

Clinical Application of
Wireless Technology for
Children with
Autism Spectrum Disorder

Clinical Application of Wireless Hearing Technology for Children with Autism Spectrum Disorder

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4th Latin American Paediatric Conference, Sao Paulo, August 2015

Background

◆ Autism Spectrum Disorder (ASD)

- neurodevelopmental disorder affecting ≈ 1 in 120 children

◆ Behavioural symptoms

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

◆ Sensory abnormalities

- Auditory deficits noted in the original article on ASD (Kanner, 1943)
- consistently reported speech perception in noise deficits (Ornitz et al. 1989; Alcantara et al. 2004)

Presentation Outline

◆ Three studies

- 1. Six week trial of FM-listening devices in school-aged children
 - » Speech perception in noise
 - » Communication
 - » Educational outcomes
- 2. The effect of the ROGER system on listening-related stress
- 3. The effect of soundfield amplification on listening-related stress in the classroom

Study 1: FM-Listening Systems

◆ Initial test session

- FM device fitting (Inspiro transmitter / iSense micro receiver)
- Free field speech perception testing (CNC words in noise)
- Comparison of aided (FM) and unaided speech scores

◆ 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
- Subjects completed a hearing disability questionnaire at the end of each period (APHAB)
- Teacher survey at end of trial (LIFE)

Participants

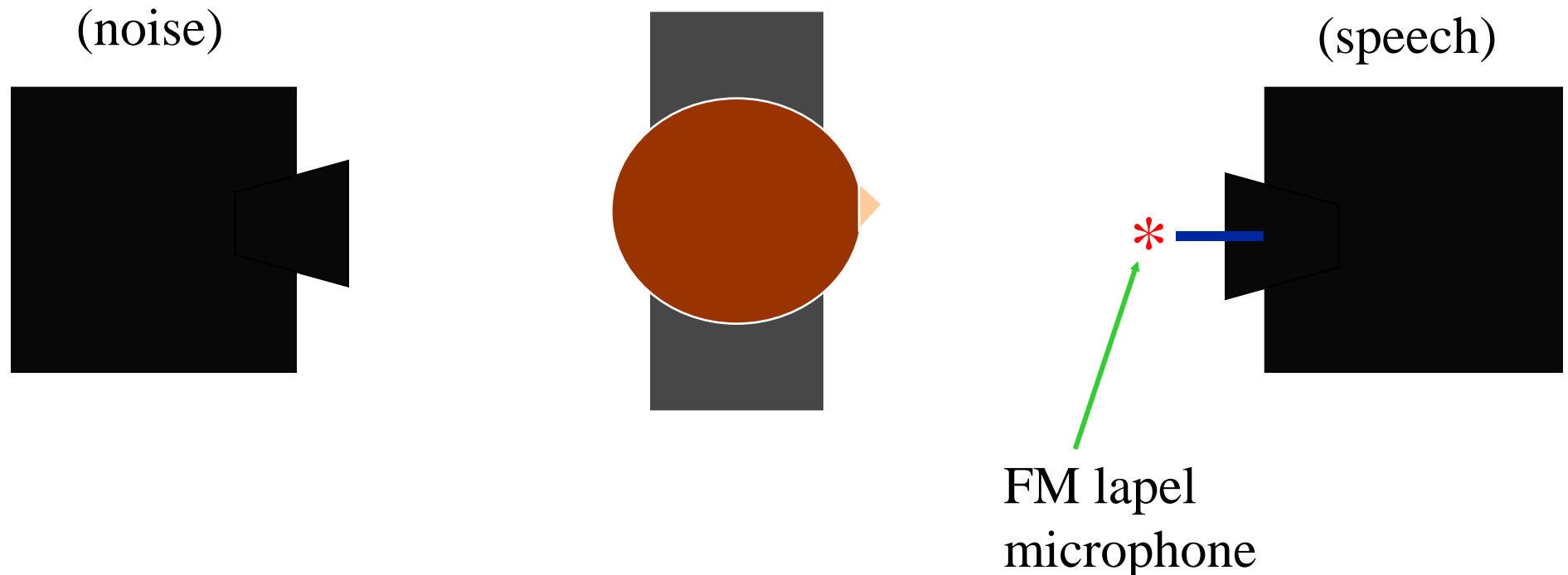
◆ 20 children with ASD

- **Diagnosis:** met DSM5 autism criteria
- **Intelligence/Cognitive Profile:**
Wechsler Intelligence Scale for Children (FSIQ>80)
- **Education:**
- All in mainstream settings: secondary N=10, primary N=10
- **Age range:** 8.0 yrs to 15.4 yrs
- **Audiogram:** normal

◆ 20 controls matched for age/gender/hearing level

FM Test Setup: Free Field Speech in Noise

- ◆ Speech: CNC words - 65 dBSPL
- ◆ +0 dB S/N ratio (at the subject's head)
- ◆ Comparison of FM-aided and unaided scores



Results: Free-field Speech in Noise

◆ Control Group (N=20)

– unaided:	78.9 ± 8.4%
– aided (FM device):	89.1 ± 4.0%

P=0.009

◆ ASD Group (N=20)

– unaided:	68.9 ± 11.7%
– aided (FM device):	85.6 ± 5.1%

P<0.001

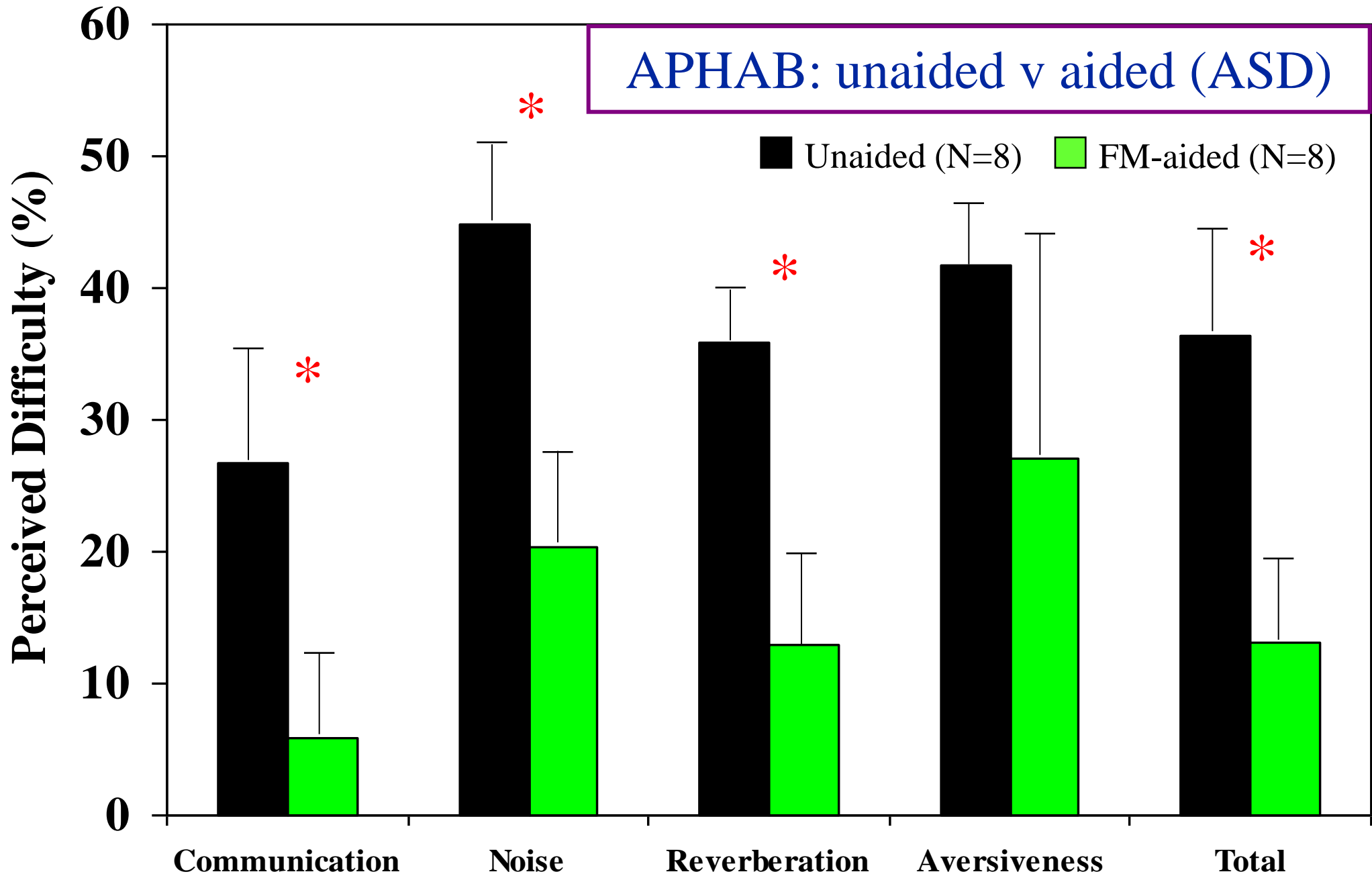
6 Week FM-Device Trial

- ◆ 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)
 - 8 completed
 - 2 rejected
 - » Both had significant behavioural issues
(tactile hypersensitivity)
- ◆ Device usage
 - 4-6 hours per day

Hearing Disability Survey

- ◆ 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 v aided (ASD)



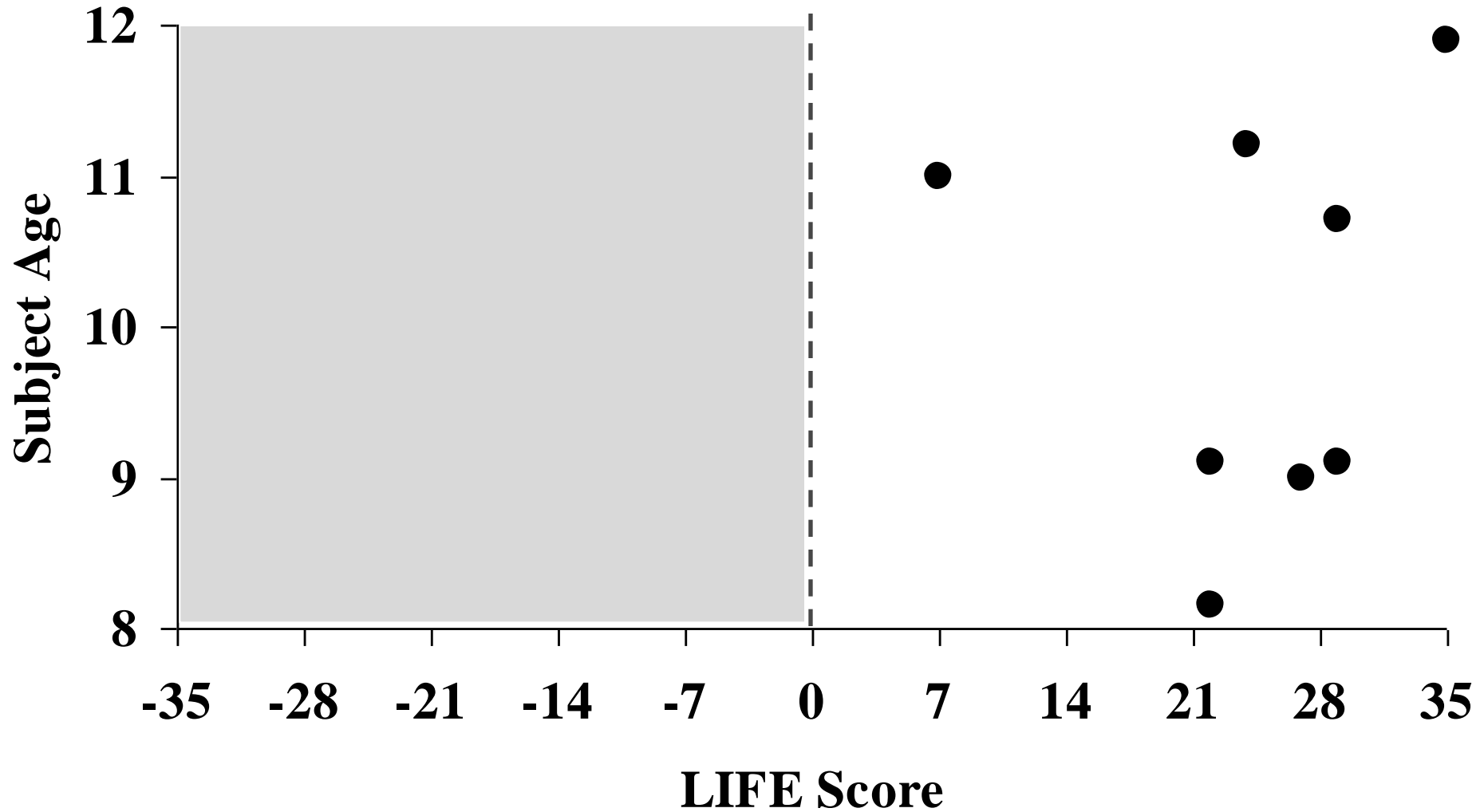
Educational Impact

- ◆ 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



Conclusions

- ◆ Participants with ASD suffered impaired speech perception in noise
- ◆ All showed improved speech scores when wearing the FM device
- ◆ Those children who completed the 6 week trial reported fewer listening and communication difficulties when wearing the system
- ◆ Teachers reported more social involvement and better attention when FM-aided
- ◆ All of the teenagers failed to complete the FM trial
- ◆ 8/10 younger participants (<12 yrs) were still enthusiastic device users at the end of the 6 week study
- ◆ All are still wearing their FMs 2 years later

Study 2

- ◆ The effect of ROGER devices on listening-related stress
- ◆ Fatigue and stress are recognized consequences of hearing impairment
- ◆ Children with ASD are particularly susceptible to stress/anxiety in social situations
- ◆ In this study we used a physiologic marker of stress/fatigue (salivary cortisol) to measure the effects of auditory intervention
- ◆ Cortisol (*hydrocortisone*) is a steroid hormone known to be responsive to communication stressors

Study 2: Protocol

◆ Initial Session

- ROGER device fitting
- Free-field unaided & ROGER-aided speech perception
- 1-2 weeks device experience (adjustment period)

◆ Two structured listening sessions (30 mins)

- Usually on consecutive days
- Range of listening/comprehension tasks
- Tester seated 2.5 meters in front of child
- 4-talker babble at 60 dBA

Study 2: Protocol

◆ Test Conditions

- 1. wearing ROGER (OFF)
- 2. wearing ROGER (ON)
- (randomised order)

◆ Saliva samples

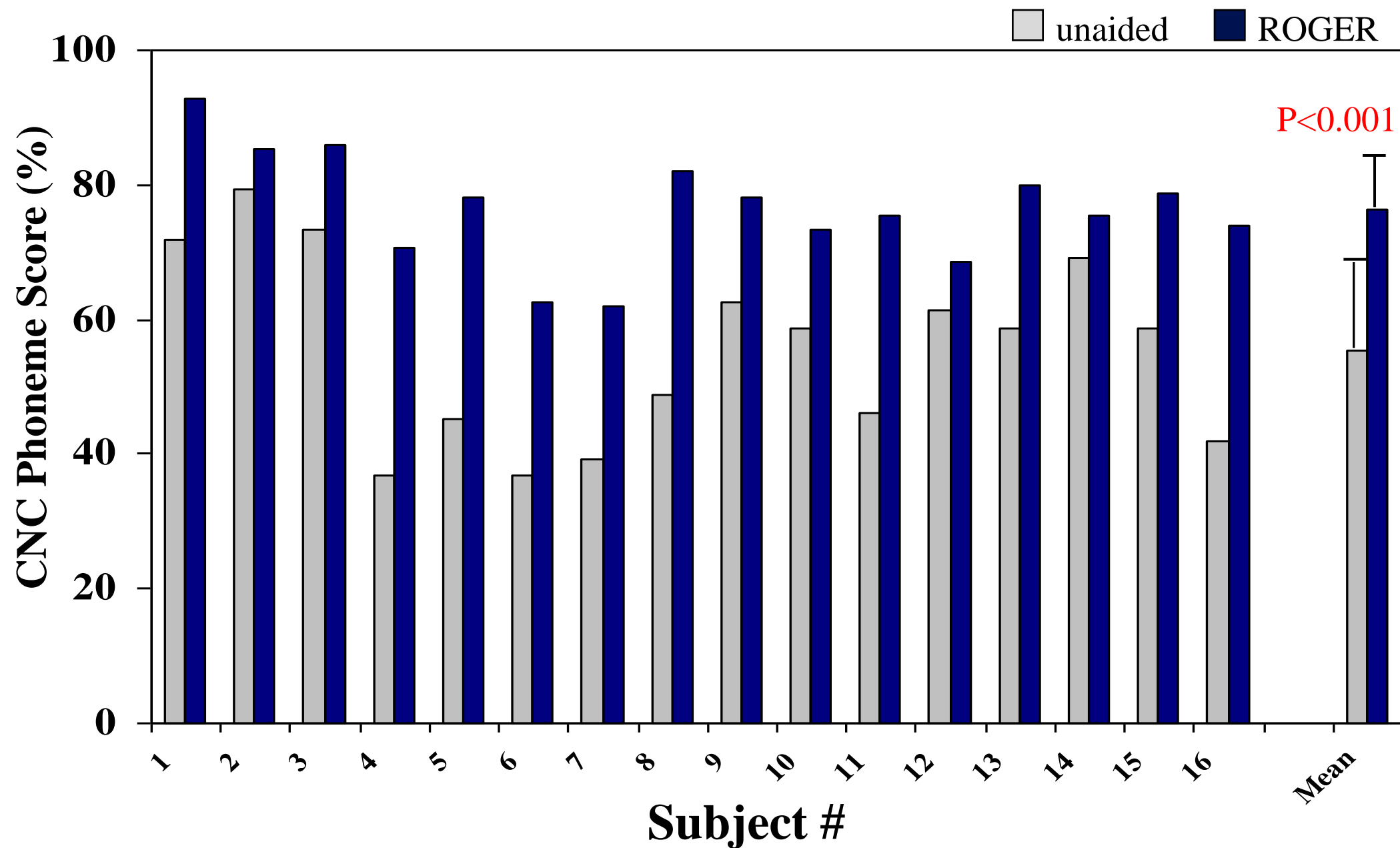
- Immediately **before** and 5 mins **after** each session
- 4 samples per subject
- Child required to spit in tube/bowl and produce 3 ml each time

Study 2

◆ Participants

- 16 children (10 boys)
- Age range: 5 to 12 years
- High functioning (FSIQ >80)
- Mainstream school settings
- Normal sound detection thresholds

Unaided/FM-Aided Speech Scores (ASD)



Study 2: Listening Stress (cortisol)

◆ Pilot: N=6

◆ 1st discovery



◆ children with ASD struggle to spit on demand

– some children failed to produce any saliva

– those that did found the sampling more stressful than the listening task!

Study 2: Listening stress (cortisol)

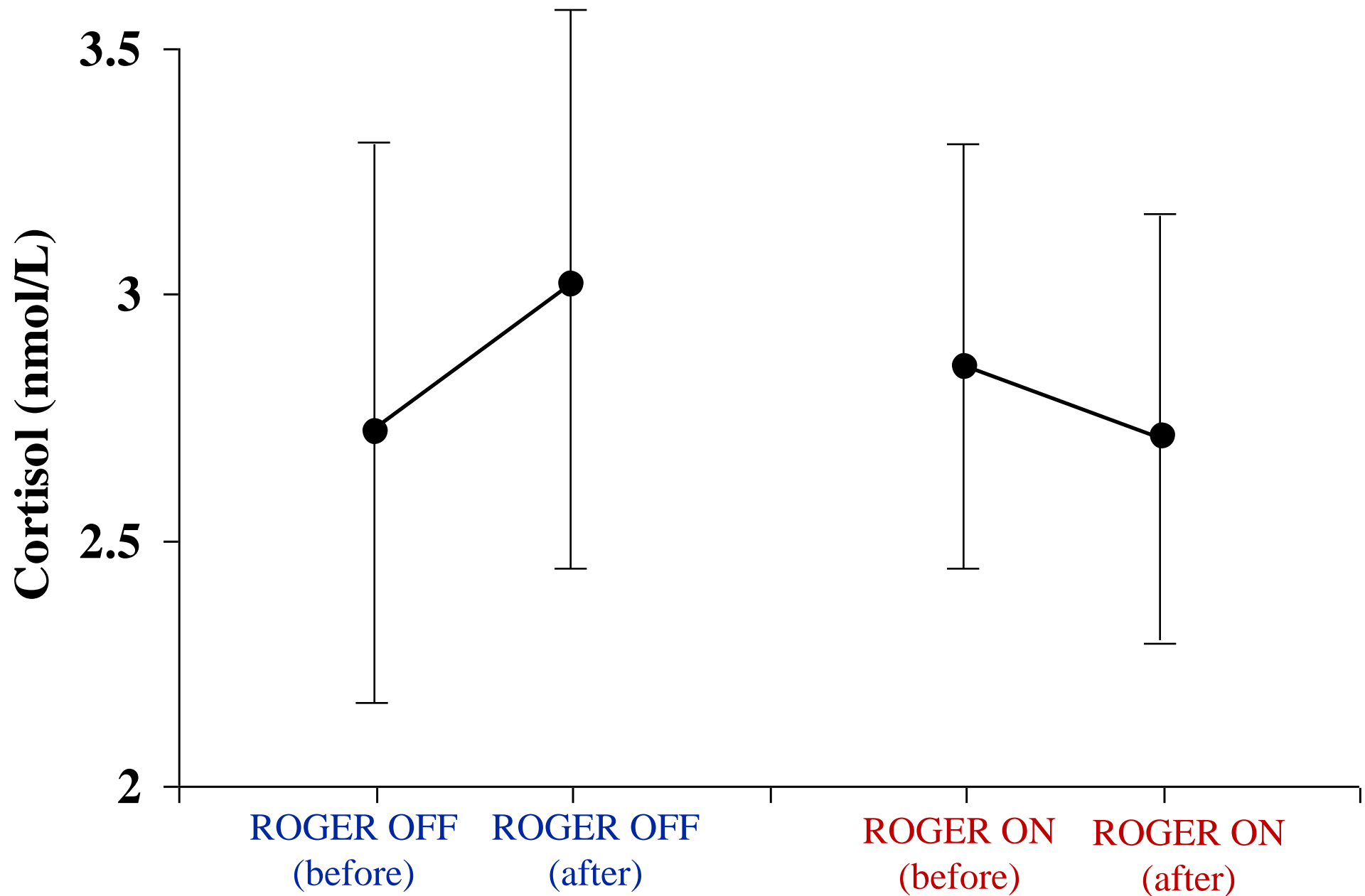
◆ 10 participants

- Spitting practice

◆ Hypotheses

- That cortisol level will increase over the course of the listening session
- That cortisol increase will be reduced when the child can hear better (ROGER-aided)

Salivary Cortisol Levels: ROGER Device Trial



Study 3: Soundfield Classroom Amplification for ASD

- ◆ **Background**
- ◆ **Not all children with ASD are good candidates for ROGER fitting**
 - Teenagers
 - Tactile hypersensitivity
 - Low-functioning
- ◆ Soundfield amplification improves classroom listening conditions without the child wearing a device
- ◆ **Hypothesis:** that soundfield amplification of the teacher's voice would reduce classroom stress for children with ASD

Study 3: Soundfield amplification for ASD

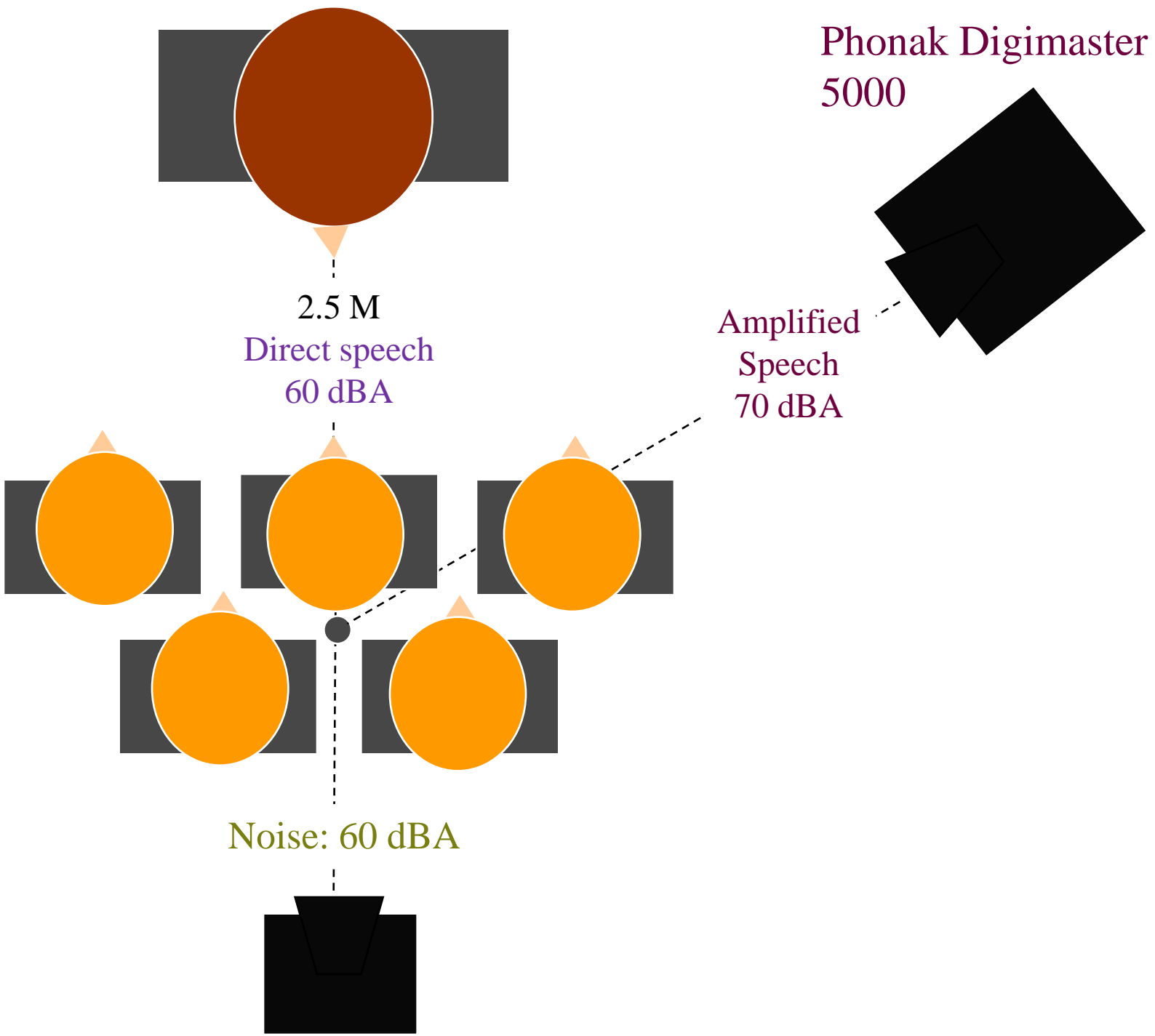
◆ Participants

- 10 children with ASD (12-15 years)
- Normal sound detection
- Poorer speech perception in noise than matched controls

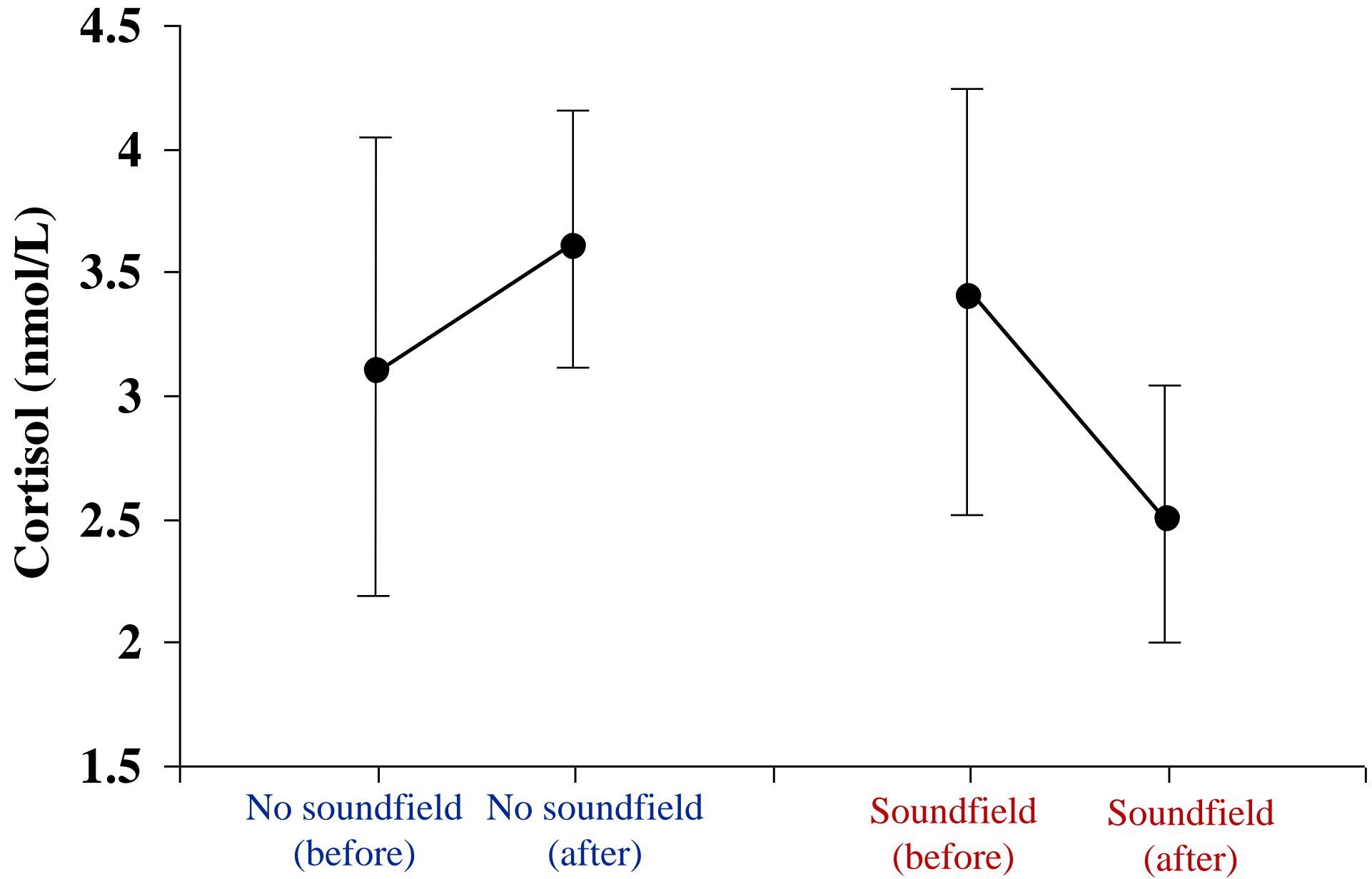
◆ Protocol

- Cortisol analysis: saliva samples before & after two structured listening sessions (**soundfield off/on**)
- Tested in 2 x groups of 5 children
- Test order (soundfield off/on) **randomized**

Soundfield Test Setup



Salivary Cortisol Levels: Soundfield Amplification Trial



Summary & Conclusions

- ◆ Children with ASD suffer listening-in-noise difficulties severe enough to exacerbate the communication problems central to the disorder
- ◆ Wireless technologies (**FM/ROGER devices**) can ameliorate these auditory deficits
 - improved perception
 - easier communication in everyday listening situations
 - more appropriate classroom behaviors
- ◆ Both **ROGER** and **soundfield amplification** reduce listening-related stress in challenging listening situations

Acknowledgements

◆ Co-authors

- Dr Kerryyn Saunders: Developmental Pediatrician,
Monash University
- Donella Chisari: Audiologist, The University of Melbourne
- Peter Carew: Audiologist, The University of Melbourne
- Johanna Tan: Audiologist, The University of Melbourne

◆ Hardware

- Phonak: who donated the FM, ROGER & Soundfield systems

◆ Funding Support

- Jack Brockhoff & Collier Foundations

Obrigado

