



The Use of FM  
Technology in  
school-aged children  
with Autism  
Spectrum Disorder

# The Use of FM Technology in School-Aged children with Autism Spectrum Disorder

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# Background

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## ◆ Autism Spectrum Disorder (ASD)

- neurodevelopmental disorder affecting  $\approx$  1 in 120 children

## ◆ Behavioural symptoms

- social interaction impairment
- communication deficit
- restricted, repetitive and stereotyped patterns of activity/interest

## ◆ Sensory deficits (particularly auditory)

- consistently reported speech perception in noise deficits (Ornitz et al. 1989; Alcantara et al. 2004)
- inability to use brief gaps in noise to gain release from masking (Groen et al. 2009)

# Study Aims

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- ◆ Characterize the pattern of auditory deficits in children with ASD
- ◆ Determine whether FM-listening devices can improve speech understanding/general communication

# Study Design

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## ◆ Initial test session

- Psychophysical & formal speech perception testing
- FM device fitting (Inspiro device / iSense micro receiver)
- Comparison of aided (FM) and unaided scores



# Study Design

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## ◆ 6 week FM trial

- » 1. Period of non-use (prior to fitting)
  - » 2. Two week period wearing the device
  - » 3. Another two week period wearing the device
  - » 4. Two week period of non-use
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- Subjects completed a hearing disability questionnaire at the end of each period (APHAB)
  - Teacher survey at end of trial (LIFE)

# Subjects

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## ◆ 20 children with ASD

- **Diagnosis:** Childhood Autism Rating Scale (CARS)
- **Intelligence/Cognitive Profile:**  
Wechsler Intelligence Scale for Children (IQ>80)
- **Education**
- All in mainstream settings: secondary N=10, primary N=10
- **Age range:** 8 to 15.4 yrs

## ◆ 20 controls matched for age/gender/hearing level

- Identical test battery (apart from the FM trial)

# Psychophysical Protocol

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## ◆ Audiogram (4-freq average)

- ASD:  $12.6 \pm 6.4$  dBHL
- Control:  $10.4 \pm 8.3$  dBHL

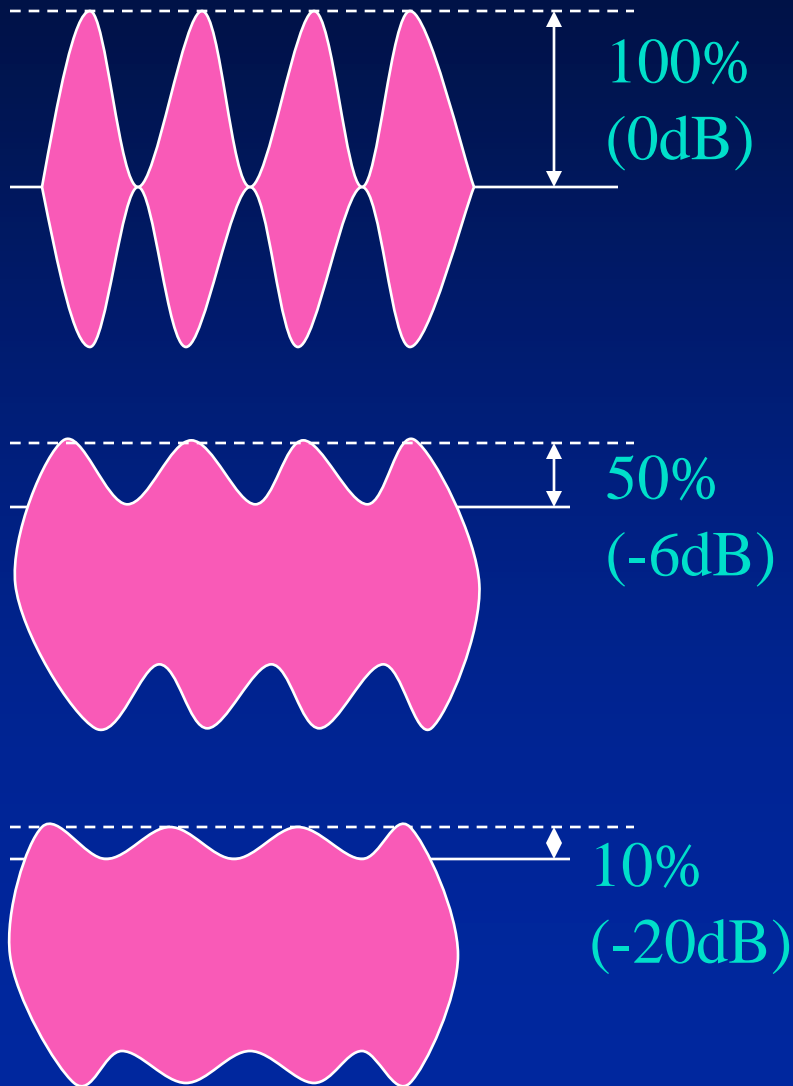
## ◆ Temporal Resolution

- Ability to detect changes in stimuli over time
- Temporal modulation transfer function (TMTF)



# Temporal Modulation Transfer Function (TMTF)

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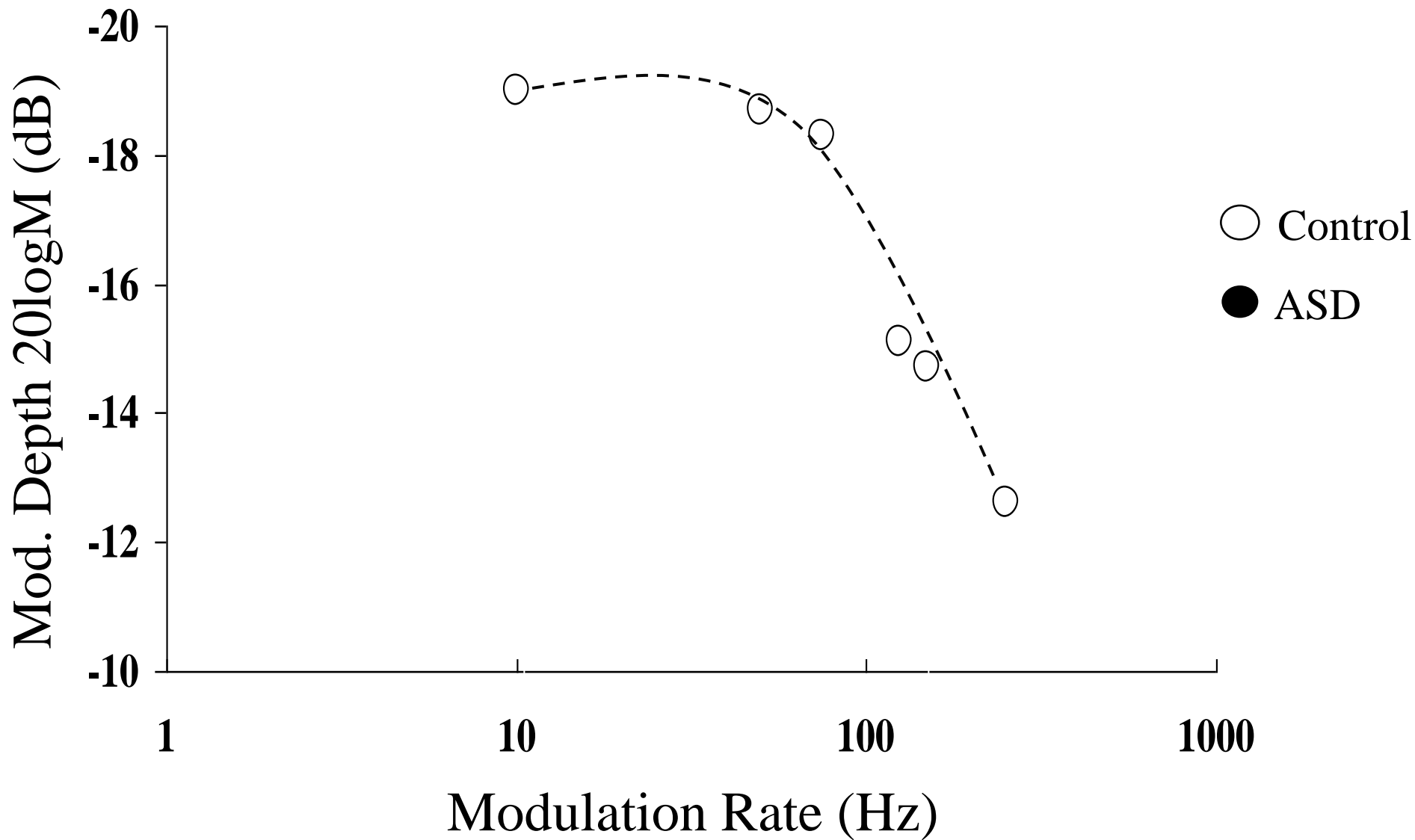


◆ Determines the listener's ability to perceive rapid amplitude changes in a continuous signal

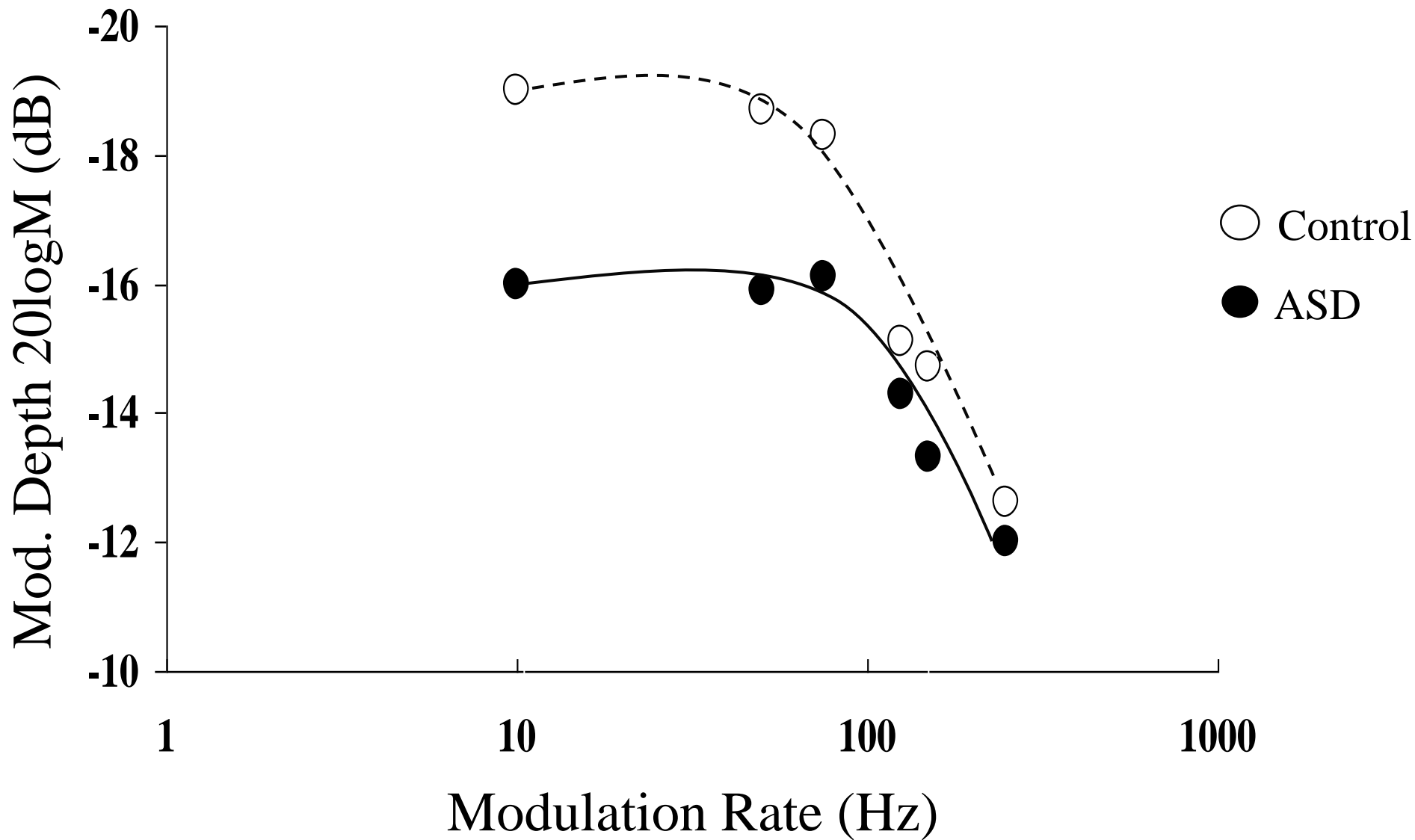
## ◆ Variables

- Modulation rate
- Modulation depth

# Temporal Modulation Transfer Function



# Temporal Modulation Transfer Function



# Spatial Processing

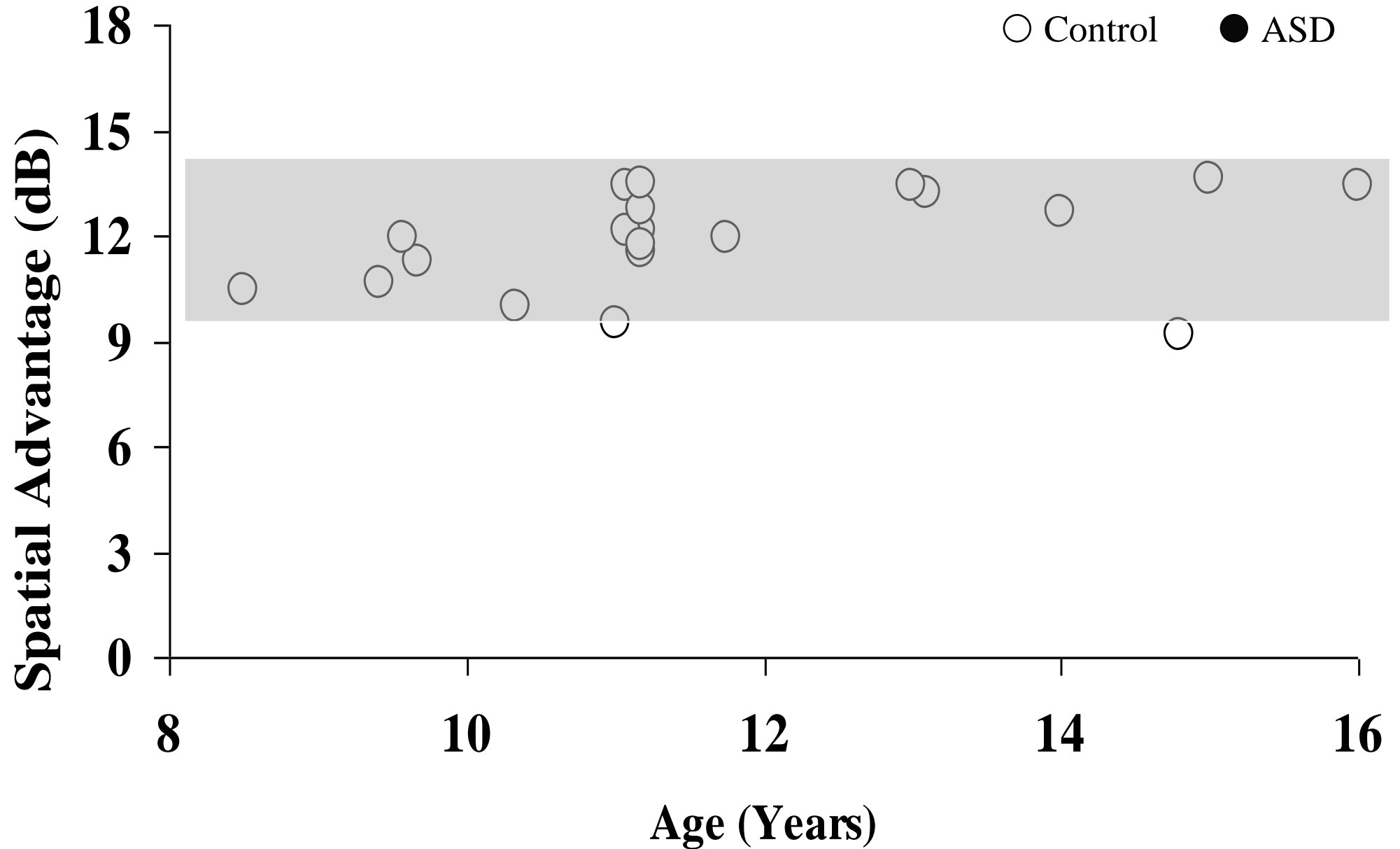


# Binaural Speech Perception

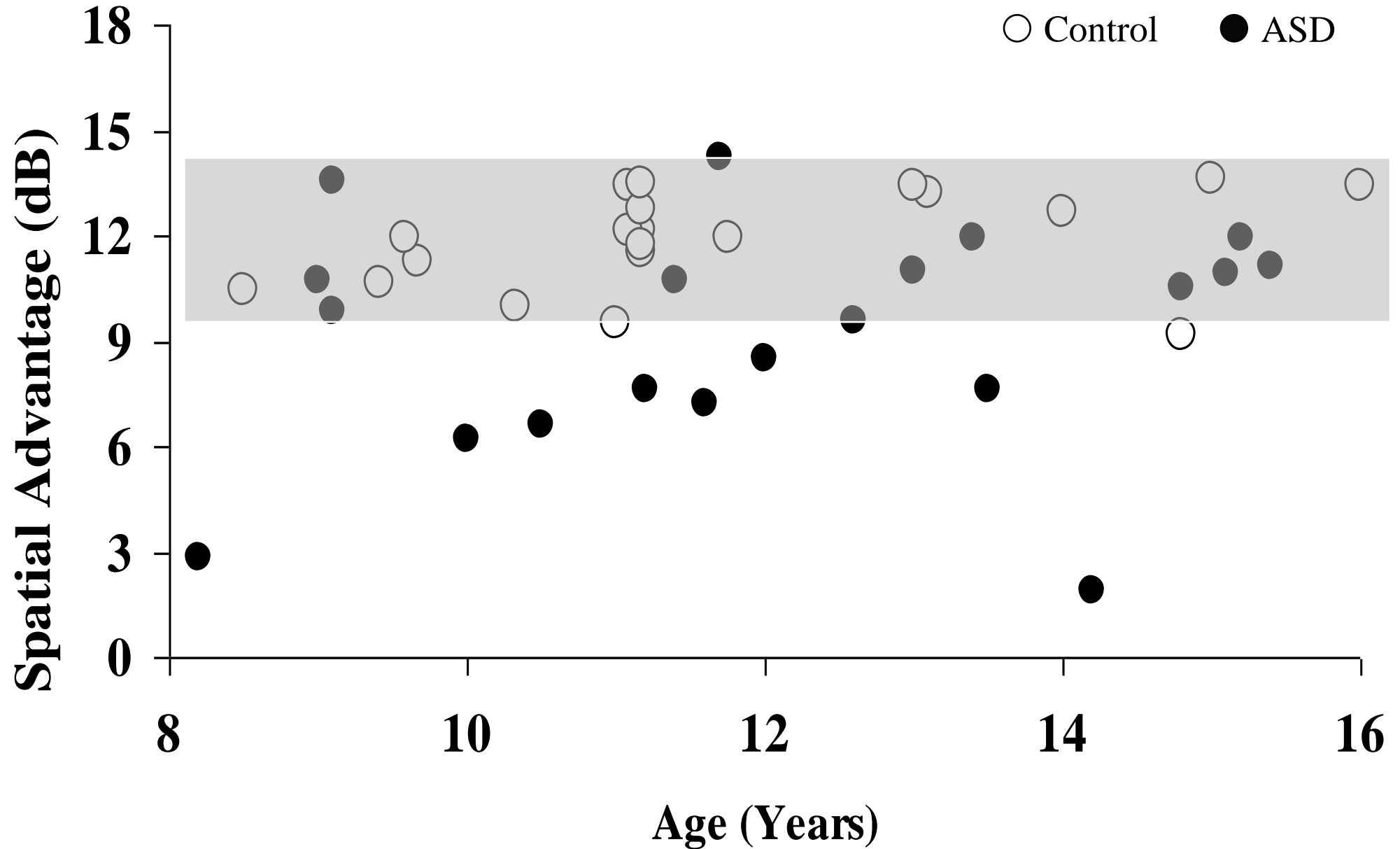
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- Listening in Spatialized Noise Test (LiSN-S)
- Speech in background noise
- Measures the listener's ability to use spatial cues to improve perception
- **Spatial Advantage**
  - Difference in speech reception threshold (SRT)
  - 2 test conditions:
    - Target speech and noise presented from the same direction (i.e. no spatial cues available)
    - Target and noise spatially separated ( $90^{\circ}$ )

# LiSN-S Spatial Advantage



# LiSN-S Spatial Advantage



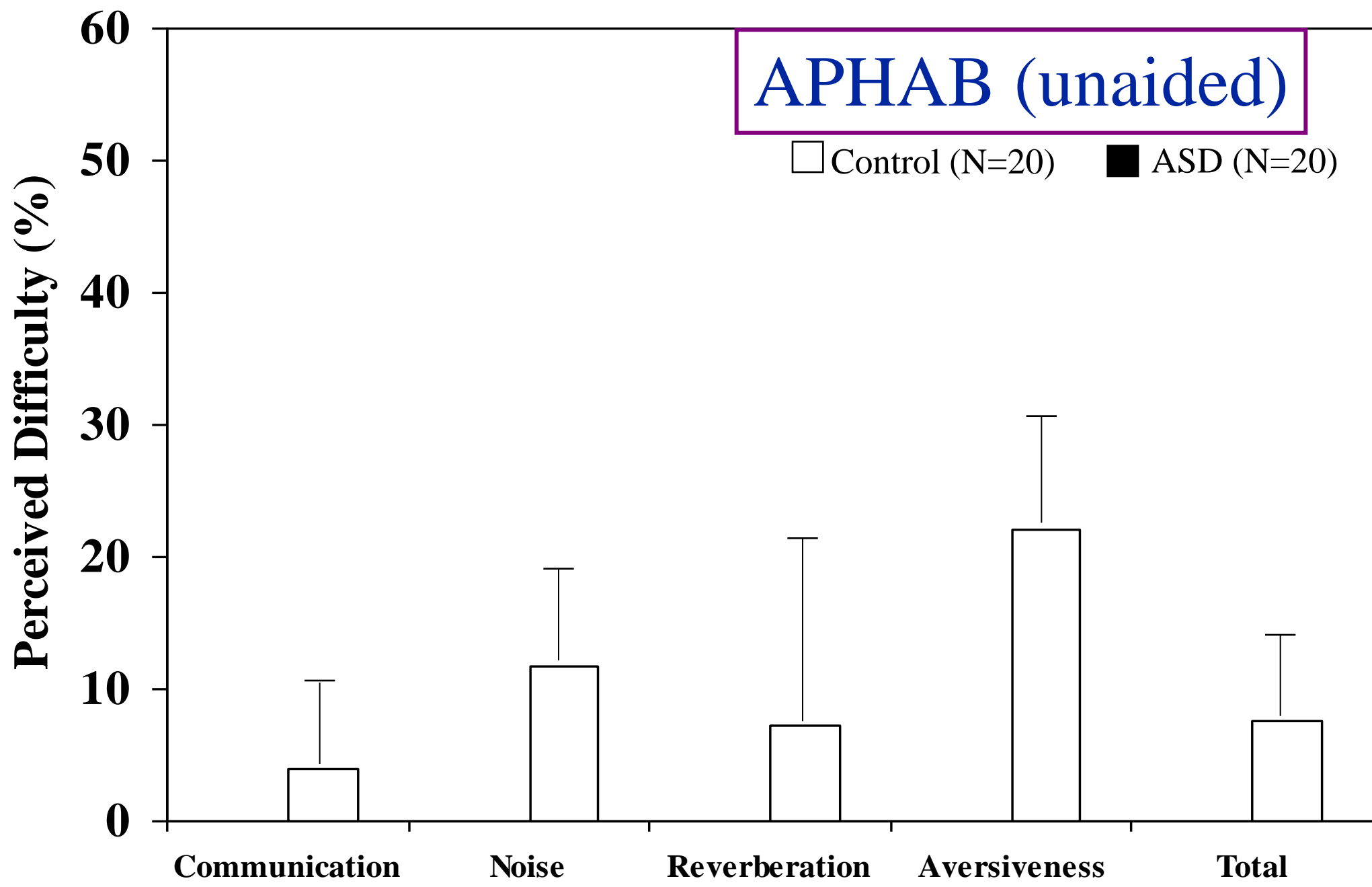
# Hearing Disability Survey

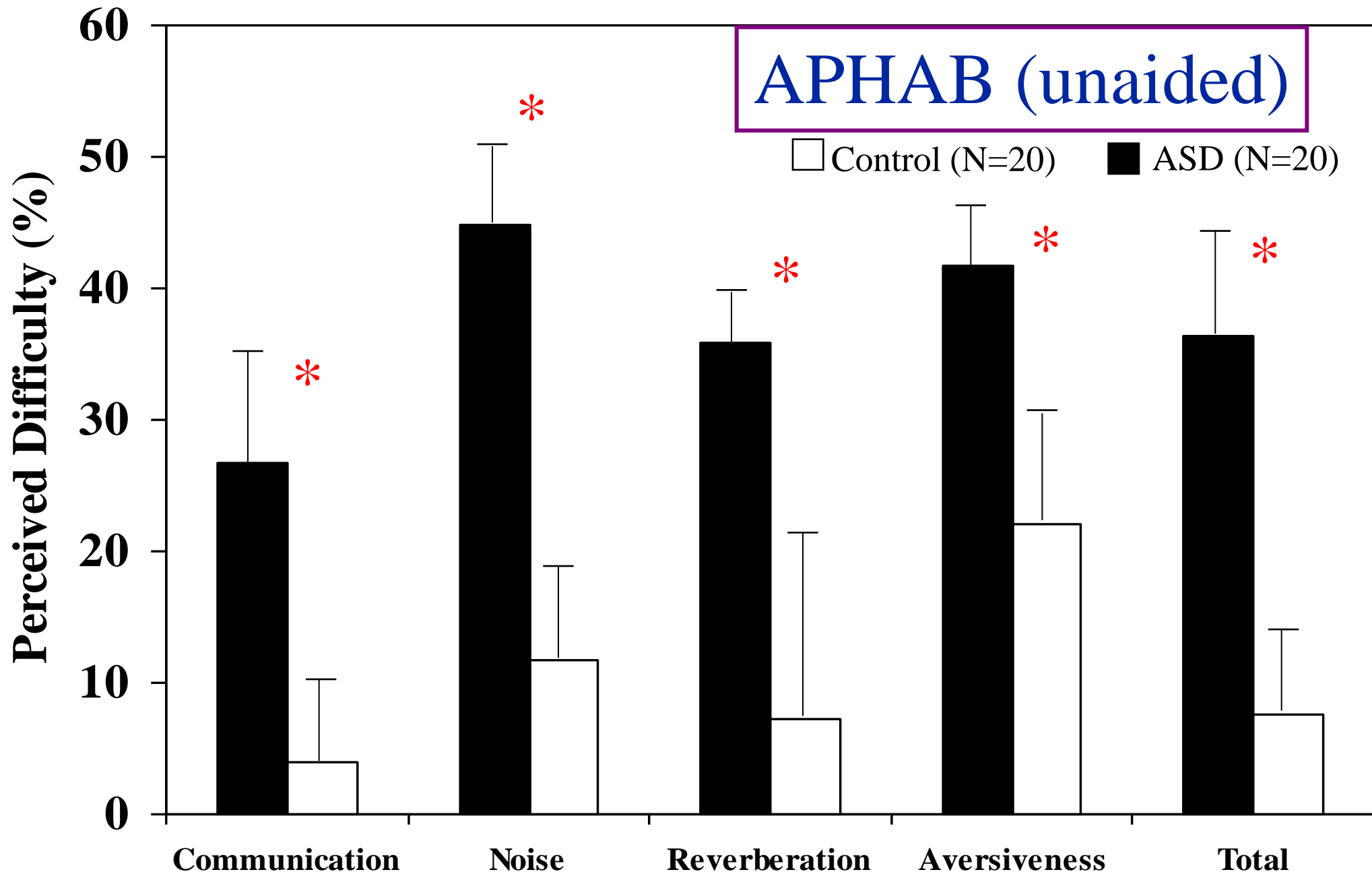
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- ◆ Abbreviated Profile of Hearing Aid Benefit (APHAB)
- ◆ Self-assessment survey examining various aspects of everyday listening and communication
- ◆ Evaluation categories
  - Ease of communication
  - Listening in background noise
  - Effect of reverberation
  - Aversion to sound



# APHAB (unaided)





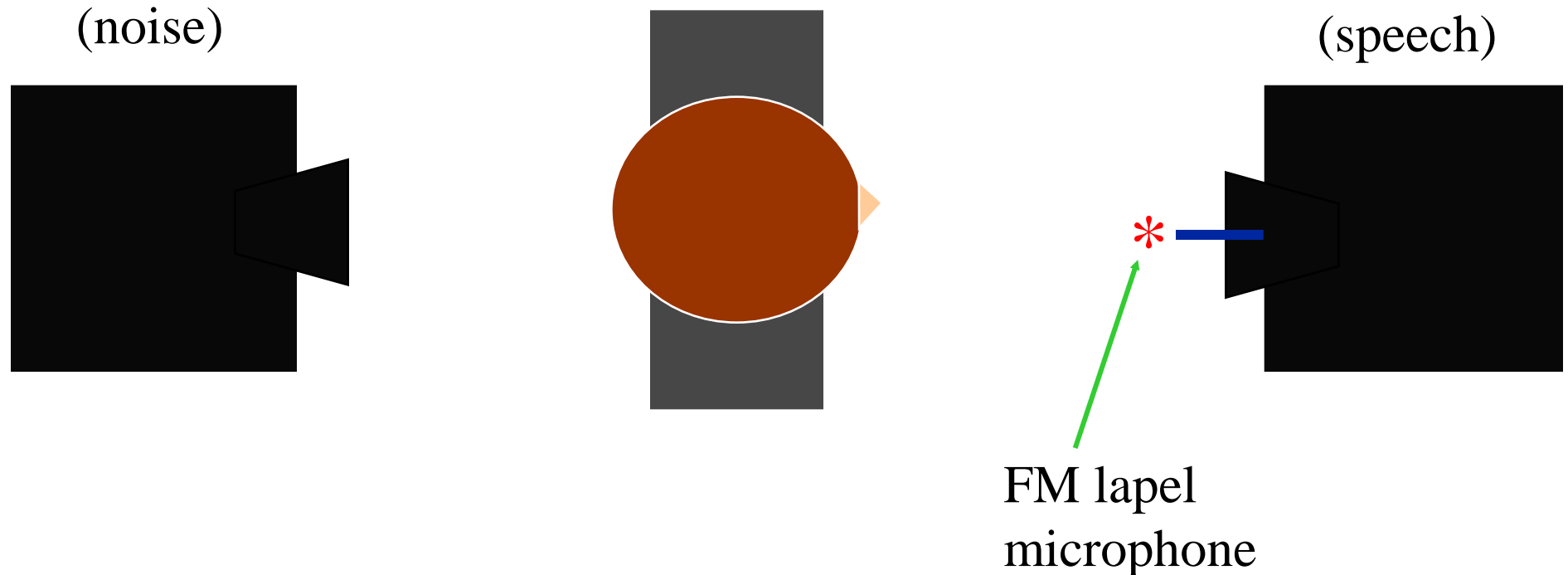


◆ Management of speech in noise problems

Personal FM systems

# FM Test Setup: Free Field Speech in Noise

- ◆ Speech: CNC words - 65 dBSPL
- ◆ +0 dB S/N ratio (at the subject's head)



# Results: Free-field Speech in Noise

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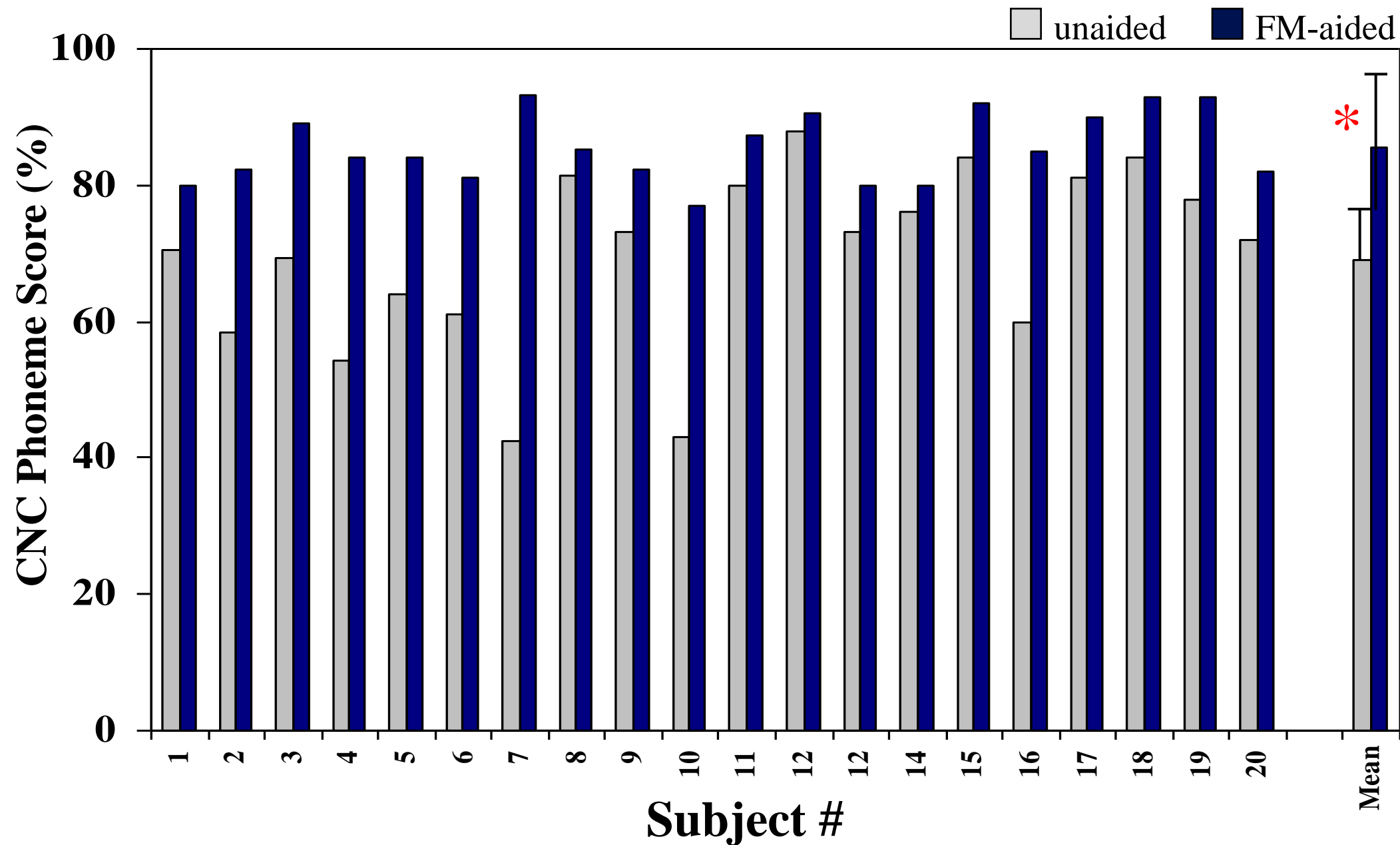
## ◆ Control Group (N=20)

- unaided:  $78.9 \pm 8.4\%$
- aided (FM device):  $89.1 \pm 4.0\%$

## ◆ ASD Group (N=20)

- unaided:  $68.9 \pm 11.7\%$
- aided (FM device):  $85.6 \pm 5.1\%$

# Unaided/FM-Aided Speech Scores (ASD)

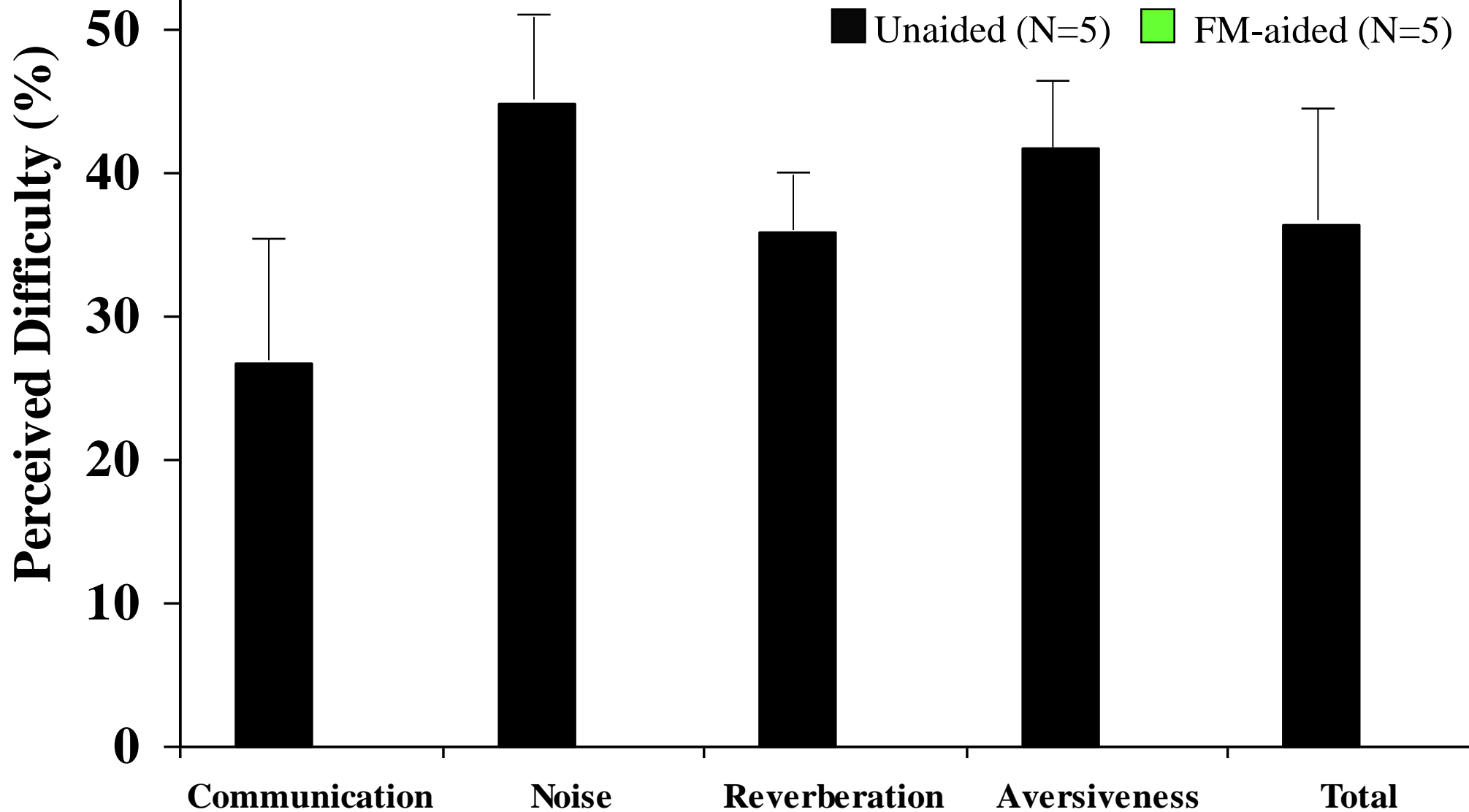


# 6 Week FM-Device Trial

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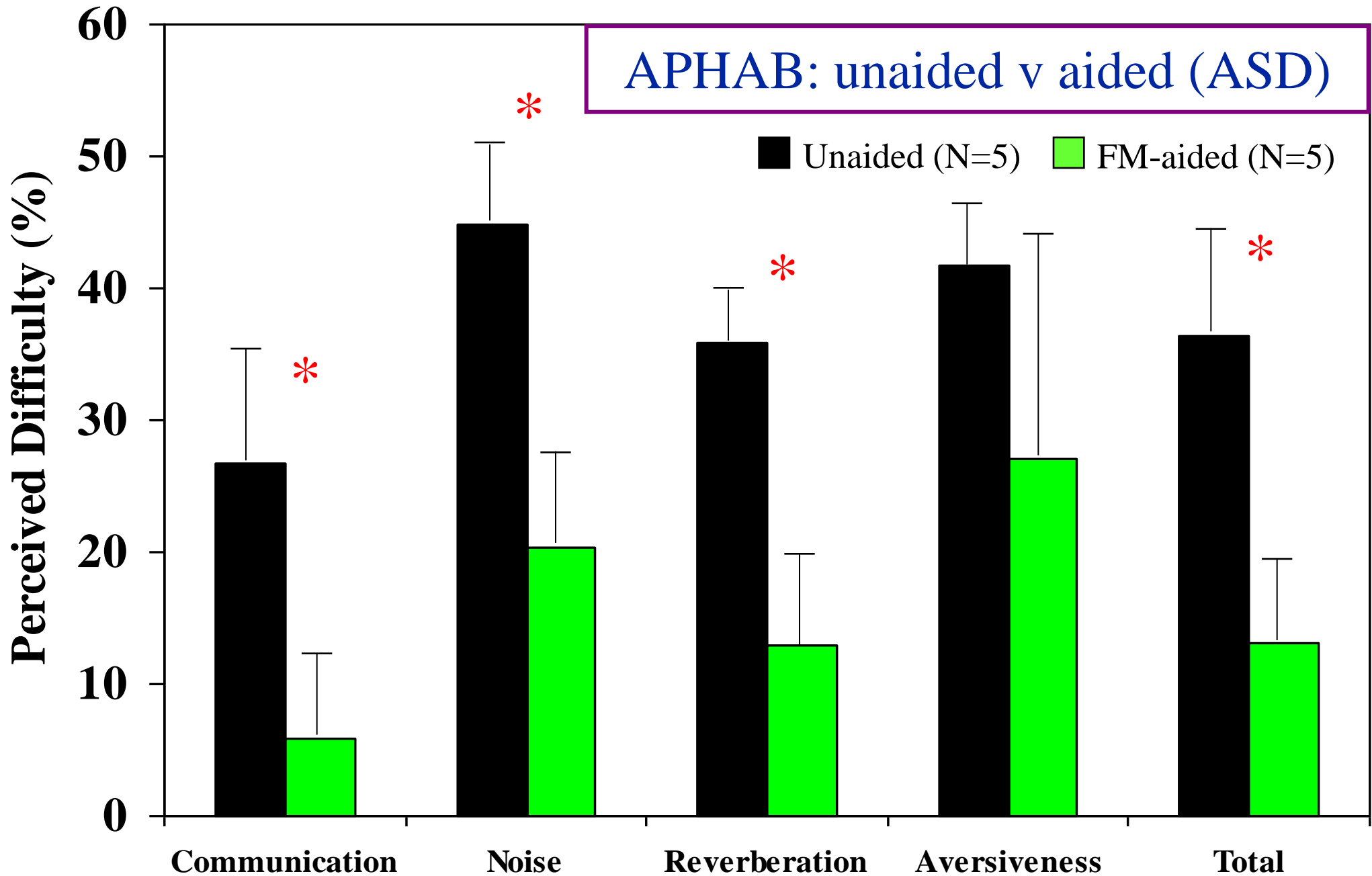
- ◆ Secondary School Children: 13-15 yrs (N=10)
  - All rejected
    - » Resistance from the child
    - » Inconsistent teacher support
- ◆ Primary School Children: 8-12 yrs (N=10)
  - 5 completed
  - 3 mid-trial: all consistent users at this stage
  - 2 rejected
    - » Both had significant behavioural problems

# APHAB: unaided v aided (ASD)





# APHAB: unaided v aided (ASD)



# Educational Impact

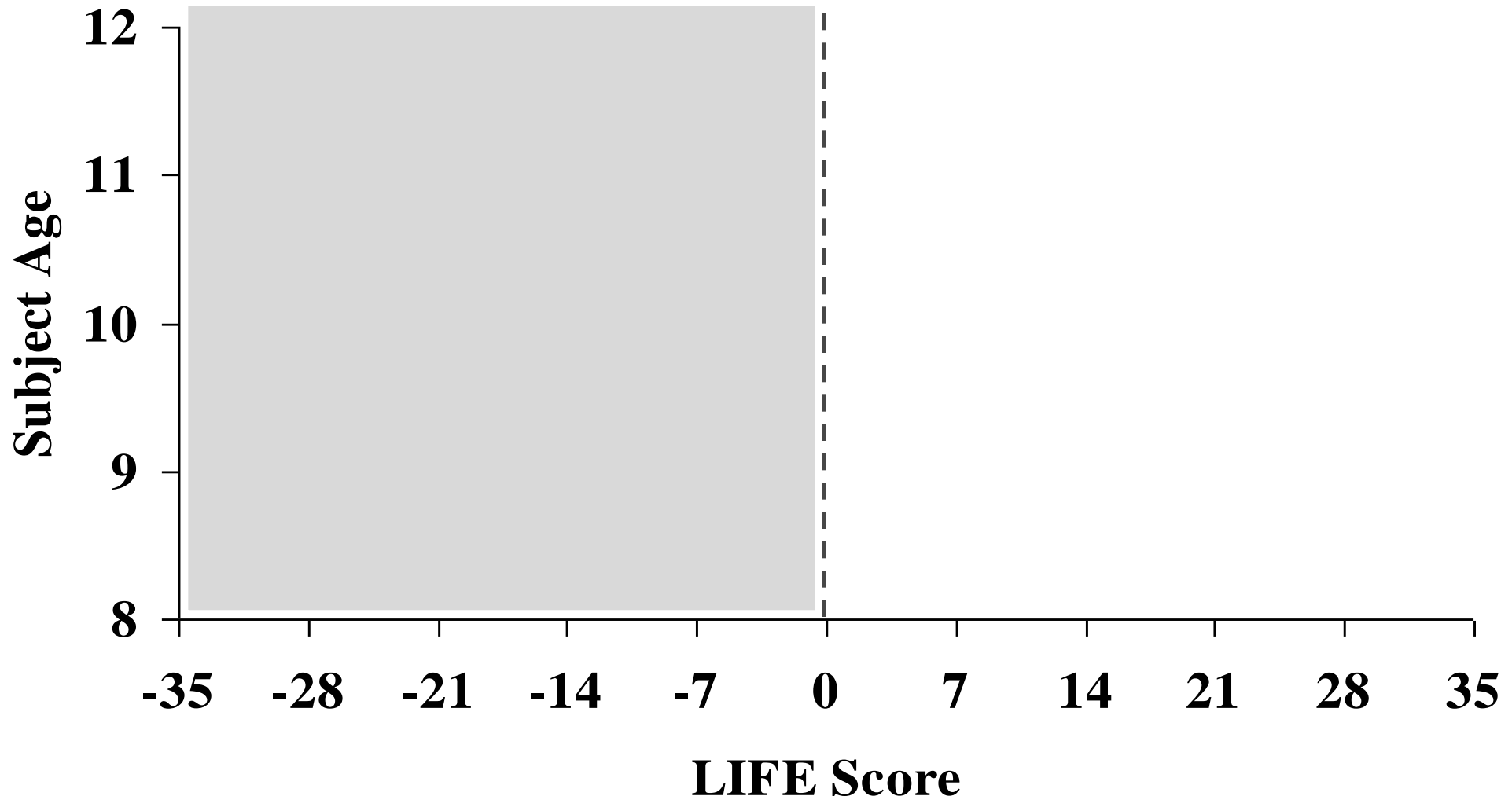
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- ◆ Listening Inventory For Education (LIFE)
- ◆ Completed by classroom teacher at the end of the FM-trial
- ◆ Aims to determine the efficacy of device usage
- ◆ 16 questions
  - 1. “Focus on instructions has improved”
  - 2. “Appears to understand instructions better”
  - 14. “Socially more involved with other children”
- ◆ 

<u>Agree</u>		<u>No Change</u>		<u>Disagree</u>
(2)	(1)	(0)	(-1)	(-2)
- ◆ Maximum score = 35

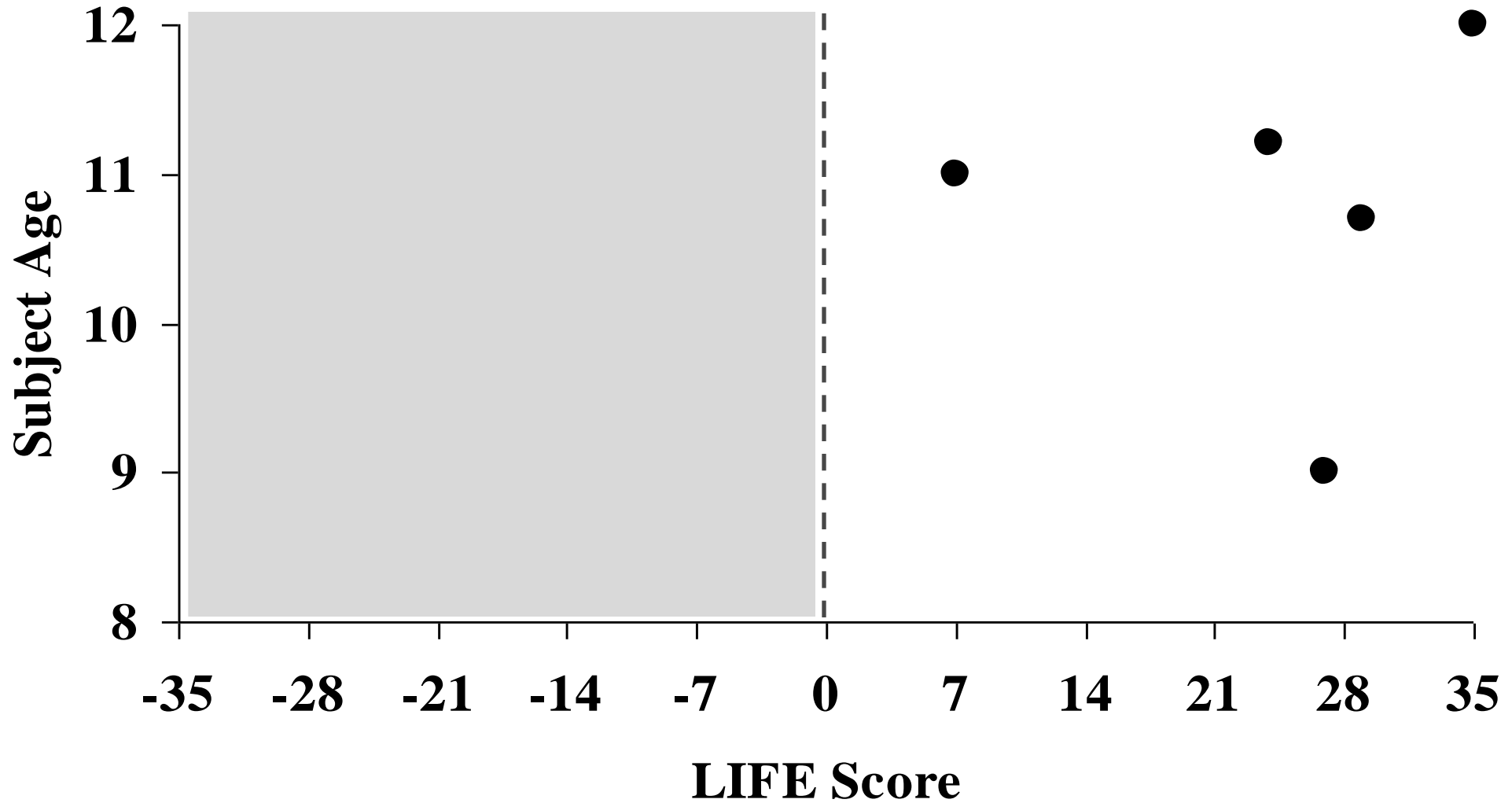
# Listening Inventory For Education (LIFE)

ASD Participants



# Listening Inventory For Education (LIFE)

ASD Participants



# Conclusions

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- ◆ ASD participants showed **monaural & binaural** auditory processing deficits
- ◆ Impaired speech perception (in noise) and a greater degree of everyday listening/communication difficulty
- ◆ All ASD subjects showed better speech perception in noise when wearing the FM device
  - teenagers failed to complete the FM trial
  - most of the younger participants (8-12 yrs) were still enthusiastic device users 6 weeks post-fitting

# Acknowledgements

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## ◆ Co-authors

- Dr Kerryyn Saunders: Pediatrician
- Peter Carew: Audiologist, The University of Melbourne
- Johanna Tan: Audiologist, The University of Melbourne
- Marlin Johansson: Master of Audiology Student,  
(Lund University, Sweden)

## ◆ Hardware

- Phonak: who donated the FM systems

## ◆ Funding Support

- Jack Brockhoff & Collier Foundations

Thankyou

