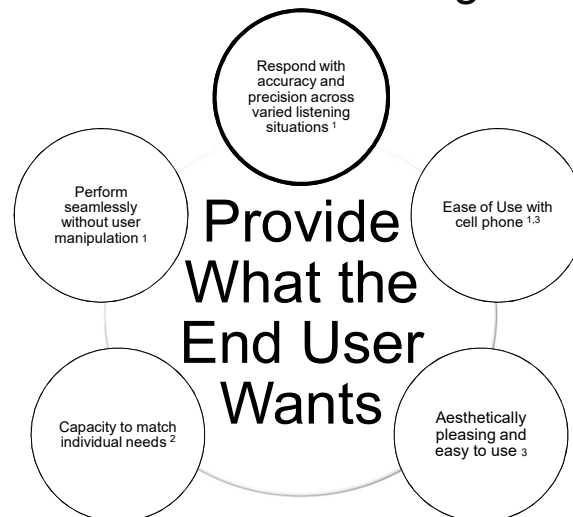
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hearing aid users
should not have to
think about their
hearing

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Research Provides Consumer Insights



¹ Kochkin S. The Hearing Journal, November 2007, Increasing hearing aid adoption through Multiple Environmental Listening Utility.

² Hickson L, Clutterbuck S, Kahn A; International Journal of Audiology; 2010, Factors associated with hearing aid fitting outcomes on the IOI-HA

³ Consumer needs survey, n =1800, March 2014 Phonak, March 2014.

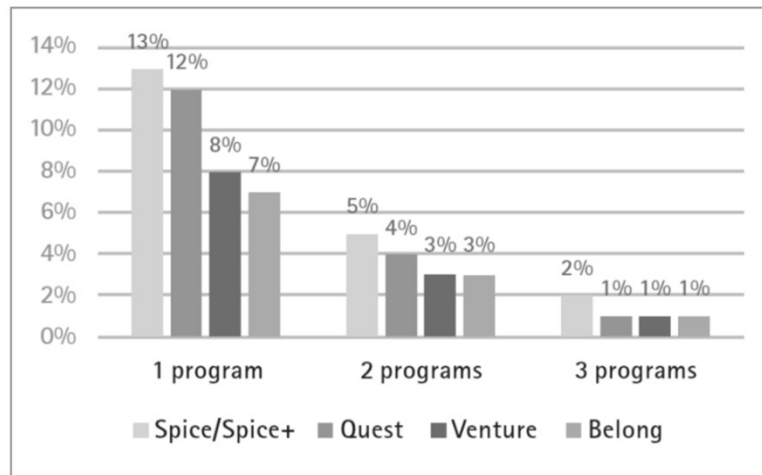
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Preference of Wearers for Automatic Adaptation vs. Manual Programs



Rakita, Jones 2015

The Hardware: Chip Technology

| | 2005 | 2008 | 2012 | 2014 |
|-------------------------------|-------------|-----------|--------------|--------------------|
| | Palio | Core | Spice+/Quest | Venture/ Belong |
| Transistors | 7.5 million | 8 million | 16 million | 45 million |
| Million operations per second | 100 | 120 | 200 | 552 |
| Structure | 130nm | 90nm | 65nm | 65nm |

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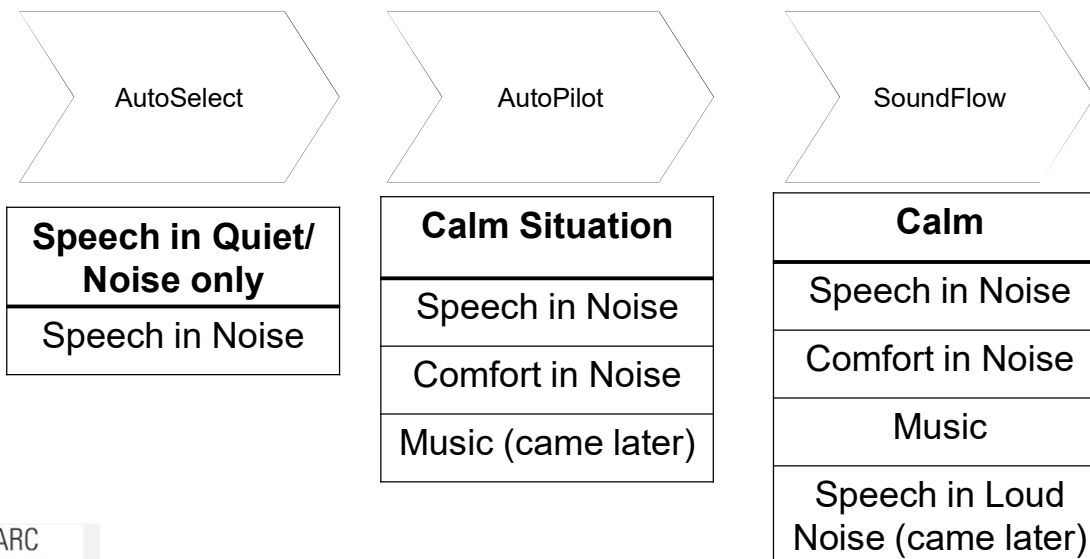
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State-of-the-art technology

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| | SWORD 3.0 | Other hearing aid manufacturer | W1 Apple AirPods |
|---------------------------|---|--|--|
| Size in mm | 1.9 x 3.58 | 2.7 x 2.9 | 3.23 x 4.42 |
| Technology | 40 nm | 65 nm | 65 nm |
| Wireless protocols | Bluetooth classic Bluetooth LE Roger™ AirStream™ BinauralVoice Stream Technology™ | --- Bluetooth LE LEA (MFi) --- --- | Bluetooth classic Bluetooth LE --- --- --- |

Evolution of Automatic Hearing Aid Technology



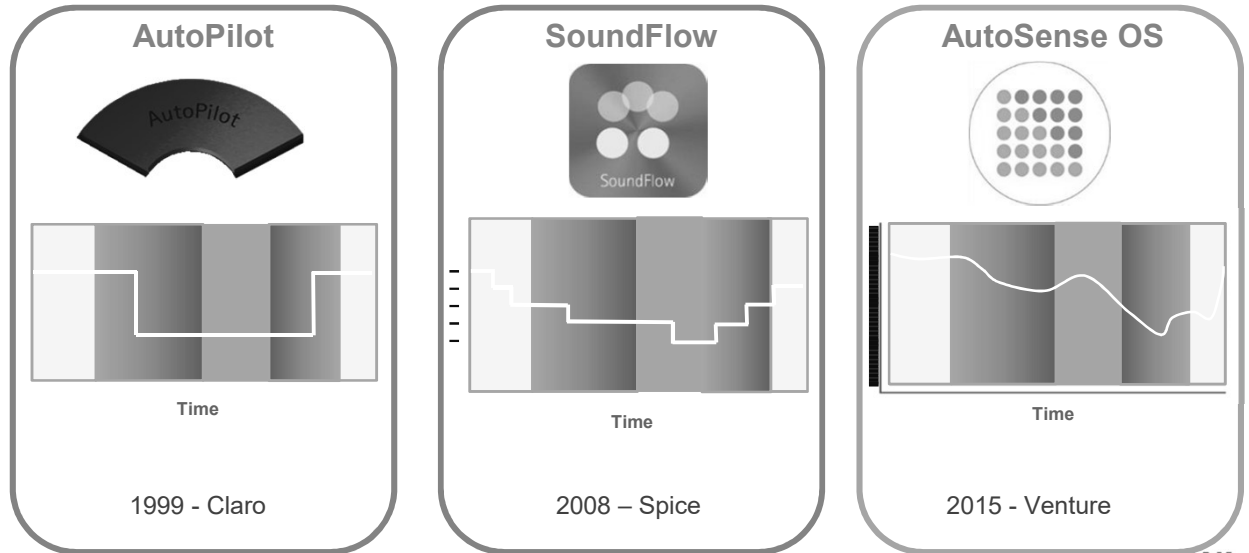
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Phonak Audiology
Research Center

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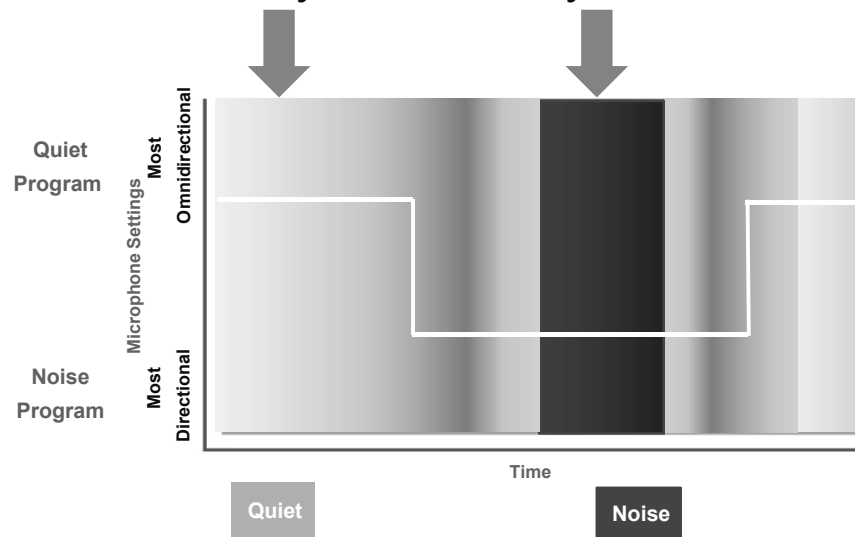
The Evolution of Automation Technology



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A basic auditory scene analysis

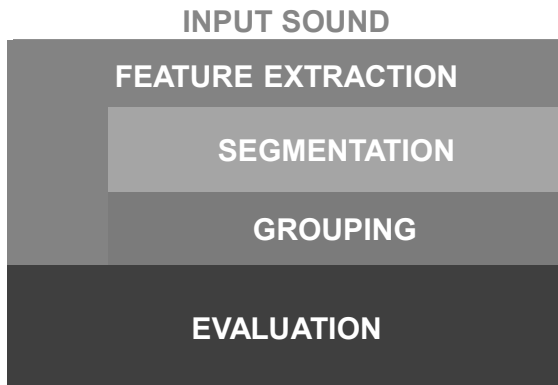

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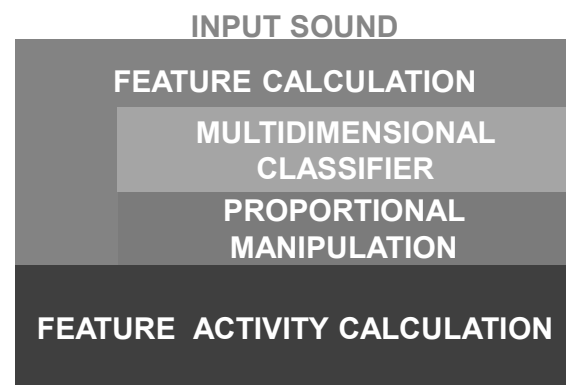
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Auditory and acoustic scene analysis

Brain



AutoSense OS



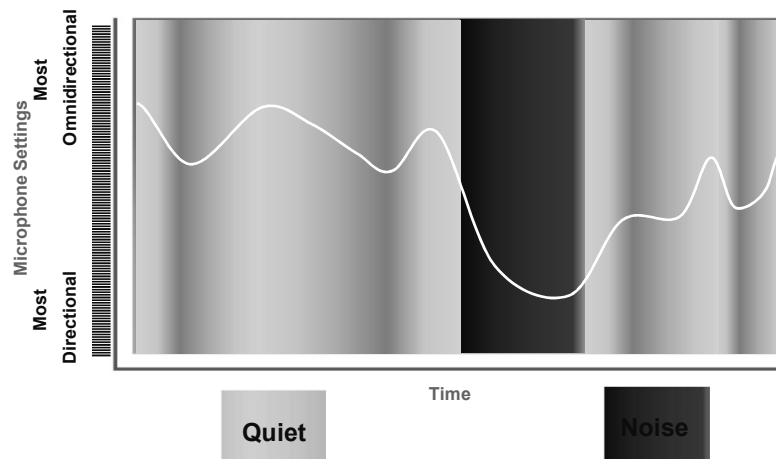
Auditory scene analysis computational models: Image adapted from the International Encyclopedia of the Social & Behavioral Sciences 1992

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AutoSense OS: accuracy and precision at its most powerful

Precision unlocks the potential provided by accuracy



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Accuracy and precision are both important

Accuracy:

- How many sound environments can the hearing aid correctly identify

Example:

“Am I in noise” or “Am I in quiet”?

→ EASY

“Am I in a noisy car” or “Am I in a noisy café”?

→ HARDER

Why is accuracy important?

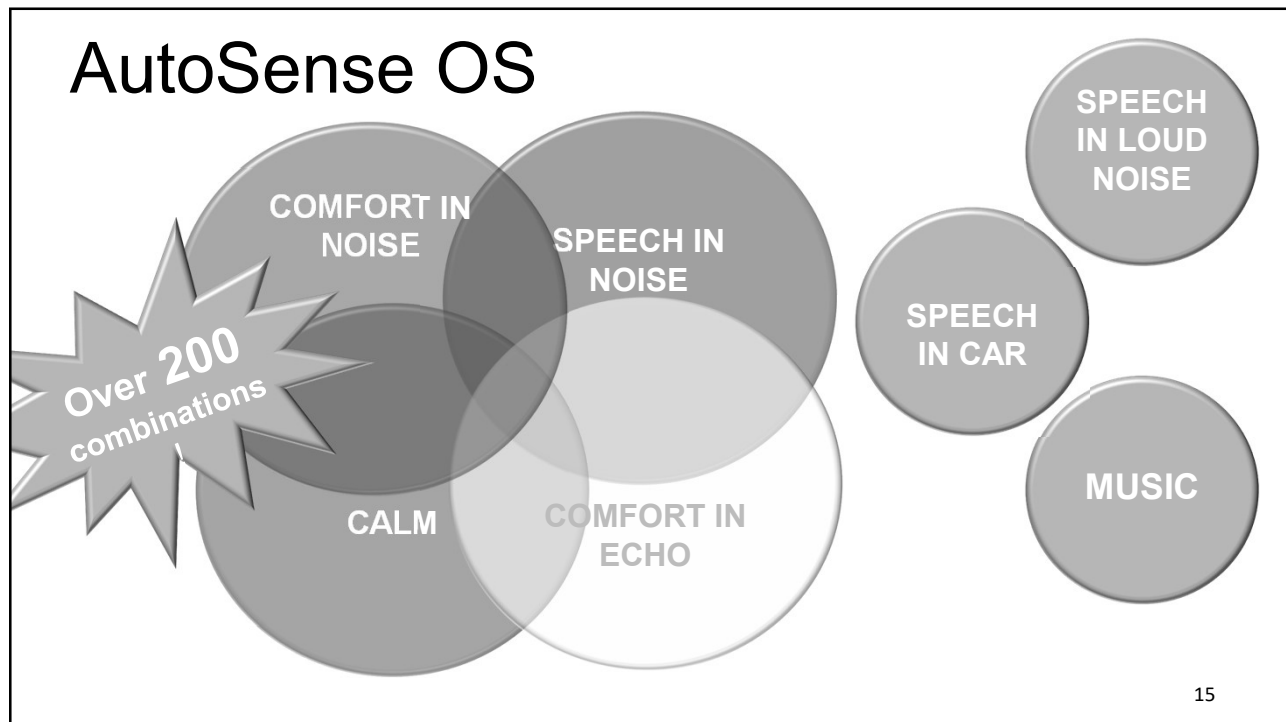
- The hearing aids will accurately recognize the sound environment

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Phonak Marvel™ Feature Summary

| 90 Premium | 70 Advanced | 50 Standard | 30 Essential |
|-----------------------------------|--|------------------------------|------------------------------|
| Calm Situation | Calm Situation | Calm Situation | Calm Situation |
| Speech in Noise | Speech in Noise | Speech in Noise | Speech in Noise |
| Comfort in Noise | Comfort in Noise | Comfort in Noise | Streamed Speech |
| Music | Music | Streamed Music | Streamed Music |
| Comfort in Echo | Streamed Speech | Streamed Speech | WhistleBlock |
| Speech in Loud Noise ¹ | Streamed Music | SNR-Boost | NoiseBlock |
| Speech in Car | Speech in Loud Noise ¹ (manual) | DuoPhone ² | QuickSync |
| Streamed Speech | Speech in 360° ¹¹ | Real Ear Sound | SoundRecover2 |
| Streamed Music | WindBlock | WhistleBlock | Tinnitus Balance |
| Speech in 360° ¹¹ | SoundRelax | NoiseBlock | Environmental Balance |
| EchoBlock | SNR-Boost | QuickSync | auto Acclimatization |
| WindBlock | DuoPhone ² | SoundRecover2 | UltraZoom Standard |
| SoundRelax | Real Ear Sound | Tinnitus Balance | UltraZoom Essential |
| SNR-Boost | WhistleBlock | Environmental Balance | 8 channels |
| DuoPhone ² | NoiseBlock | auto Acclimatization | Rechargeable model available |
| Real Ear Sound | QuickSync | UltraZoom Premium | |
| WhistleBlock | SoundRecover2 | 16 channels | |
| NoiseBlock | Tinnitus Balance | 12 channels | |
| QuickSync | Environmental Balance | Rechargeable model available | |
| SoundRecover2 | auto Acclimatization | | |
| Tinnitus Balance | UltraZoom Advanced | | |
| Environmental Balance | Rechargeable model available | | |
| auto Acclimatization | | | |
| UltraZoom Premium | | | |
| 20 channels | | | |
| Rechargeable model available | | | |

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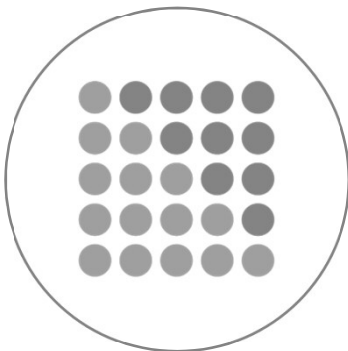
How to Test Automatics?

PARC'S Answer:
Instead of "Recreating" the real world,
BRING participants into the
REAL WORLD

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AutoSense OS

Over 200 distinct settings in 1 unique operating system



AutoSense OS selects
the best settings to maximize
hearing performance
automatically so that your clients
don't have to.

 **FACH
HOCHSCHULE
LÜBECK**
University of Applied Sciences

*Überlacker, Tchorz, and Latzel 2014, Automatic classification of acoustic situation versus manual selection.
University of Applied sciences Lübeck and Phonak AG, Hörakustik, January 2015 edition.*

www.phonakpro.com/evidence

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Scene Creation

Challenges:

- Speech from behind
- Reverberation
- Noise

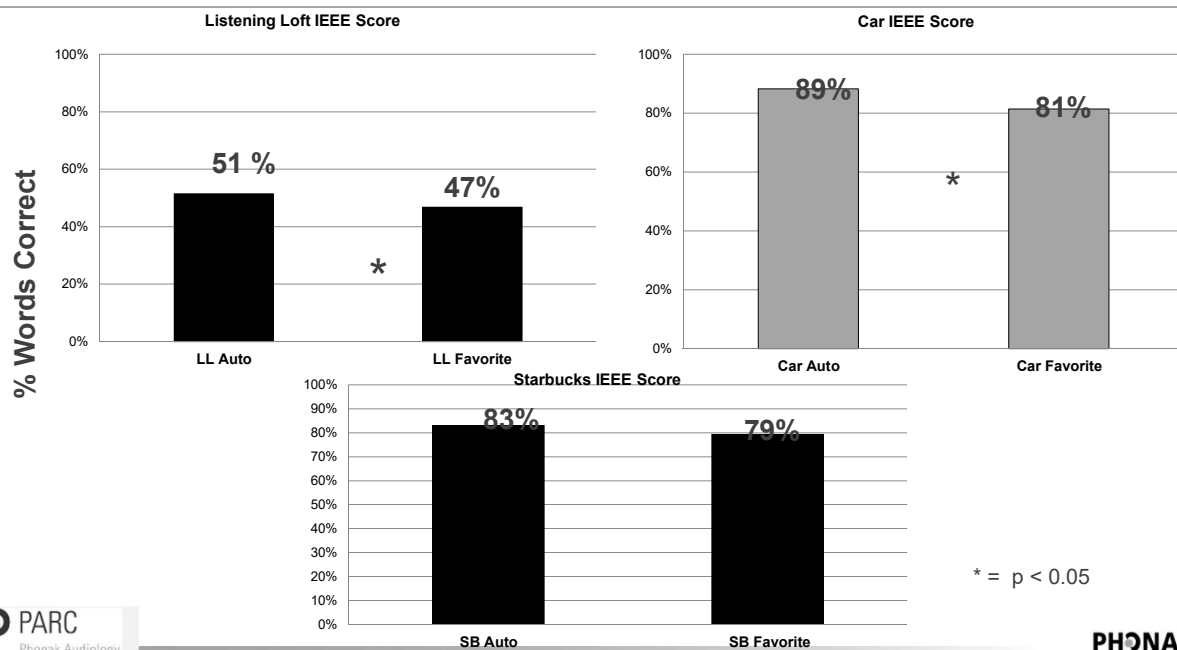
Challenges:

- Road Noise
- Speech from side

Challenges:

- LOTS of noise
- Reverberation

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Study Conclusions

- AutoSense OS is an incredibly powerful and **accurate** scene classification system
- Participants **performed better** in AutoSense OS than their preferred manual program
- Participants **performed better** in AutoSense OS than the “acoustically appropriate” target program
- Participants **preferred AutoSense OS** in all three listening scenes



Automatic Systems: Head to Head

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Study Design

Competitive Automatic Study

Study Design

Double blind repeated measures

Subjects:

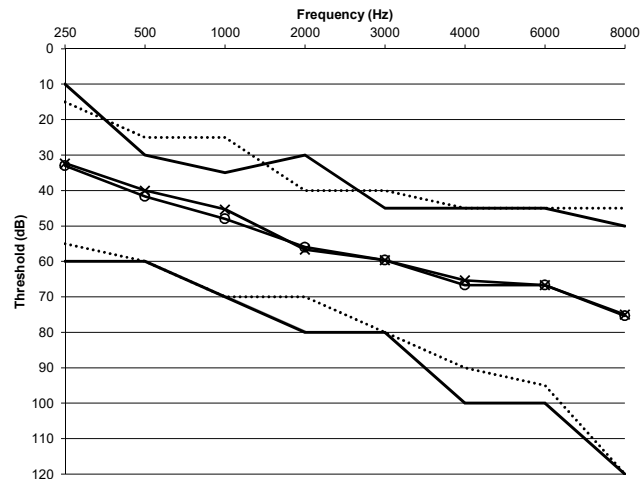
14 subjects

Mild to severe sloping SNHL on average

Hearing aids:

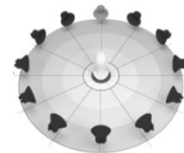
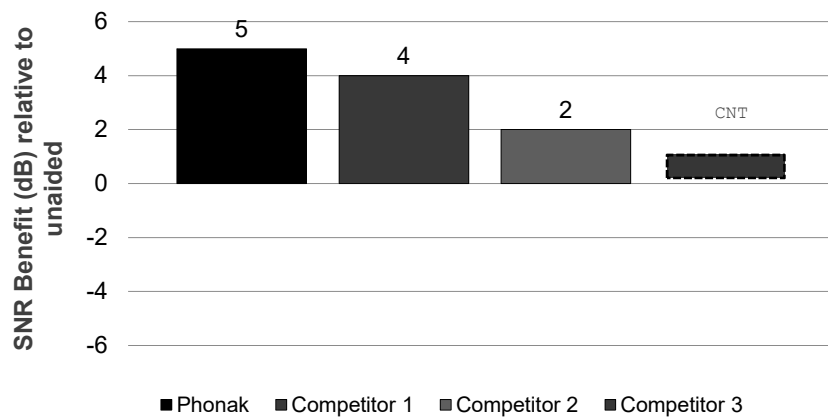
Audéo B 90 and 2 competitors

All fitted to NAL-NL2



Automatic Programs- Noise Stimuli

Average SNR Benefit Across Two Ears



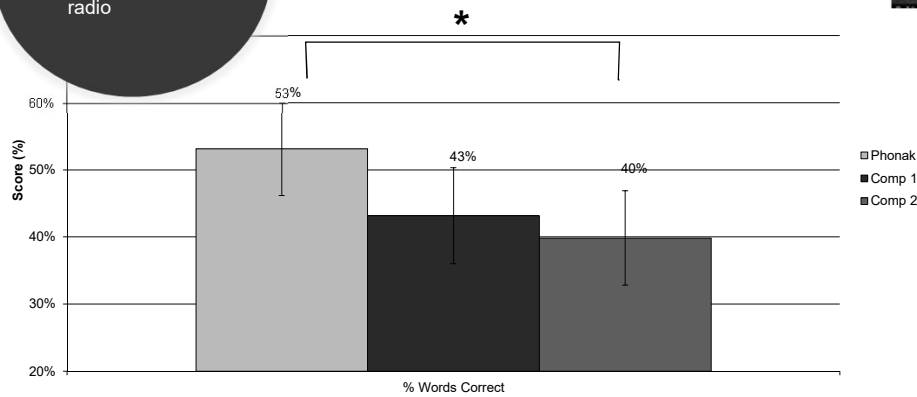
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Speech performance results - CAR

- Speaker from backseat
- 60dB speech babble from radio

IEEE sentences

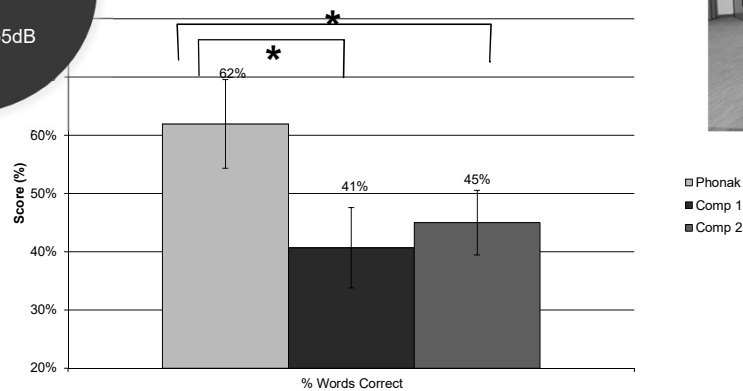


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Speech performance results – COMPLEX ACOUSTICS

- PARC Loft
- 4 corner noise speakers @ 60dB
- Speech @ 65dB
- RT=.8 sec

Word Recognition



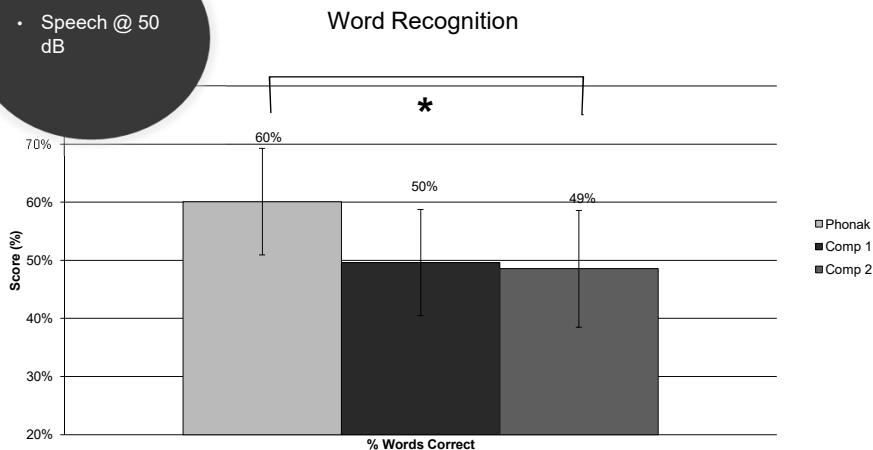
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Speech performance – soft speech

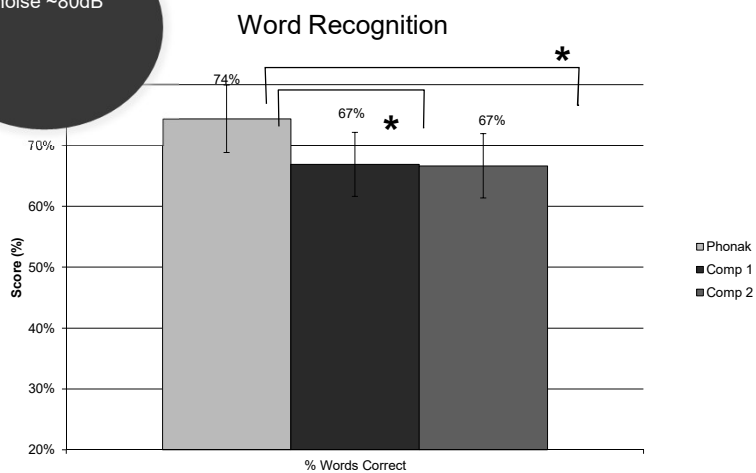
- PARC Loft
- Speech @ 50 dB



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Speech performance – bustling coffee shop

- Ambient noise ~80dB



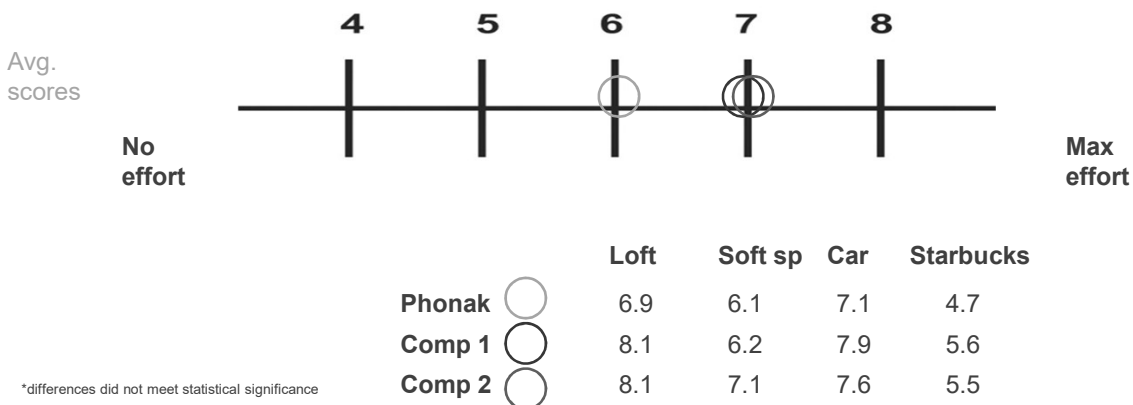
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Listening effort results

In each of the 3 scenes Phonak received the lowest average scores for listening effort*



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Research FINDINGS



20% better speech understanding thanks to the automatic selection of the best setting for everyday listening situations.



Better speech and sound performance in everyday listening situations compared to other automatic technology.



60% improvement in speech understanding by zooming in on a single voice in a noisy environment - versus without hearing aids.



37% reduction in effort when listening to conversations in cars compared to other automatic technologies



Calm 10% improvement in soft speech understanding with our newest products.

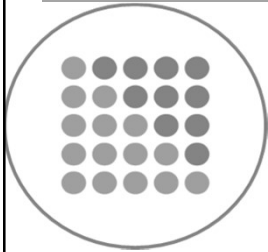


Most natural music experience. Top rated hearing aid for music sound quality.

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AutoSense OS Conclusions

- AutoSense OS is more than just a convenience
- It optimizes hearing performance in real time
- And does this better than any other manufacturer tested

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Does this apply to all Phonak
Hearing Aids?

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Phonak pediatrics mission statement



Phonak **understands the needs and challenges of children**, their families, and the hearing care professionals who work with them. We have developed the **most comprehensive portfolio of solutions and services to provide children of all ages** with the best possible outcomes – truly helping them live their lives to the fullest.

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It is not only size – children listen and learn differently



Children depend more on audibility of high-frequency amplification (Stelmachowicz et al, 2002)



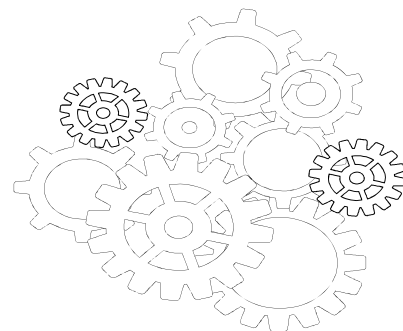
Children need higher signal-to-noise ratio (Hall et al, 2002)



Children need lower reverberation times (Neuman et al, 1983)



Children are less able to make use of context (Nitttrouer & Boothroyd, 1990)

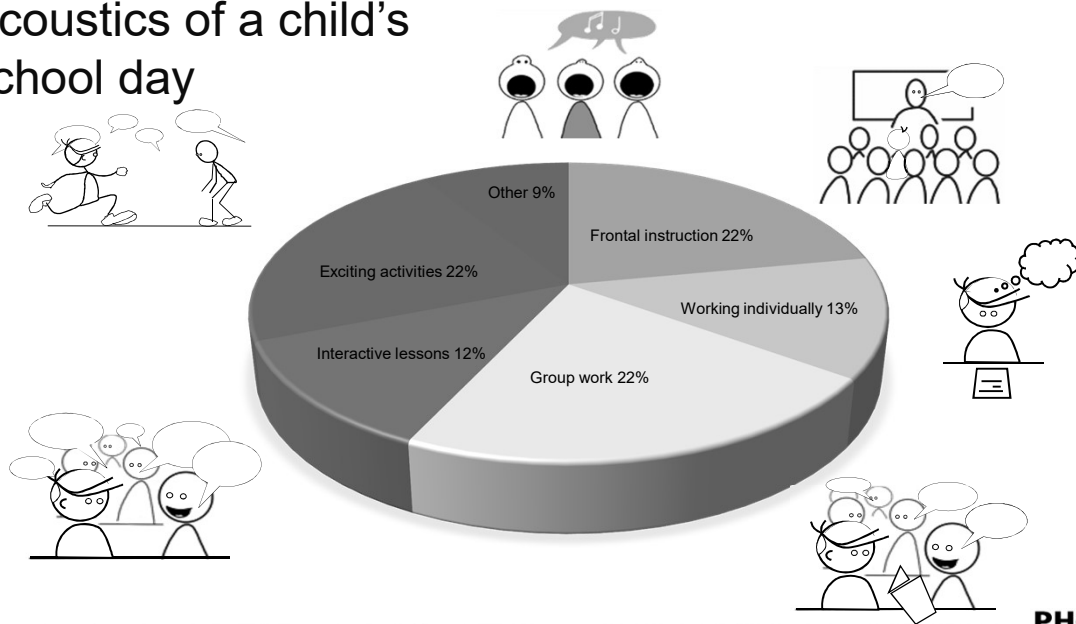


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Acoustics of a child's school day



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AutoSense Sky OS – for the soundscapes of a child's life

Helps to improve understanding during group and peer conversations where Roger is not available

Up to 30% more precise Speech in Noise classification

Activation of directional microphones more often and at lower noise levels

Improving comfort for yelling and shouting throughout a child's day

Up to 39% more precise Comfort in Noise classification

Accurately recognizes yelling and shouting as unwanted noise

Feilner, Rich and Jones (2016) Phonak Insight Automatic and Directional for Kids

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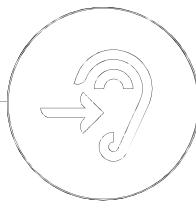
AutosenseOS 3.0: What's New?

The first moment of truth

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New AutoSense OS™ 3.0 – Developed with Artificial Intelligence



New, improved & unique

New pre-calculation delivers exceptional sound quality from the first fit

=

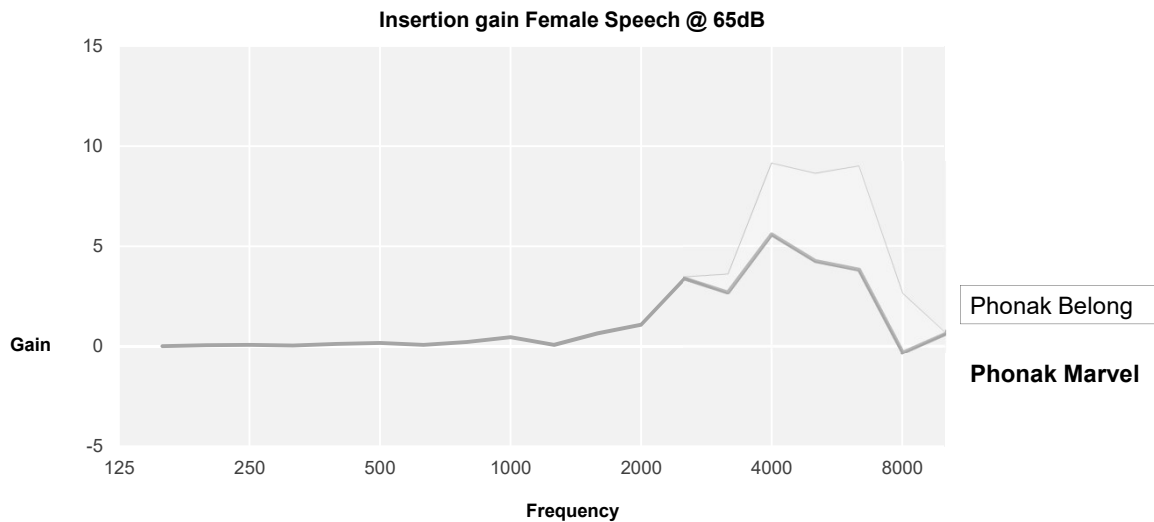
The best first fit Phonak has ever achieved

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New approach for 80% Gain Level

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Marvel vs. Belong - sound quality ratings

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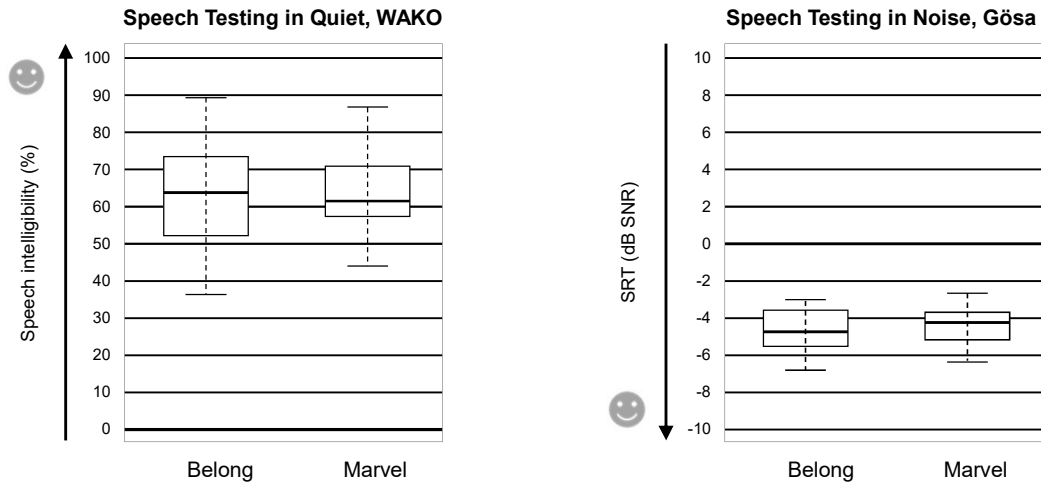
Source: Jansen, S., & Woodward, J. (2018). Love at first sound: the new Phonak precalculation. Phonak Insight

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Excellent speech intelligibility

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Source: Jansen, S., & Woodward, J. (2018). Love at first sound: the new Phonak precalculation. Phonak Insight, October 16th, 2018 (Gain level 80%, N=20)

Everyday life

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New AutoSense OS™ 3.0 – Developed with Artificial Intelligence



New

Enhanced precision in identifying more listening situations

=

More natural listening experience



New

Adaptive compression speed

=

Reduced listening effort in noise



New

Classifies streamed signals

=

Top rated streamed sound quality



New

Advanced vent loss compensation

=

Rich sound experience when streaming

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continued

Clear, rich sound

From the first moment of truth ... in everyday life ...
when hearing gets tough

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Exceptional sound
quality from the
first fit



Better speech
understanding
in noise



Reduced listening
effort in noise



Top rated
streamed sound
quality

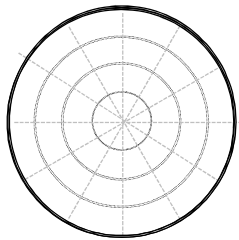
Better speech
understanding in noise

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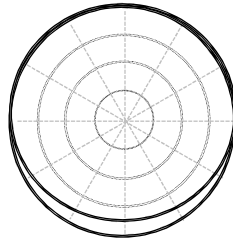
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Phonak Microphone Technology

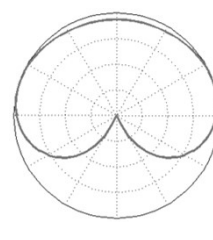
Four different microphone modes, automatically



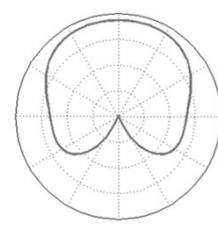
Omni



Real ear sound



UltraZoom

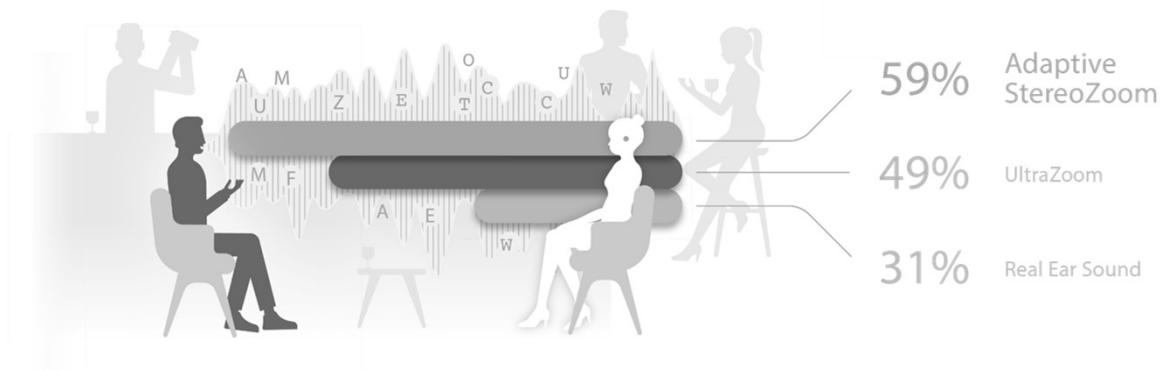


Adaptive StereoZoom

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Better speech understanding in noise

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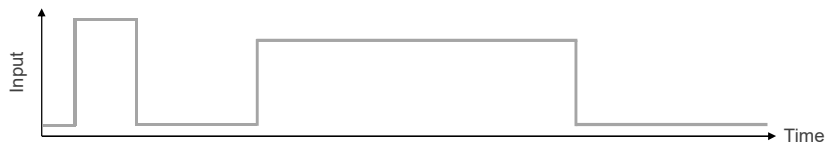
Adaptive compression speed

Compression speed based on listening environments

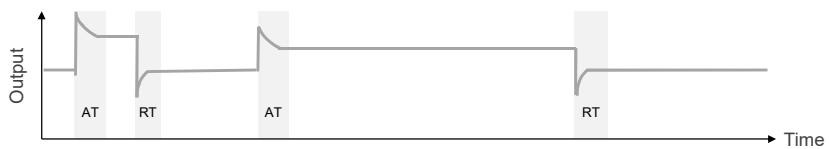
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AT: Attack Time
RT: Release Time

Unamplified Signal



Fast Acting Compression System (FAC)



Slow Acting Compression System (SAC)



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The benefit of slow compression

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Preserves...

- ... differences in sound levels between the ears, maintaining localization cues
- ... intensity and modulation differences speech improving speech intelligibility
- ... the temporal envelope

Reduced listening
effort in noise

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Binaural VoiceStream Technology™

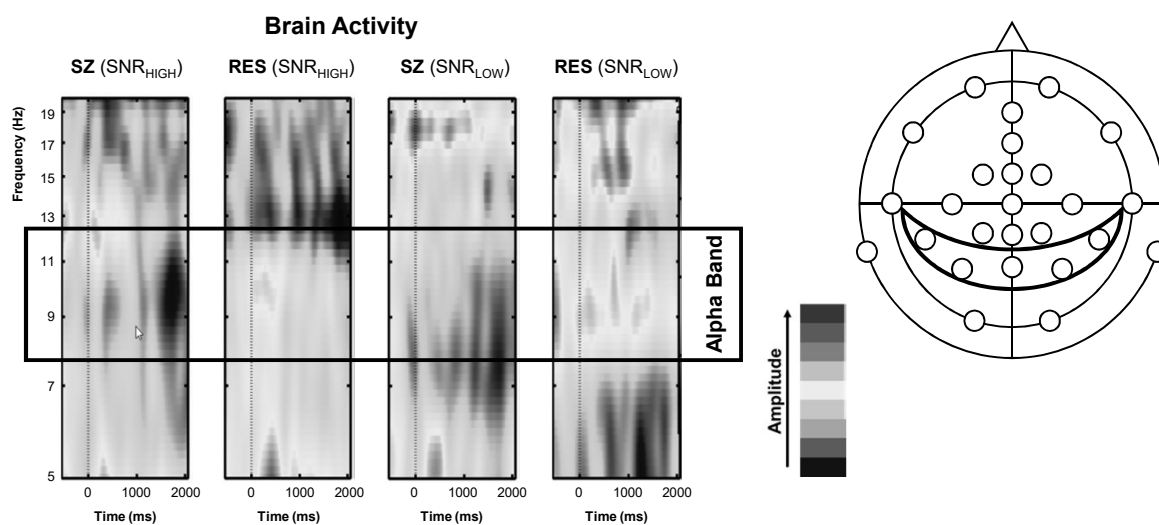
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Full bandwidth audio streaming

EEG study

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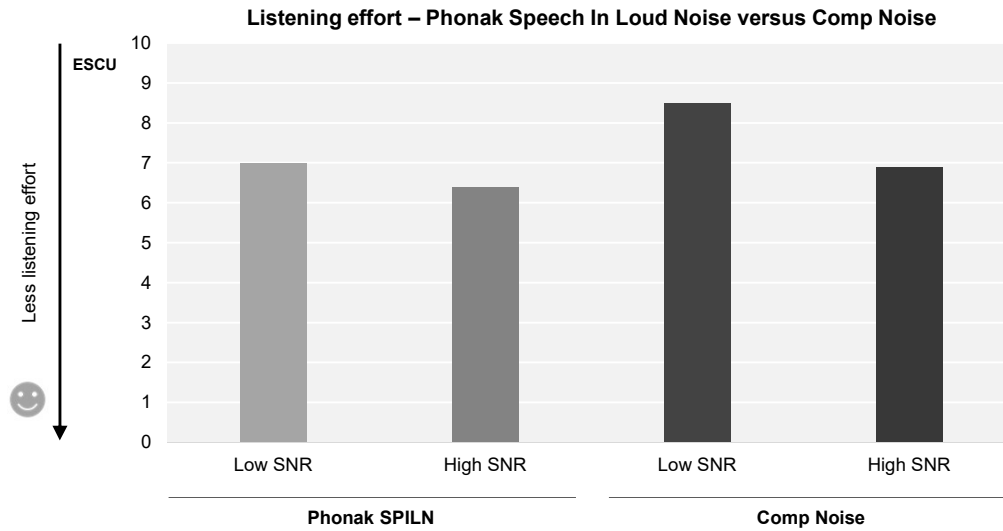
Source: Winneke, A., Latzel, M., & Appleton-Huber, J. (2018). Less listening- and memory effort in noisy situations with StereoZoom. Phonak Field Study News

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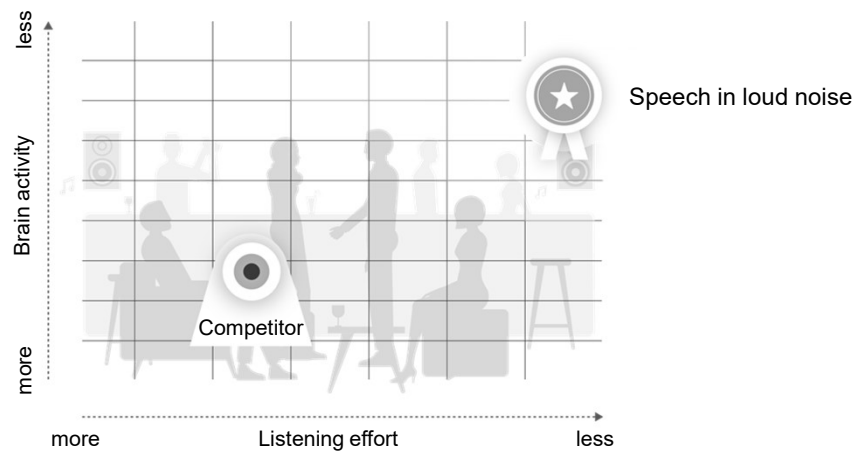
Reduced listening effort

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Reduced listening effort in noise Speech in loud noise vs. Competitor

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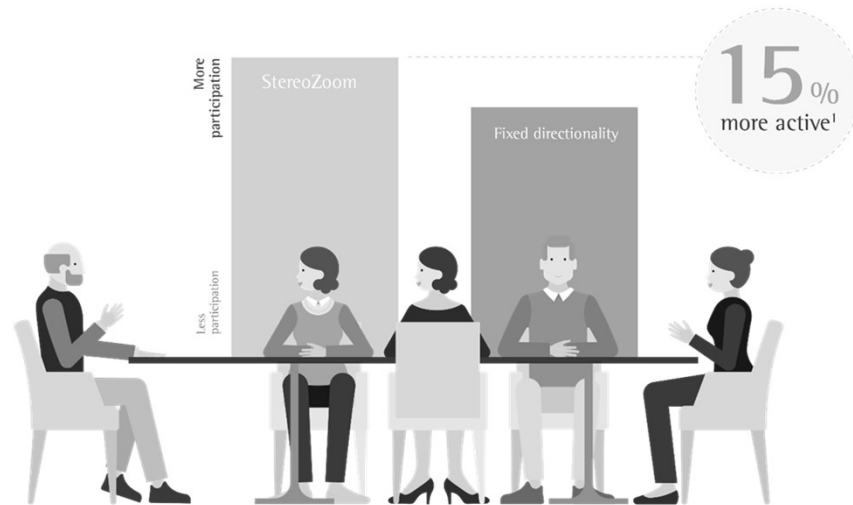


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Video analysis study

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Source: Schulte, M., Meis, M., Krüger, M., Latzel, M., Appleton-Huber, J. (2018). Significant increase in the amount of social interaction when using StereoZoom. Phonak Field Study News.

Top rated streamed sound quality

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How important is television to our patients?

Aspiration

85%

consider hearing well when watching TV as “very important” or “extremely important”

Reality

60%

of hearing aid wearers are less than satisfied with how they hear the television

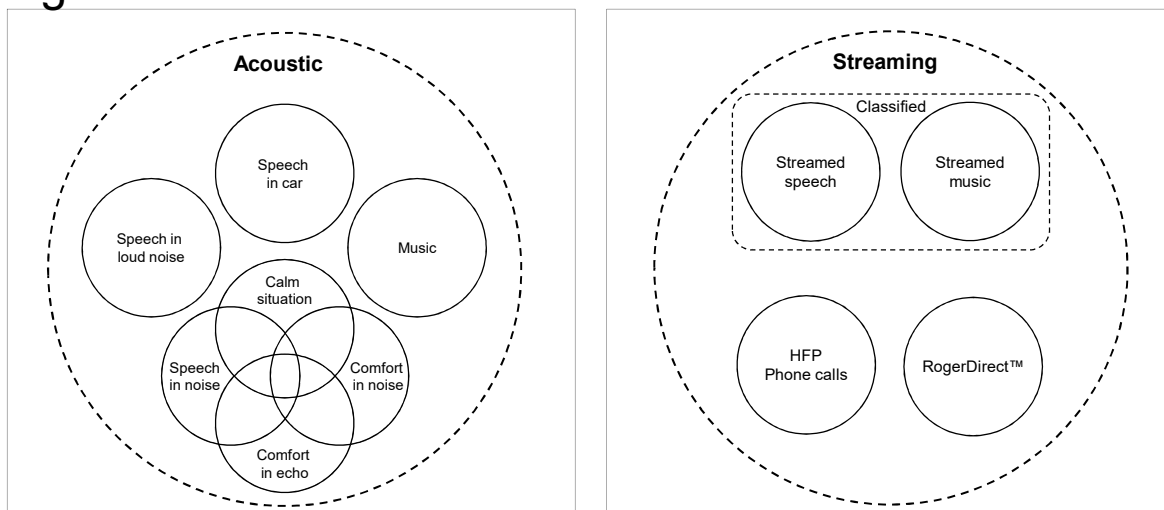
Source: Strelcyk, O., Singh, G., Standaert, L., Rakita, L., Derleth, P., and Launer, S. (2010, August). TV/media listening and hearing aids. Poster session presented at the International Hearing Aid Research Conference, Lake Tahoe, CA.

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With Marvel - Classification of streamed input signals

AutoSense OS™ 3.0

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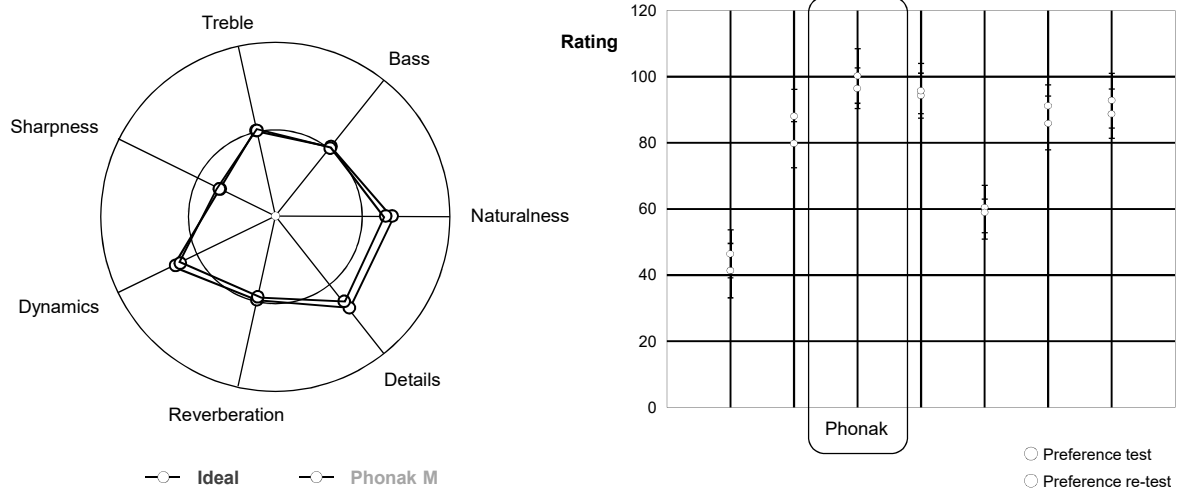


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Top rated streamed sound quality

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Connectivity with Clear Sound Quality

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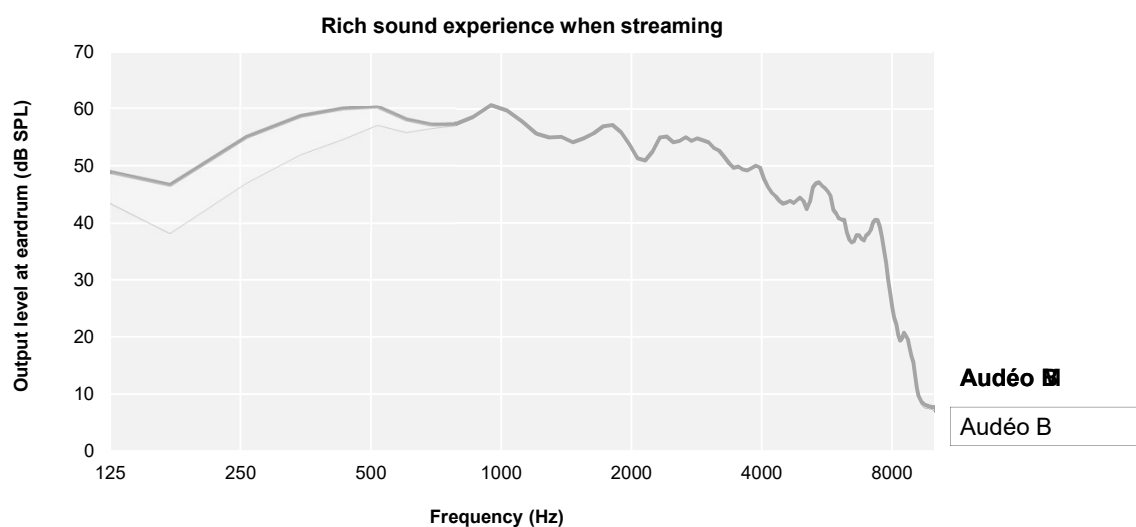
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Advanced Vent Loss Compensation

Dual path processing of Vent loss compensation

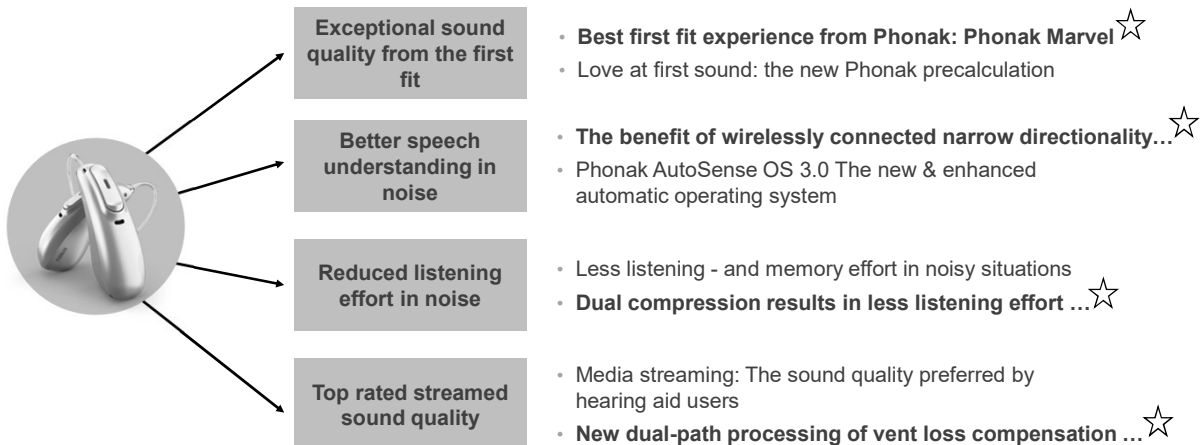
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Clear, rich sound: From the first moment of truth to when hearing gets tough



Field study news and Phonak Insights available on phonakpro.com/evidence

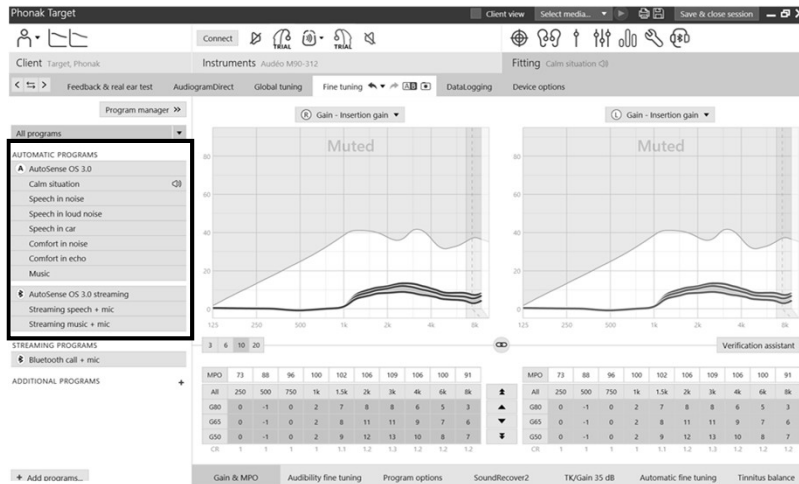
Target 6.0.2

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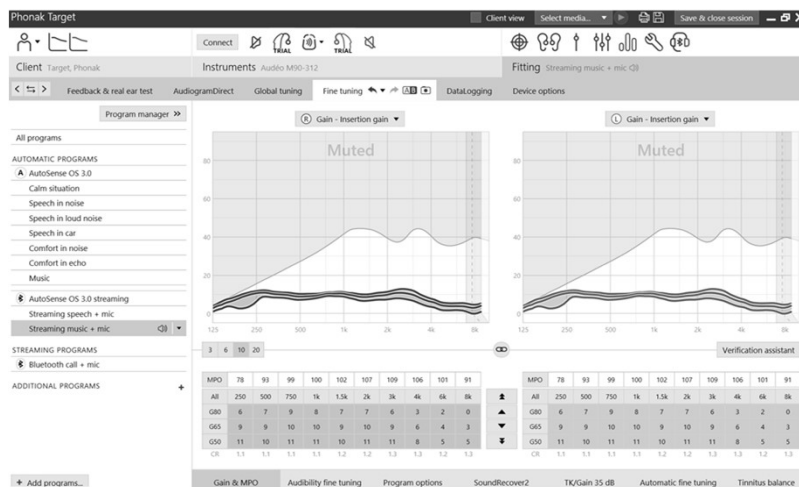
AutoSense OS 3.0: overall structure

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AutoSense OS 3.0: streaming structure

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What do your peers think?

95% would recommend Audéo Marvel to other hearing care professionals

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9 out of 10 hearing care professionals report:

“Audéo Marvel provides first time users with exceptional sound quality from the first fit.”



The biggest advantage of Audéo Marvel is combining rechargeability and connectivity without compromising on sound quality.

stated by **92%**

Phonak B2B survey, January 2019, Canada, Germany, USA, n=204

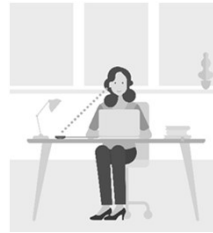
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"I would recommend Audéo Marvel over other brands to my patients for connectivity to their smartphones, TV's and more."



reported by
84%



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83%
confirm

Audéo Marvel combines exceptional sound quality from the first fit with better speech understanding in noisy situations.



Phonak B2B survey, January 2019, Canada, Germany, USA, n=204

Audéo Marvel

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Fall 2019 Audéo M-RT

Audéo M-312

Audéo M-R

New Audéo M-312T

New Audéo M-13T



RIC SecureFit
(Silicone)

SlimTip Acrylic

New SlimTip Titanium



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In Summary...

**Together,
we change lives**

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