Early Detection and Management in Children with Mild Hearing Loss

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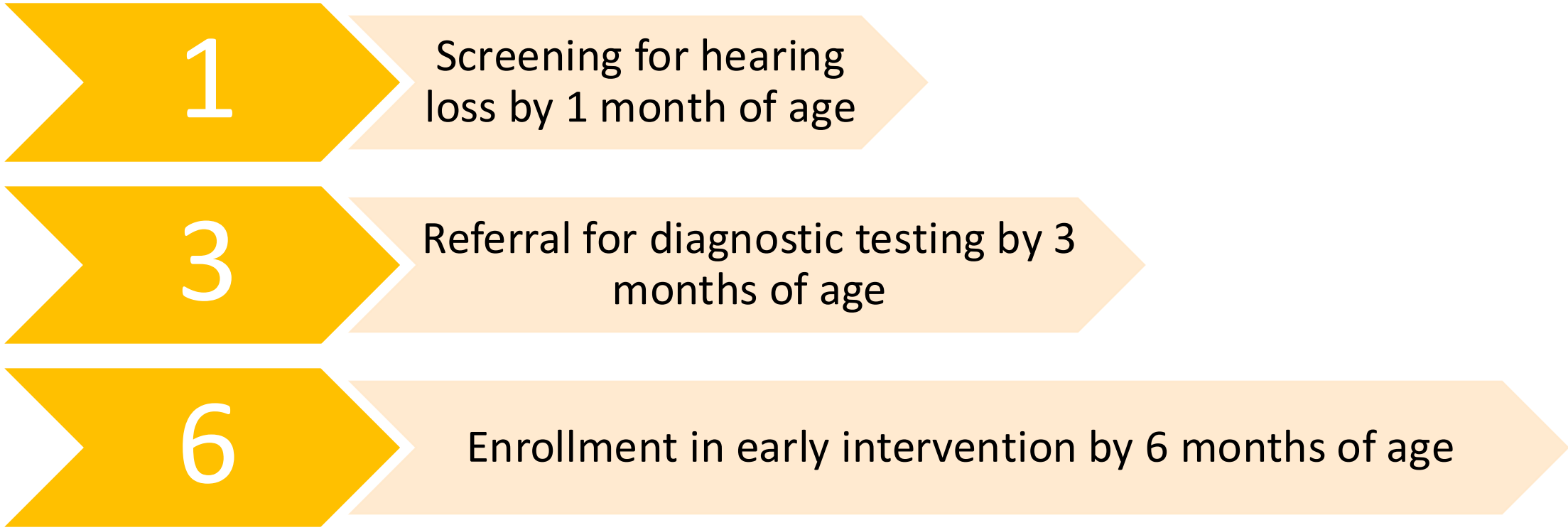
- Associate Professor
- University of Iowa, Iowa City, IA

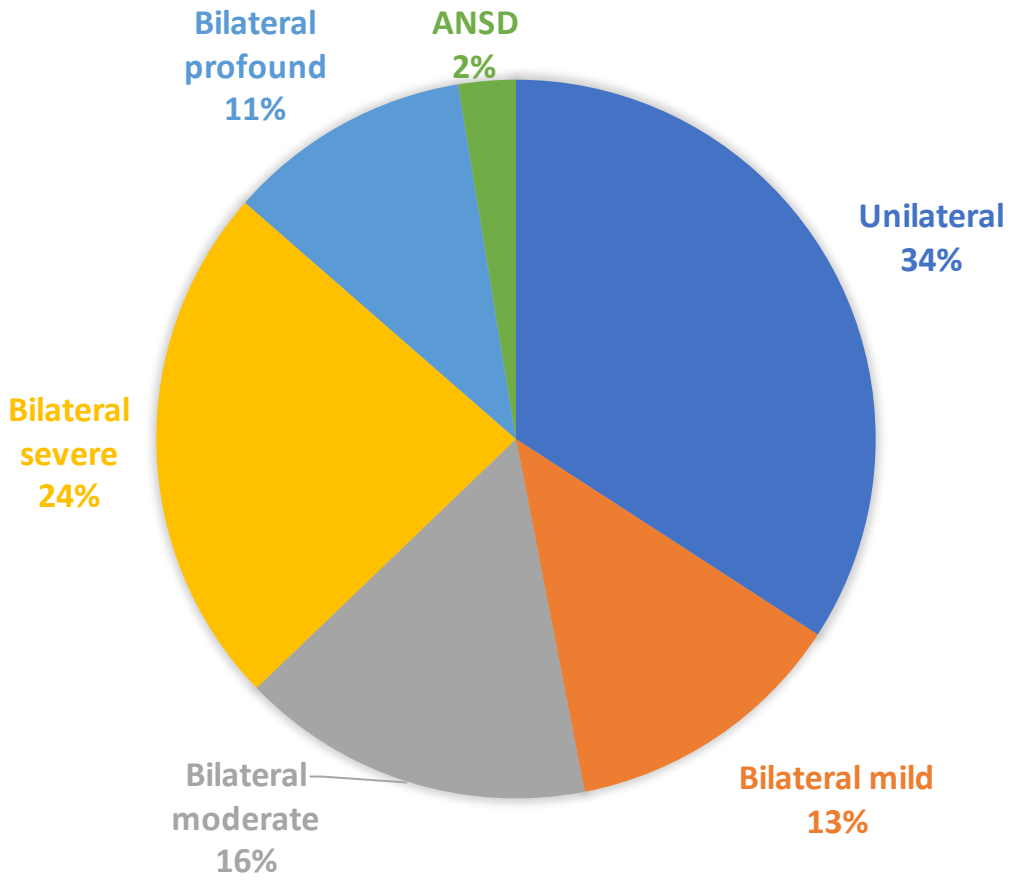
Topics to be discussed today:

- Special challenges for children with mild hearing loss
- Is mild bilateral hearing loss a developmental risk?
- Does amplification help children with mild bilateral hearing loss?
- How to implement an audibility-based criteria for children with mild hearing loss

Infants and children with hearing loss benefit from early identification and early access to language through technology or visual communication.



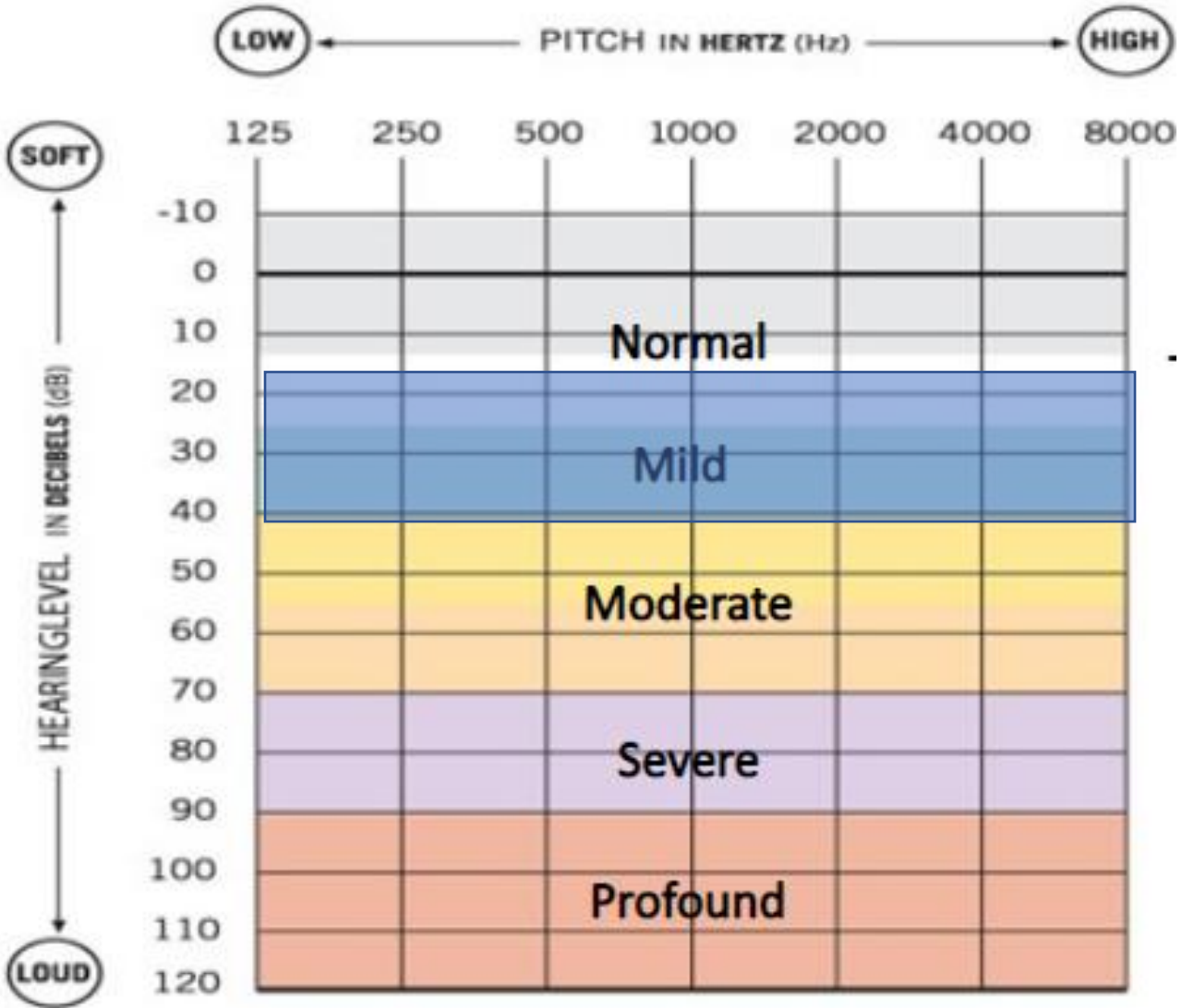
~15% of children ages 6-19 years have a significant hearing loss



40-50% have mild or unilateral hearing loss (Fitzpatrick et al., 2010)

Are children with significant amounts of residual hearing at risk?

Is intervention (e.g., hearing aids) warranted?



Children with mild hearing loss present special challenges

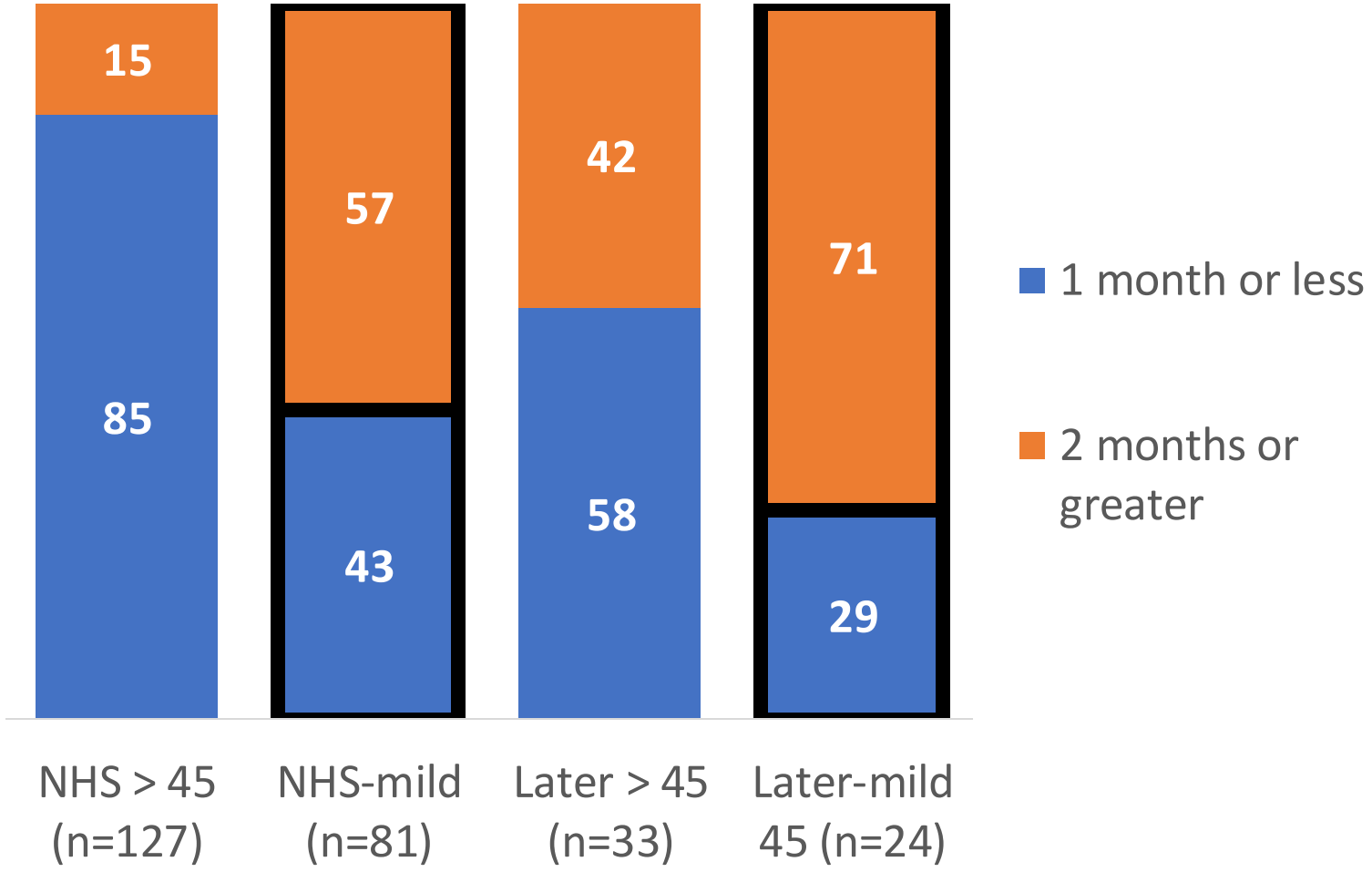
Identification and diagnosis

- Delays in confirmation
- NHS not intended to identify < 35 dB
- Insert earphones calibrated to 2 cc coupler. Sound is louder in an infant ear canal than an adult ear canal.
- Self-generated noise can mask thresholds

Management

- Delays in hearing aid fitting
- Lack of consensus on optimal intervention strategies
- Limited evidence that HAT or EI will lead to better outcomes

Children with mild HL experience delays between confirmation & HA fitting

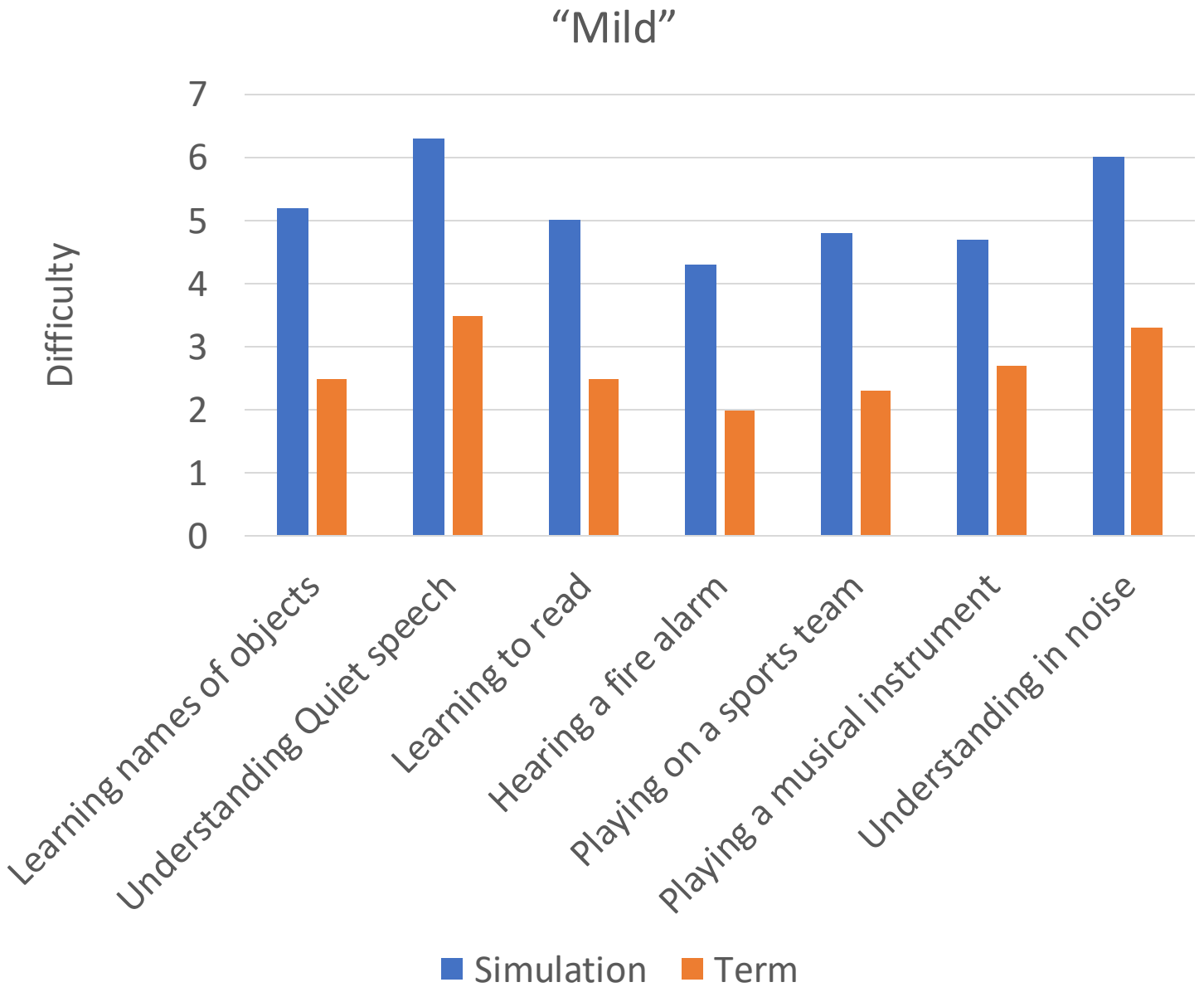


Walker et al, 2016, American Journal of Audiology

Why are children with mild HL receiving services later?

- Terms we use?
  - It's "just a mild hearing loss" (Fitzpatrick et al., 2017)

Terms we use to describe loss = parent perception of disability

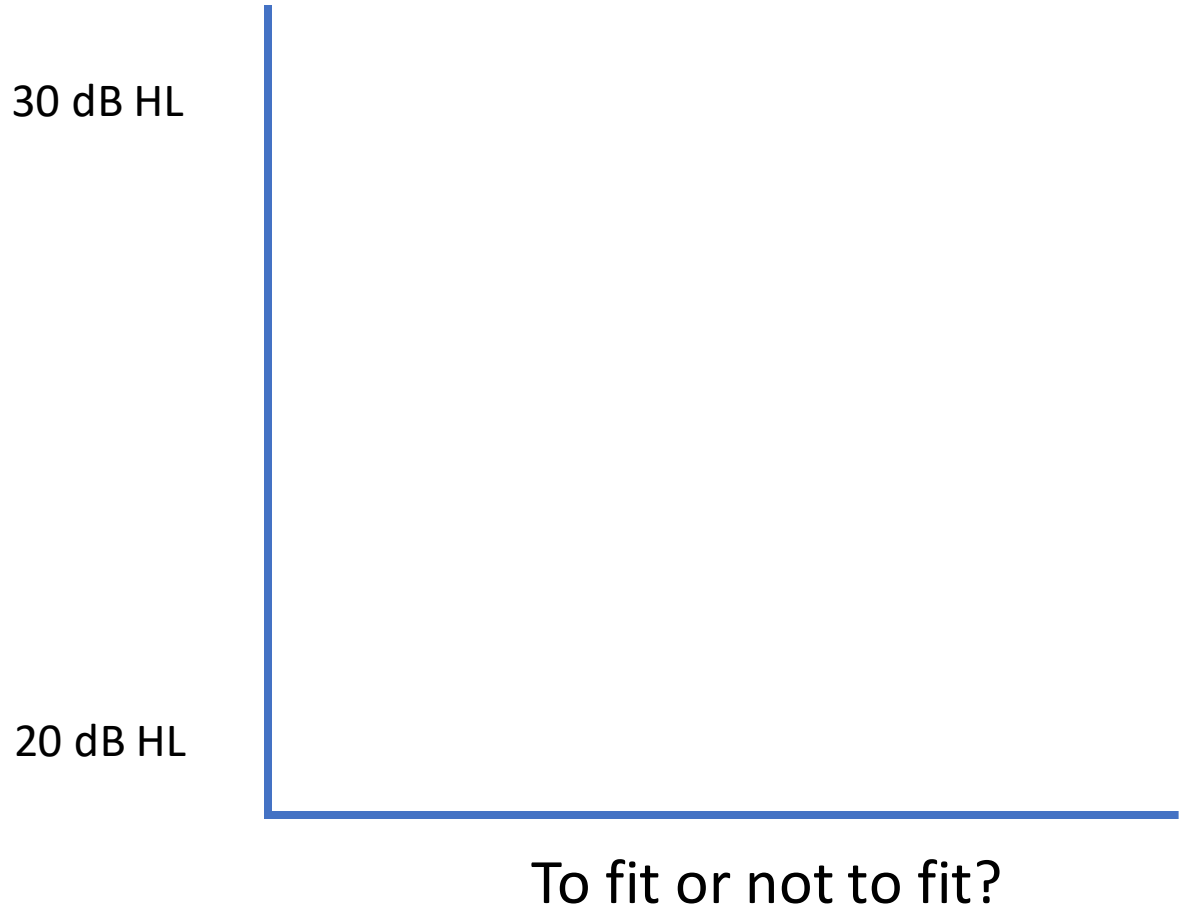


Modified from Haggard & Primus 1999 AJA

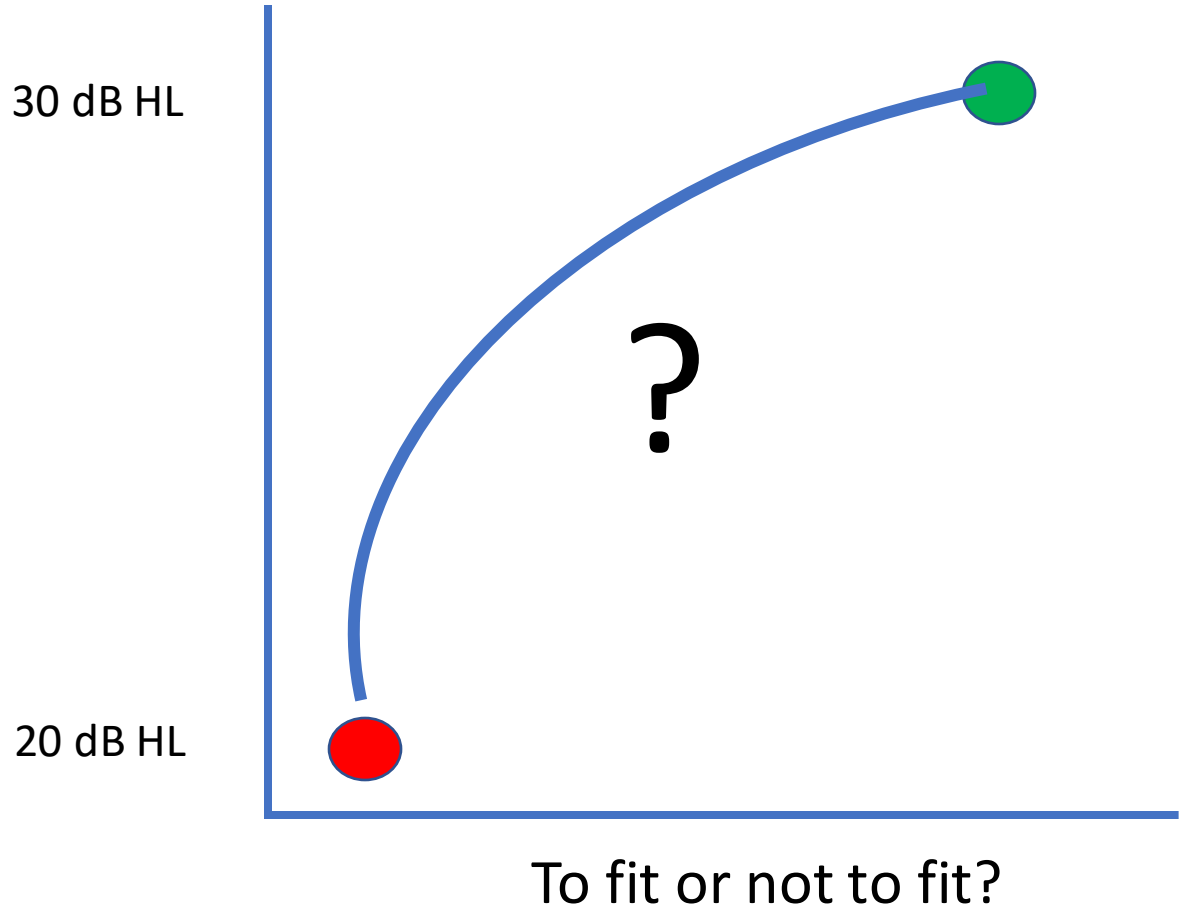
Why are children with mild HL receiving services later?

- Terms we use?
  - It's "just a mild hearing loss" (Fitzpatrick et al., 2017)
- Inconsistency in evidence base?

Fit children with mild bilateral hearing loss?



Fit children with mild bilateral hearing loss?



<u>Clinical equipoise</u>

Uncertainty about clinical decisions in the face of limited or unclear evidence

Situation of “clinical equipoise” regarding management for children with mild hearing loss

Current evidence base

- Children with mild HL are at risk for delays and difficulties in the academic setting
  - Bess et al., 1985; Blair et al., 1985; Davis et al., 1981; Dokovic et al., 2013; Yoshinaga-Itano et al., 2008; Lewis et al., 2015

Situation of “clinical equipoise” regarding management for children with mild hearing loss

Current evidence base

- Other studies show minimal impact of mild HL on outcomes, with ambiguity re. benefit from hearing aids and early identification and intervention
  - Porter et al., 2014; Wake et al., 2006; Carew et al., 2017

Child: care, health and development
Original Article
doi:10.1111/cch.12477

Mild–moderate congenital hearing loss: secular

Alternatively, mild hearing loss could represent 'overdiagnosis', defined as identification of a real condition for which treatment does not actually benefit an individual's outcomes (Coon *et al.* 2014). This would imply that these children's developmental deficits might not be attributable solely to their hearing acuity. If so, the decision to amplify mild losses early could represent not only overtreatment (i.e. treatment that cannot deliver benefit) but also active harm (costs, burden, stigmatization).

predicts outcomes; and (iii) compare outcomes between children identified via well-established UNHS and the general population.

Methods Linear regression adjusted for potential confounding factors was used throughout. Via a quasi-experimental design, language and psychosocial outcomes were compared across four population-based Australian systems of hearing loss detection: opportunistic detection, born 1991–1993, $n = 50$; universal risk factor referral, born 2003–2005, $n = 34$; newly established UNHS, born 2003–2005, $n = 41$; and well-established UNHS, born 2007–2010, $n = 21$. In pooled analyses, we

Carew et al 2017

Limitations of past studies

- Mild often grouped with unilateral/minimal HL OR moderate to severe/profound
- Studies focus on the effects of age at service delivery, not the intervention itself
- Most studies do not describe influence of both aided audibility and amount of daily HA use on outcomes

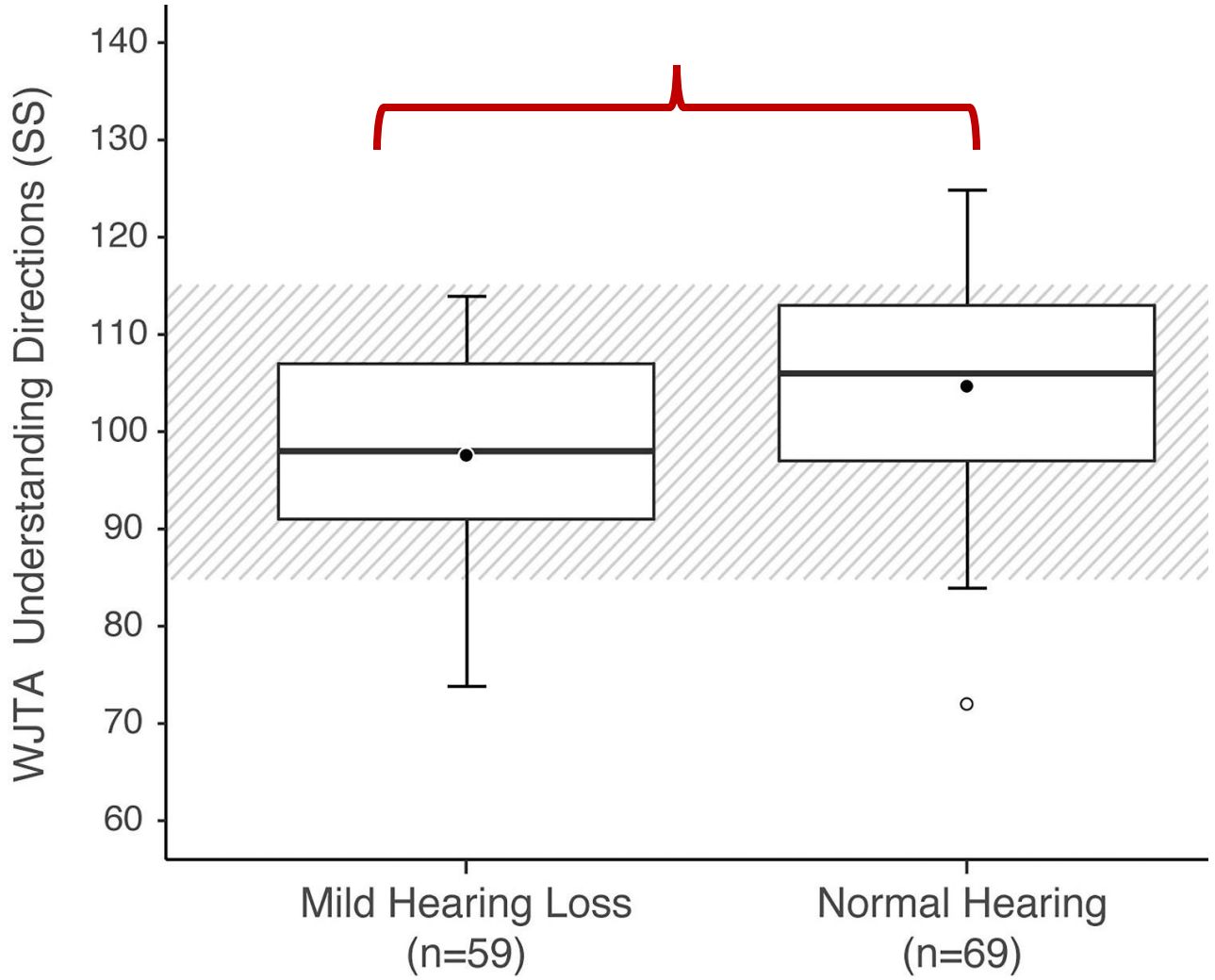
Is mild bilateral hearing loss a developmental risk?

LSHSS

Research Article

Language and Reading Outcomes in Fourth-Grade Children With Mild Hearing Loss Compared to Age-Matched Hearing Peers

Elizabeth A. Walker,[a] Caitlin Sapp,[a] Margaret Dallapiazza,[a] Meredith Spratford,[b] Ryan W. McCreery,[b] and Jacob J. Oleson[c]



LSHSS

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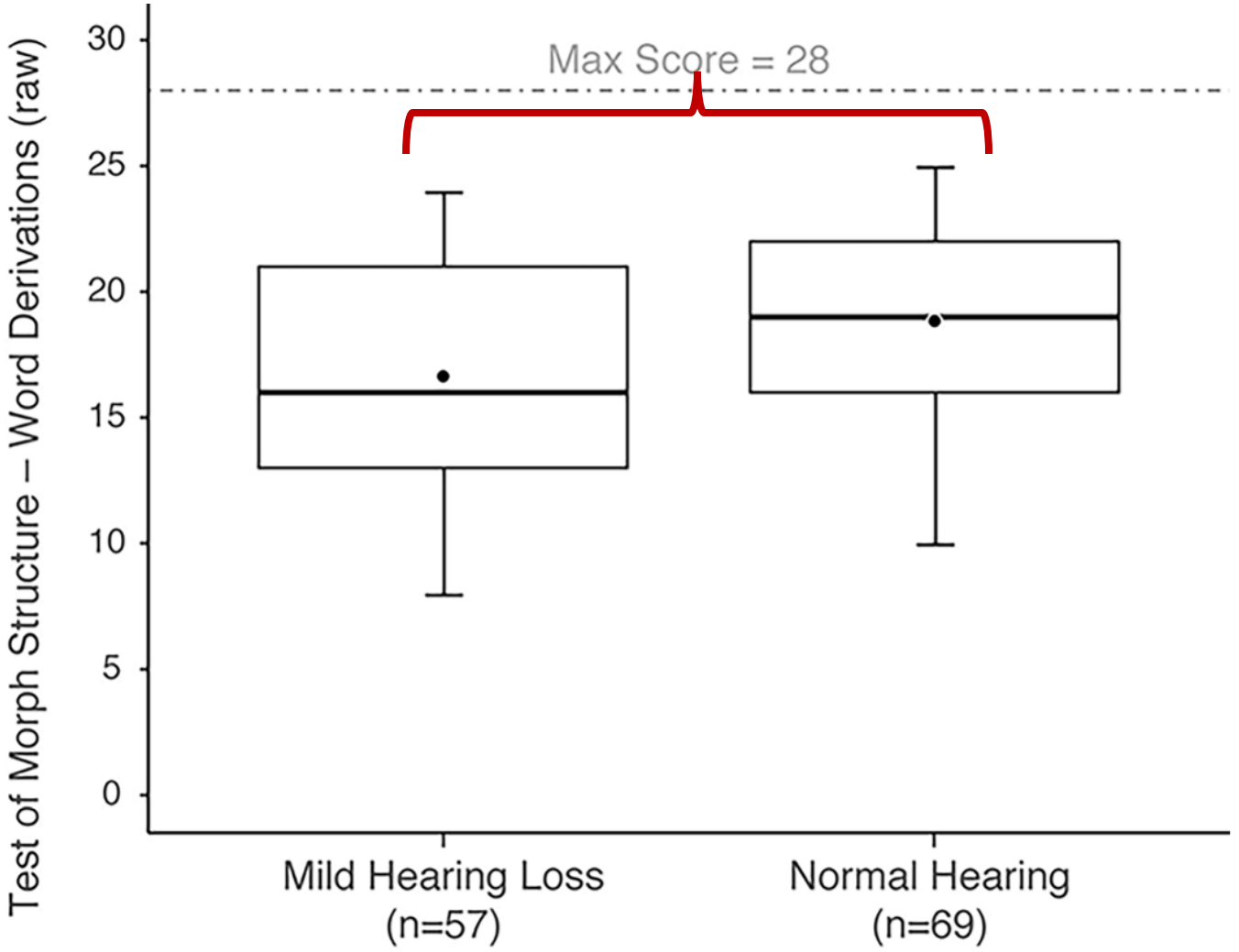


Age: 3 Years, 6 months

Take home message: Mild hearing loss affects processing of subtle acoustic cues important for morphosyntax

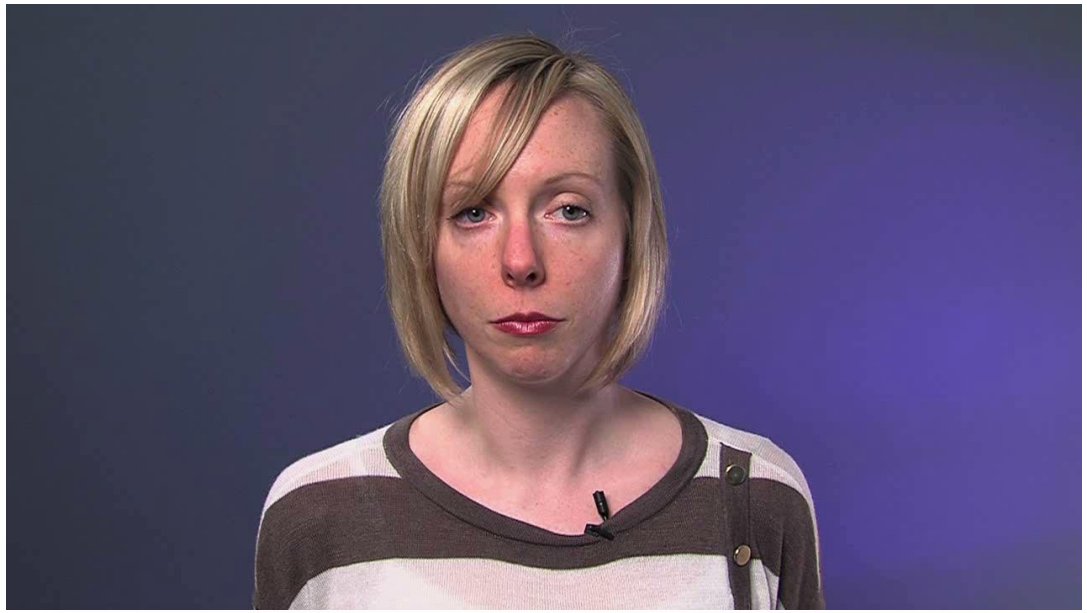
Bound morphemes, especially in verbs, are less salient and less frequent in the input

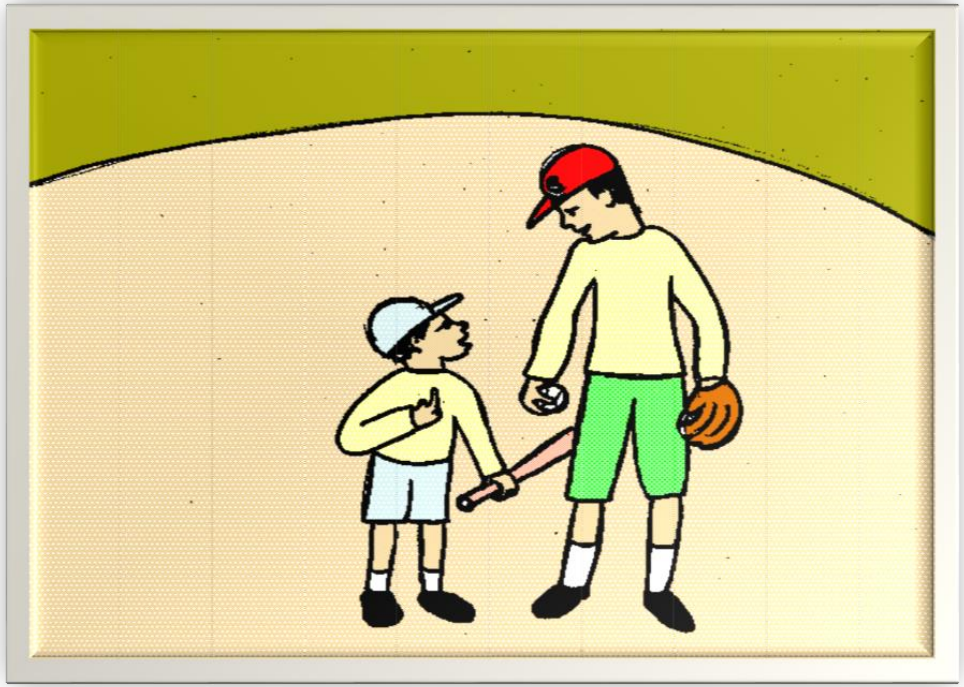
- Typically sentence medial (He need***s*** to find…)
- Often involve fricatives in English
- Complex phonetic contexts (It’s, Greg’s calling…)

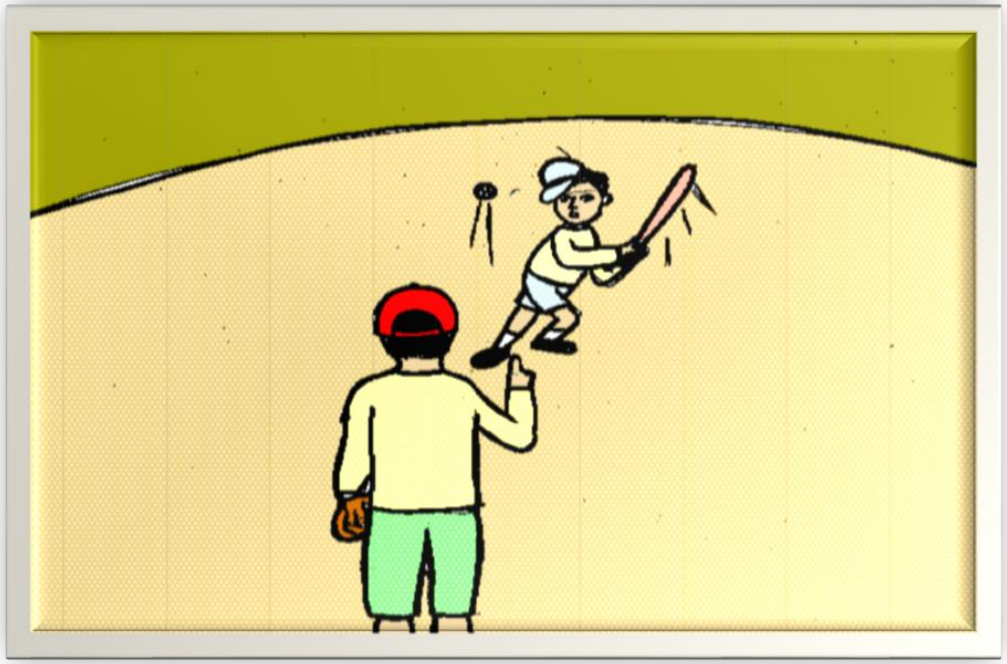
Higher-level social cognition: Sarcasm

Method

- 9 Picture-Supported Stories
  - de Villiers & de Villiers
- Presented in standard audio-visual format
- Child answered questions requiring interpretation or reasoning







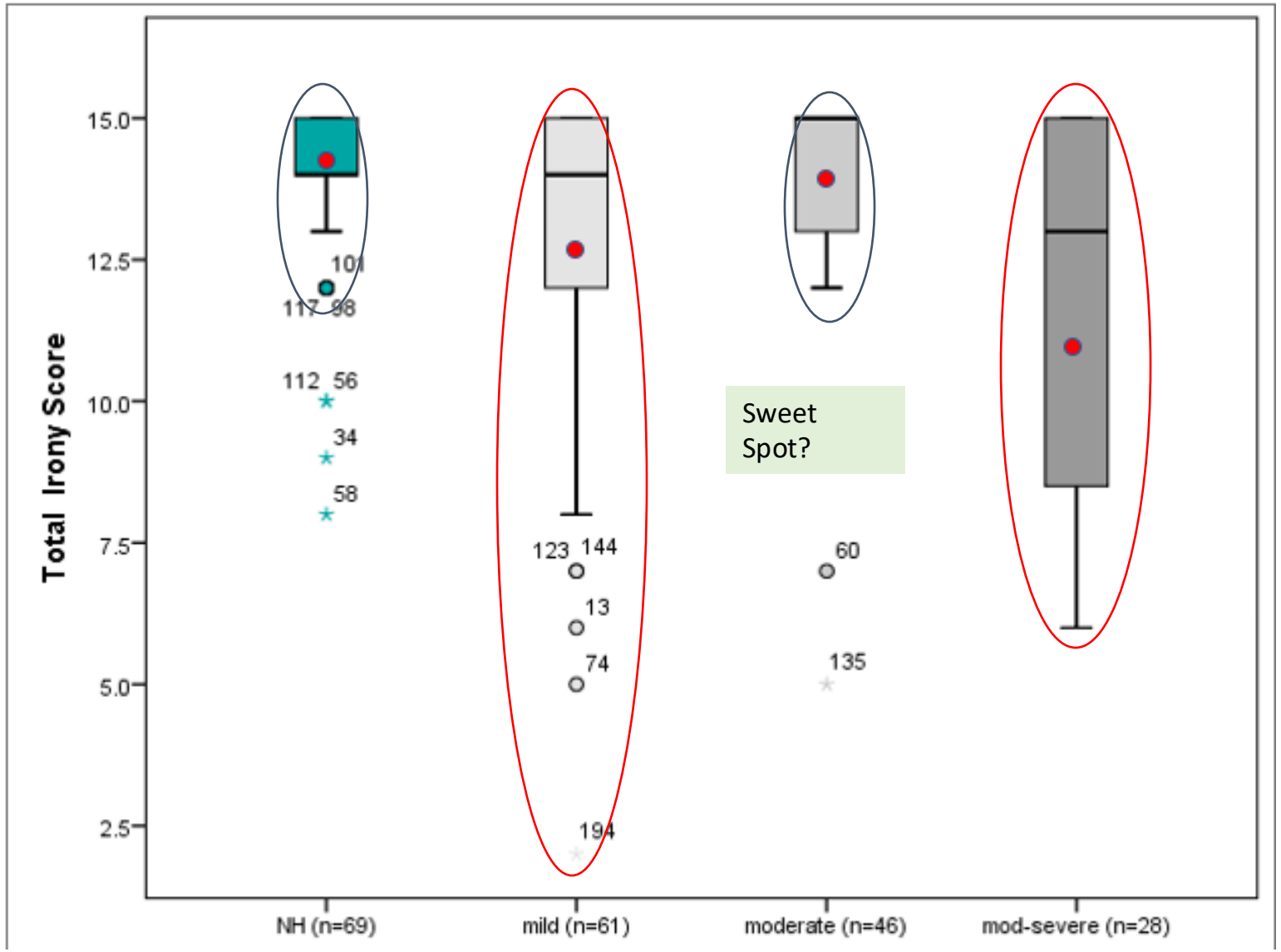
1. What did the big brother mean when he said that?

2. Did the brother think that the little boy was a bad hitter or a good hitter?

   Bad _____ Good _____

Results – Understanding Sarcasm and Irony at 8 years

Main effect of hearing category p = .001



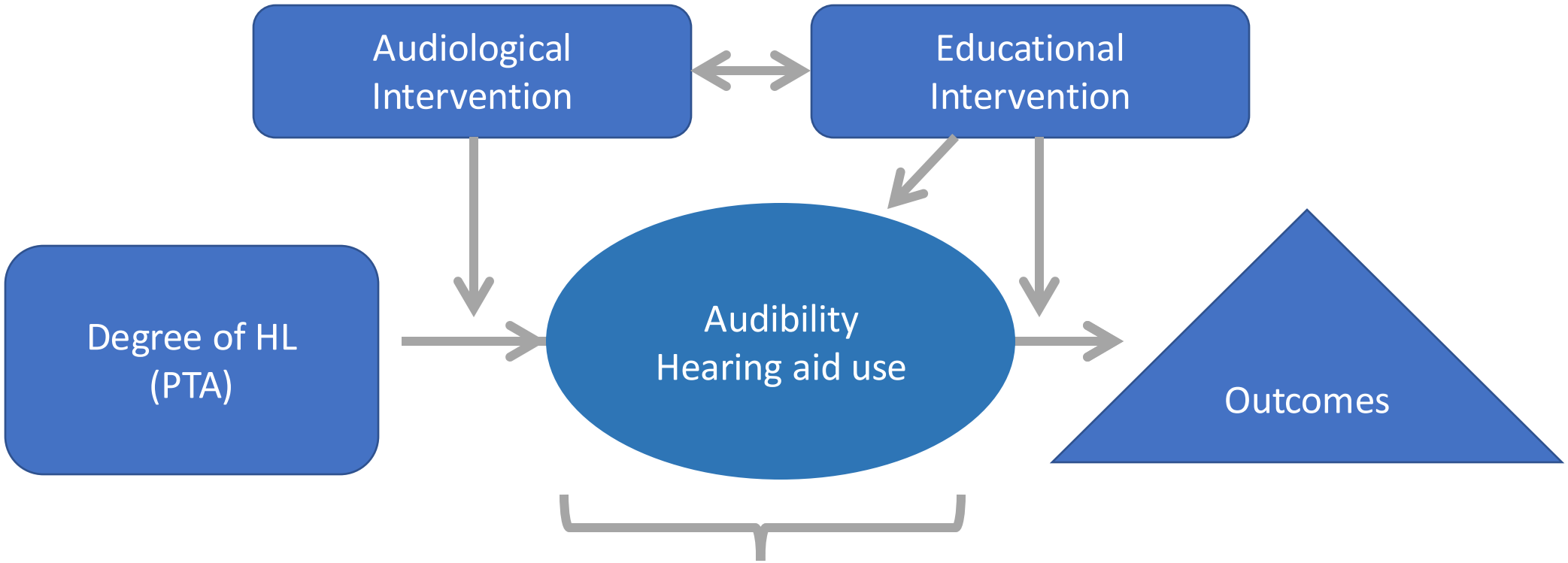
Take-home points!

- Children with mild hearing loss experience delays in diagnosis and clinical management.
- Children with mild hearing loss are at risk for deficits in language and psychosocial outcomes out to fourth grade (at least).
- Cumulative auditory experience may account for these deficits

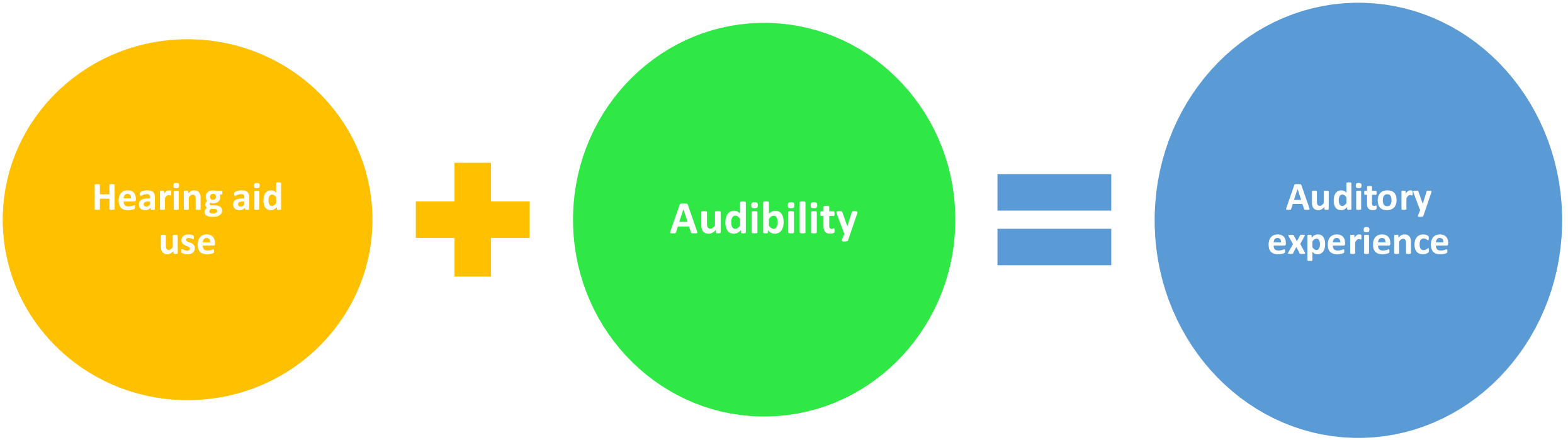
  ….but we need to consider role of hearing aid use and audibility

Does amplification help children with mild bilateral hearing loss?

OCHL model: cumulative auditory experience

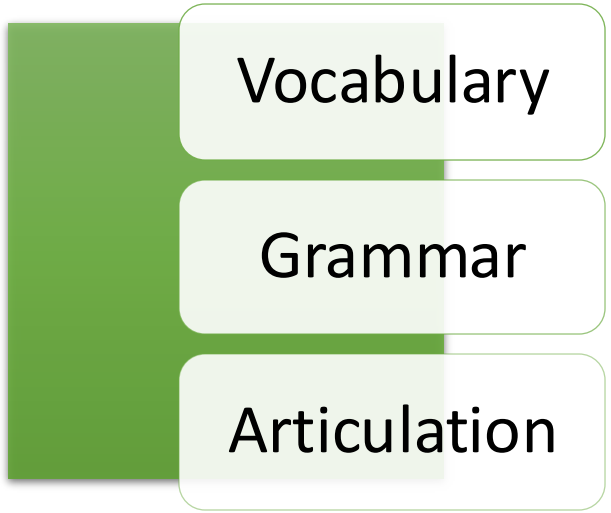


Factors that influence relationship between PTA and outcomes.


Hearing aid use
Audibility
Auditory experience

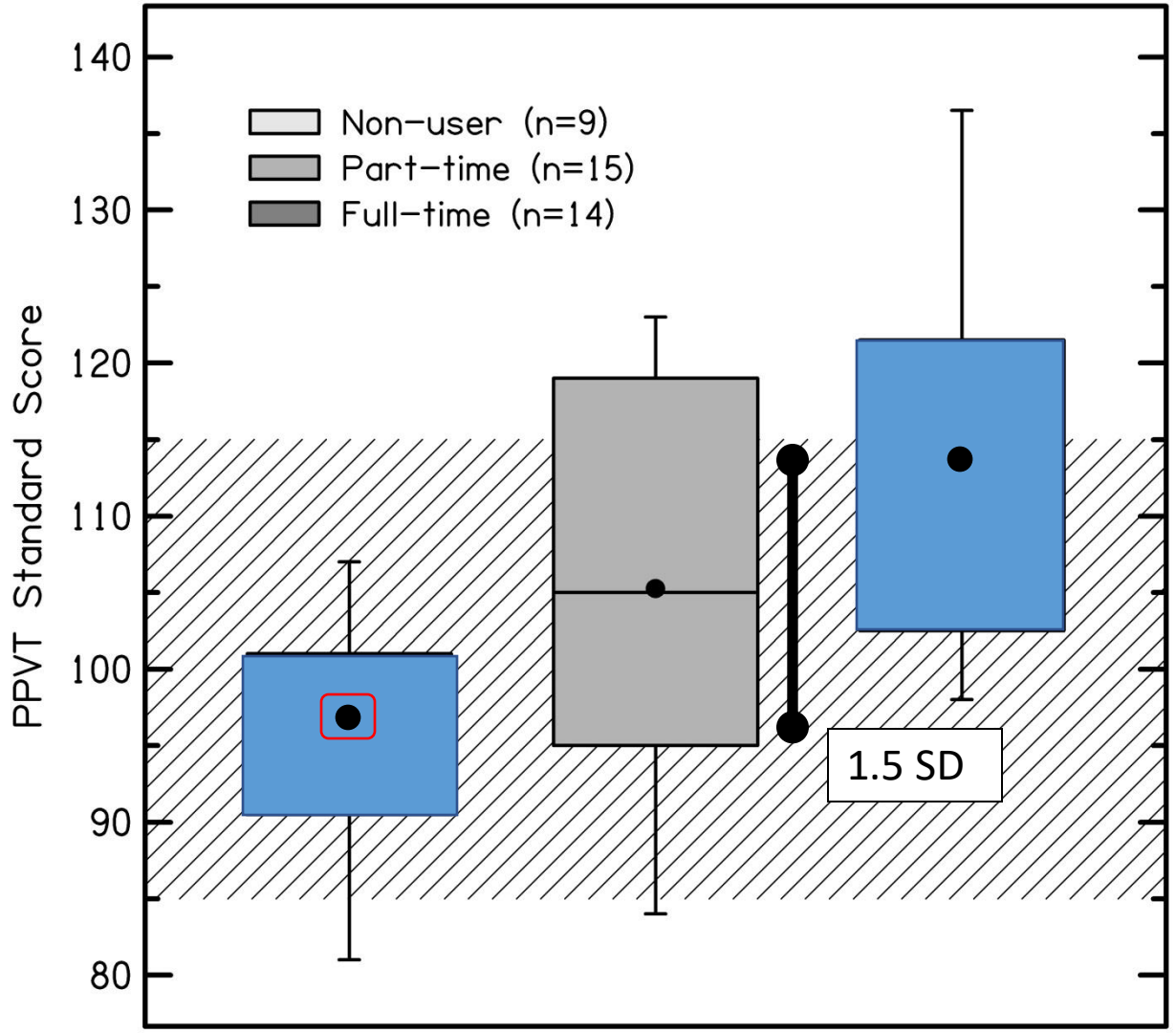
Are there differences in outcomes for children with mild hearing loss, as a function of amount of hearing aid use?

HA use groups	n=	Average HA use (hrs)
Full-time (>8.7 hrs)	14	10.99
Part-time (2-8.3 hrs)	15	5.58
Nonusers (<2 hrs)	9	0.11



Full-time HA users had better vocabulary skills than non-users

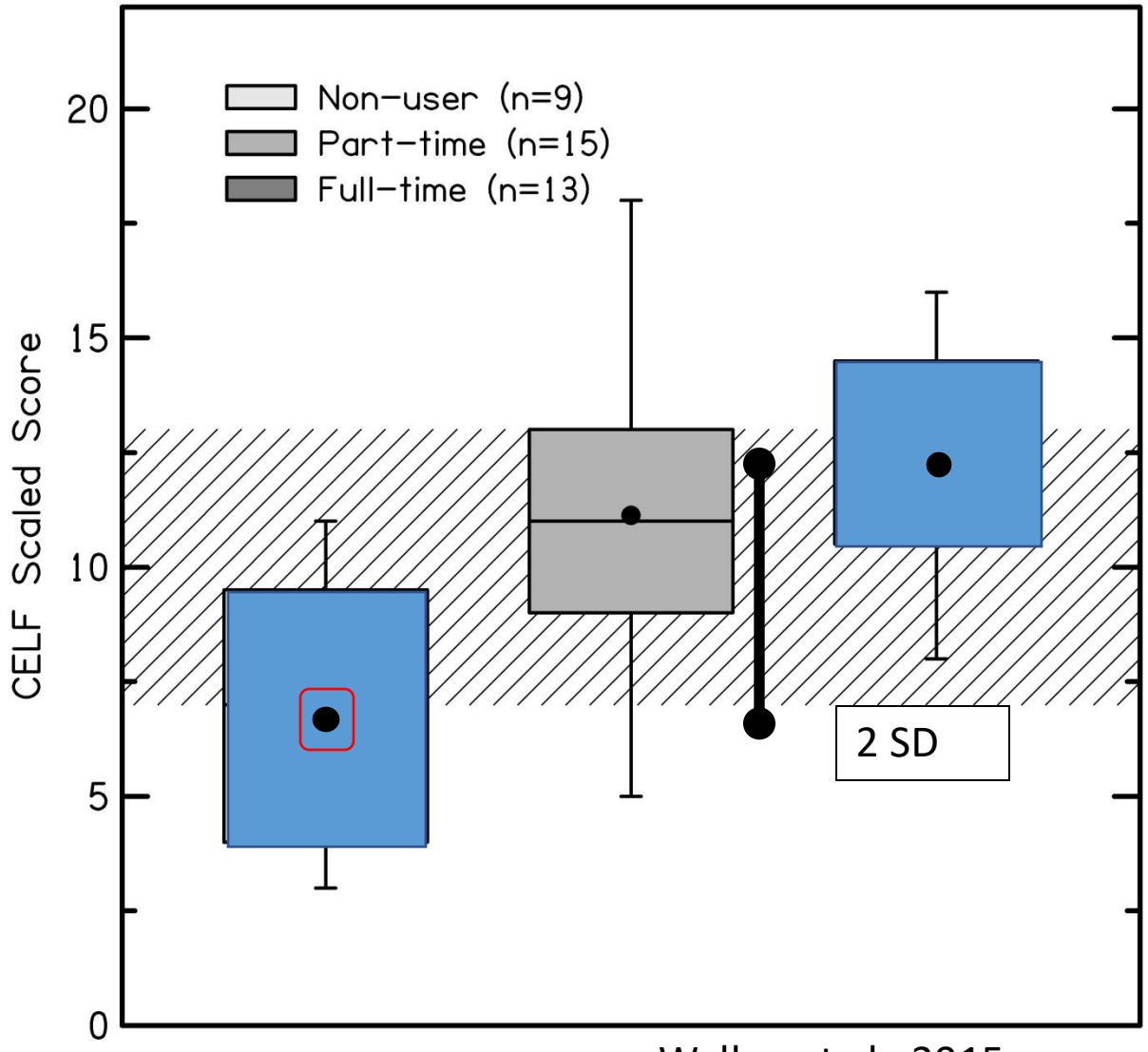
Full-time > non-users



Walker et al., 2015

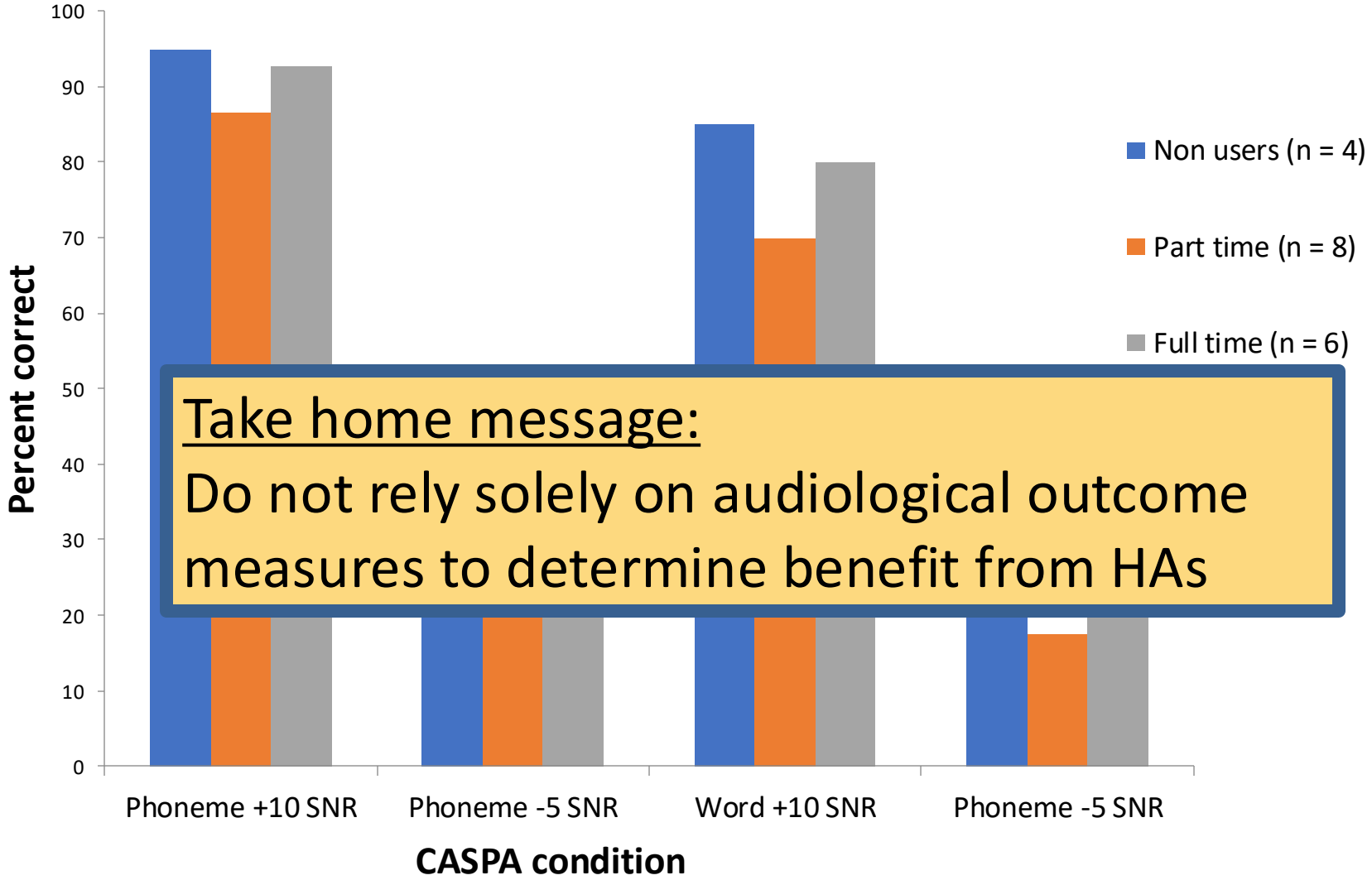
Full-time HA users had better morphosyntactic skills than non-users

Full-time, part-time > non-users



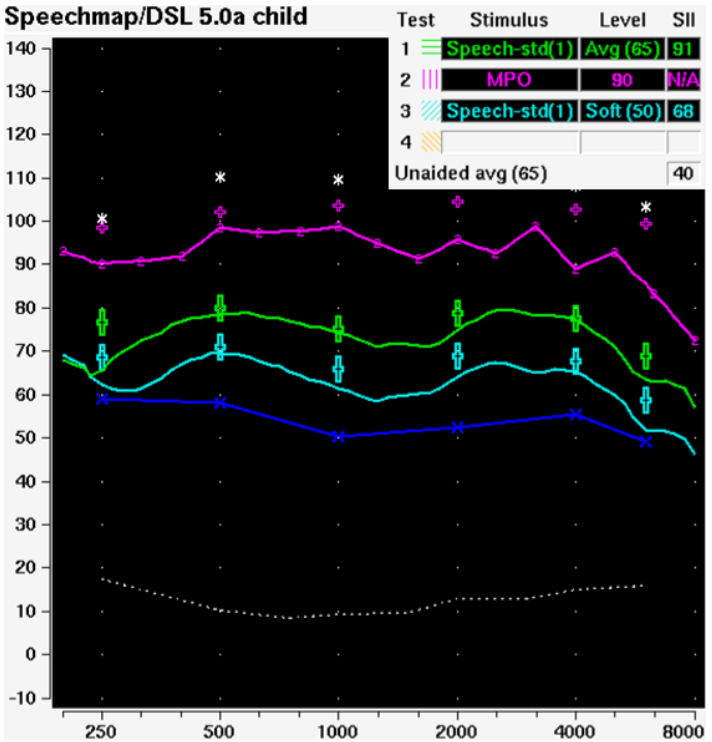
Walker et al., 2015

There were no differences between groups for speech recognition in noise



Take home message:

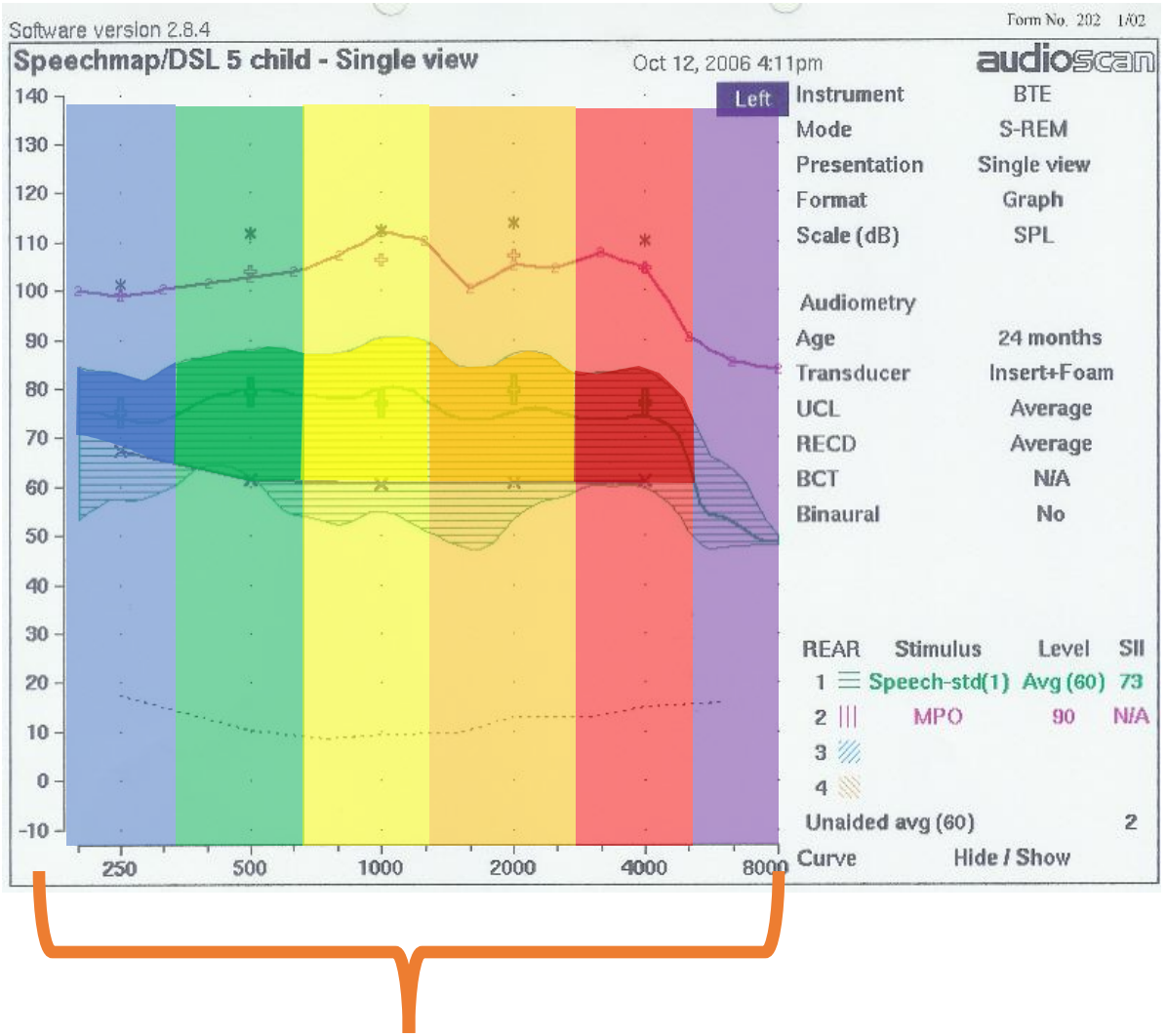
Do not rely solely on audiological outcome measures to determine benefit from HAs



Audibility

- How much access does one have to the speech spectrum?
- Children can only develop what they hear
- Determined by:
  - Level, noise, distance, auditory thresholds
  - Ear canal growth

Speech intelligibility index (SII)

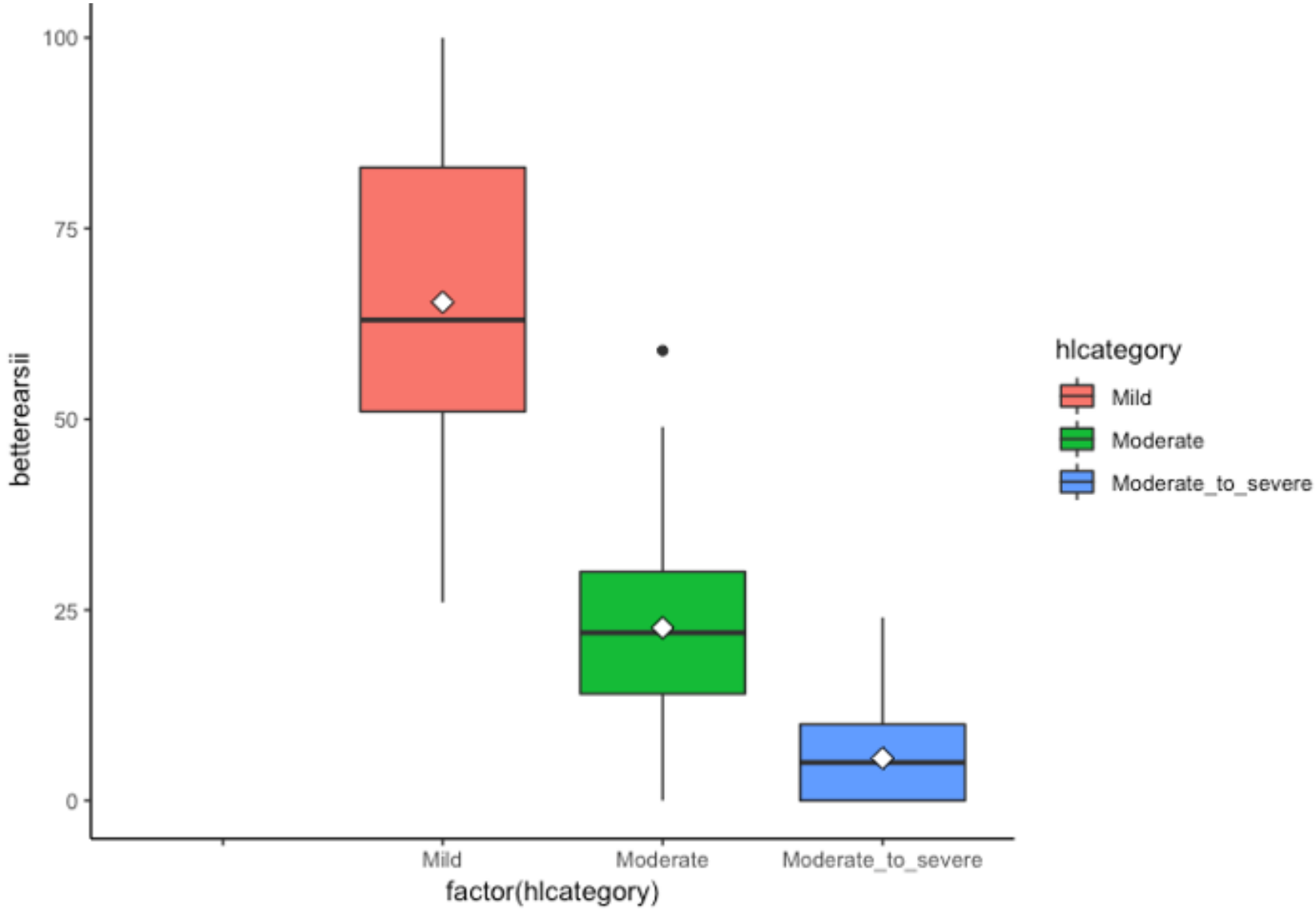


For each band:
Audibility x FIW =
weighted audibility

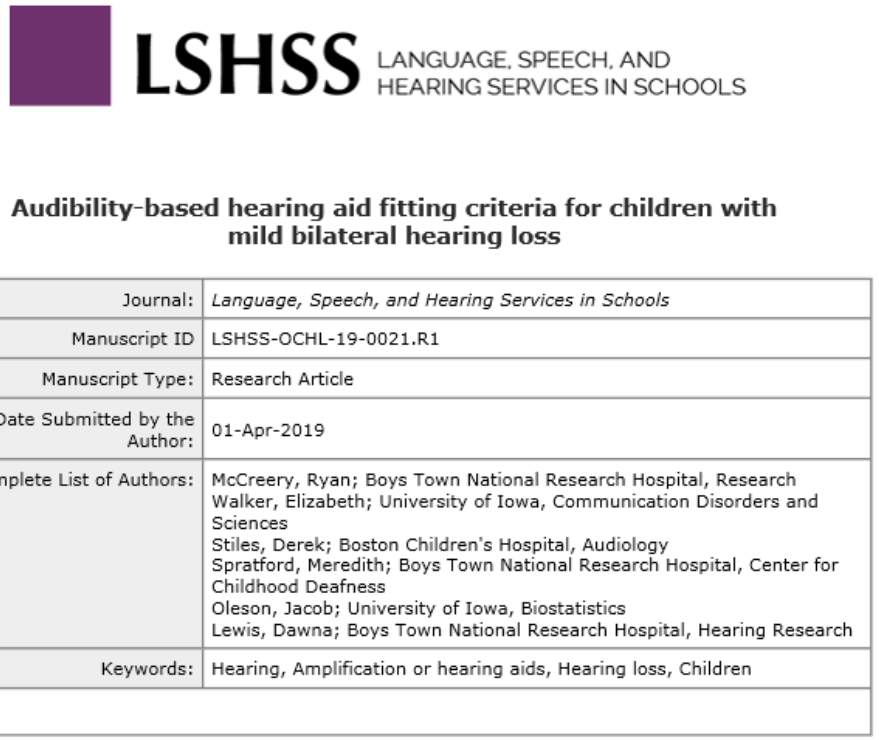
- Estimate of access to speech
  - 0=no audibility
  - 1=completely audible

SII = Sum of weighted audibility of all frequency bands

Audibility across hearing loss categories



- What is an audibility-based criteria for children with mild hearing loss?
- Compared two different criteria
  - Level = 50% percentile for children with normal hearing
  - Iterative piecewise regression
    - Finds point or “knot” in unaided SII where relationship between SII and language changes

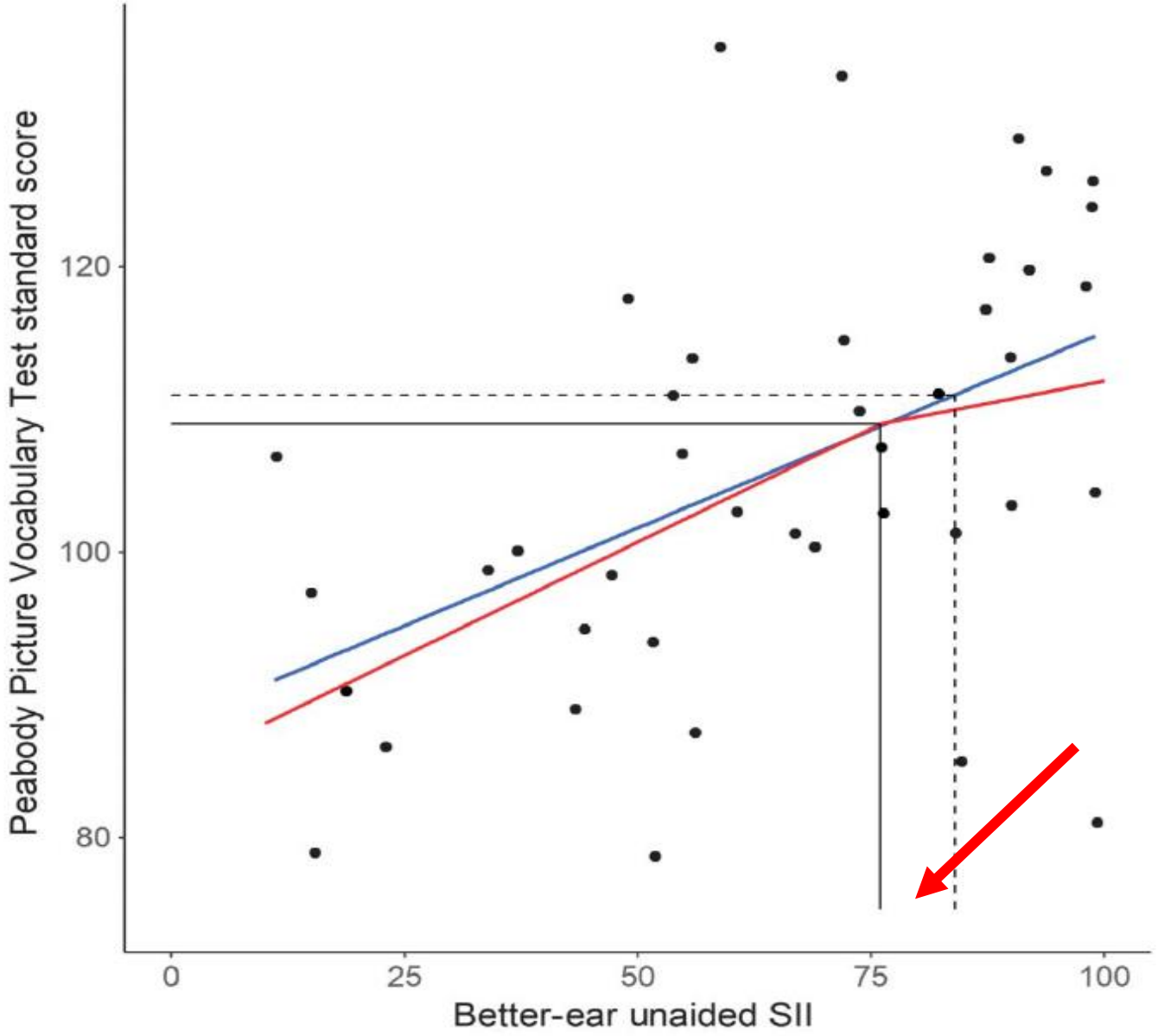


LSHSS LANGUAGE, SPEECH, AND HEARING SERVICES IN SCHOOLS

Audibility-based hearing aid fitting criteria for children with mild bilateral hearing loss

Journal:	*Language, Speech, and Hearing Services in Schools*
Manuscript ID	LSHSS-OCHL-19-0021.R1
Manuscript Type:	Research Article
Date Submitted by the Author:	01-Apr-2019
Complete List of Authors:	McCreery, Ryan; Boys Town National Research Hospital, Research Walker, Elizabeth; University of Iowa, Communication Disorders and Sciences Stiles, Derek; Boston Children's Hospital, Audiology Spratford, Meredith; Boys Town National Research Hospital, Center for Childhood Deafness Oleson, Jacob; University of Iowa, Biostatistics Lewis, Dawna; Boys Town National Research Hospital, Hearing Research
Keywords:	Hearing, Amplification or hearing aids, Hearing loss, Children

Receptive Vocabulary



Blue line: linear relationship between PPVT and SII

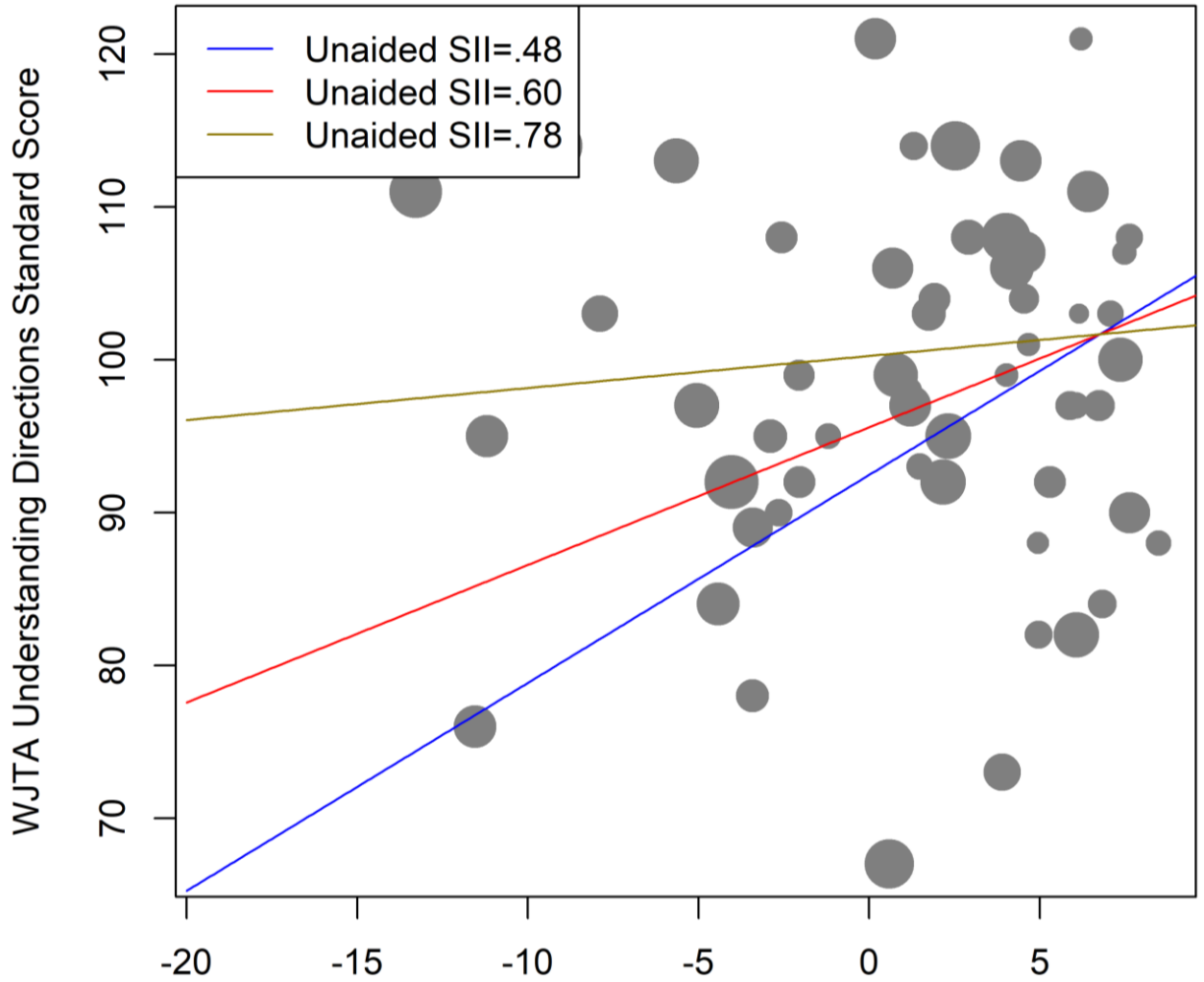
Red line: best fit from piecewise regression

Solid lines: level of unaided SII associated with "knot"

Dashed lines: level of unaided SII associated with CNH 50%ile score

McCreery et al, 2020

More benefit from HA use when unaided SII less than ~80%



Walker et al, 2020

Consistent audibility appears to be a key construct tied to positive outcomes among children whose families choose spoken language.

Across type and level of HL

Tomblin et al., 2015
Walker et al., 2016
Walker et al., 2017
McCreery et al, 2020

Adequacy of amplification

Tomblin et al., 2015
McCreery et al., 2017
Walker et al., 2017
Stiles et al., 2012

Davidson et al., 2014

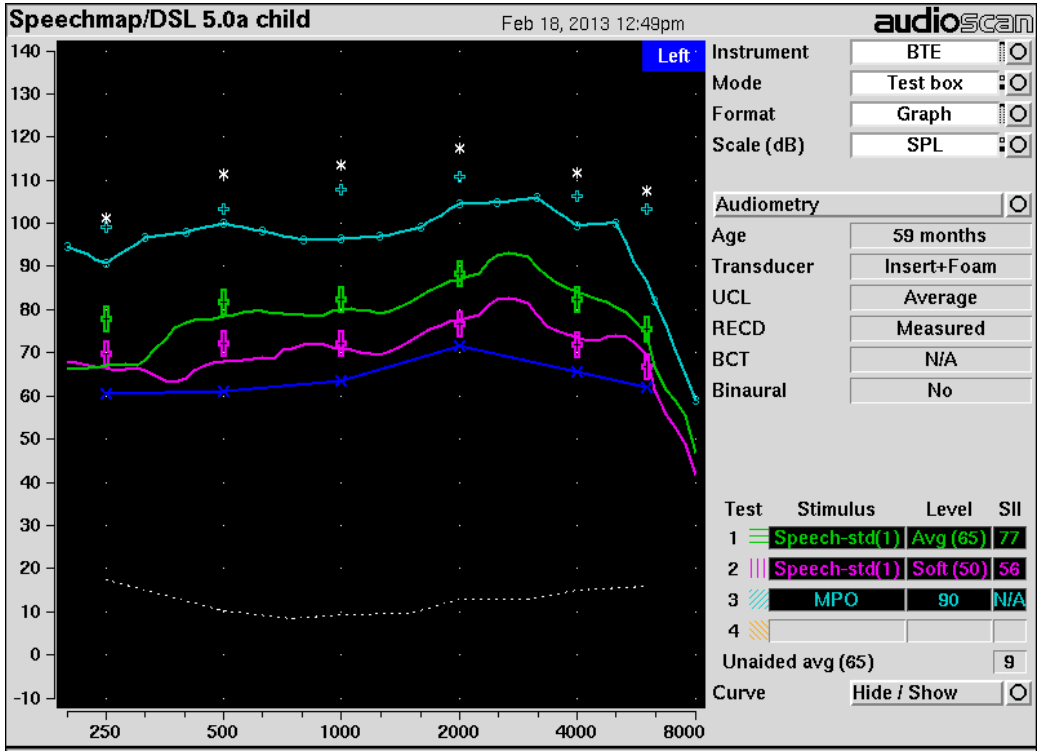
Consistency of access

Tomblin et al., 2015
Walker et al., 2015
Walker et al., 2017
Walker et al., 2019
Tomblin et al., 2020
Walker et al., 2020

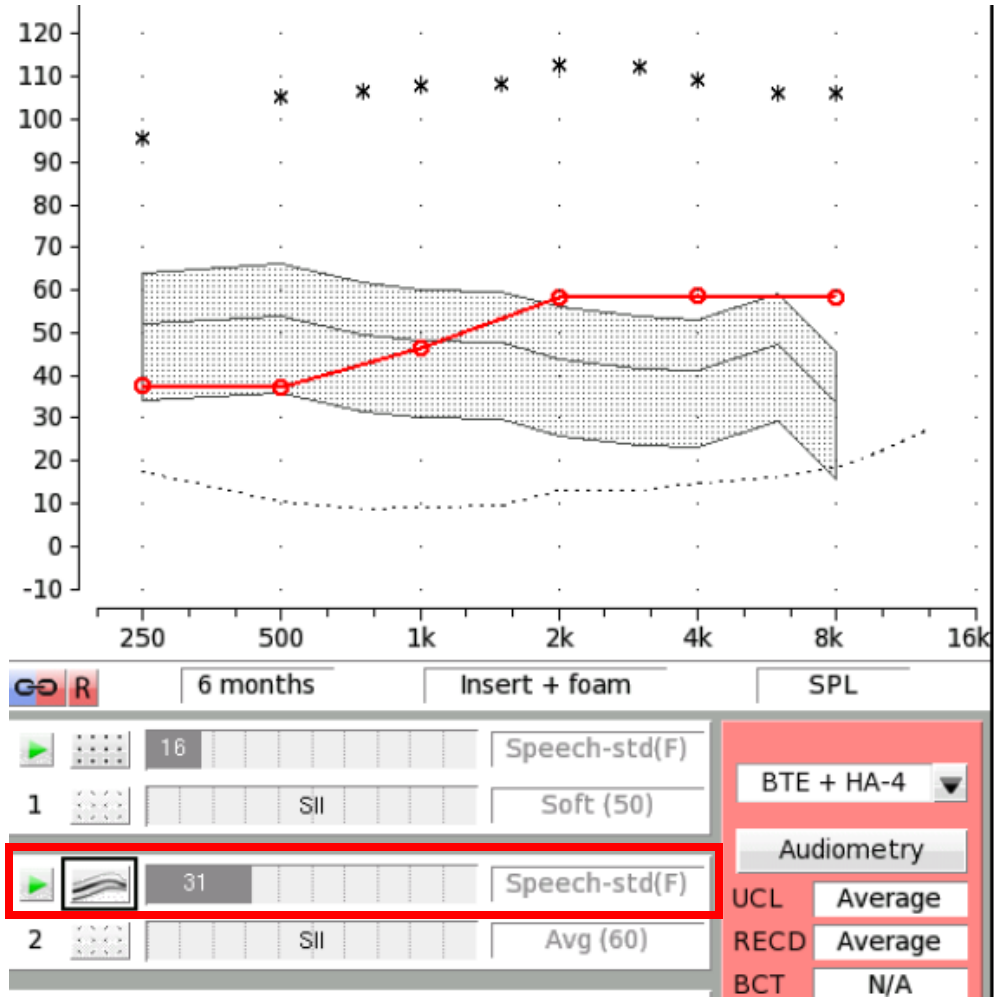
Park et al., 2019

What is the take-home message?

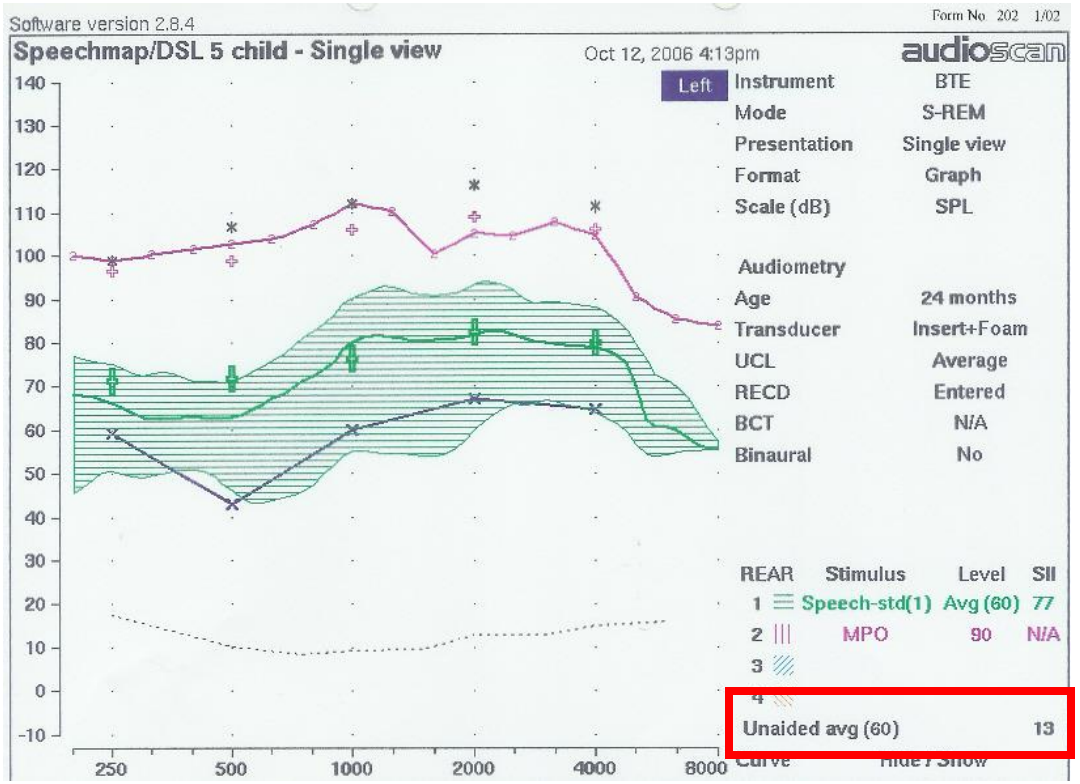
Children with mild hearing loss **(especially with unaided SII <.80)** are at risk for delays in language acquisition. Should be considered candidates for amplification.



How to implement audibility criteria



1. Enter audiogram into Verifit at diagnostic visit
2. Observe unaided SII value for average speech



KiPA
KNOWLEDGE AND IMPLEMENTATION IN PAEDIATRIC AUDIOLOGY

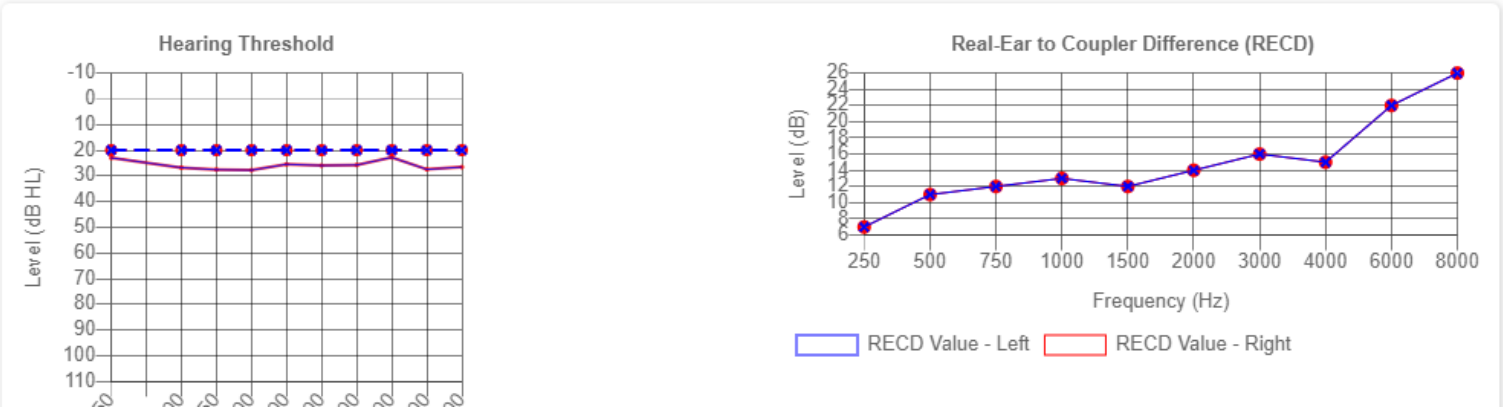
Home About Us Knowledge Translation Resources PEA

https://kipagroup.org/charts/

Minimal/Mild Hearing Loss Tool

HOW-TO VIDEO

Not sure how to use the tool?
Click the button above to watch the how-to video.



Conclusions: Implications for counseling

- Diagnostic or Educational Audiologist can:
  - Discuss audibility and why it is important for language (explain auditory access in percentage instead of descriptive terms)
  - Discuss how even small disruptions in audibility can affect communication

Conclusions: Implications for intervention for children with mild hearing loss

Children with mild hearing loss **(specifically with unaided SII >80%)** don't show increased benefit from hearing aids.

Children with mild hearing loss **(specifically with unaided SII <80%)** are at risk for delays in language acquisition without hearing aids.

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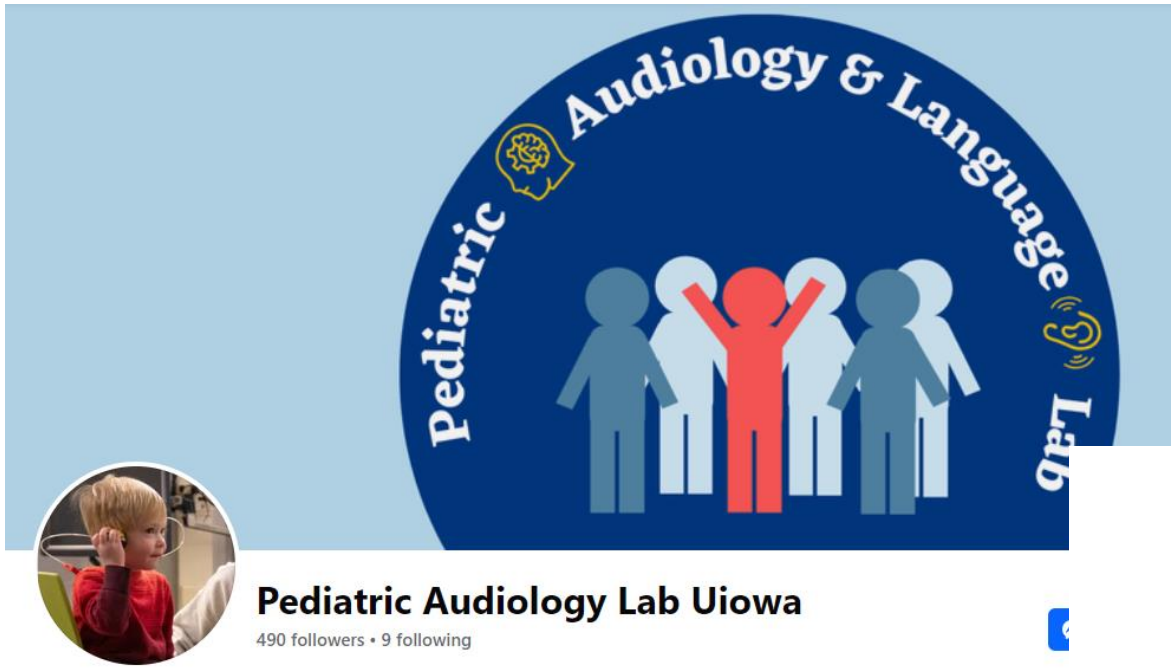

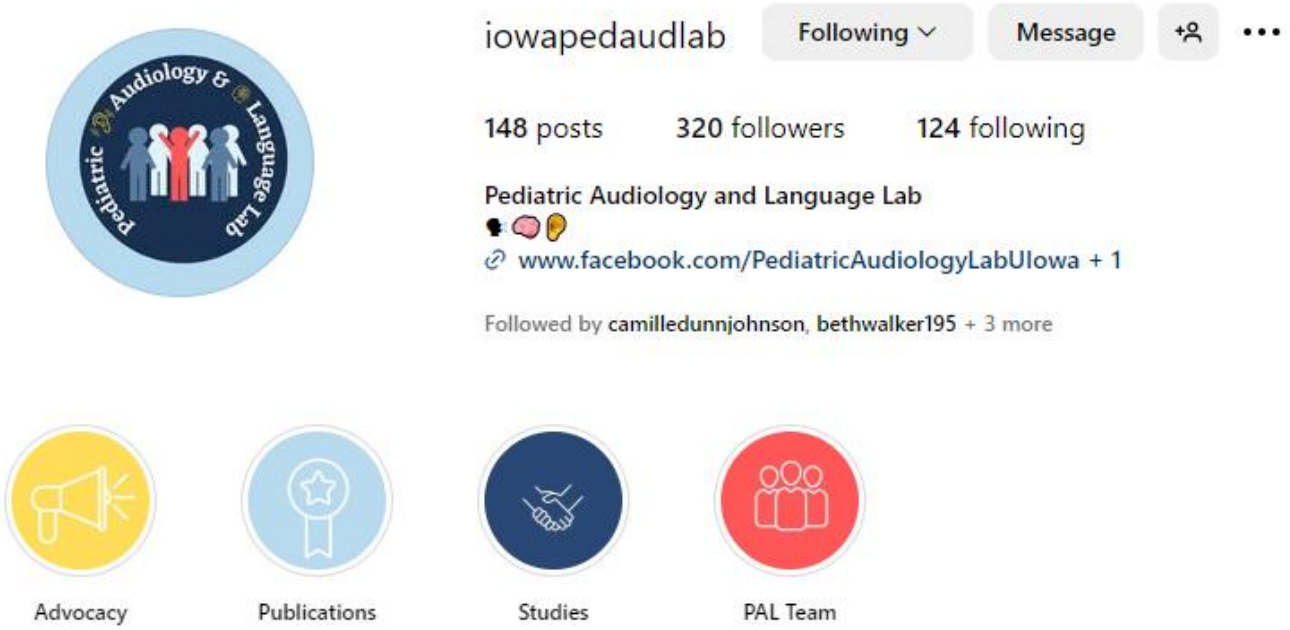

PARTICIPATE IN A HEARING RESEARCH STUDY

We are looking for children:

- Between 2-12 years old
- **Have at least 1 functioning PE tube**
- With or without hearing loss
- English as primary language

Visits last
1-1.5 hrs.

Paid
$20/hr.

What do we do?

- Check ears
- Hearing test/listening games

University of Iowa Pediatric Audiology & Language Lab

QUESTIONS & SCHEDULING:

kakingsbury@uiowa.edu
(630) 785-0920

IRB Approved 06Dec24
Does Not Expire

PARTICIPATE IN A HEARING RESEARCH STUDY

We are looking for children:

- Between 5-12 years old
- **Permanent hearing loss in ONE ear**
- With or without hearing aids/devices
- English as primary language

Visits last
2-2.5 hrs.

Paid
$20/hr.

What do we do?

- Check ears
- Hearing test
- Listening games

University of Iowa Pediatric Audiology & Language Lab

QUESTIONS & SCHEDULING:

nonalee-gardner@uiowa.edu
(319) 335-1484

IRB Approved 06Dec24
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Thank you!