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Optimizing Performance in Noise: A Review of the Evidence Supporting Signia's AX Split Processing

Presented by
Brian Taylor, AuD

Learning Objectives

- After this course, participants will be able to describe the unique properties of split-band processing.
- After this course, participants will be able to describe the wearer advantages of split-band processing.
- After this course, participants will be able to describe the research underpinning the effectiveness of split-band processing.

Disclosures

BRIAN TAYLOR, AuD

Senior Director, Audiology, Signia

- Editor, Audiology Practices (ADA)
- Editor-at-Large, HHTM blog
- Adjunct Instructor, University of Wisconsin



Overarching Objective

- Apply your knowledge of research to promote trust and create confidence with patients

Putting the “R” into R & D

- Signia has a **30-plus year** legacy of research that supports each launch
- 3 locations – **Germany**, **Sweden** and **US** – where internal research is conducted
- Over past **10 years**....
 - More than 50 white papers, trade journal publications, peer reviewed papers, scientific podiums
 - Google “Signia Scientific Library”

Signia has a great team of independent researchers who have served as the principal investigators for nearly all projects



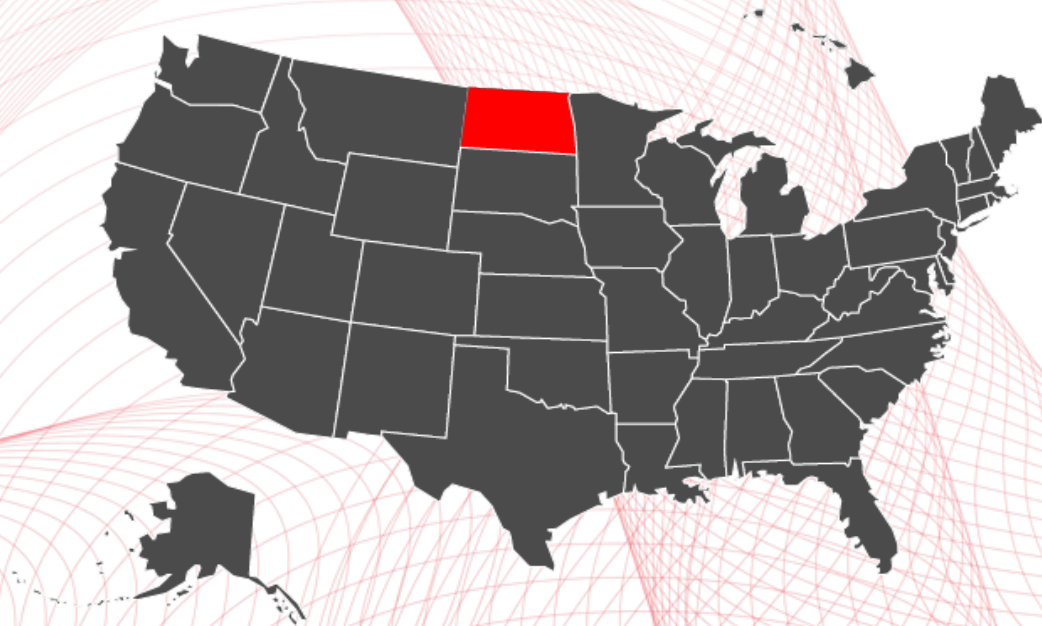
Key People from the Past Few Years



And There are More...



Special Acknowledgement



Gus Mueller, PhD
31 years, independent consultant

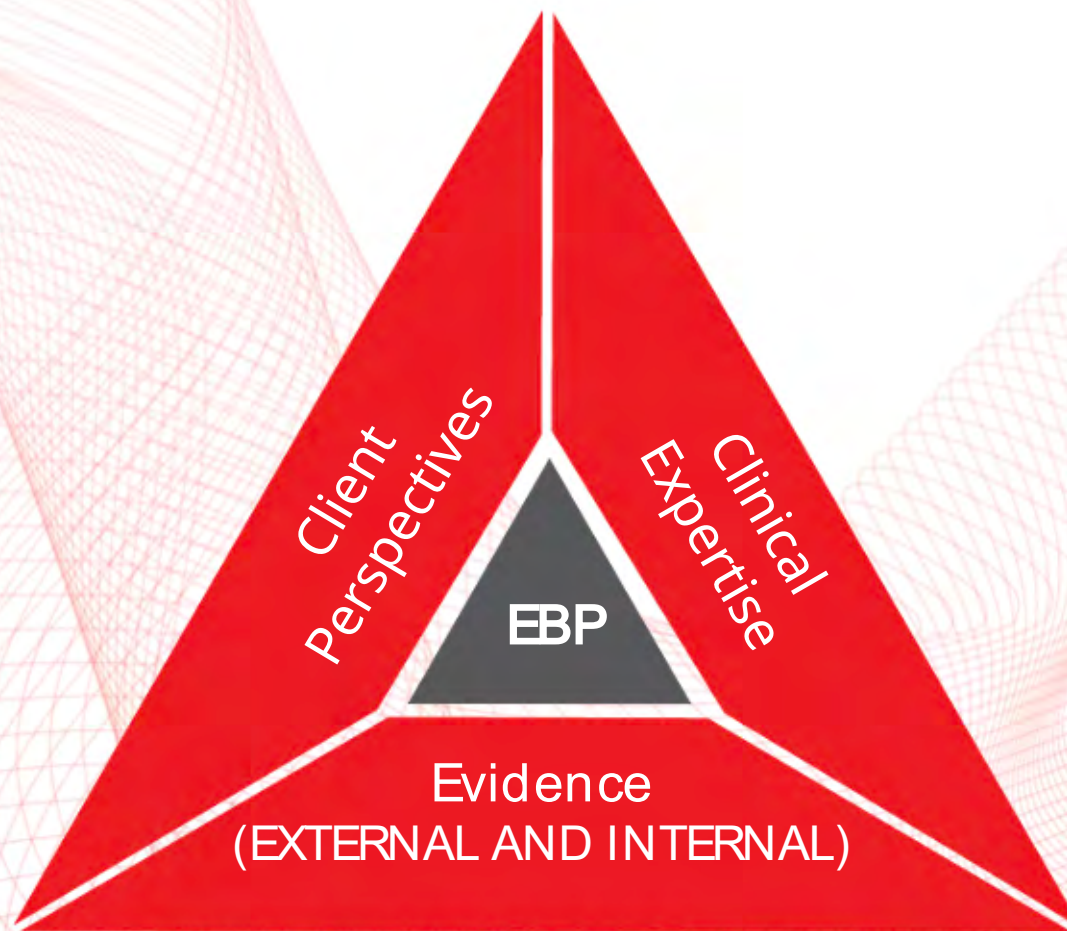
Why is Research Important to You?

Decisions, Decisions, Decisions

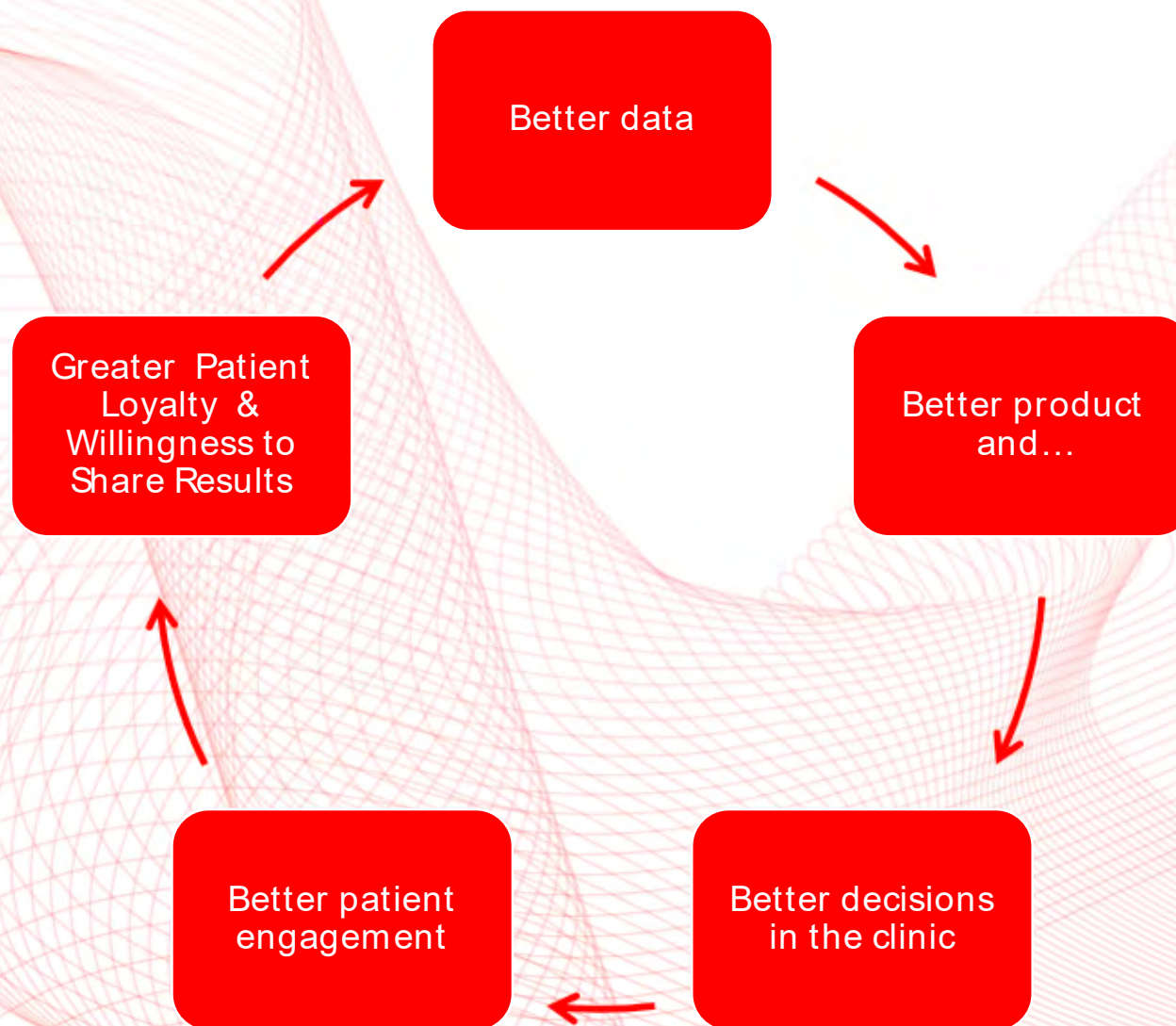
- What style?
- Direct streaming?
- What type of coupling system?
- Level of technology?
- Level of follow-up service?
- What type of noise reduction technology?



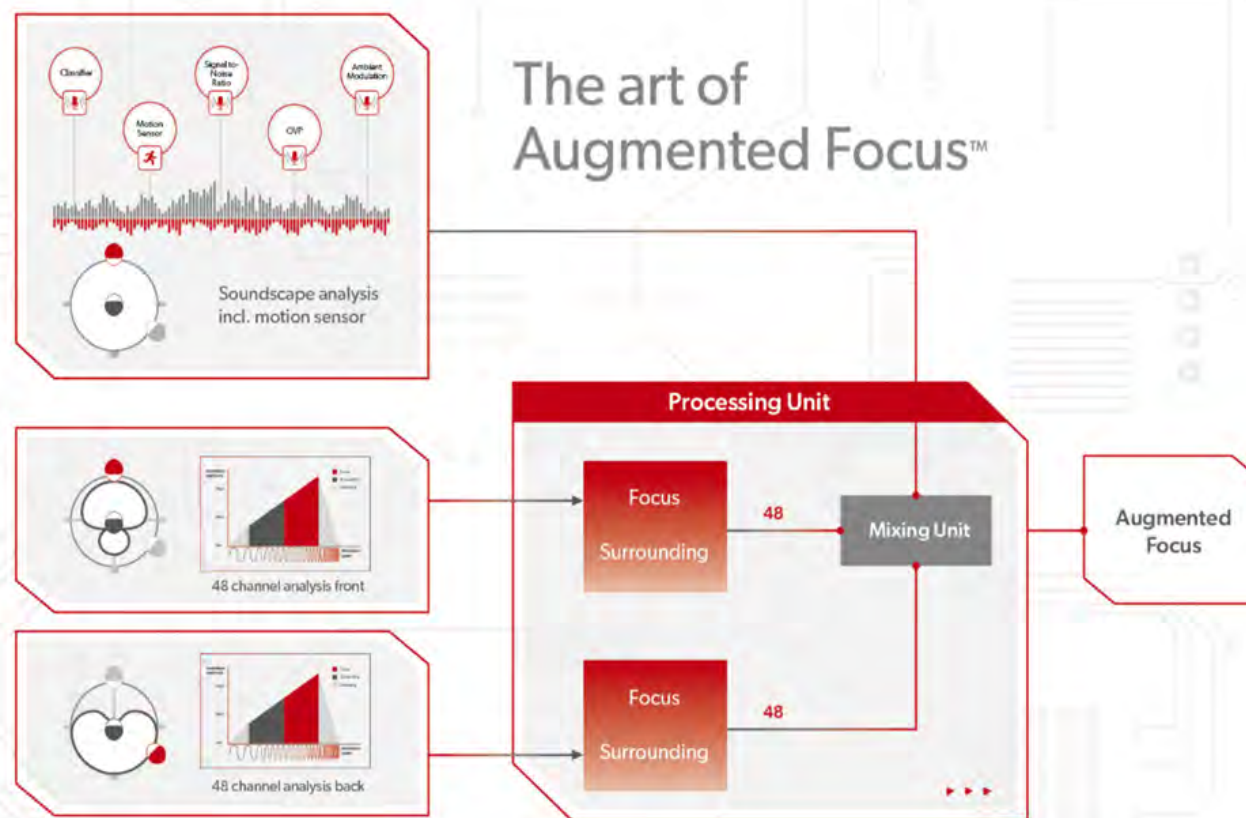
How Decisions Get Made?



Research is a Virtuous Cycle



When a New, Unique Feature Comes to Market...



Product Claims

- “94% of wearers reported excellent speech intelligibility with Signia AX”

Product Claims



Promote Trust



Create Confidence

Questions You Should be Asking about AX

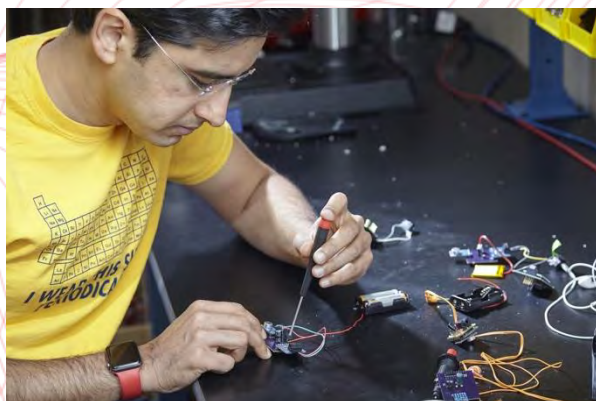
- Does it work?
- Is it unique?
- Is it effective?
- Is it better?



Progression of Evidence

Questions we are trying to answer:

- Is it worth commercializing?
- Is it different than what's available?
- How does it work?



The work of engineers



Benchtop: Proof of concept

Progression of Evidence



Benchtop:
Proof of concept



Laboratory:
Proof that it works in ideal conditions

Progression of Evidence

Questions we are trying to answer:

- Does it work under ideal conditions, simulated in a lab?



Laboratory:

Proof that it works in ideal conditions



The work of hearing aid researchers

Progression of Evidence



Benchtop:
Proof of concept



Laboratory:
Proof that it works in ideal conditions



Real-world:
Proof that it works in daily life

Progression of Evidence

Question we are trying to answer:

- Does it work in everyday conditions, experienced by typical wearer?



Real-world:
Proof that it works in daily life



The work of clinical research audiologists

Why Does It Matter?



Benchtop:
Proof of concept



Laboratory:
Proof that it works in ideal conditions



Real-world:
Proof that it works in daily life

In Places Where Patients Want to Hear Better...



Promote Trust



Create Confidence

Dining in Your Favorite Popular Restaurant



NIOSH Sound Level
Meter



Acoustically Challenging Social Situations



How Do Wearers Judge Success?

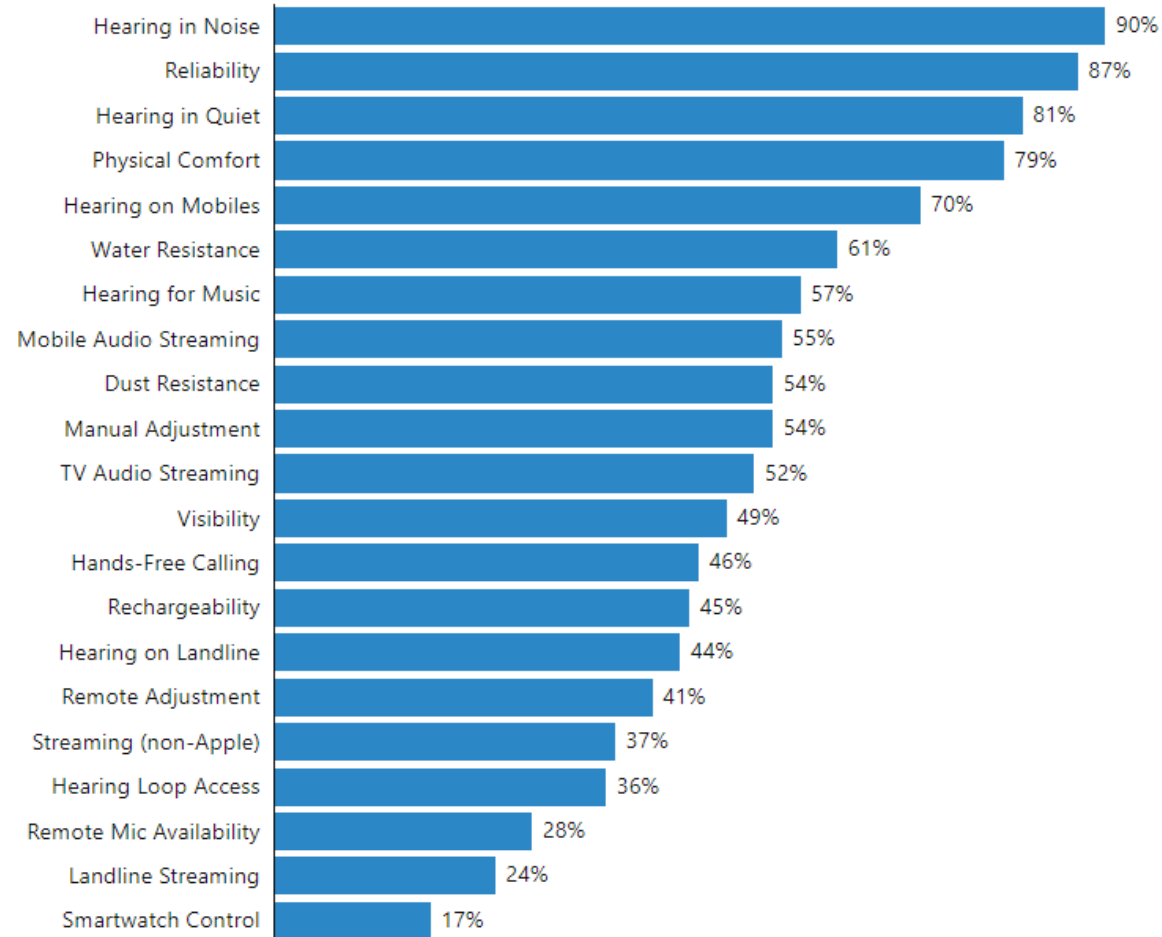
Performance in Background Noise

One of Many Surveys...

Manchaiah V, Picou EM, Bailey A, Rodrigo H (2021)

Hearing Aid Preferences in 2021

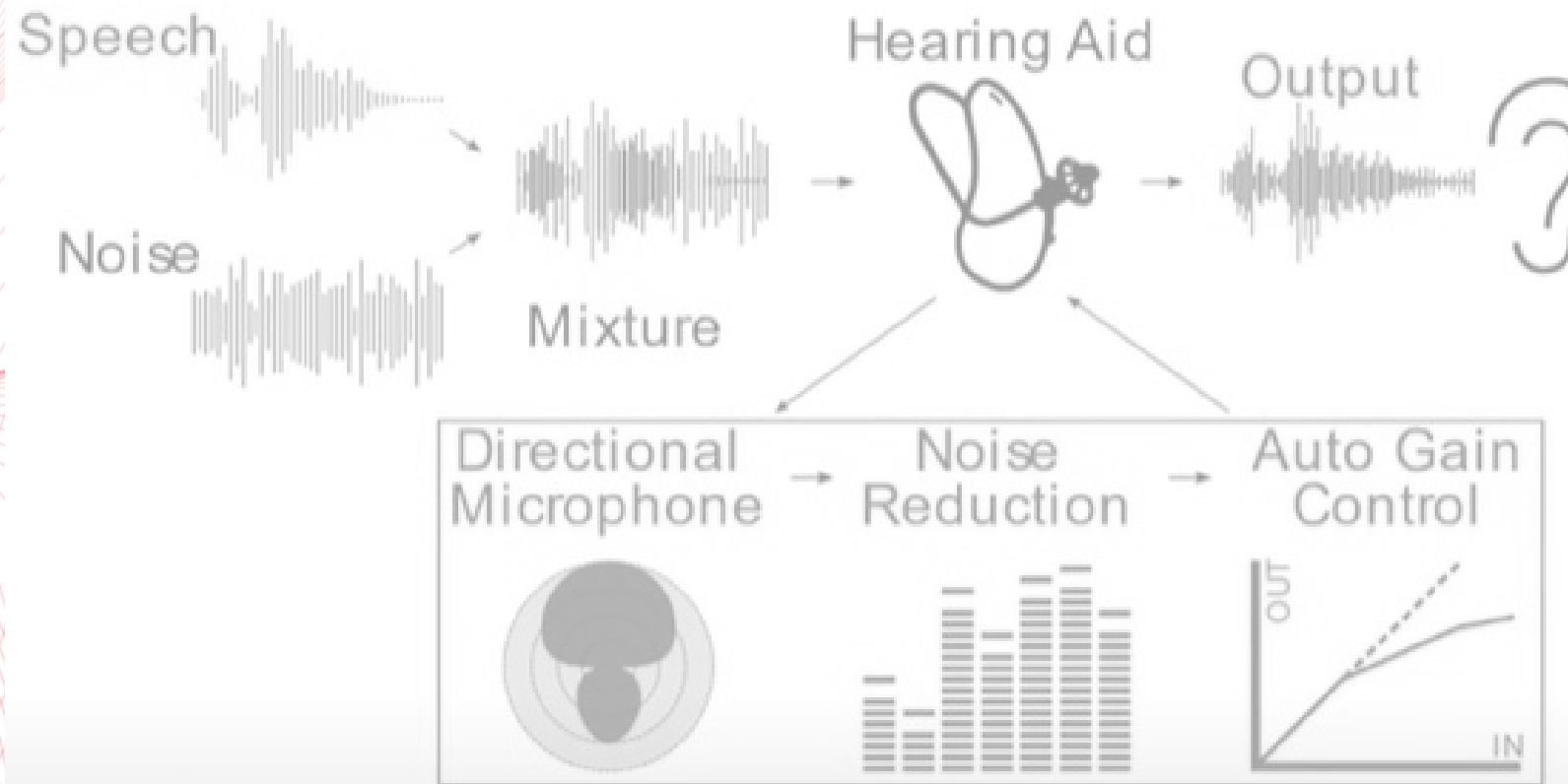
Importance ratings from over 15,000 people



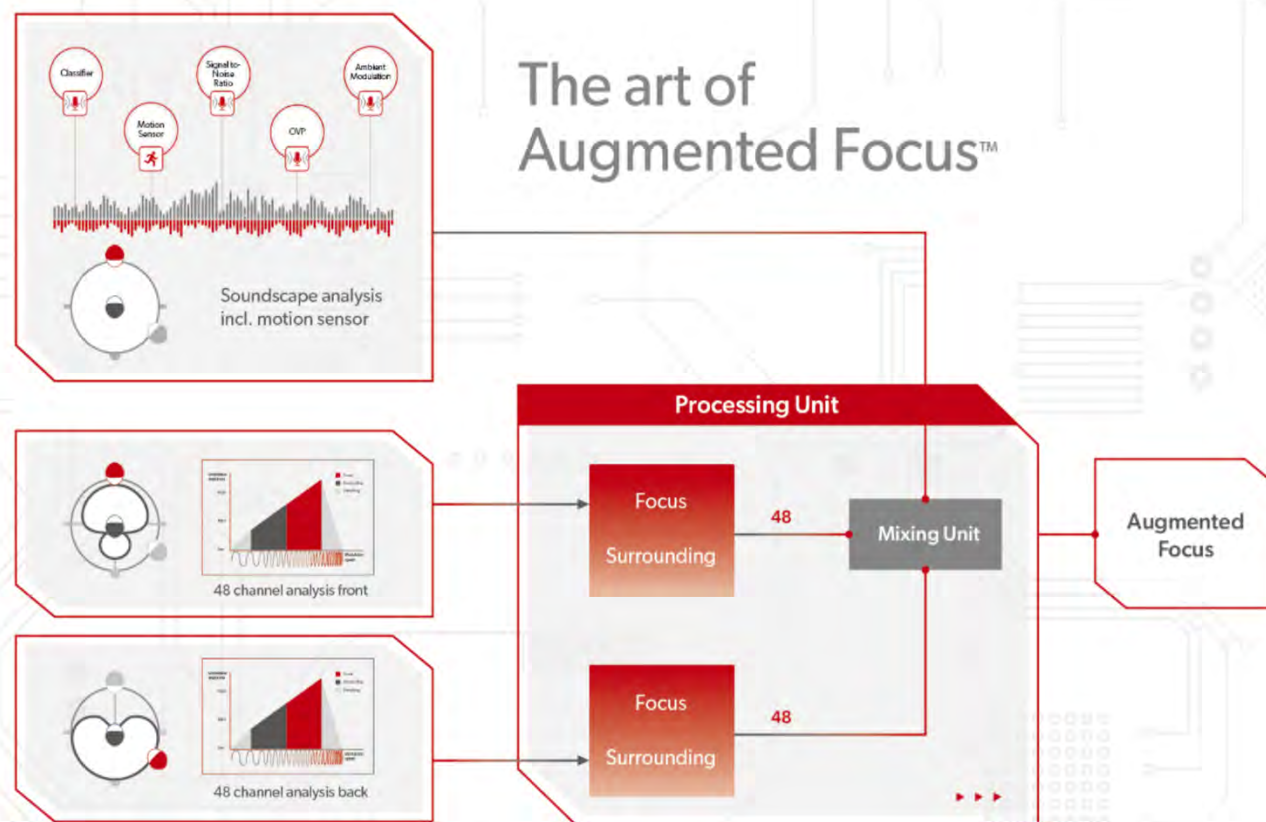
HEARING TRACKER » SOURCE: HEARINGTRACKER.COM

How Have Hearing Aids Traditionally Approached this Problem?

TRADITIONAL HEARING AID APPROACH



What Makes AX's Split-band Processing Different?



How Do We Know AX is Different than Traditional Approaches?



Electrophysiologic



Electroacoustic

Benchmark Studies

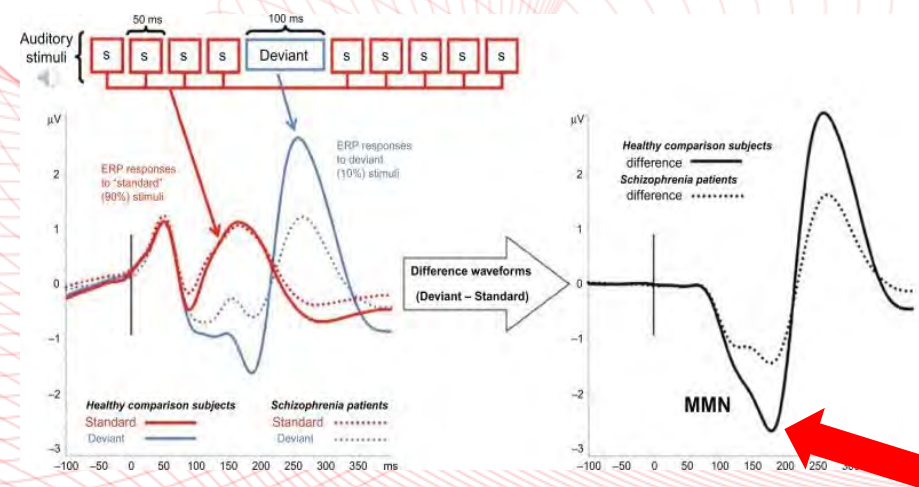
Proof that AX is Different. Study #1, Electrophysiologic

Proof that AX is Different. Study #1

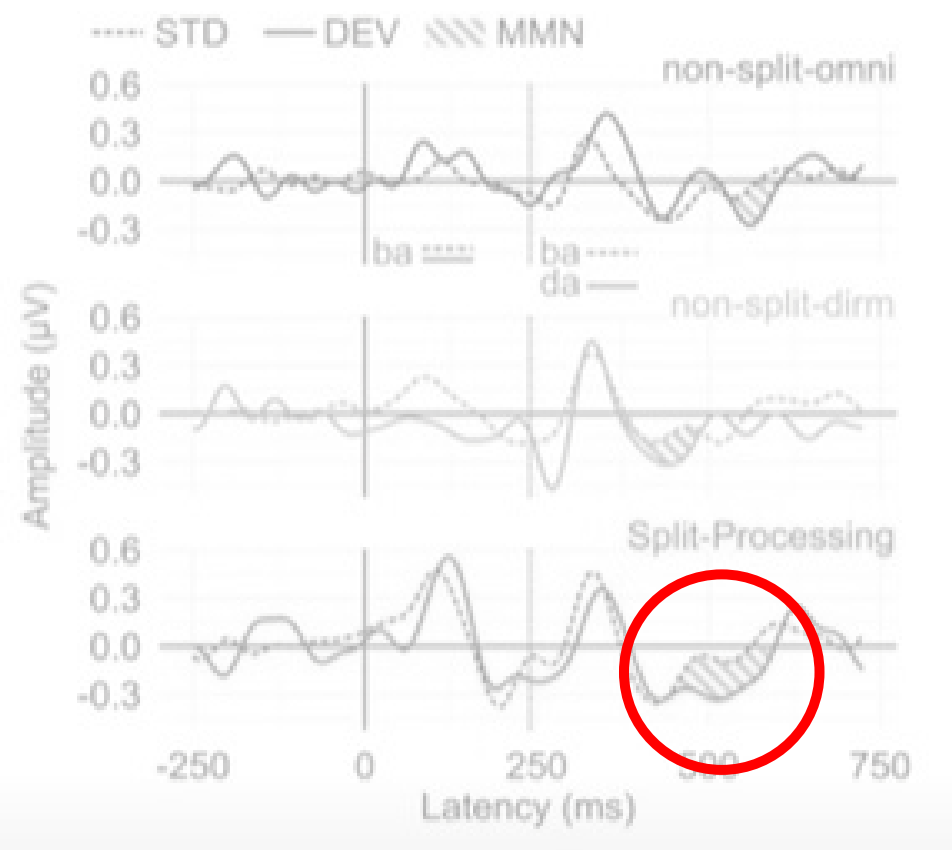
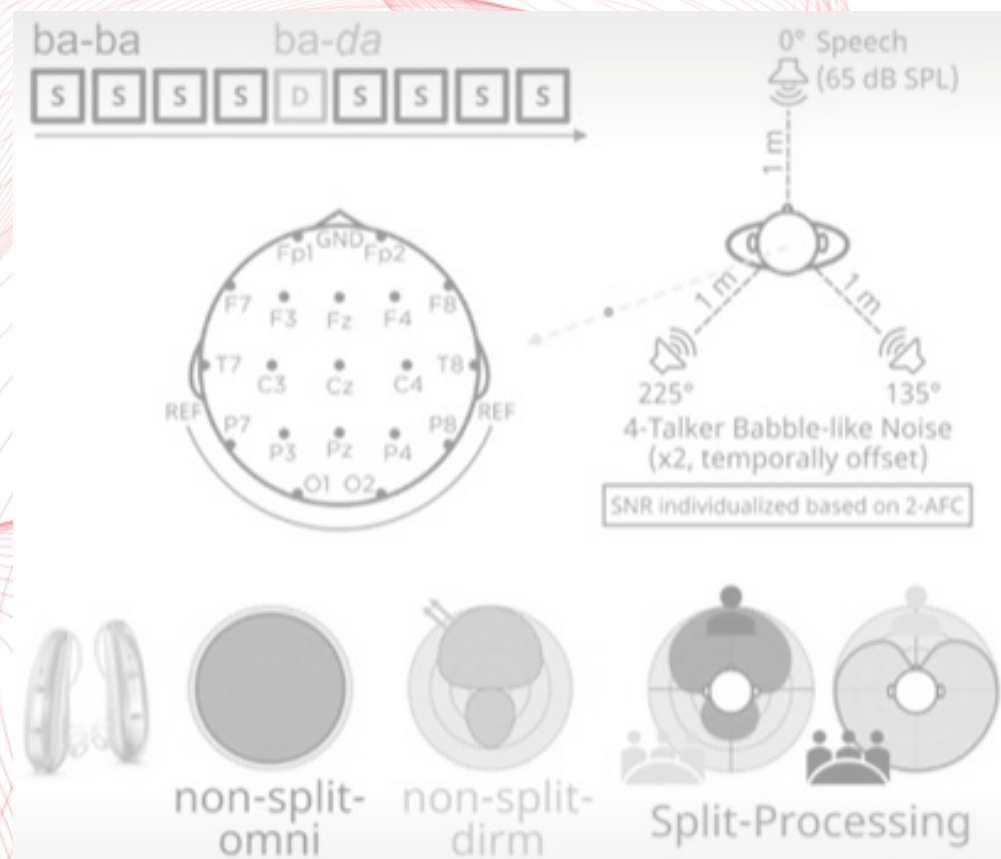
- Published in Hearing Review, Sept 2021
- Mis-match Negativity Response (MMN)

Question addressed:

- Does split processing enhance changes in the wearer's soundscape compared to other processing schemes?



Study Design and Results



Does Split Processing Enhance Changes in The Wearer's
Soundscape Compared To Other Processing Schemes?

YES!

Proof that AX is Different. Study #2, Electroacoustic

Proof that AX is Different

- Published at AO, April 2022
- Electroacoustic measures on the KEMAR (SPL at eardrum)

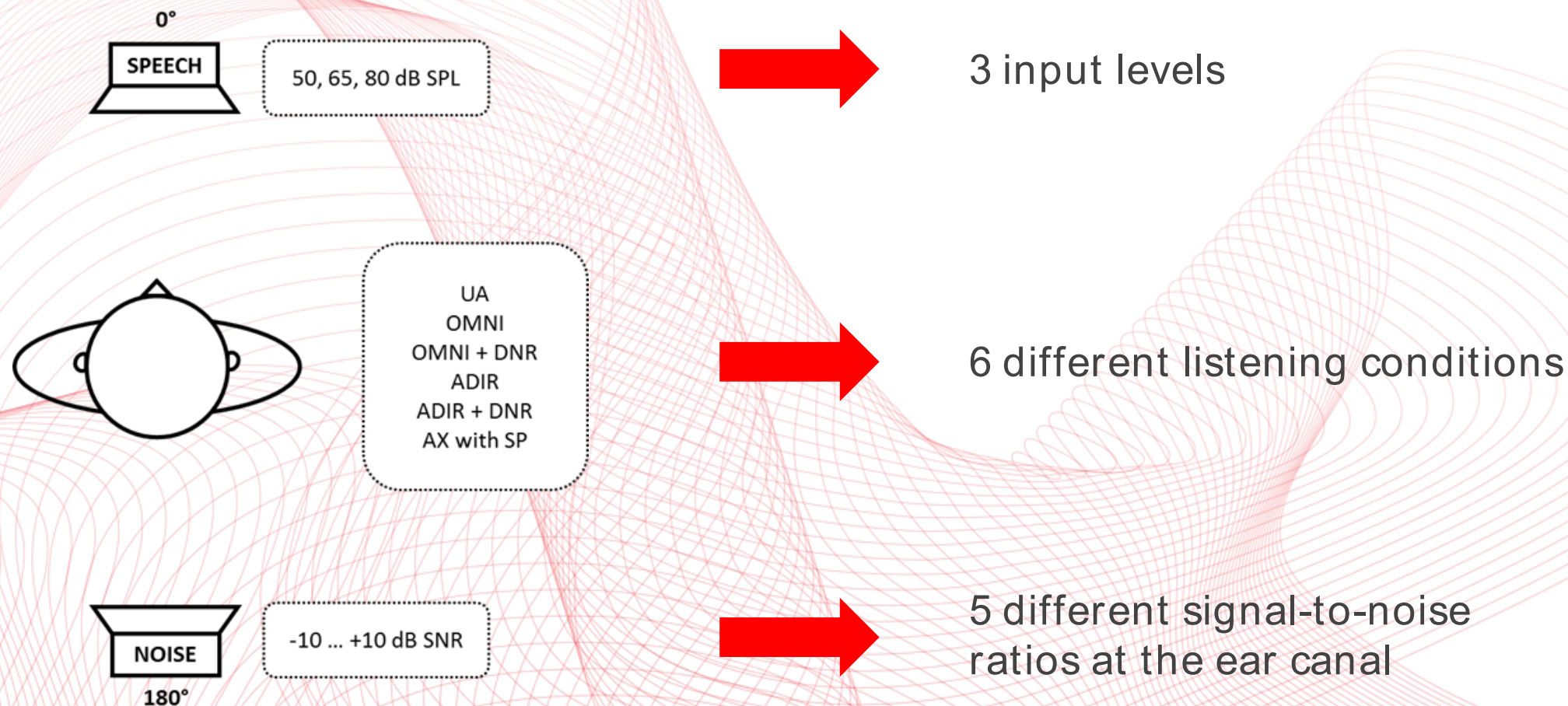
Question addressed:

Does split processing improve the overall SNR more than other types of noise reduction technology?

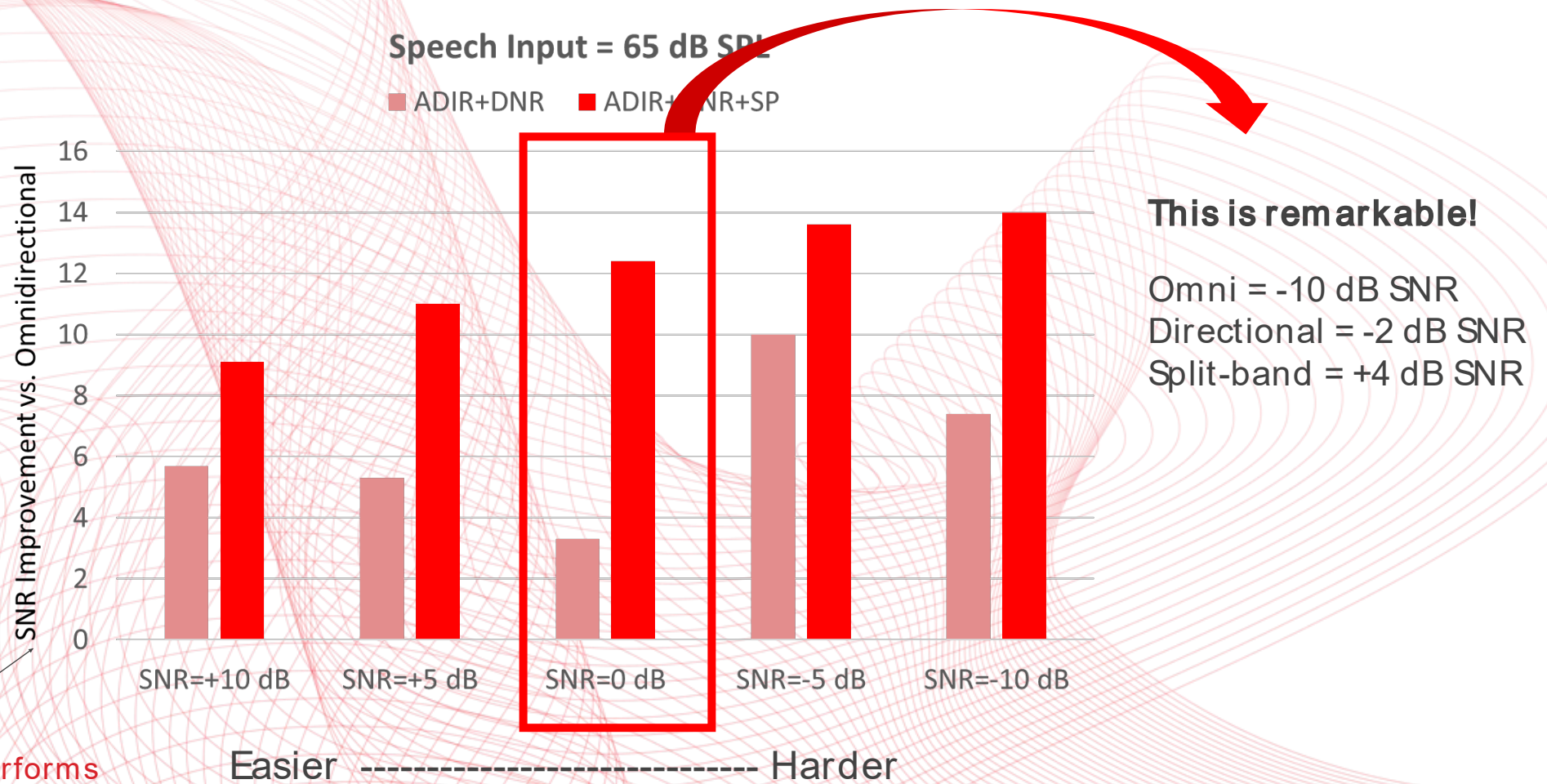


Petri Korhonen, Senior Scientist

Study Design and Results



Study Design and Results



Does Split Processing Enhance Changes in The Wearer's
Soundscape Compared To Other Processing Schemes?

YES!

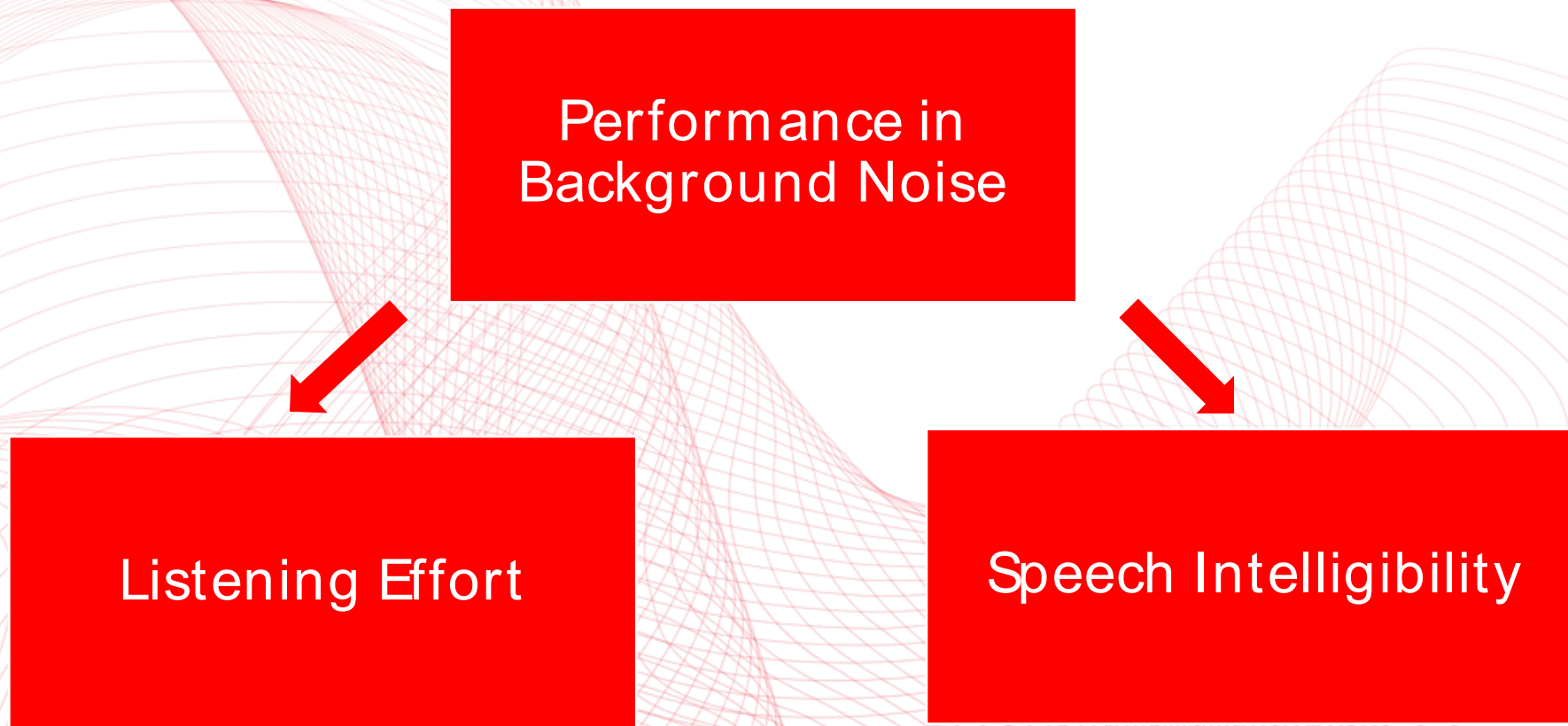
Best results in the most adverse conditions!

JUST BECAUSE YOU ARE UNIQUE

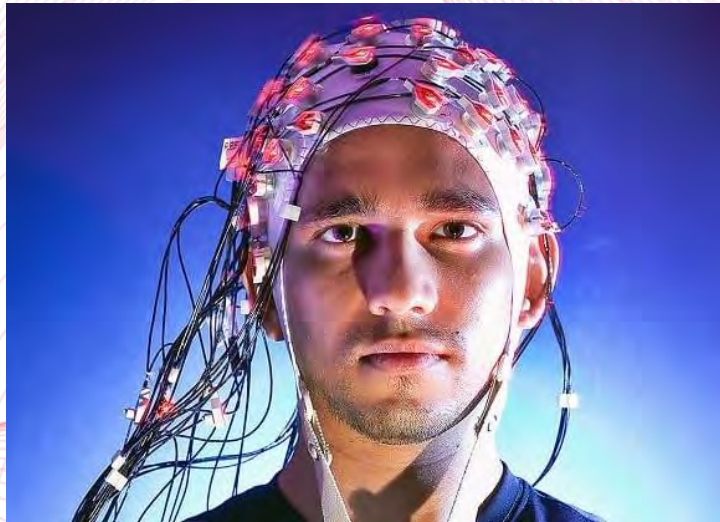


DOES NOT MEAN YOU ARE USEFUL

How Do Wearers Judge Success?



How Do We Know AX is Better than Traditional Approaches?



Electrophysiologic



Lab-based Behavioral



Real-World Self-Reports

Proof that AX is Better.

Study #3, Alpha EEG Activity

- Hearing Review, May 2022
- Alpha-band EEG activity of adults performing a speech in noise listening task

Question asked:

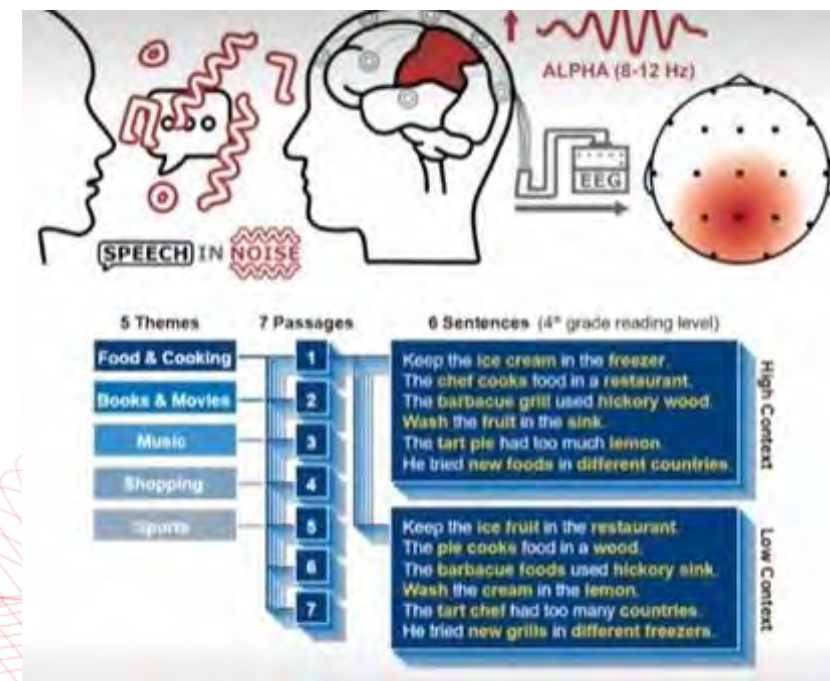
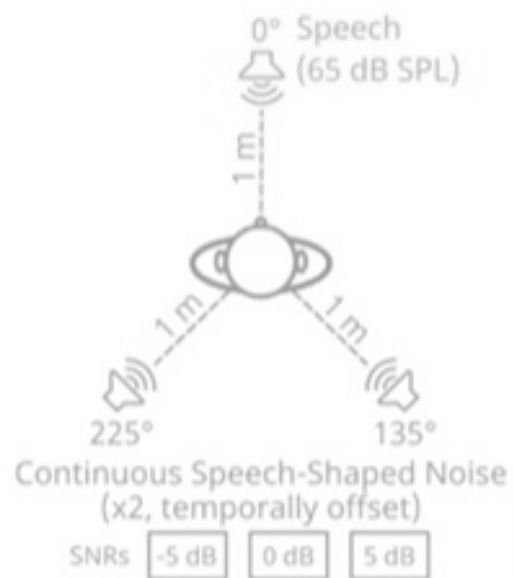
Does split processing reduce alpha wave EEG activity (a proxy for listening effort) compared to other processing schemes?



Christopher Slugocki
Research Neuroscientist

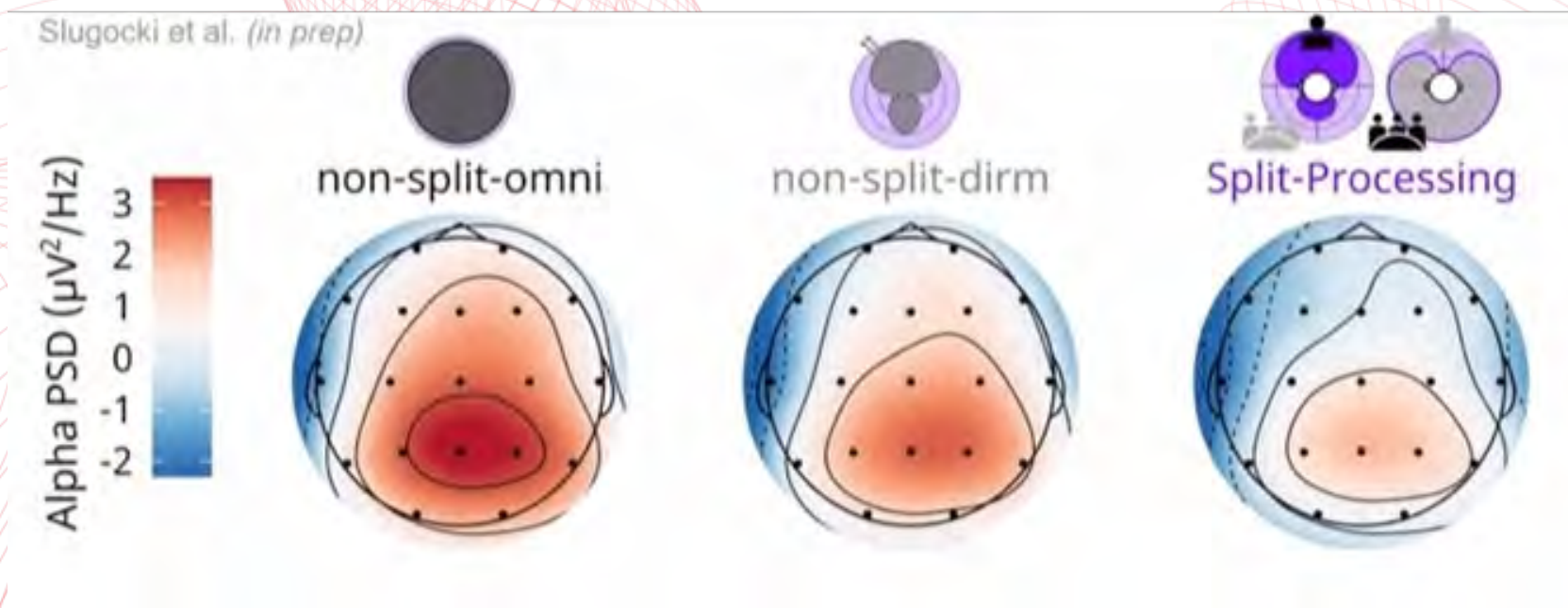
Study Design

- Posterior alpha waves are greater when listening is more effortful
- Repeat-Recall Test



Results

- Split processing significantly reduces alpha-band EEG activity compared to traditional directional technology.
- Improved listening effort is associated with use of split processing.



Do Wearers Actually Experience the AX Difference?



Electrophysiologic:
While performing a task

Simulated noisy conditions

Proof that AX is Better.

Study #4, Listening Effort

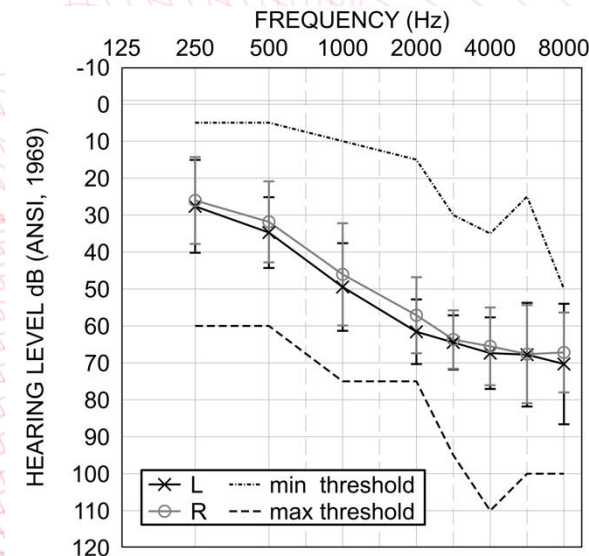
- IJA, Dec 2021
- Lab-based study of noise tolerance

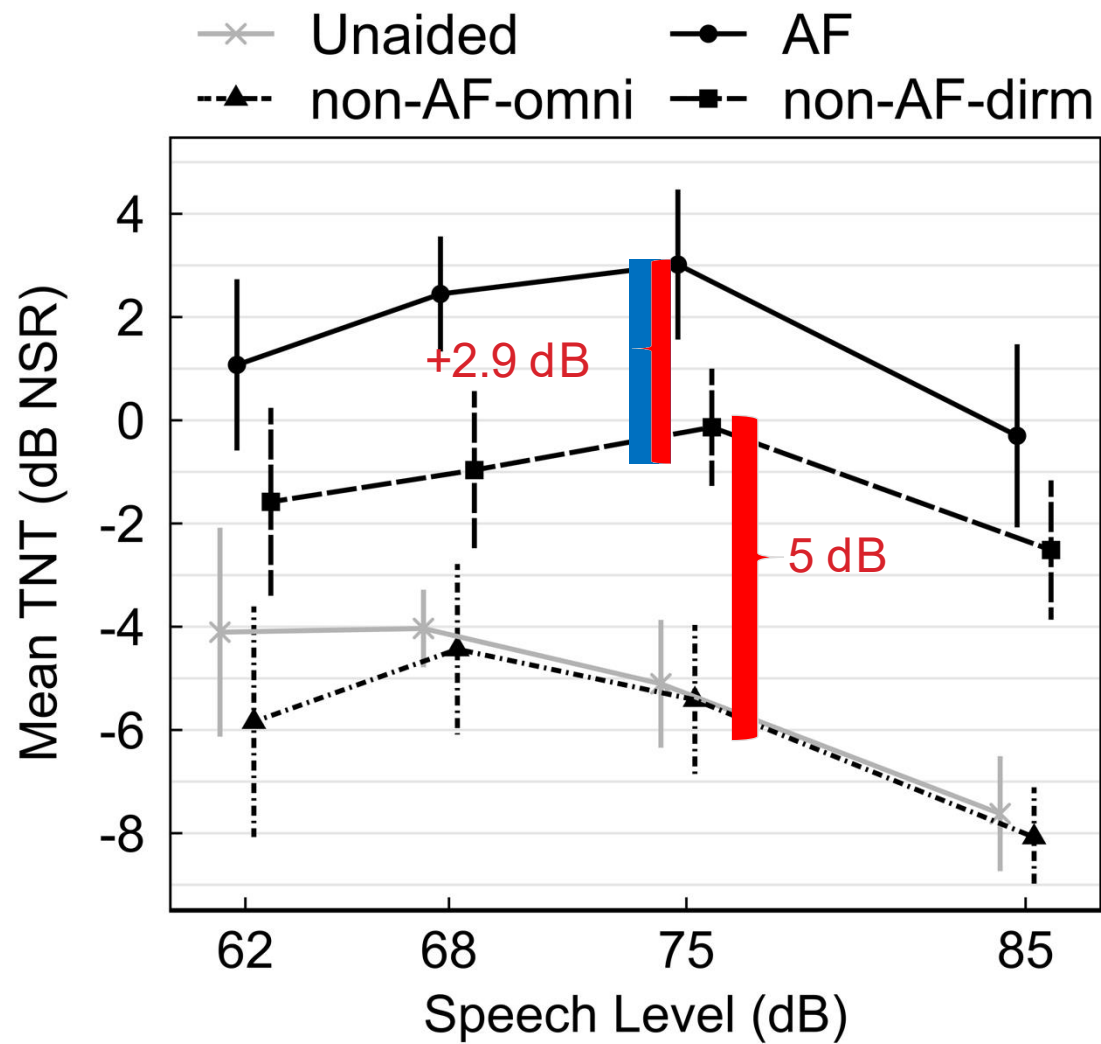
Question asked:

- Does split processing reduce listening effort in a controlled condition more than traditional processing schemes?

Study Design

- 19 listeners with mild to moderate hearing loss
- Tested in booth
- Fitted bilaterally, matched to NAL-NL2 targets in 4 conditions:
 - Unaided
 - Omnidirectional + DNR (non-AF)
 - Directional +DNR (non-AF)
 - Directional +DNR + Augmented Focus
- Speech at four levels (62-, 68-, 75-, and 85-dB SPL) from zero degrees azimuth
- Continuous speech-shaped noise from 180 degrees, presented adaptively
- Used Tracking of Noise Tolerance (TNT) test to measure tolerance of sounds





AX wearers can tolerate conditions that are 3 dB louder than non-AX wearers

Proof that AX is Better.

Study #5, Speech Intelligibility

- Hearing Review, June 2021
- Lab-based study of simulated restaurant

Question asked:

- Does split processing improve speech intelligibility in challenging social situations more than traditional processing schemes?

Speech Intelligibility Improvements in Restaurant Listening

Participants: 16 adults, average age 61.8 year, bilateral, sloping HL, experienced wearers

Devices: AX, closed instant fit ear tips, matched to NAL-NL2 target

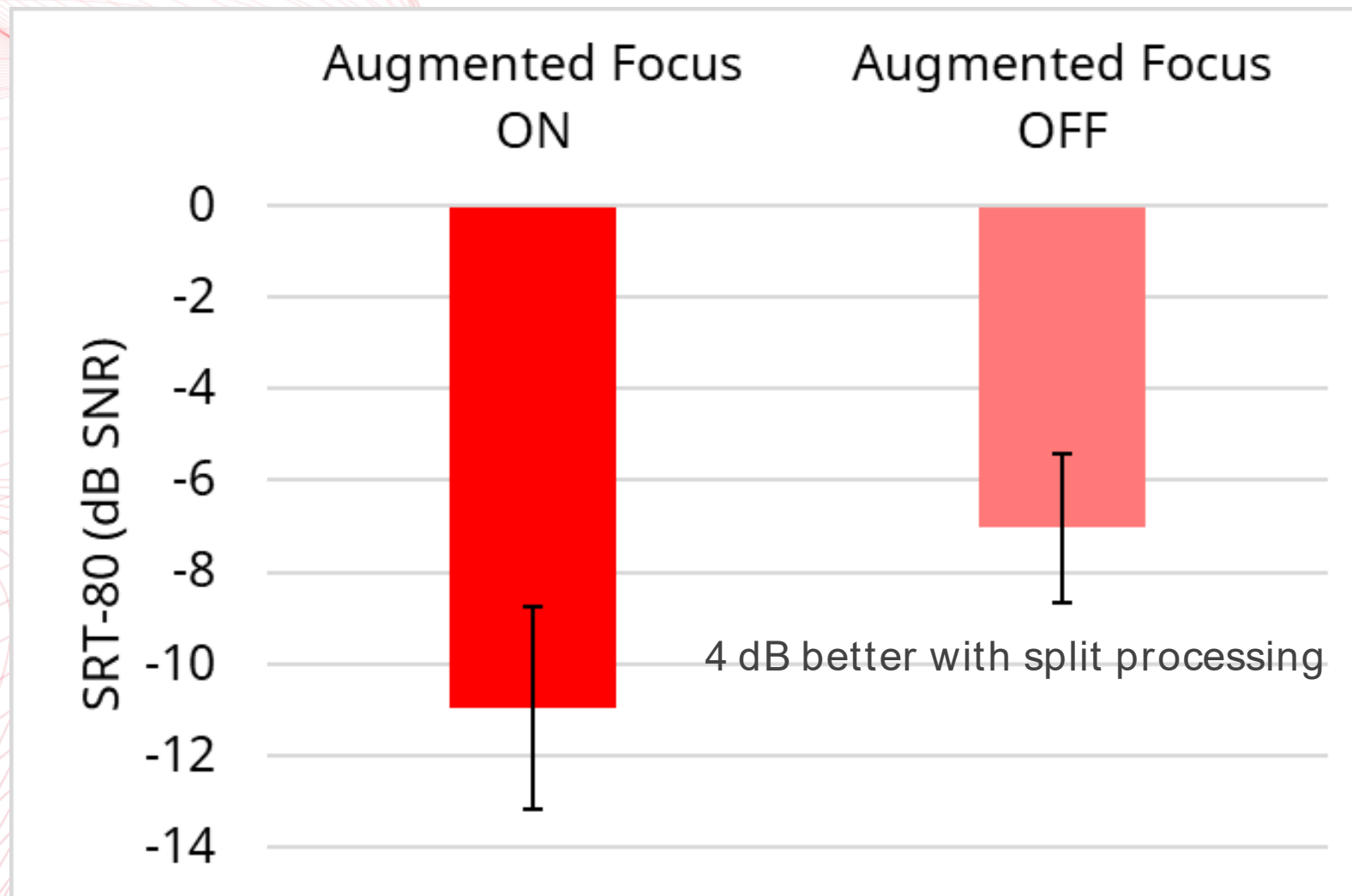
Speech:

- Sentence-length, using modified version of American English Matrix Test
- Intensity level of sentences was adaptive
- Recorded SNR where 80% correct was achieved

Simulated Restaurant:

- 8 speaker array
- Speech from 0 degrees
- Soft (45dBA) continuous noise from 5 speakers
- Bursts of laughter, presented randomly from 3 rear speaker locations at 76dB A





How Do We Know AX is Better than Traditional Approaches?



Simulated noisy condition



Real-World Self-Reports

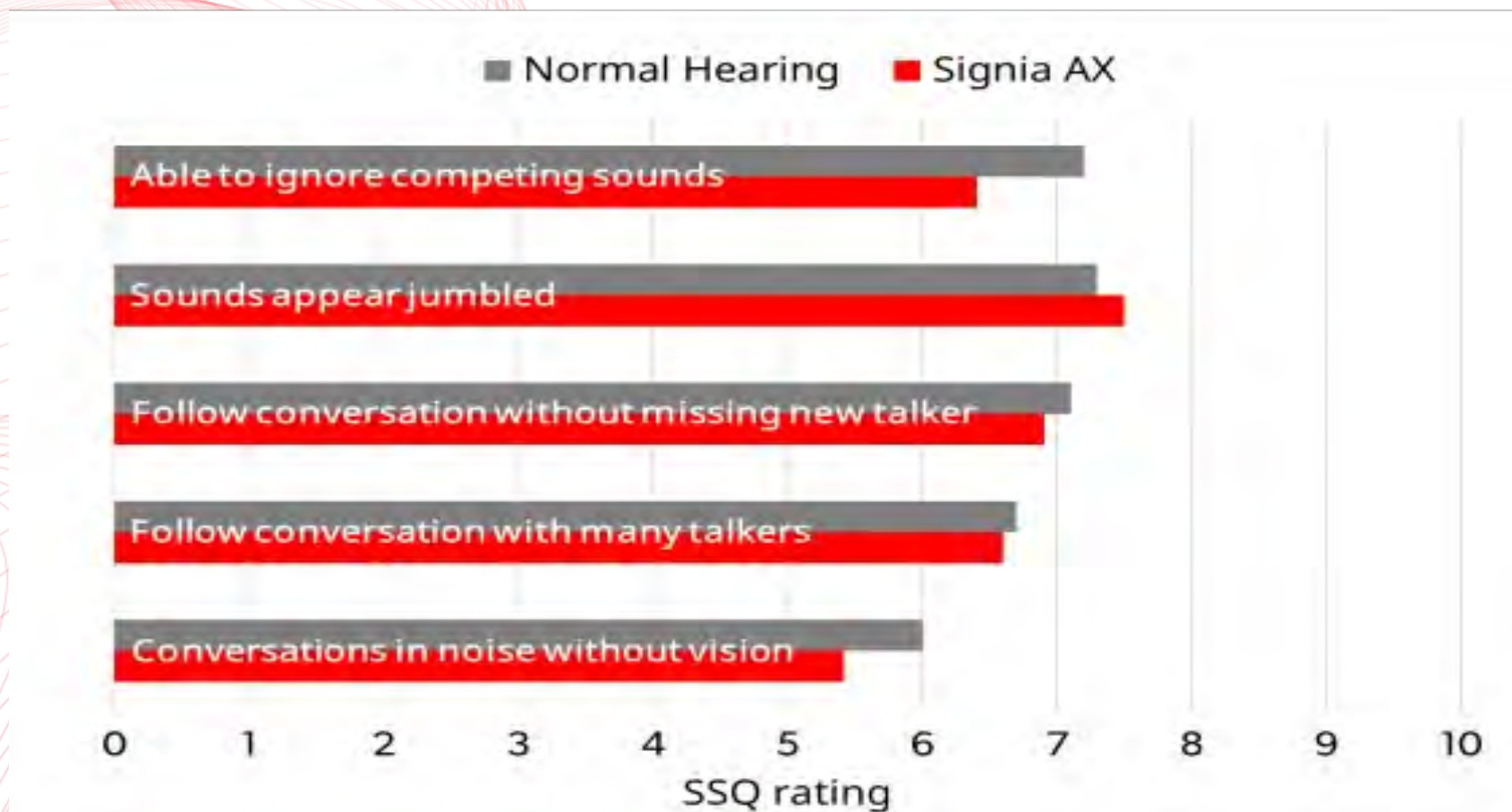
Proof that AX is Better. Study #6, Real World Benefit

- 2021 AO publication and 2022 AAA Poster
- Self-reports of benefit

Question asked:

- Does split processing improve everyday communication compared to a group of same-aged adults with normal hearing?

On Par with Normal Hearing in Complex Listening Situations



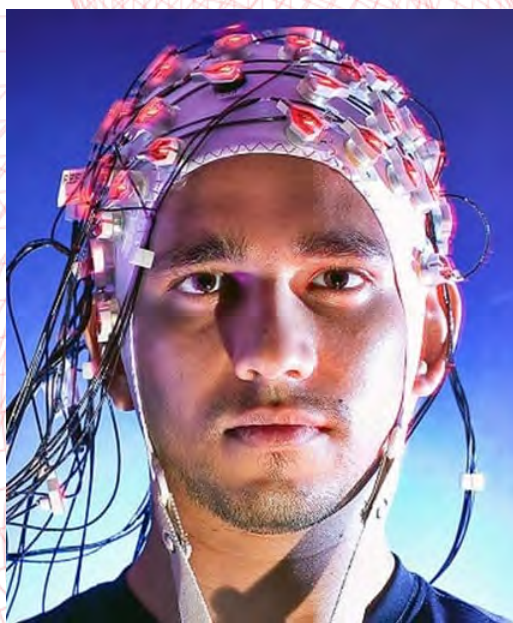
n = 37

Conclusions

Conclusions

AX with split processing is different and unique.

- MMN study
- KEMAR study



Conclusions

- AX with split processing is different and unique.
- AX with split processing provides better performance in noise compared to traditional processing.
 - Improved Listening Comfort
 - Improved Speech Intelligibility
 - Improved Real-world Outcomes

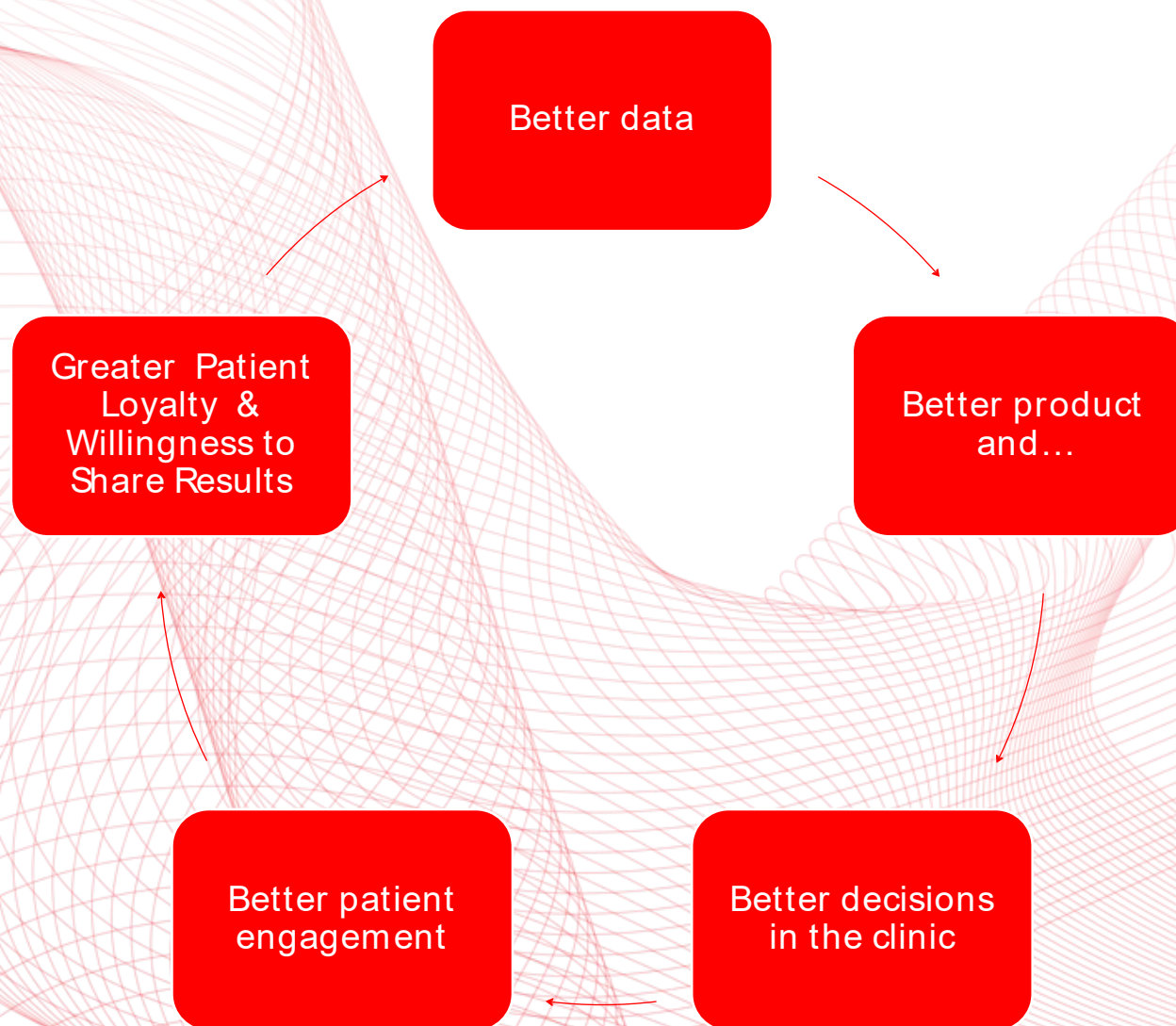


Conclusions

- To optimize individualize results, there are critical decisions still to be made:
 - Coupling system (more open than closed)
 - Match a validated gain target (e.g., NAL)
 - Provide a manual program
 - Ensure adequate adaptation time with counseling



Research is a Virtuous Cycle



Trust and Confidence



“Audiologists agree that Signia AX optimizes SNR performance in noise”

Acknowledgements to Our Global Teams

Erlangen, Germany

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Thank you!