

Voice Emotion Recognition of Children and Teens who are D/HH

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Speaker Disclosure

Relevant financial relationships:

Mandy Weydeck is an employee of Oticon, Inc. and receives a salary

Relevant nonfinancial relationships:

None

Learning outcomes:

Participants will be able to:



How the brain processes and organizes sound.



The impact of hearing differences on voice emotion recognition.



Hearing aid technology strategies that support communication access.

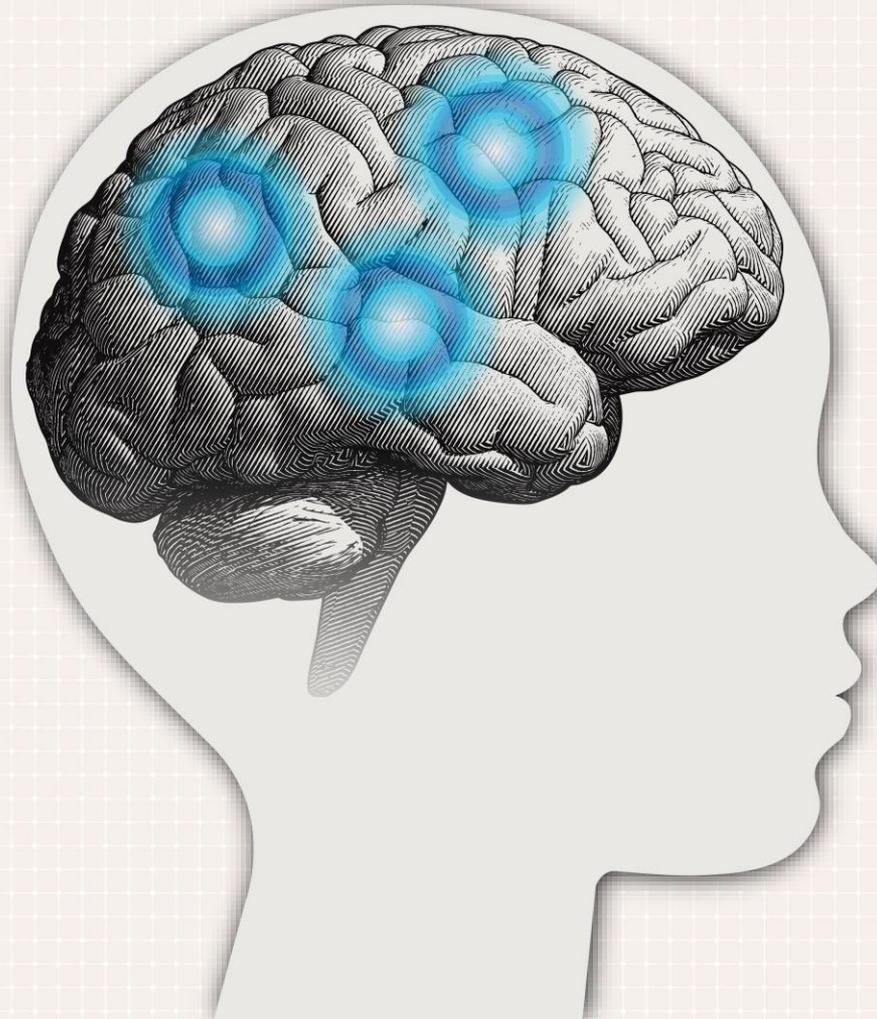
Hearing happens in the brain

Decades of research documenting that hearing is a cognitive process



BrainHearing™

Supporting young brains



The Oticon BrainHearing philosophy

Optimal support for the brain in a timely manner



**Full access to communication
and the world of sounds**

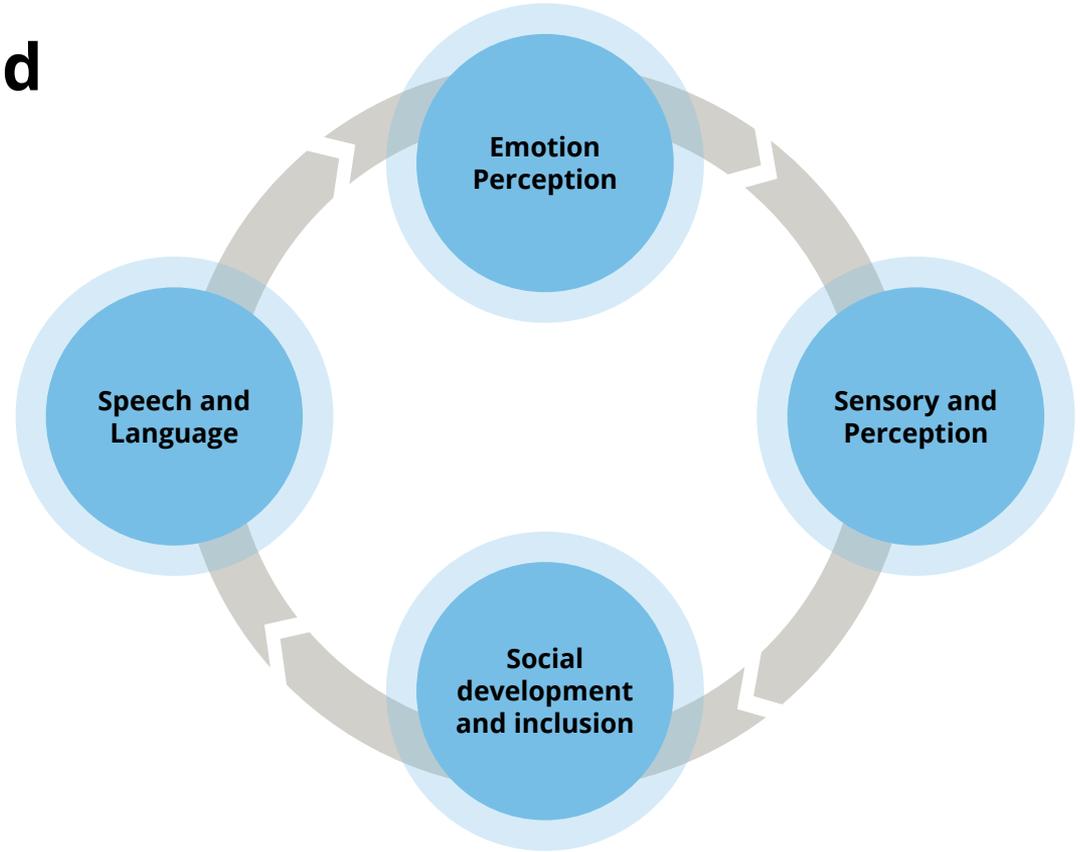
**Optimal conditions
for social development**

What do we mean by “BrainHearing”?



- Speech Understanding is a **cognitive process**
- Our Opinion: signal processing should **support what the brain already does very well**
- We want to provide the brain with **the most useful auditory information possible**
- We want to fully support the **natural course of cognitive development**

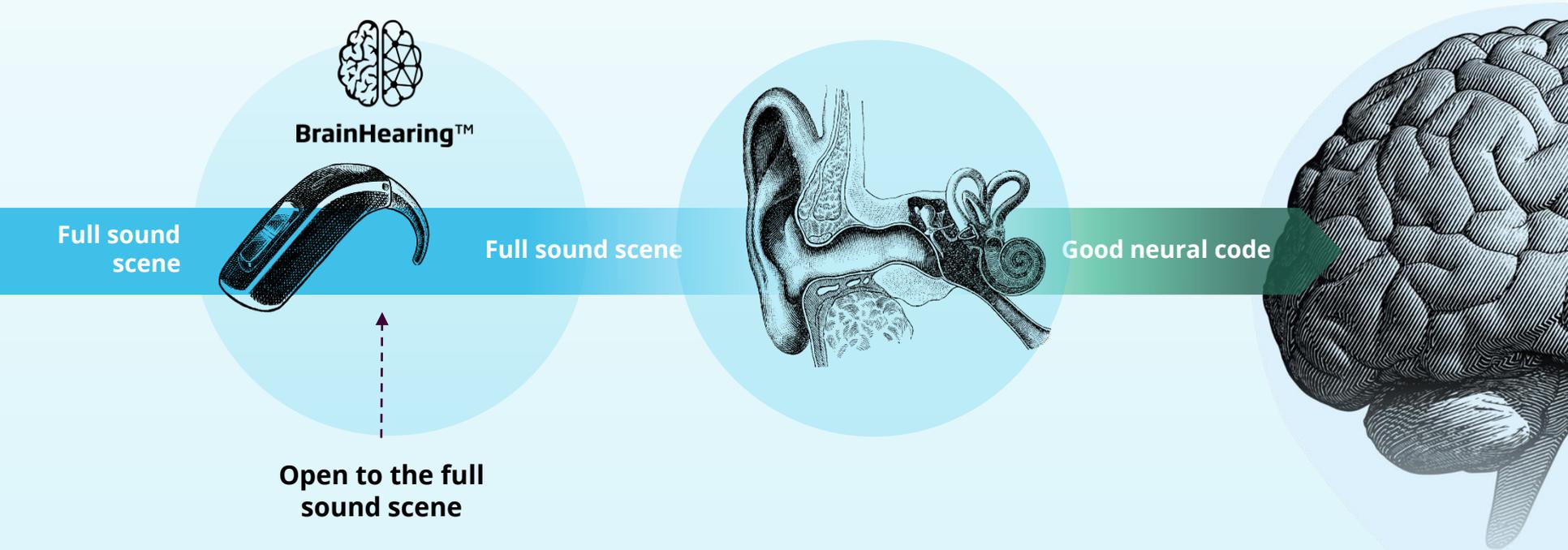
Brain Development and Children with Hearing Loss



Pittman, 2017; Tomblin et al., 2015

Oticon technology

Providing the full sound scene optimally supports listening, learning, and development



Today's children and teens with hearing loss



Most children with hearing loss attend their neighborhood school



Engagement, participation and inclusion in these environments are crucial



Hearing aid technology is an integral part of their connections in the classroom and the community

Essential features



Superior sound
quality



Educational
support



Connectivity



Rechargeable



Child-friendly
design



Best practice
fitting

Oticon Play PX

Dedicated to childhood



OTICON | **Play PX**

Supporting engagement, participation, and inclusion



miniBTE R



miniBTE T



miniRITE R



miniRITE T

Oticon's first rechargeable miniBTE

Proven by children

Backed up by science

- Children need optimal auditory access
- Communication access is crucial for their development
- Conventional technology may limit this access in complex environments

Cruckley et al., 2011; Gordey & Ng, 2021



Powered by Polaris™

Oticon's most intelligent platform ever



16 times more capacity*

Twice the **computation capacity and speed***

On-board Deep Neural Network processing

Intelligent use of **industry-leading 64-channel**

2x precision in 1.5-5kHz frequency bands*



* Compared to the Velox S™ platform

Deep Neural Network

Trained with real-life sounds — just like the brain

Trained with **12 million** real-life sound scenes and mimicking the way a child's brain learns



The first pediatric hearing aid with a Deep Neural Network (DNN)

**What is a DNN?
How does it work?
Why is it important?**

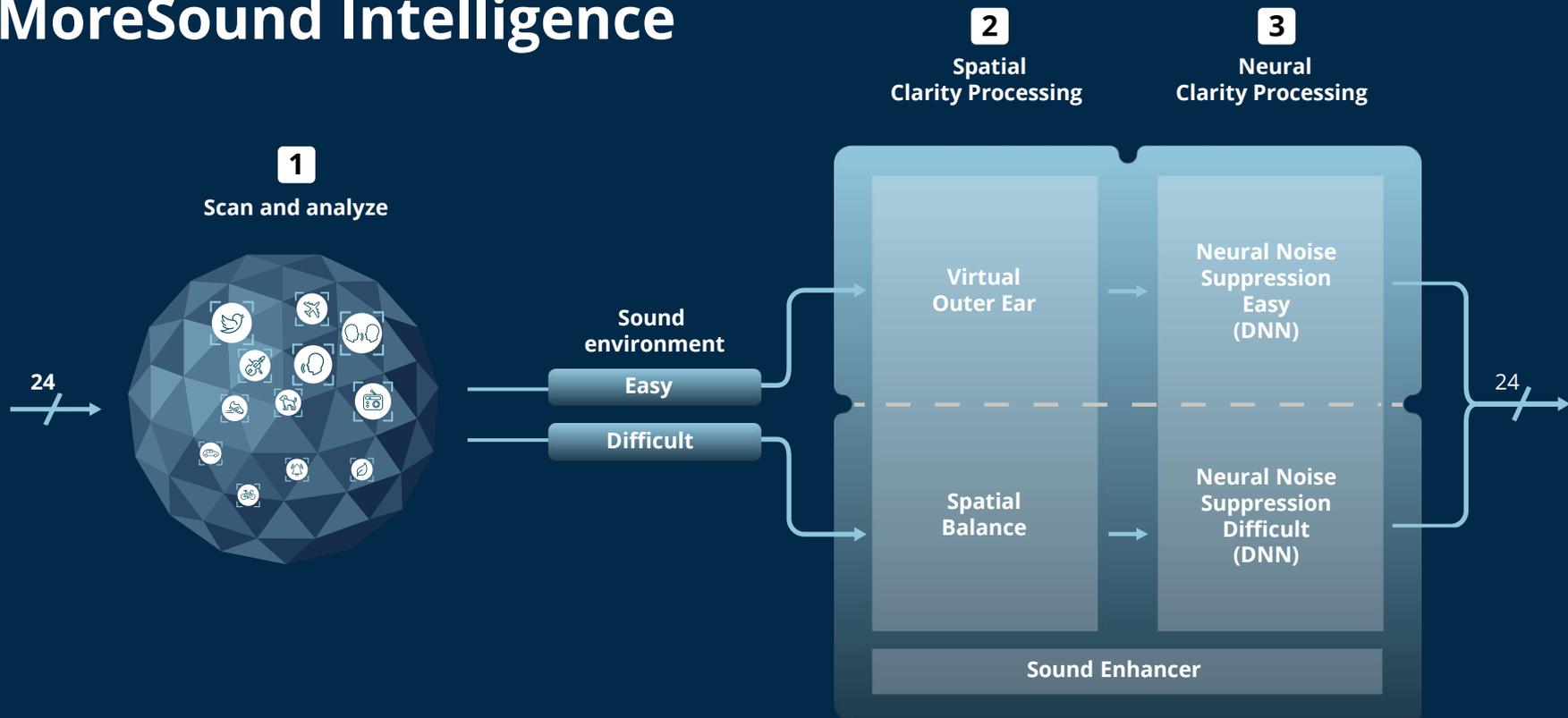


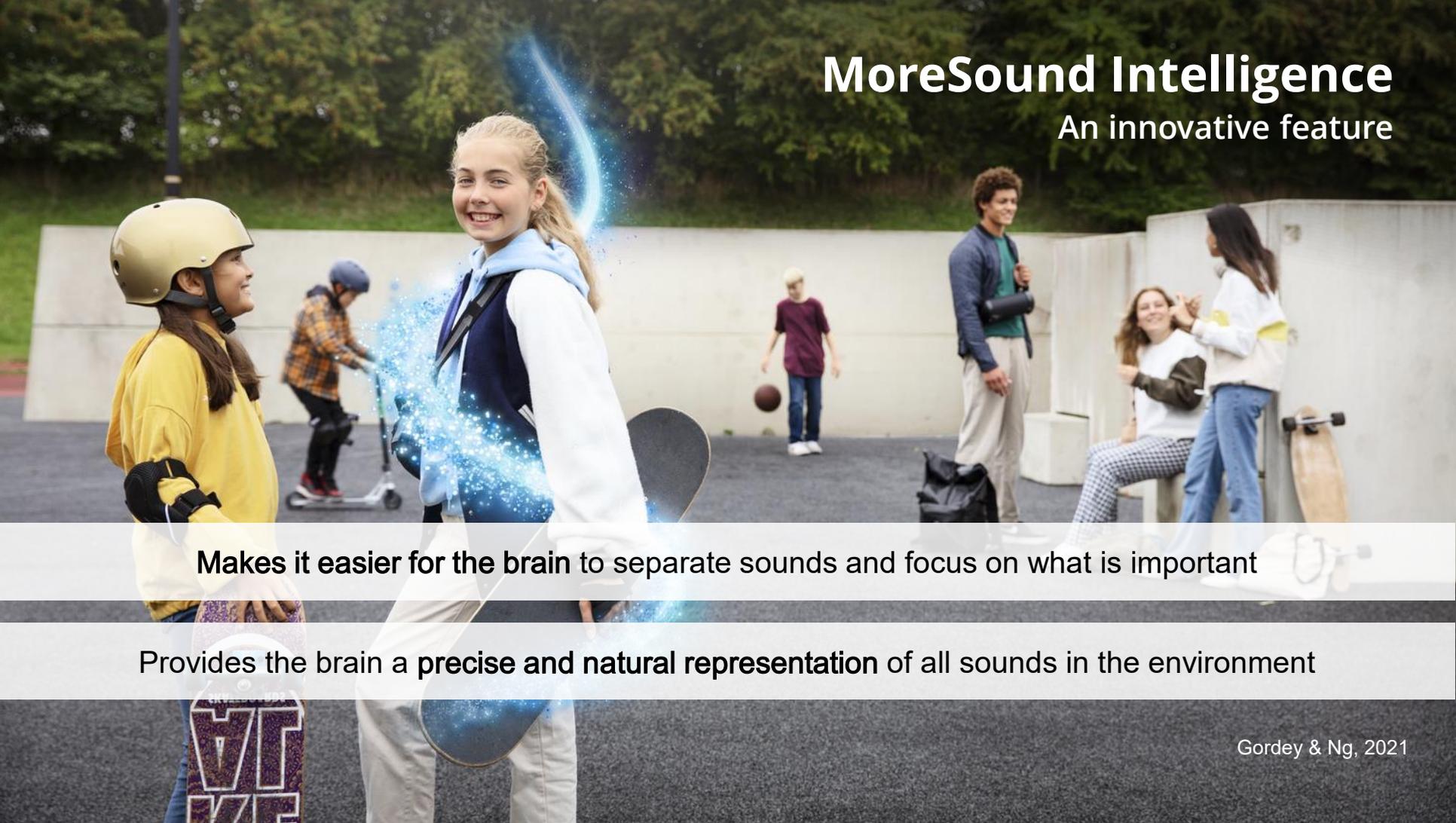


MoreSound Intelligence



MoreSound Intelligence



A group of young people are in a skate park. In the foreground, a girl with blonde hair, wearing a white hoodie and a blue backpack, is smiling and looking towards a girl in a yellow hoodie and a gold helmet. A blue, glowing particle effect surrounds the blonde girl. In the background, other people are engaged in various activities: one is riding a scooter, another is holding a basketball, and a group of three people is talking. The setting is an outdoor skate park with a concrete wall and trees in the background.

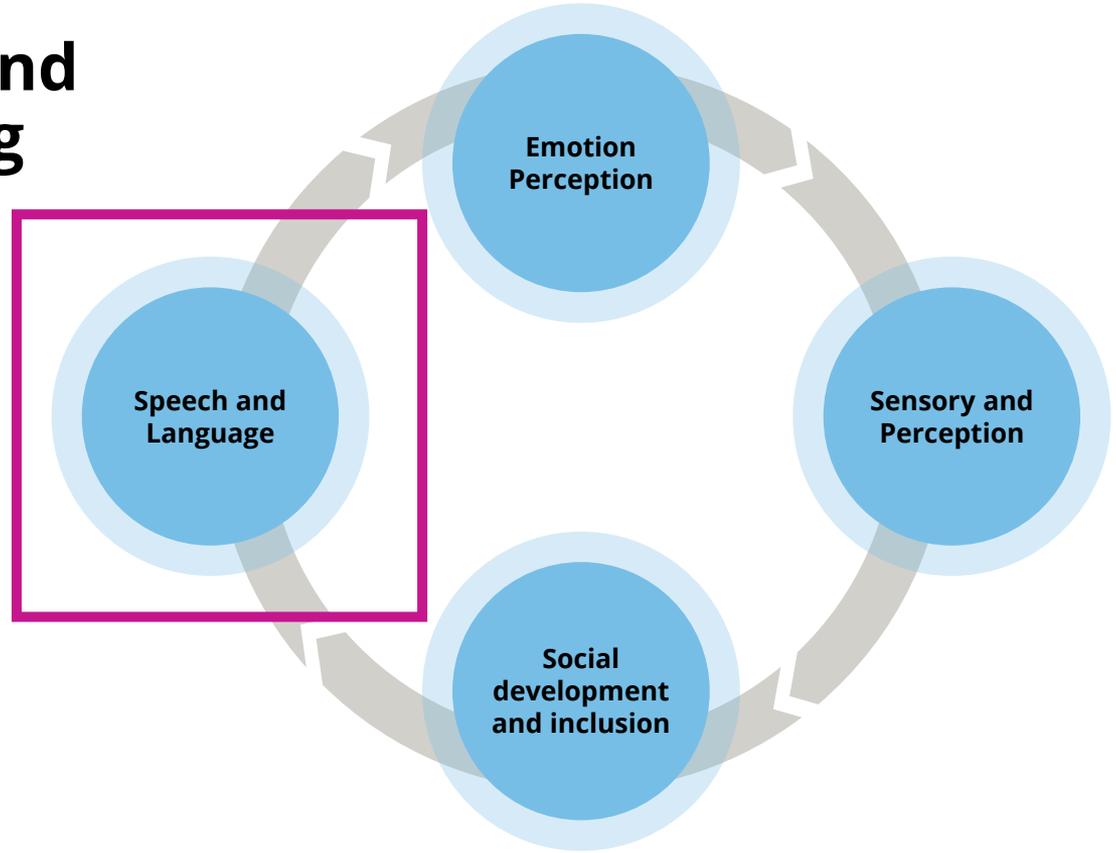
MoreSound Intelligence

An innovative feature

Makes it easier for the brain to separate sounds and focus on what is important

Provides the brain a precise and natural representation of all sounds in the environment

Brain Development and Children with Hearing Loss



Pittman, 2017; Tomblin et al., 2015



The Evidence for Oticon Play PX

The research supporting MoreSound Intelligence



Objective

To assess children's ability to recognize and recall speech coming from different directions

Methods

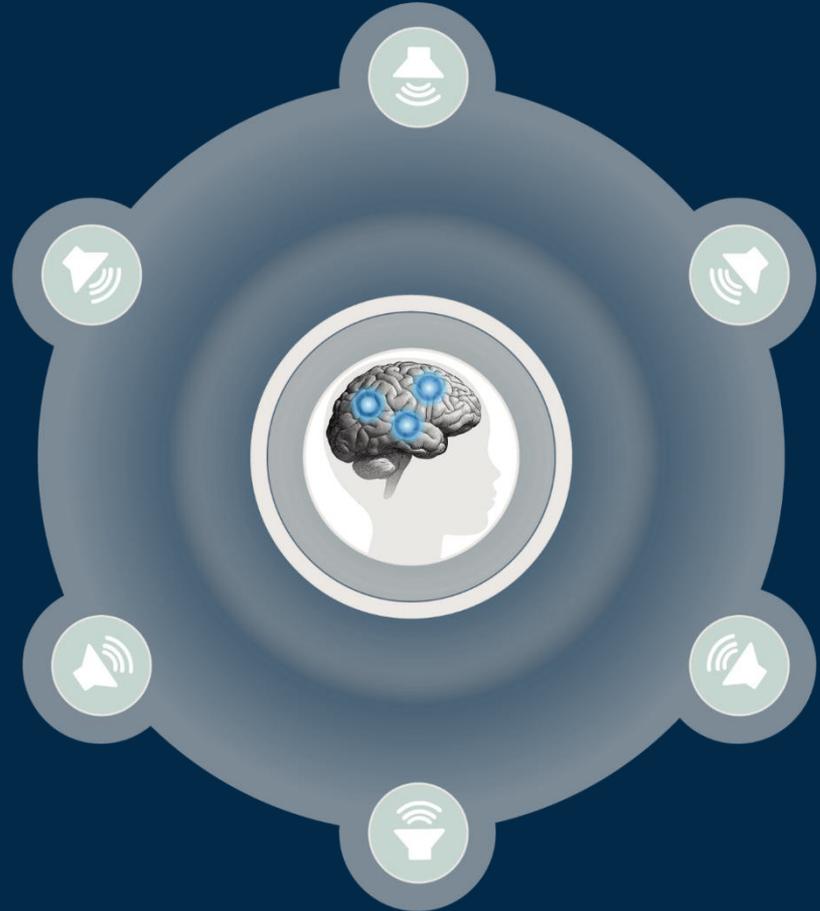
Recognition and memory

Test setup

- Lists of 12 words from the Auditory Verbal Learning test
- Words distributed across six locations
- Words presented at 70 dB SPL in 67 dB SPL cafeteria noise

Task

- Children were asked to **listen to the 12 words and repeat as many as they could remember**



Participants

Two groups of children were recruited



Group 1: Normal hearing

- 19 children (10 to 15 years)
- Pure tone average < 20 dB HL



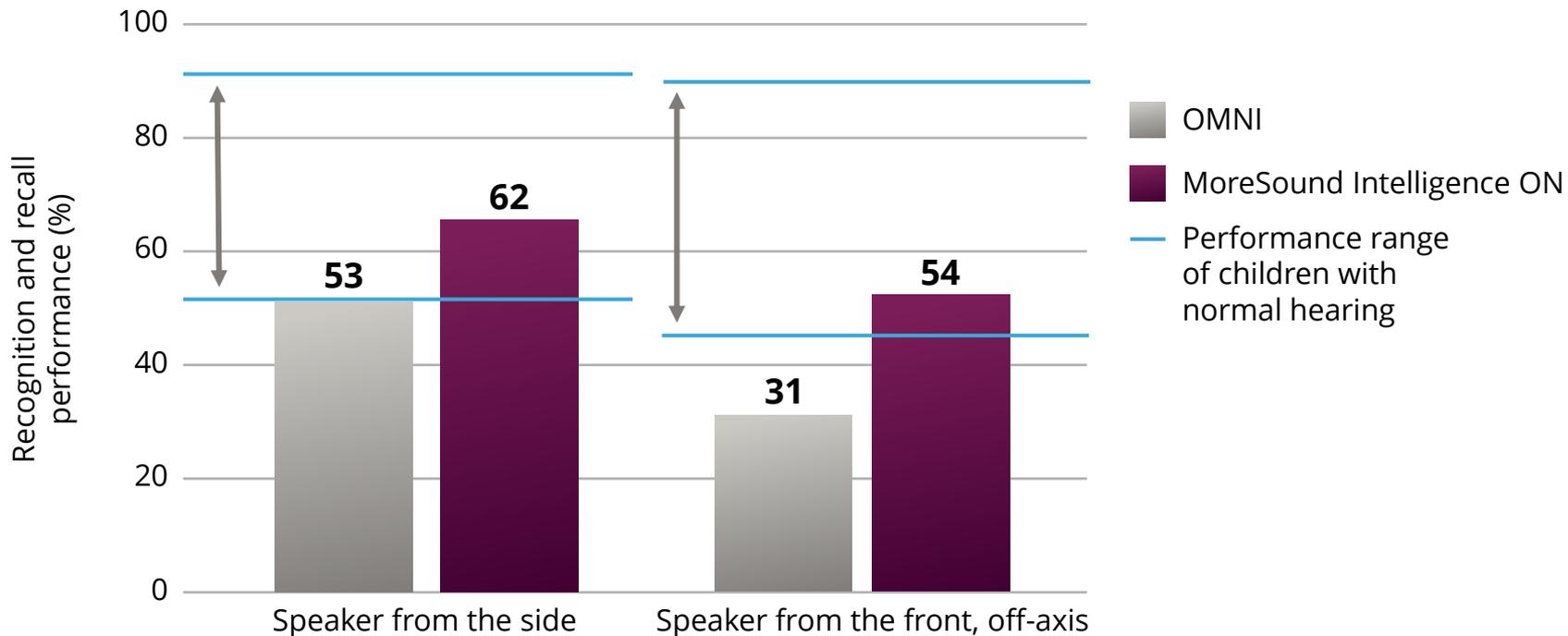
Group 2: Hearing loss

- 12 children (11 to 15 years)
- Bilateral, symmetrical mild to moderately severe hearing loss

The study compared the performance with MoreSound Intelligence
ON and OFF

Documented access with MoreSound Intelligence

Speech understanding and word recall in noise was similar to peers with normal hearing



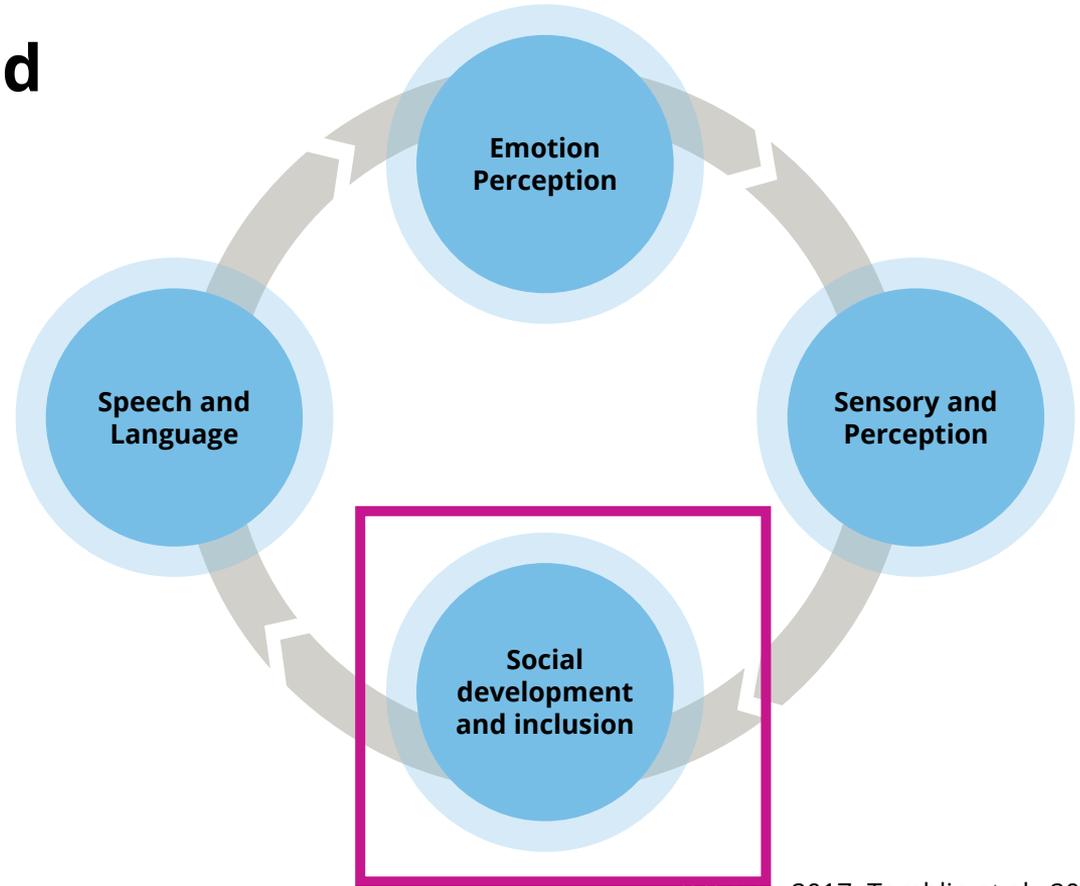
Conclusions

A photograph of two young children riding scooters in a park. The child on the left is wearing a pink helmet and denim overalls, while the child on the right is wearing a purple helmet with star patterns and a green top. A digital effect of blue and white particles is shown between them, suggesting communication or interaction. The background is a blurred outdoor setting with trees and a clear sky.

Results suggest **improved communication access** when MoreSound Intelligence is enabled

Confirmation and extension of the benefits of the BrainHearing technology for children

Brain Development and Children with Hearing Loss



Pittman, 2017; Tomblin et al., 2015

Focus Group December 2016

Cuyahoga Falls, Ohio
N=28



If you could invent/develop the perfect hearing aid, what would it look like? What are the things it could do?

A summary of the top ten attributes they listed

- It would have rechargeable batteries that would last all day.
- Lightweight, slim, small
- Eliminates all feedback
- Video captions can be created from sounds going into hearing aid, displayed on my phone, making it easier to understand when in really noisy rooms.
- Mute function for FM, on FM receiver, so I can turn off the teacher when needed.

A summary of the top ten attributes they listed (cont.)

- Better retention options for sports; Sports mode for hearing aid so they can work well underneath a hockey or football helmet.
- Tracking device via an app in case they get lost.
- Hearing aid could connect to electronics, computers, internet.
- All controlled by my phone.
- Waterproof, I could hear with my device underwater.

Final task

Write a letter to their younger self or a younger student.

Expectations:

- Allow expression of personal impact of hearing loss
- Learn from their stories
- Develop additional strategies for working with children

Student Advice:

- Hearing loss is ok, it does not define you, no matter what people might say to you.
- Wearing glasses and headbands with hearing aids can be hard!
- Everything was going to be ok, and not be ashamed of having a hearing loss.
- Accepting who you are can be difficult, when you do not know anyone with a hearing loss.

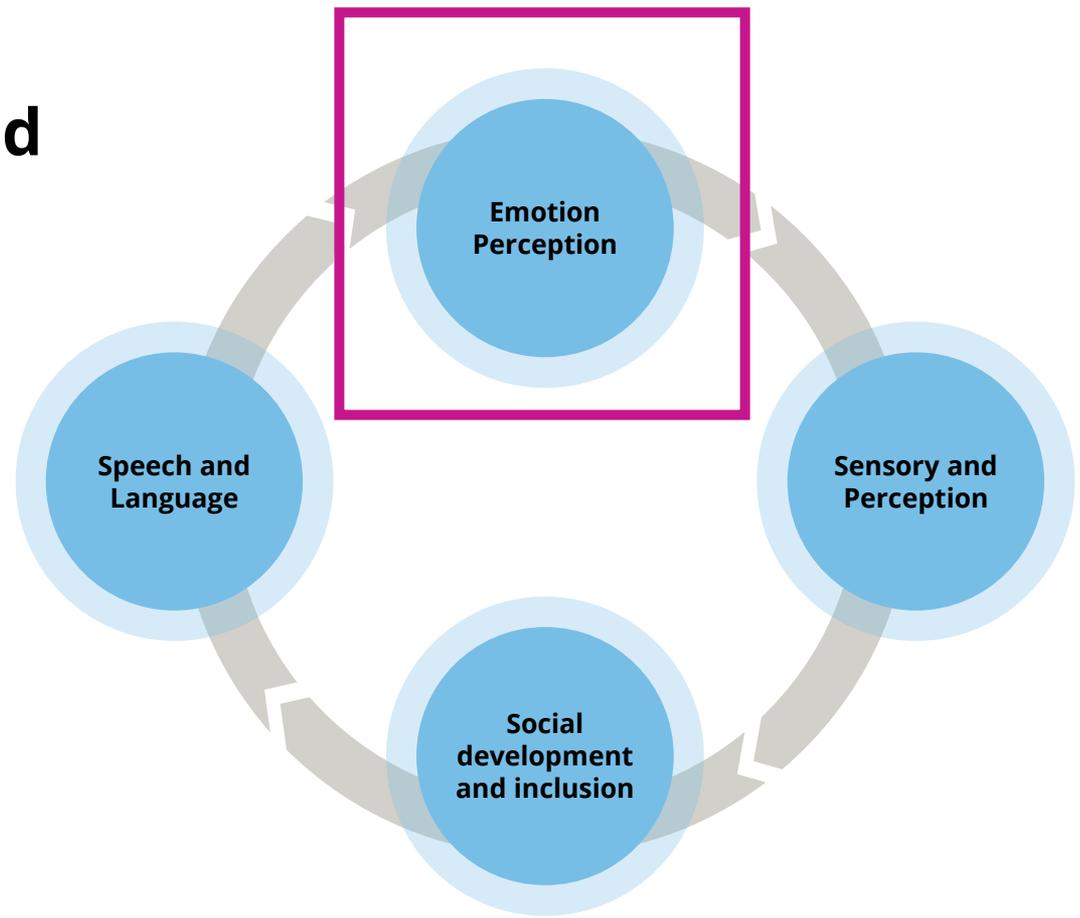
Student Advice:

- When all the students in the room are talking it is hard to hear.
- Use your FM system always. It helps make it easier to concentrate.
- No one is better than you.
- I wish someone would tell me what it will be like when I get older.
- Having hearing aids does not affect your personality.

Student Advice:

- It is ok to be nervous going to school and meeting new people.
- I was afraid in school that I was going to miss something someone said.
- It was hard to talk with my hearing classmates
- I wish I could have met other children with hearing loss.

Brain Development and Children with Hearing Loss

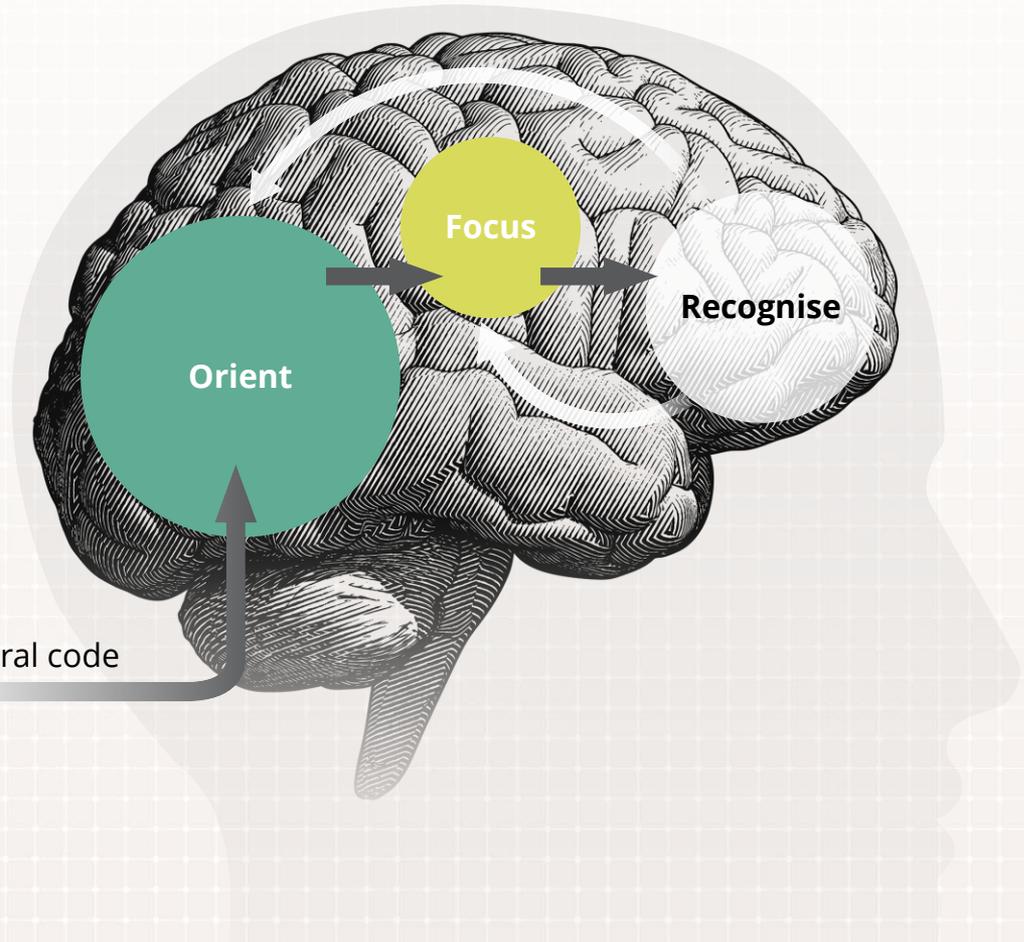


Pittman, 2017; Tomblin et al., 2015

How is voice emotion recognized?



Neural code



Acoustic characteristics of emotion

Mean Fundamental Frequency

■ Male ■ Female



The development of voice emotion recognition



**Rapid changes from
childhood to
adolescence**

**Sadness recognized
during infancy;
Happiness and
disgust in
adolescence**

**No difference noted
in gender; Elderly
speakers more
difficult**

Why do we need voice emotion recognition?

A photograph of three young people (two men and one woman) sitting together and smiling. They appear to be in a casual setting, possibly a classroom or a group discussion. The man on the left is looking towards the woman on the right, who is holding a smartphone. The woman in the middle is also smiling and looking towards the woman on the right.

**Communication
Access**

Shifting Attention

Social Skills

Voice emotion recognition in children and teens

A group of diverse teenagers are shown in a candid, outdoor setting, likely a school hallway or courtyard. They are engaged in conversation and smiling. The group includes a young man with glasses on the left, a young woman with blonde hair, a young woman with long dark hair wearing a purple shirt and a long necklace, a young woman with long dark hair wearing a camouflage jacket and colorful earrings, a young man with dark skin and a blue hoodie, and a young man with red hair wearing a purple plaid shirt and a backpack. The background is slightly blurred, showing a red traffic light and other people.

**Impact of Hearing
Differences**

Emotion recognition by children with mild to moderate hearing loss

n= 20, typical hearing and
n=19, mild/mod HL

Verbal and non-verbal tests

Sentence recognition: happy,
sad, angry, neutral

Presented at 65 dB SPL
(quiet)

Non-verbal IQ a predictor of
performance for children
with HL.



Voice emotion perception and production in cochlear implant users

- Review of current literature
- CI users face significant deficits; rely on intensity and duration to identify the emotion of a speaker.
- For CI users utilizing auditory information, pitch cues are most poorly represented.
- A rehabilitation or training program that focuses on voice emotion perception may be useful.



Can new, advanced features in hearing aids provide better communication access? Improvements in voice emotion recognition?

Study Background



Research question

Is voice emotion recognition in noisy environments an area of concern for children and teens who wear hearing aids?



Gordey, 2022

Participants

Two groups of children were recruited



Group 1: Hearing loss

10 children (8 to 18 years)

Bilateral, symmetrical mild to moderately severe hearing loss



Group 2: Normal hearing

10 children (11 to 15 years)

Pure tone average < 20 dB HL

Methods



Hearing aids

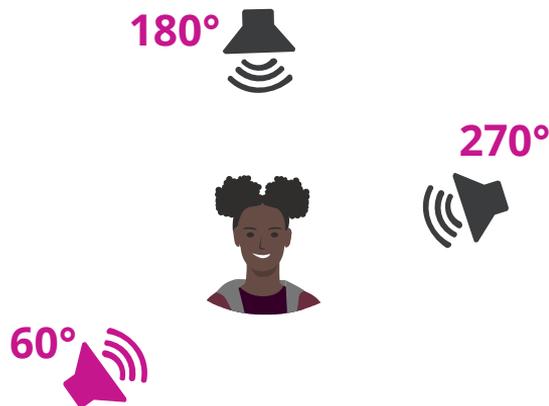
- RITE hearing aids
- MoreSound Intelligence ON
- DSL v5 Paediatric

Gordey, 2022

Methods

Task

- Toronto Emotional Speech Set (TESS)
- 70 dB SPL at 60° with multi-talker babble at 180° and 270°
- 25 word lists




Anger


Sadness

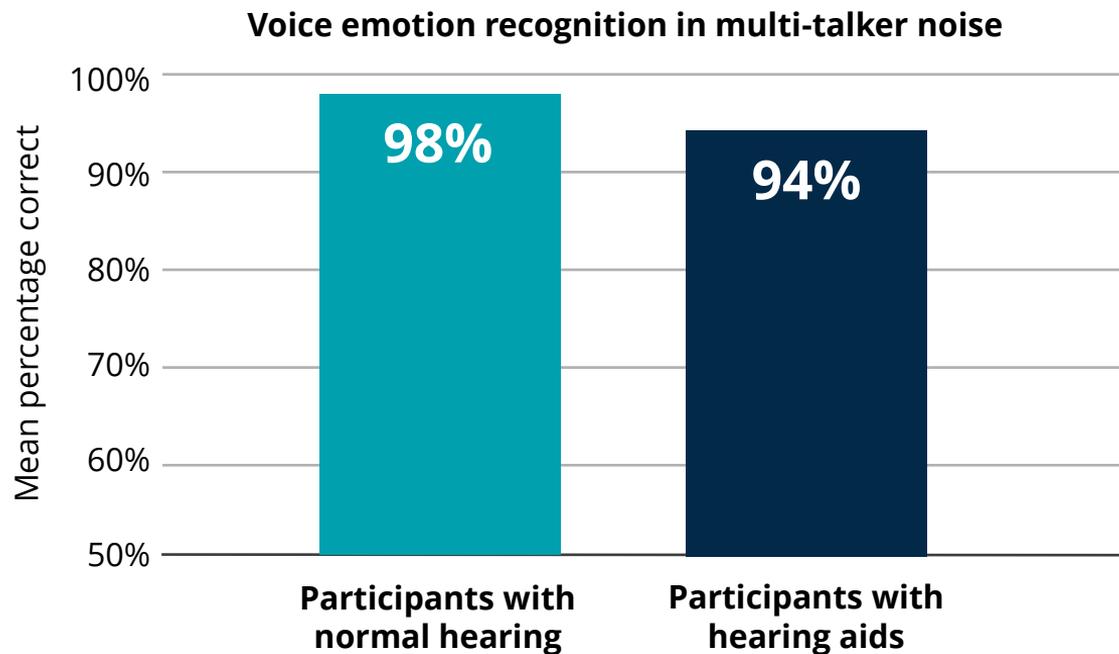

Happiness


Fear



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Results



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Summary



Voice emotion recognition is a developmental process essential for communication.



Oticon hearing aids **support voice emotion recognition** in noisy environments



Oticon hearing aids provide the **communication access required for the development of social competency**

Thank you

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