

Outcomes of Children with Hearing Loss



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Background



- Most outcome studies focus on children who are deaf
- Reduced body of literature concerning children with mild to severe HL
 - Sample sizes are small or mix D/HH children
 - Lack of control of amplification histories/audibility
 - Few studies attempted a population sample
 - Varied measurement strategies; earlier generation technologies
- Need to understand sources of individual difference in outcomes



Aims of study



- To describe the characteristics of:
 - children and families
 - intervention services
 - factors associated with service variations
- To characterize:
 - developmental, behavioral and familial outcomes
 - compared to normally-hearing age mates with similar backgrounds
- To explore:
 - how variations in child and family factors and in intervention characteristics relate to functional outcomes

Target Population



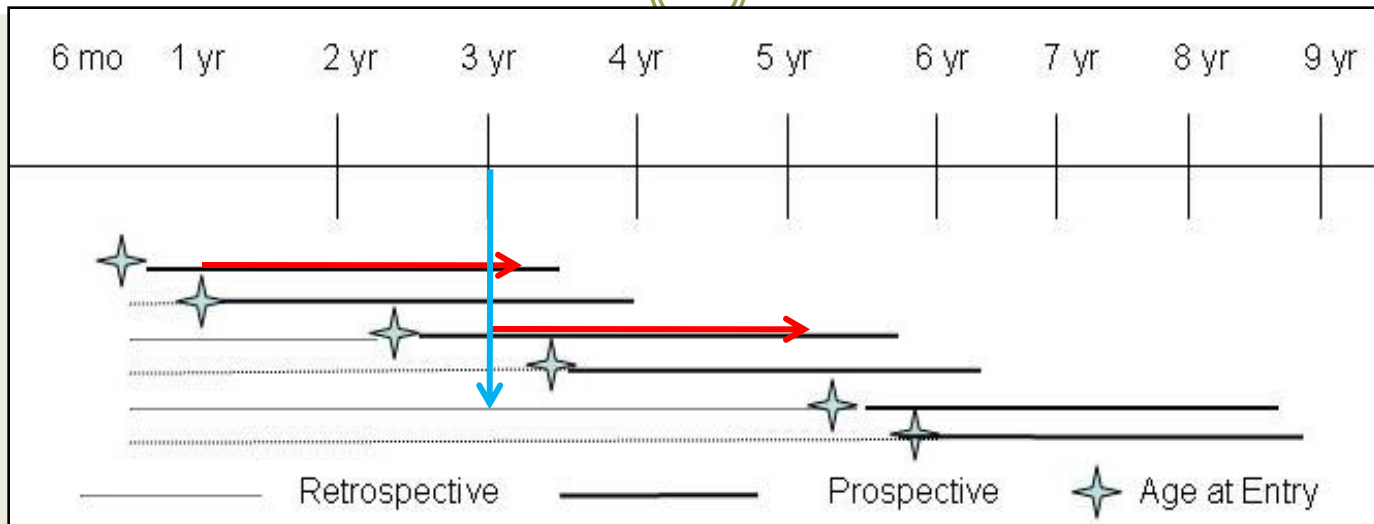
- 400 children with hearing loss
- 150 children with normal hearing
- Ages 6 months to 6 years 11 months
- Speaks English in the home
- No major secondary disabilities
- Permanent Bilateral Mild to Severe Hearing Loss
 - PTA of 25-75 dB HL (500, 1k, 2k, 4 kHz)

Recruitment



- Sampling Frame
 - All children in Iowa, Nebraska, Eastern Kansas/Northern Missouri, Northern Illinois and North Carolina with mild to severe permanent bilateral hearing loss
- Sampling Method
 - Recruit children who have been identified via
 - ✦ Refer from Newborn Hearing Screening
 - ✦ Children identified in EHDI via follow up clinics
 - ✦ Children identified via audiology or medical service providers
 - ✦ Children identified through school screening
- Contact Method
 - Return of post card in flyer or telephone contact
 - Flyers come to Iowa for processing
 - Telephone contact is made by the appropriate the regional research group

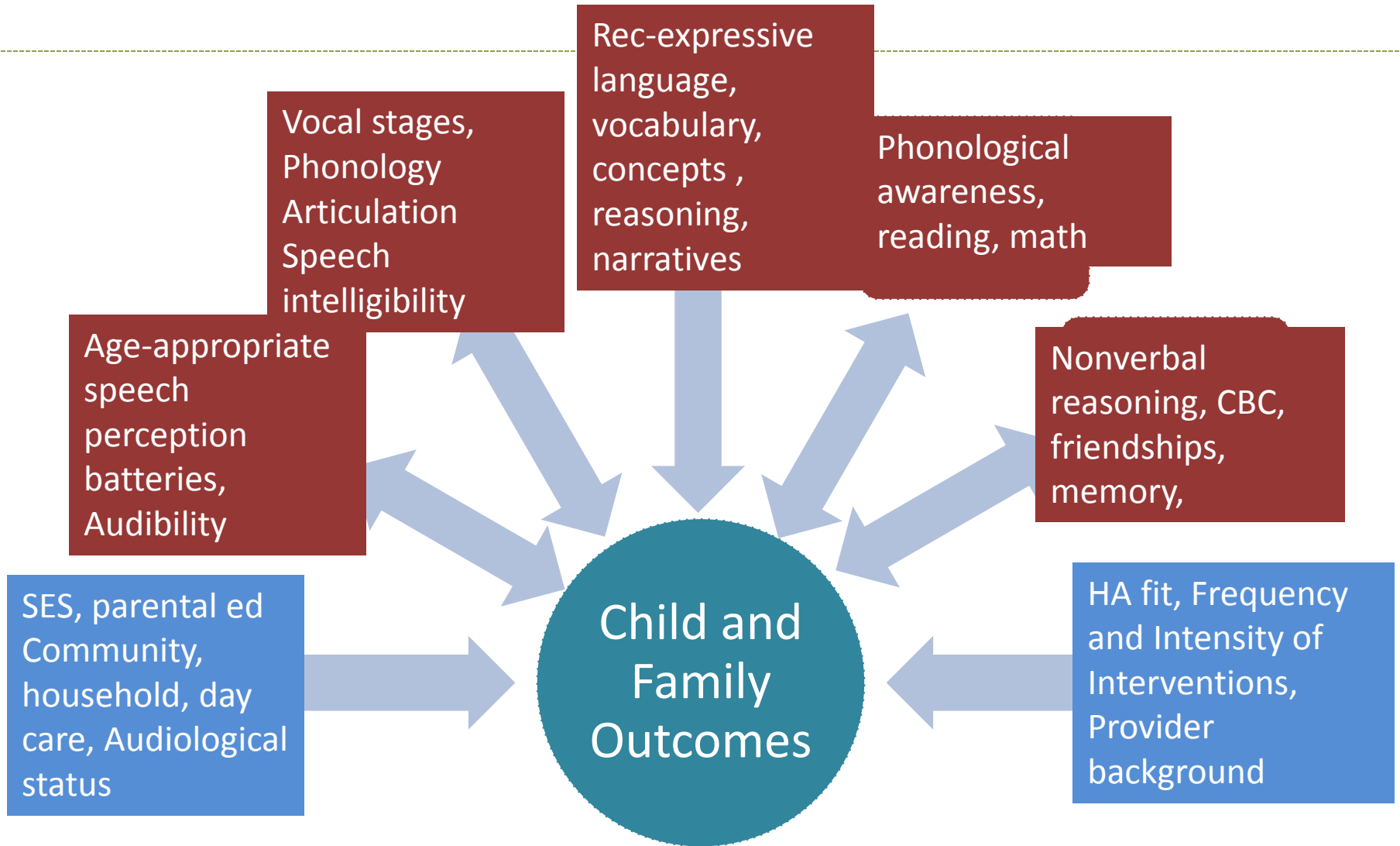
Study design



Accelerated Longitudinal Design

- Each child followed for 3 years+.
- Retrospective data prior to enrollment obtained by medical record history.

Domains of study



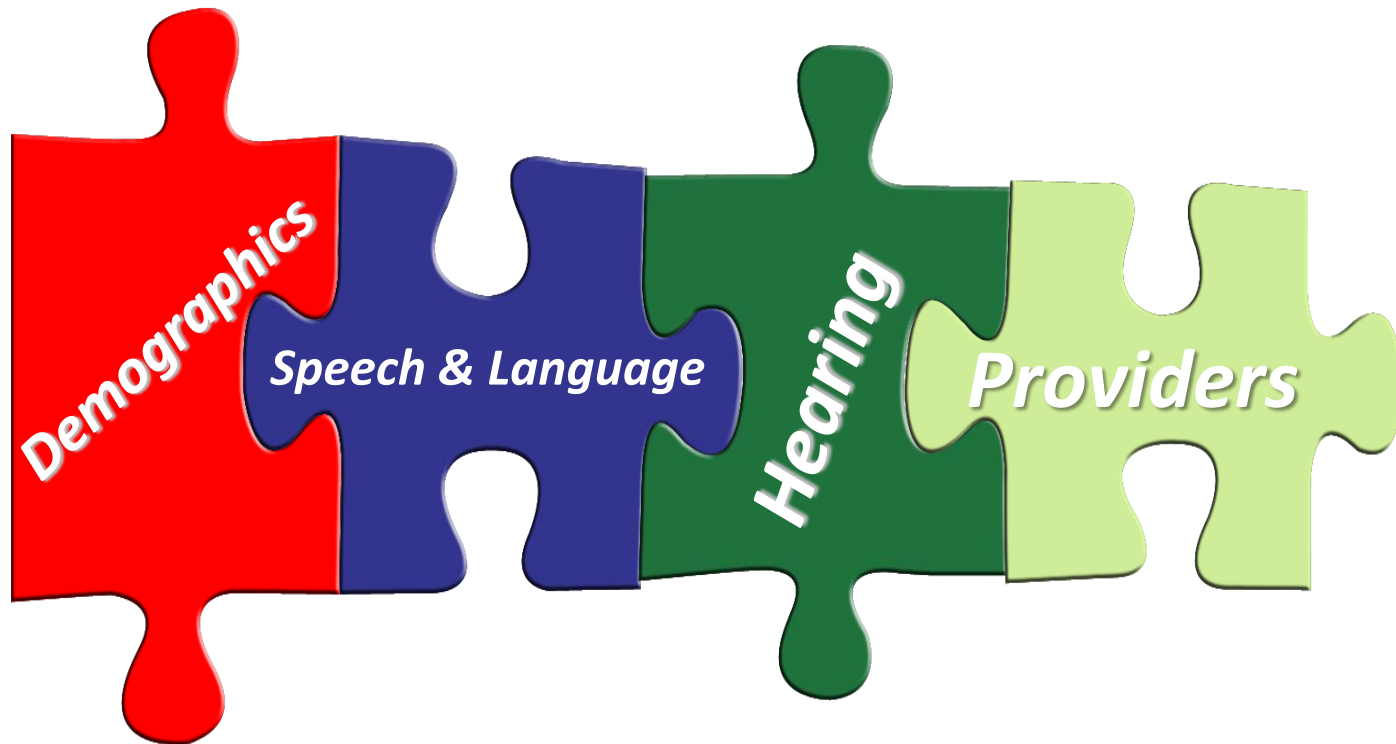
Data collection and management



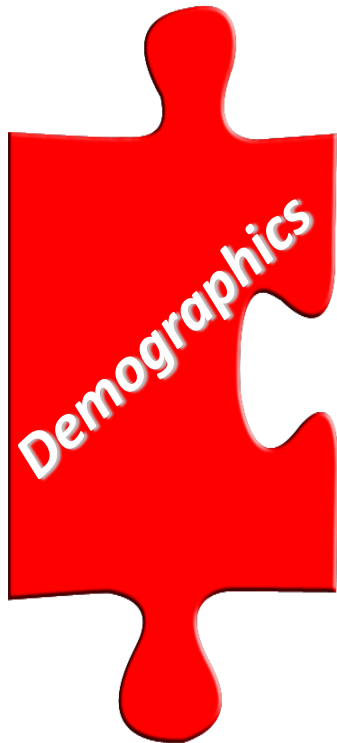
- Telephone Survey of Parents
 - One person conducts a phone interview (between test sessions) concerning home and parental information
- Audiology Service Provider Survey (online)
- Services & Provider Survey (online)
 - Birth to Three
 - Pre-School
 - School Age
- Teacher Survey
 - Pre-School
 - School Age
- Medical Records
 - ENT & Pediatrician



Year one results



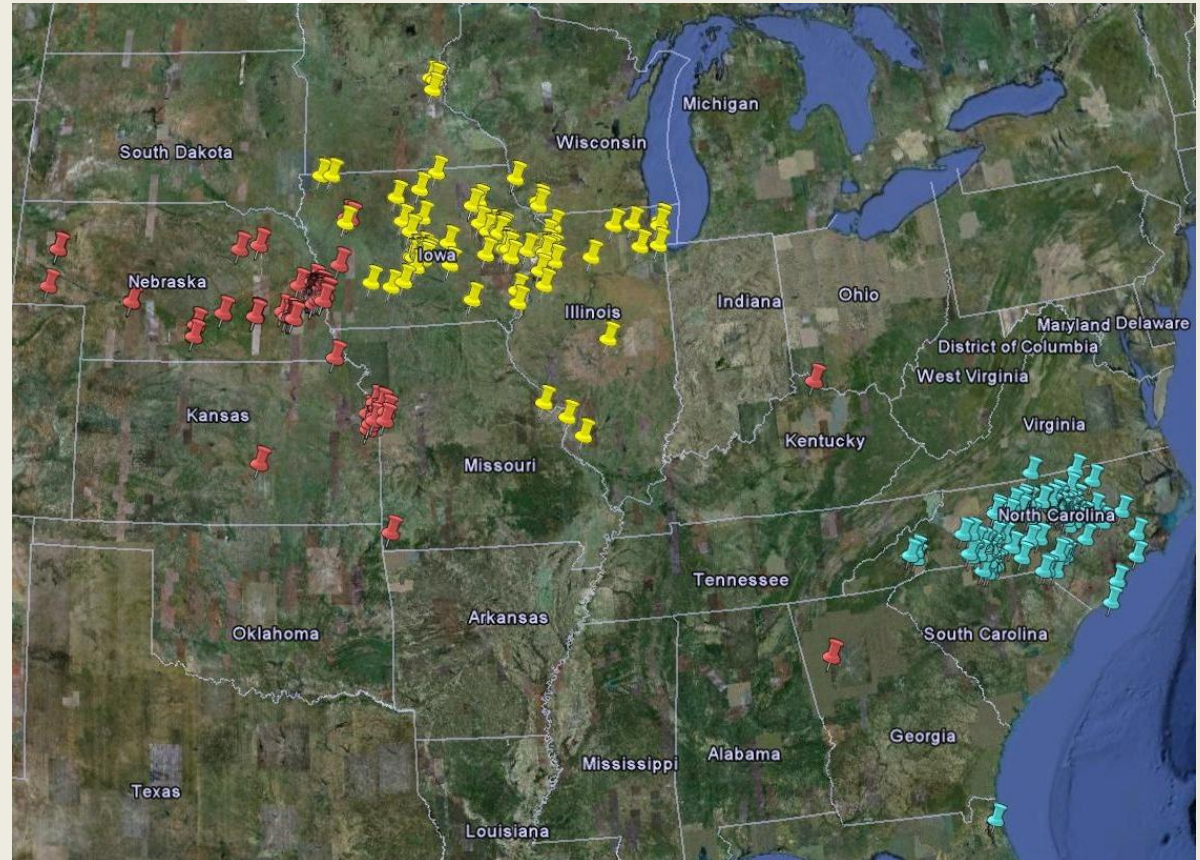
Demographics



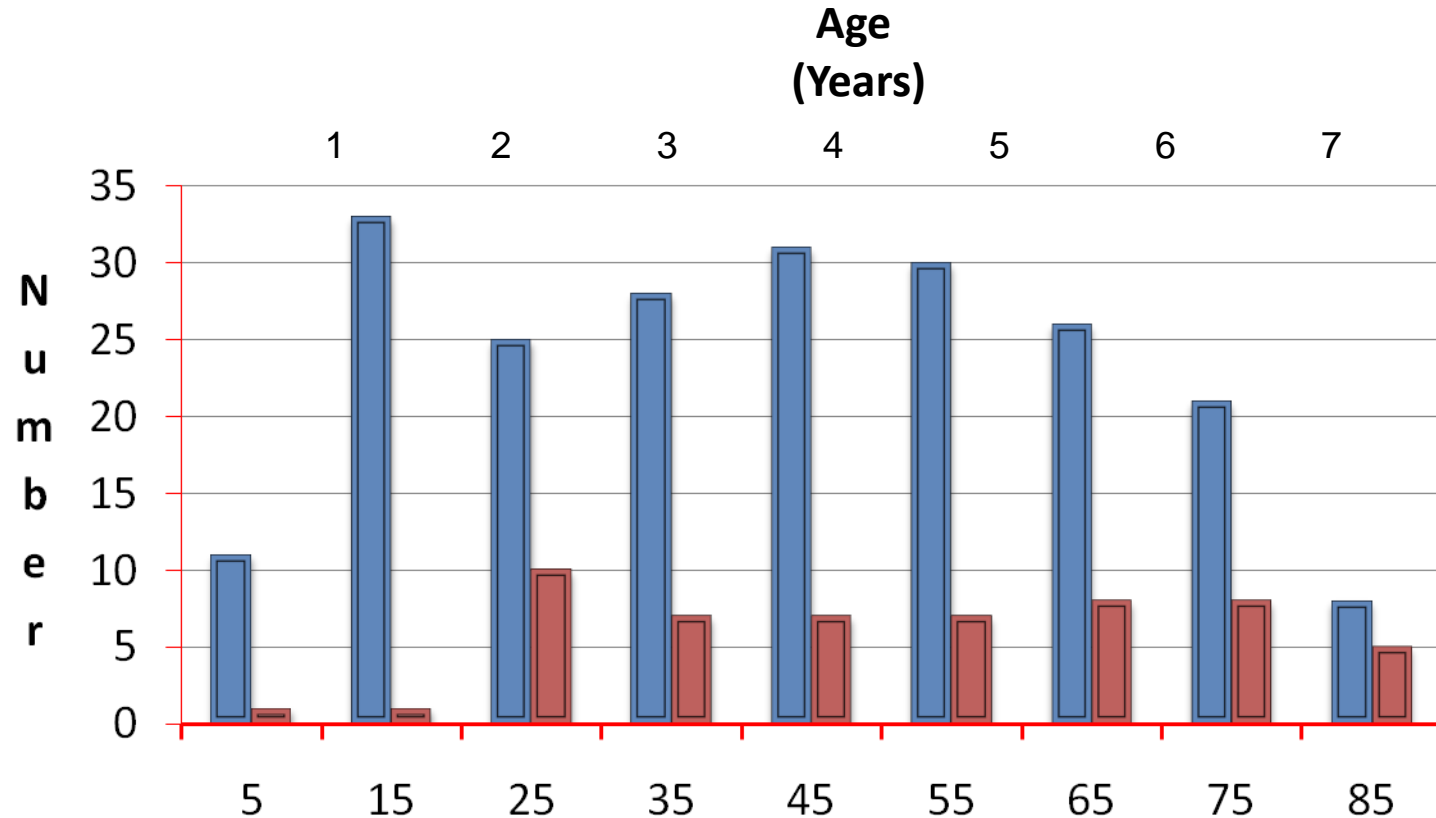
Geographic Distribution of Participants



| Centers | HH | NH |
|----------------|-----|----|
| Boys Town | 73 | 29 |
| Iowa | 72 | 26 |
| North Carolina | 87 | 15 |
| Total | 232 | 70 |



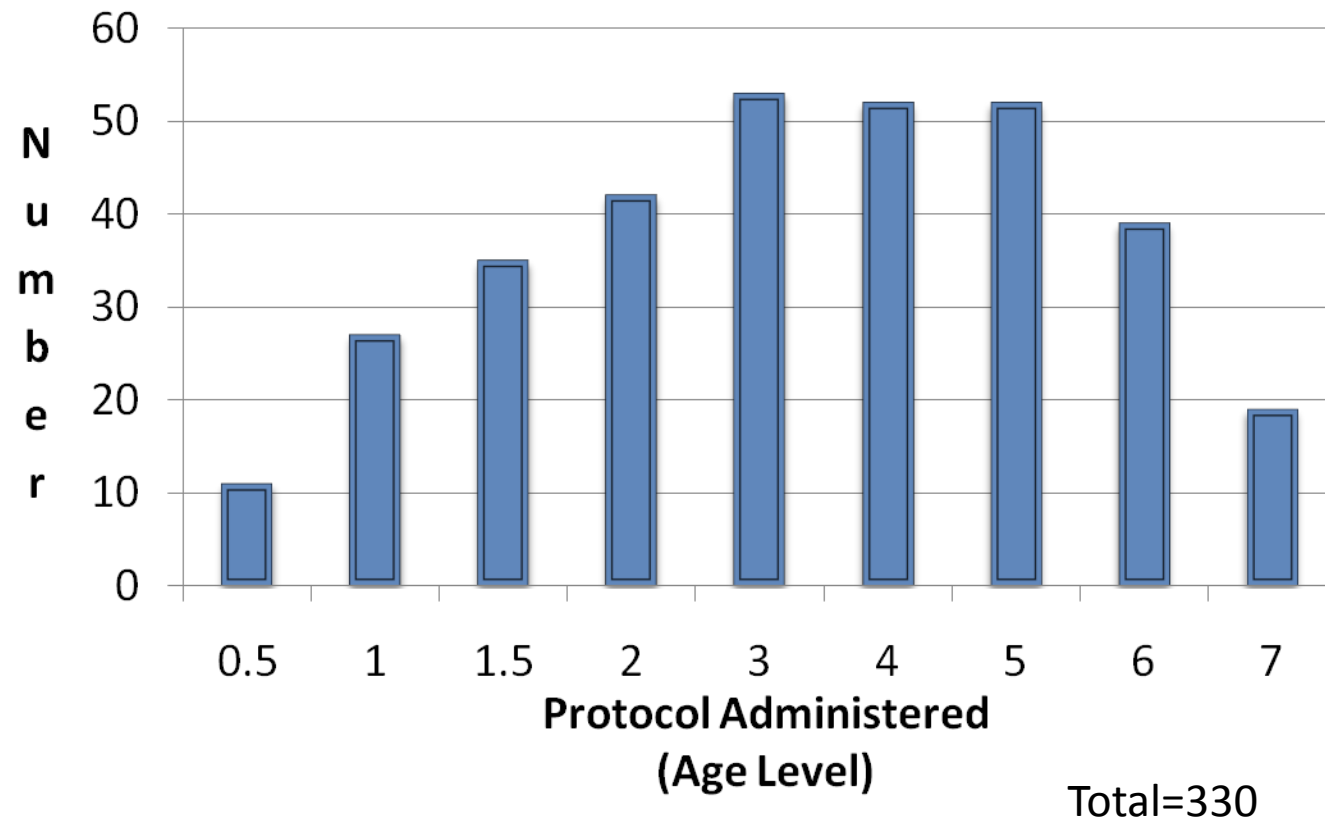
Age Distribution of Children at Enrollment



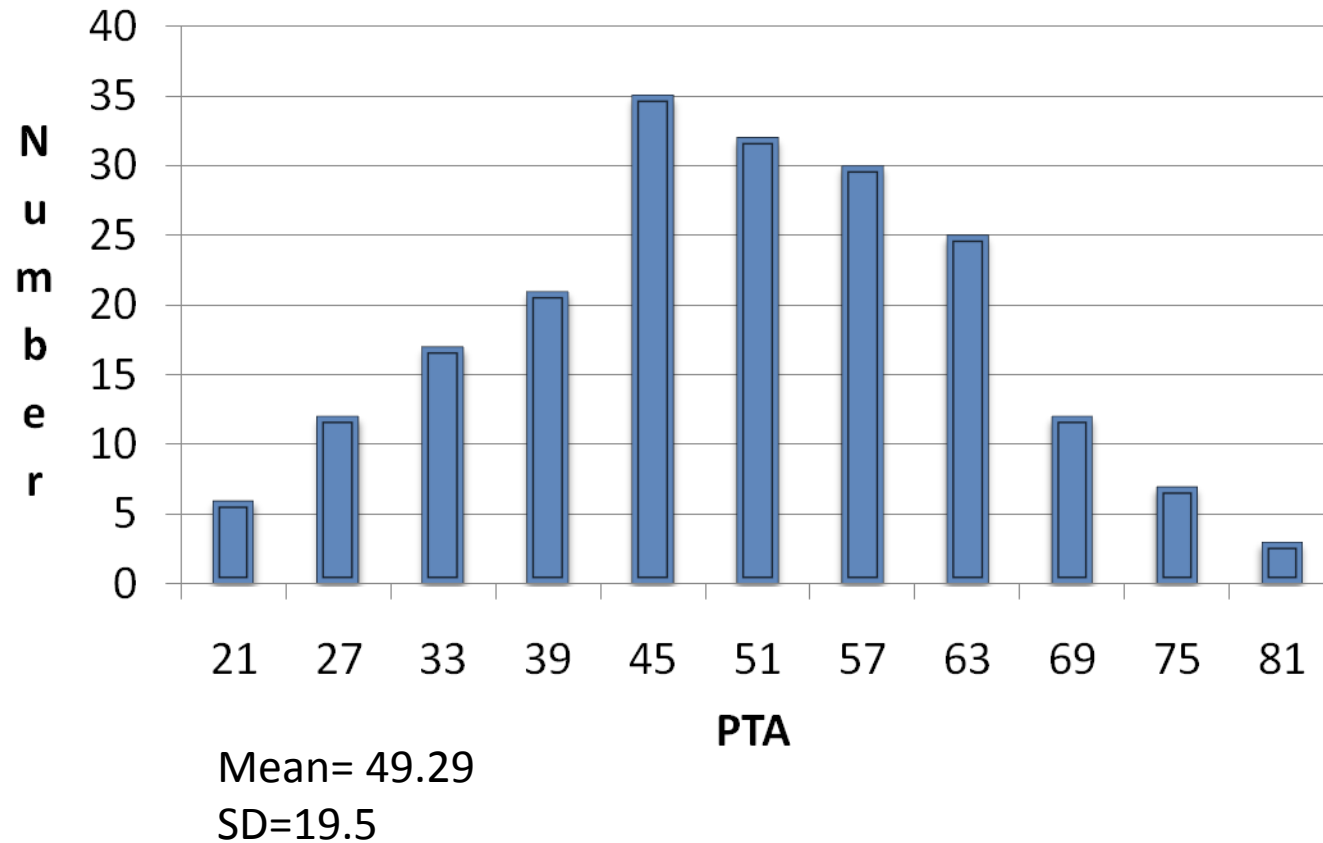
| | HH | NH |
|------|------|------|
| Mean | 42.8 | 51.0 |
| SD | 21.8 | 21.0 |

Age
(Months)

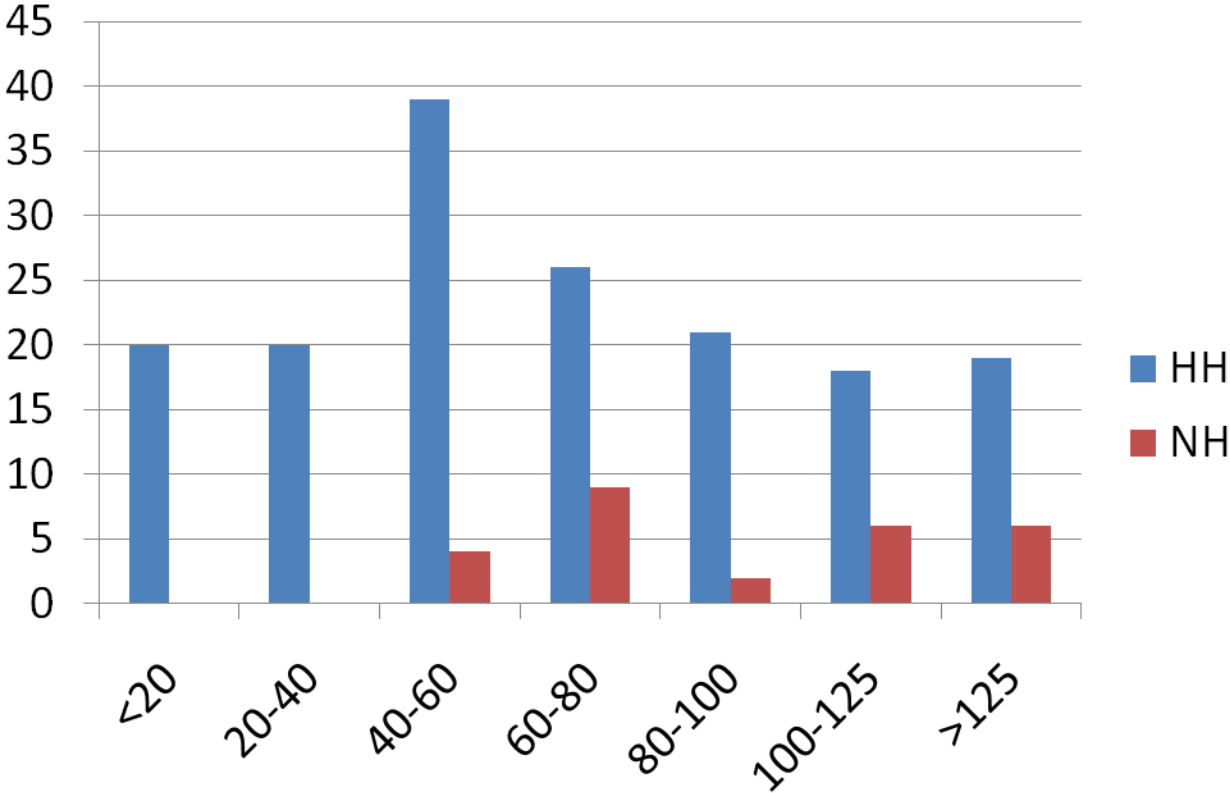
Distribution of HH Children Tested at Each Age Level



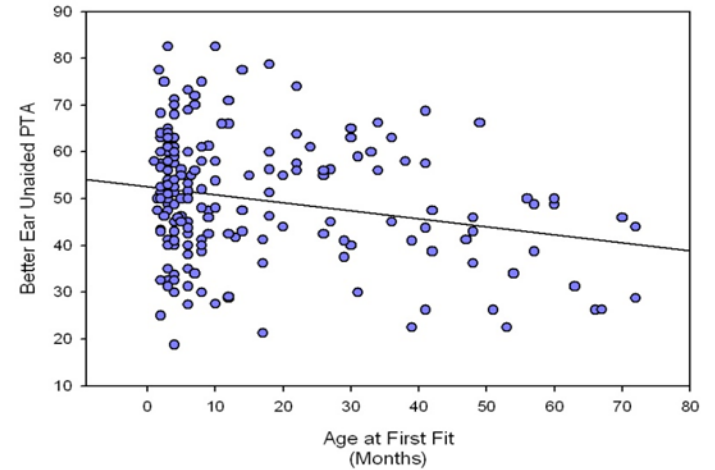
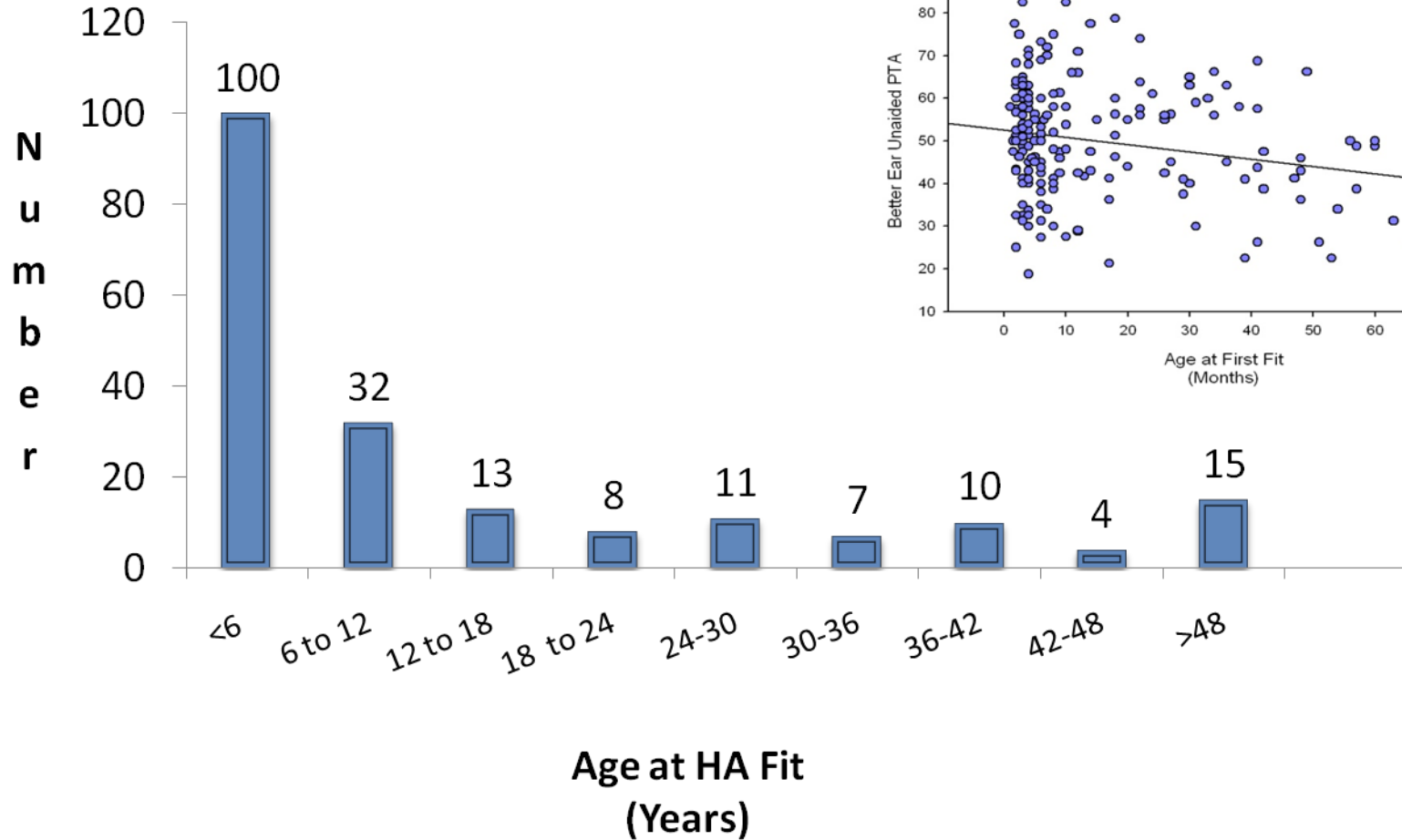
Distribution of Better Ear PTA



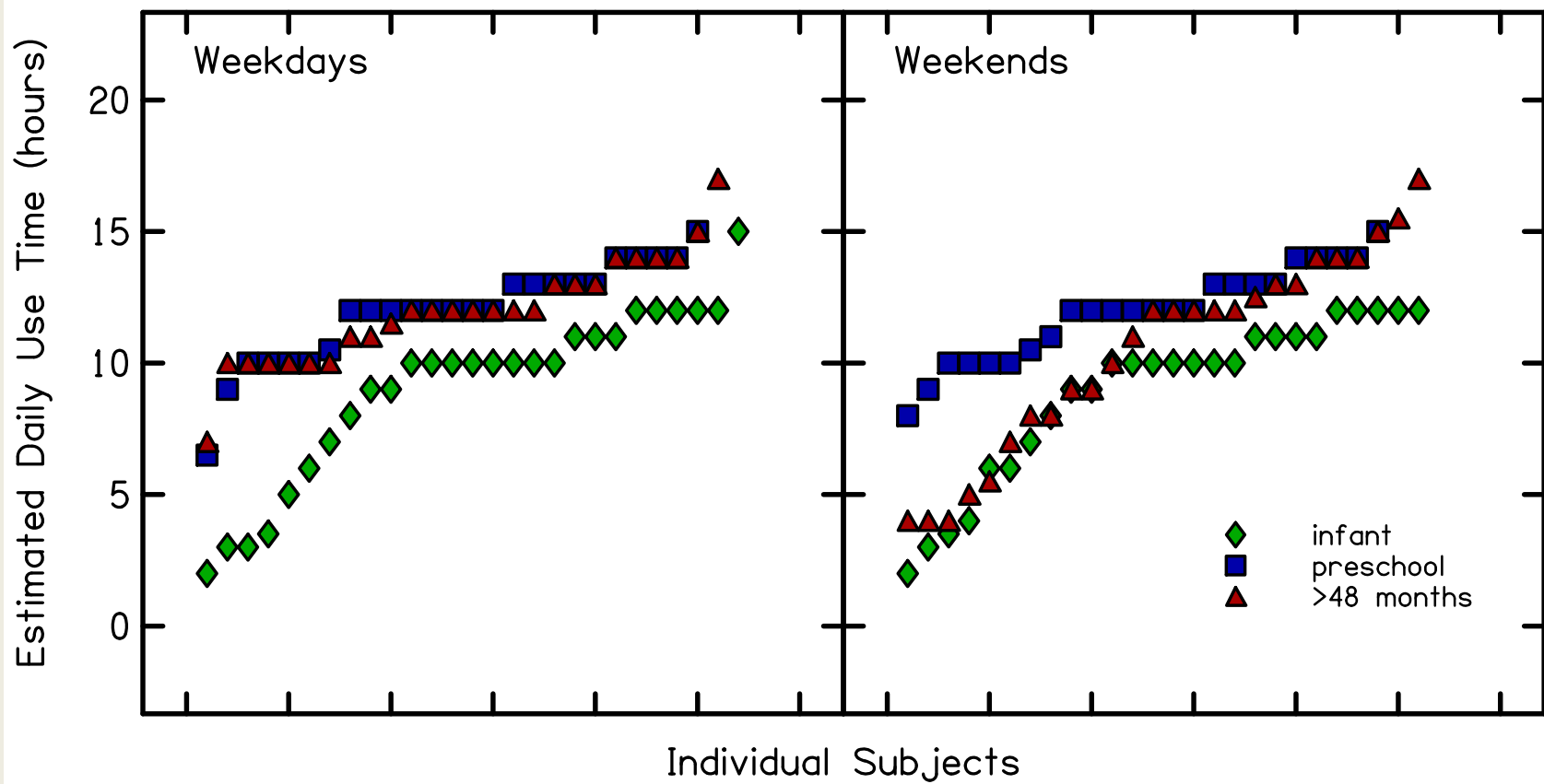
Household Income



Age at First HA Fit



Hearing aid use consistency



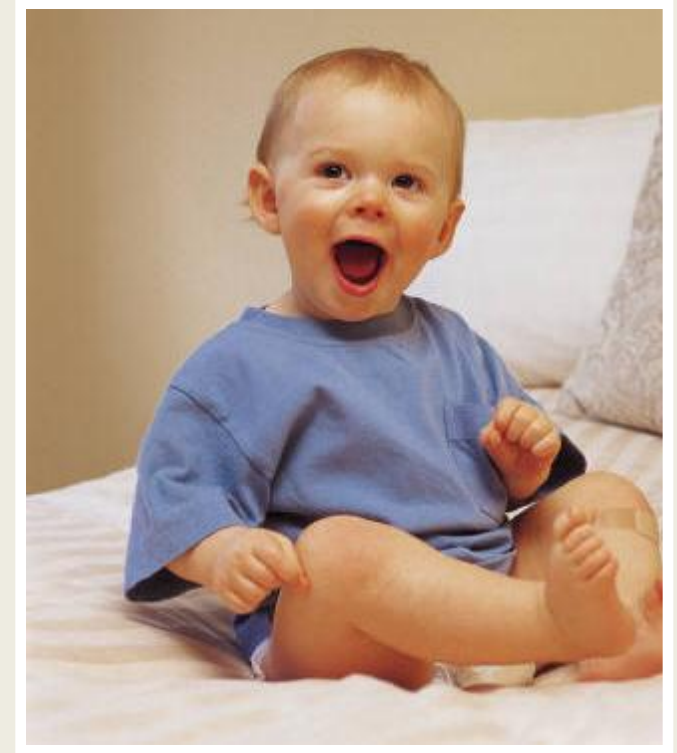
Speech and Language



Speech and Language Outcomes



- Standardized tests
 - Vocabulary
 - ✦ MBCDI, WPPSI, PPVT, WASI
 - Receptive/Expressive Language
 - ✦ Mullen Scales, CASL
 - Articulation
 - ✦ GFTA
- Non-standardized tests
 - Infant Vocal Interview, Open and Closed Set Test, Morphology Elicitation Task

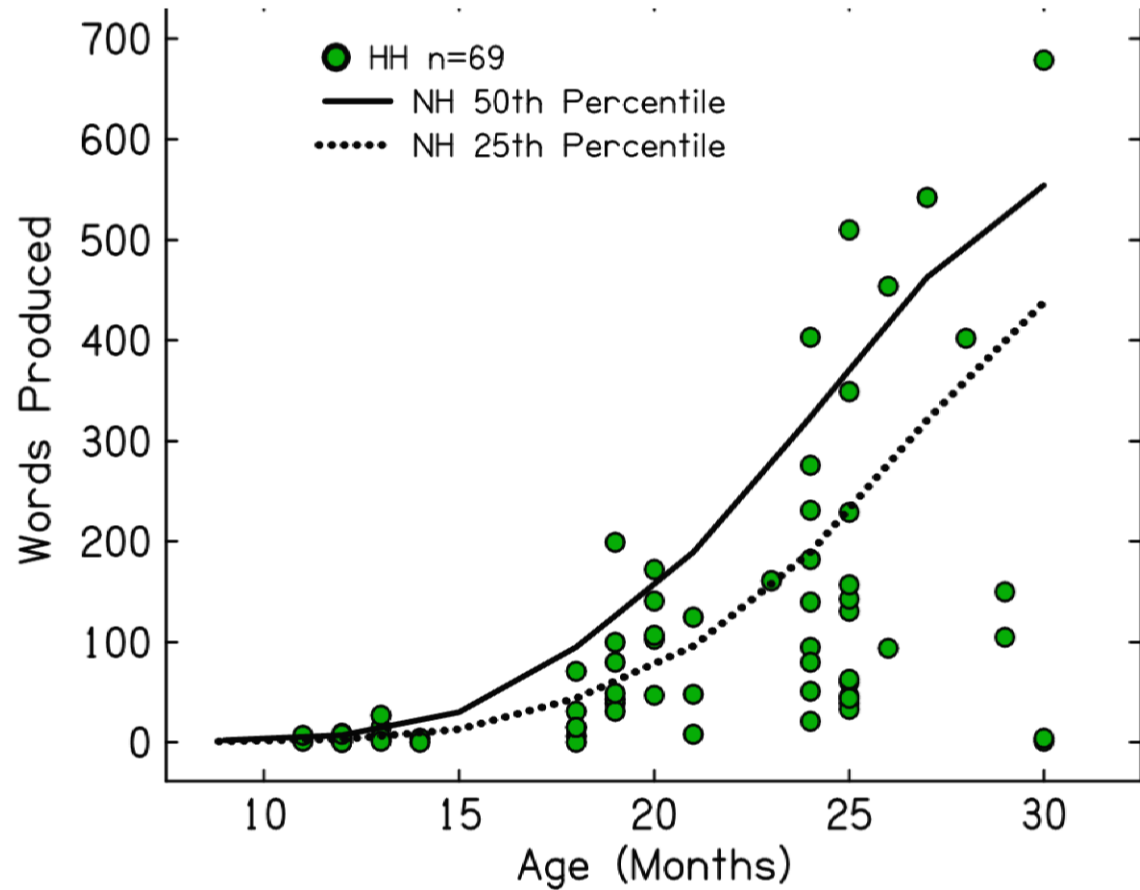


Vocabulary



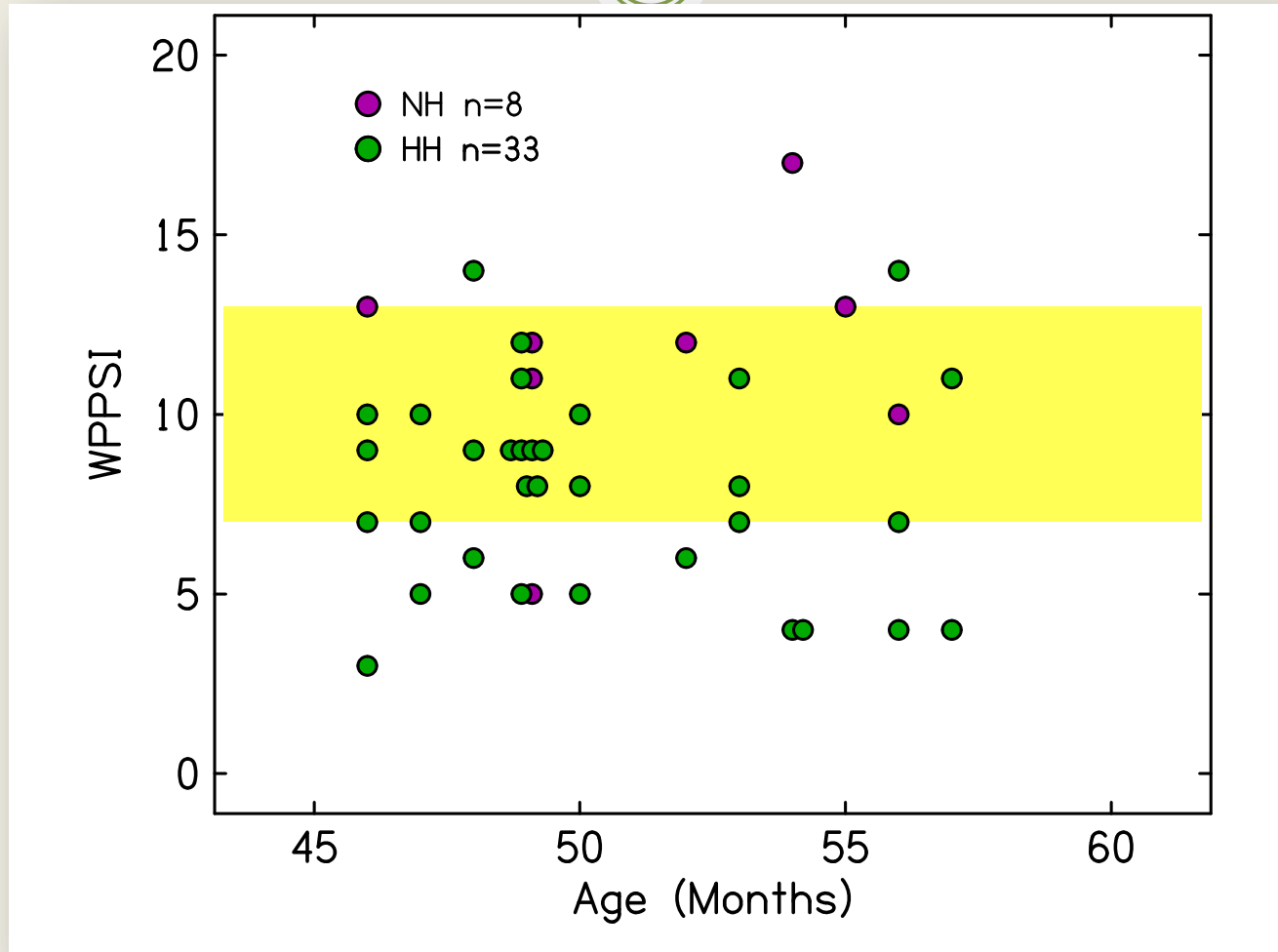
- Conflicting reports related to vocabulary development
 - Early lexicon delayed (Mayne, et al, 2000, Kiese-Himmel & Reeh, 2006)
 - Delayed at school age (Davis, et al, 1986; Wake, et al, 2004)
 - Not delayed at school age (Plapinger & Sikora, 1995; Wolgemuth, et al, 1998)
 - Bimodal distribution of performance (Gilbertson & Kamhi, 1995)
- Less efficiency in Novel Word Learning (Pittman, et al, 2005; Stelmachowicz, et al, 2004)
- Prolonged lexical access (Jerger et al, 2006)

Vocabulary at 12 months-2 years: MBCDI



12-18 months:
Words and Gestures
19-30 months:
Words and Sentences

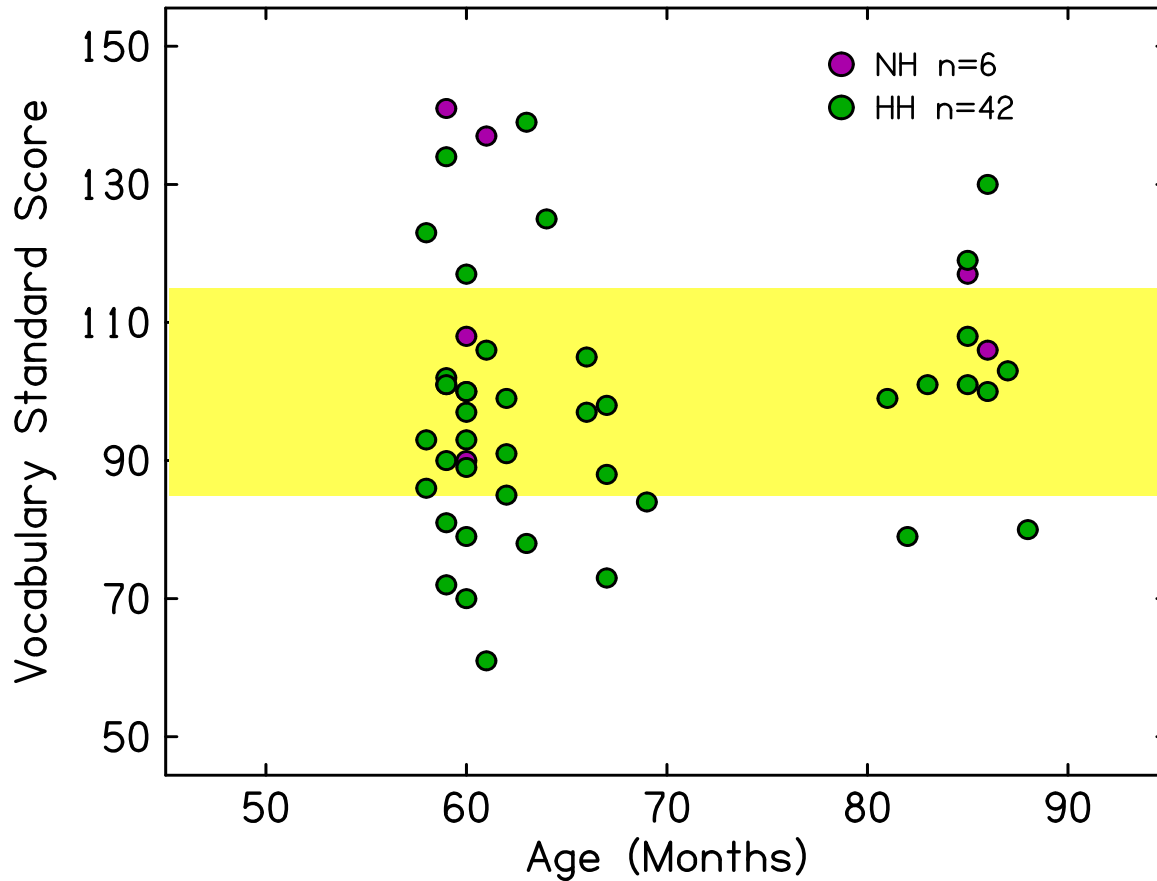
Vocabulary at 4 years: WPPSI



X=7.96

<7 Sc S=30.3%

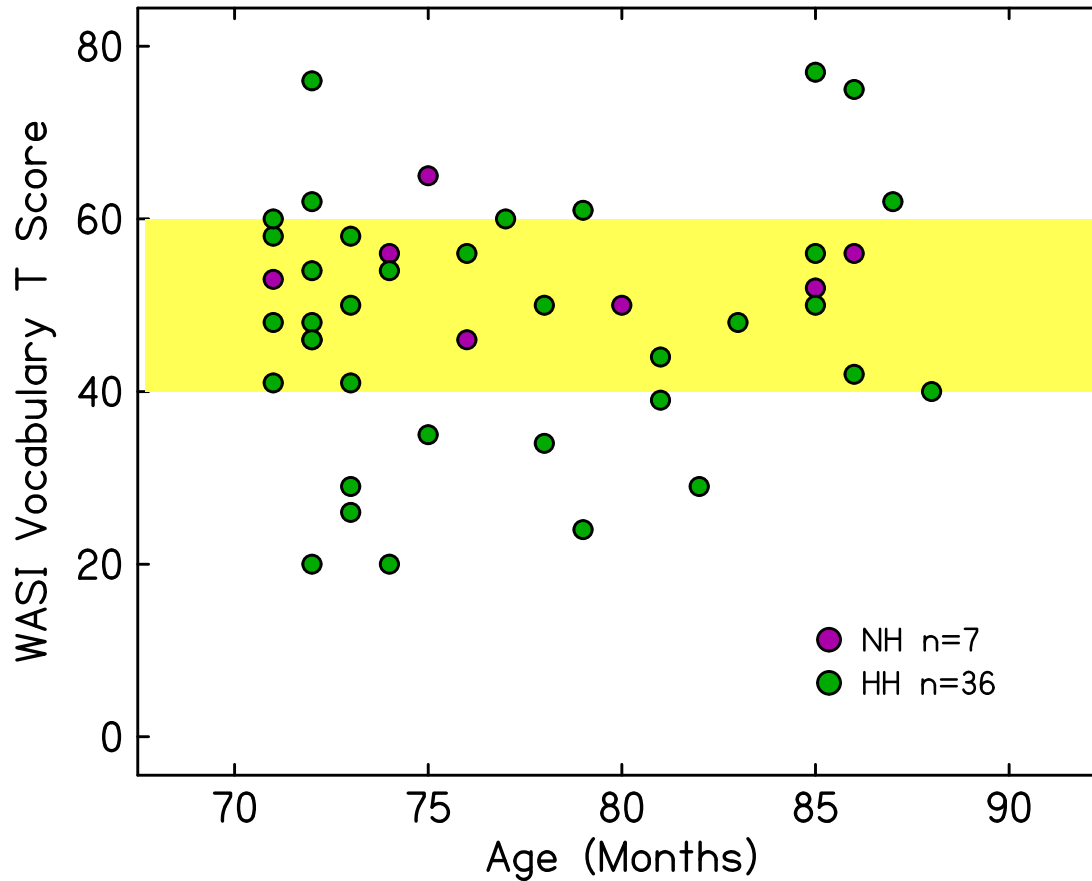
Vocab at 5 & 7 years: PPVT



X=95.53 (5 yr), 102 (7 yr)

<85 SS=28.1% (5 yr), 20% (7yr)

Vocab at 6 & 7 years: WASI



X=46.28 (6 yr), 51.09 (7 yr)
<40 T=28% (6 yr), 18% (7 yr)

Key points: Vocabulary



- MBCDI: Early vocabulary development may be delayed.
- Mean scores in average range, but wide variance in vocabulary scores.
- About 30% of children below average range.
- Possible improvement by 7 years



Receptive/Expressive Language

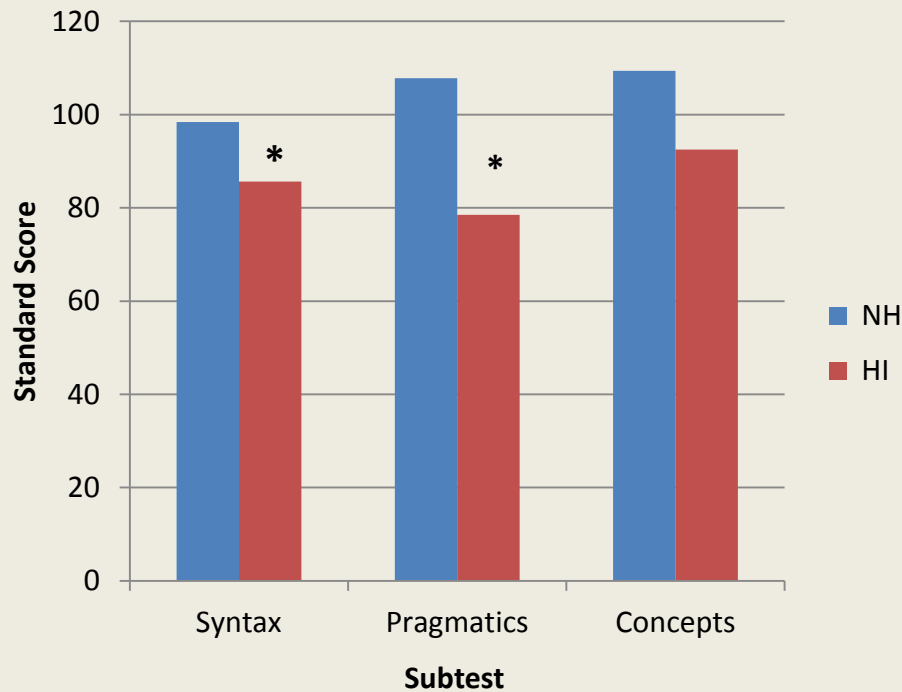


- Previous studies report wide variability in the outcomes for children with hearing loss.
 - Children with HL performed similarly to age matched peers on receptive grammar (Briscoe, Bishop & Norbury, 2001)
 - Children with HL performed similarly to *younger* children with normal hearing on test of grammar understanding (Gilbertson & Khami, 1995).

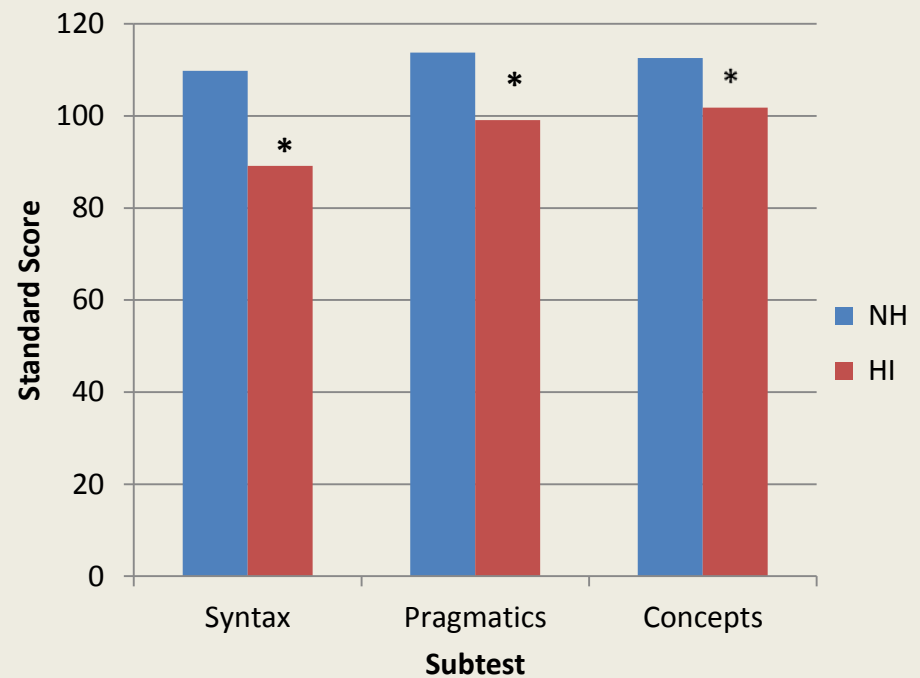
CASL at 3 & 4 years



CASL: Age Three



CASL: Age Four



Key points: Language



- Like vocabulary, wide variance in scores
- Many falling below the average range
- Syntax remains delayed while other domains may be catching up (pragmatic judgment and basic concepts)



Literacy in Children who are Hard of Hearing



- The current evidence is mixed with regard to component literacy skills in children with mild to severe hearing loss.
 - **Phonological Processing**
 - ✦ Gilbertson & Kamhi (1995) and Bristoe et al. (2001) showed poorer phonological awareness, phonological memory in children with HI than controls. Gibbs (2004) did not find differences.
 - **Word Reading**
 - ✦ Bess, Dodd-Murphy and Parker (1998) and Most et al. (2006) found poorer word reading in mild HI children.
 - ✦ Bristoe et al. (2001) and Gibbs (2004) did not find poorer word reading in HI children.
 - **Reading Comprehension**
 - ✦ Davis, et al. (1986) and Blair et al. (1985) found HI children to be below hearing norms
 - ✦ Bristoe et al. (2001) found normal reading levels.

Phonological Awareness

4 years old



Elision

Say playground

playground

Now say playground without ground

play

Say heat

heat

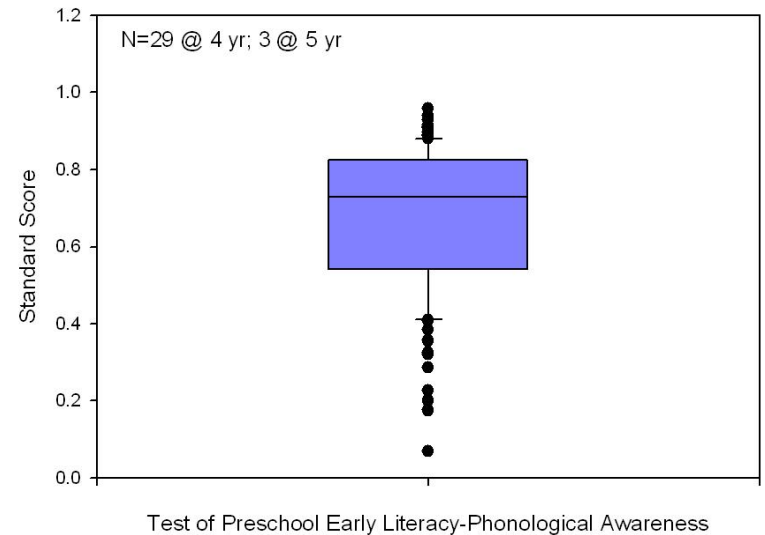
Now say heat without the /t/

he

Blending

What word do these make? Star Fish *Starfish*

What word do these sounds make? /ka p/ *Cap*



Reading Achievement at 6 yrs

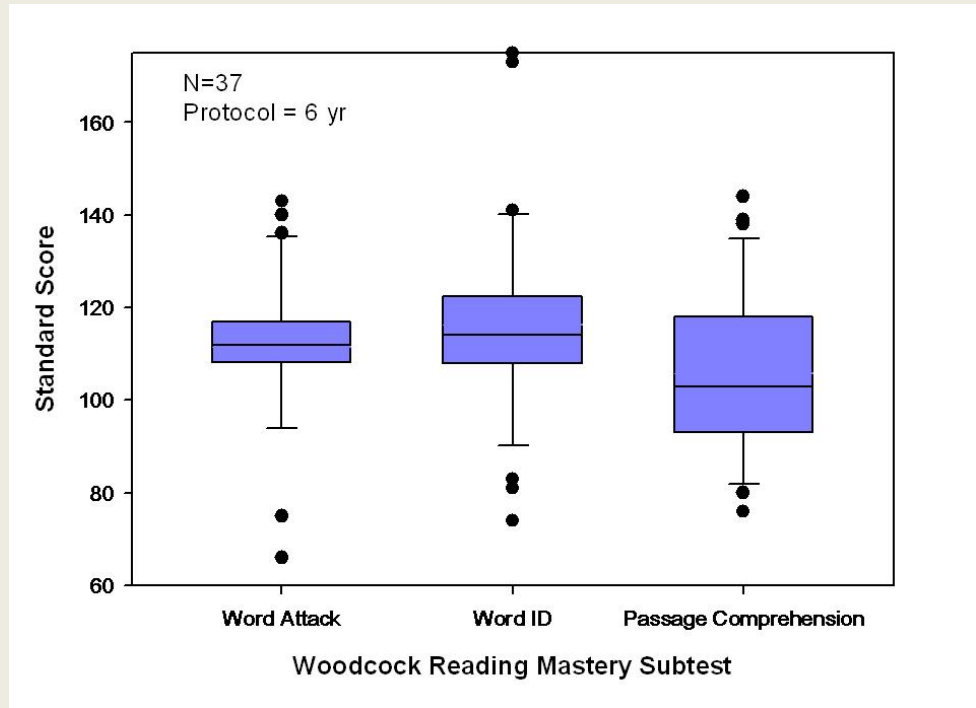


Word Attack- ability to apply phonic and structural analytic skills

- Nonsense words
- Words with very low frequency usage

Word-ID –ability to read real words

Passage Comprehension – ability to complete a passage based on information in passage.



Summary of Literacy



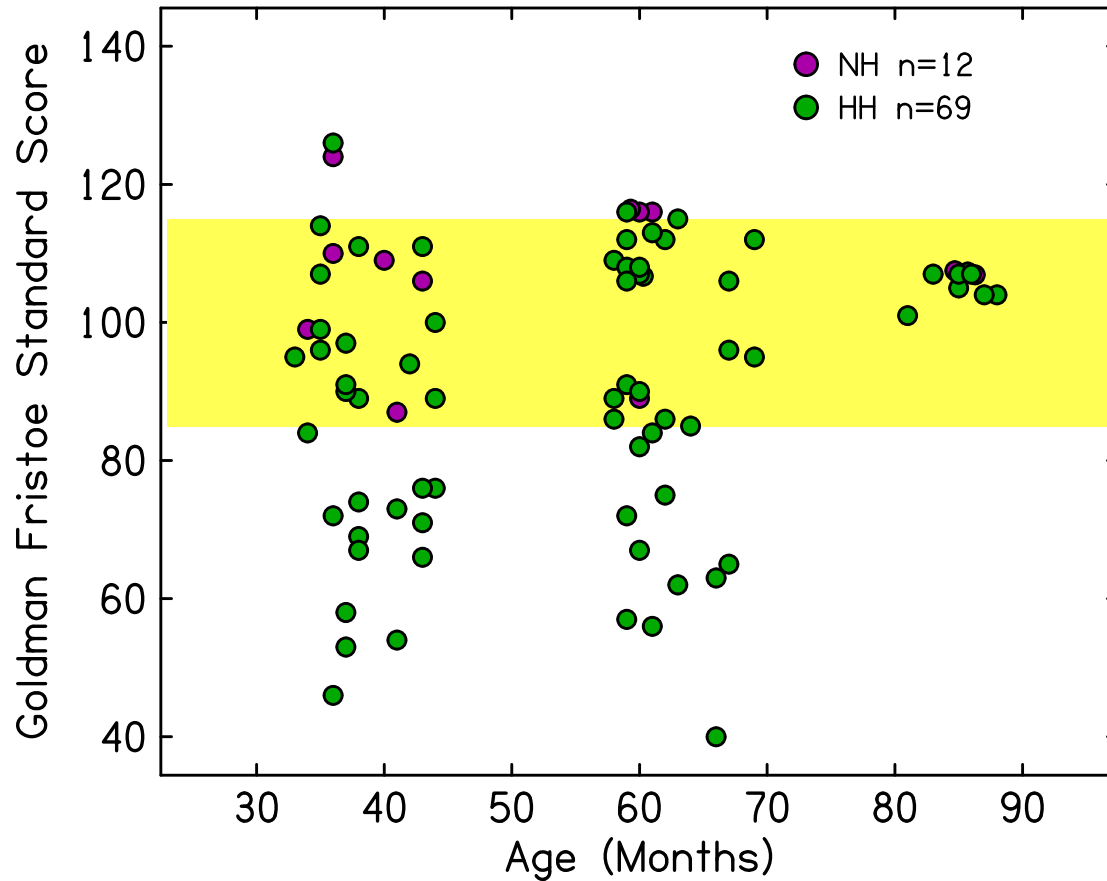
- Pre-Reading PA
 - Phonological awareness appears to be depressed in the children with HL. Why?
 - ✦ Task does require listening to phonetic details (heat without the /t/), thus some demand is placed on audition.
 - Aided SII & PA $r=0.38$, $p=0.09$
 - ✦ PA is thought to place demands on robust phonological representations.
- Early Reading
 - Initial reading appears to be slightly above average for the group.
 - We have one extremely high outlier (SS 178 on Word ID)
 - Reading at this stage in development reflects word decoding. Later reading becomes more language driven.
 - The early weak PA does not seem to be realized in the good word attack.

Speech Production



- Delays in babble onset increase with increasing hearing loss (Carney, 1996)
- Some children at risk for slow transitions from babble to word productions (Moeller, et al., 2007)
- Delays in use of fricative class (McGowan, et al, 2008; Moeller, et.al, 2007)
- Generally intelligible speech as they mature (Wallace, et al, 2000)
 - Number & type of phoneme errors increase with increased severity of loss (Elfenbein, et al, 1994)
 - Substitution of fricatives & affricates most common

Articulation at 3, 5, & 7 years: GFTA



$M=84.41$ (3 yr), 89.75 (5 yr), 105.2 (7yr) <85 $SS=48.3\%$ (3yr), 34.4% (5yr), 0% (7yr)

Non-standardized measures



- Infant Vocal Interview (Moeller & Bass-Ringdahl)
 - Parent interview
 - Early vocalizations and word production
- Ertmer's Open and Closed set test
 - Single word imitation and closed set picture identification
- Morphological Elicitation Procedure
 - Questions are asked after viewing short clips of children performing everyday activities. The clips are designed to prompt the child to use grammatical word endings (e.g., key/keys; mom/mom's, walk/walked).

Vocal Development Landmarks Interview



PROVISION OF VOCAL EXAMPLES AND PAIRED COMPARISONS

To avoid use of technical terms

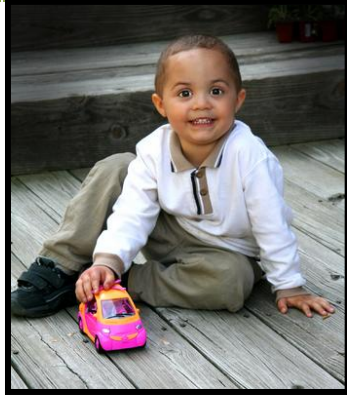
To ensure that parent and clinician “on same page”

To calibrate examiners

USES STANDARD INTERVIEW FORMAT AND PP SLIDES WITH AUDIO FILES

3 sections: precanonical, canonical, word

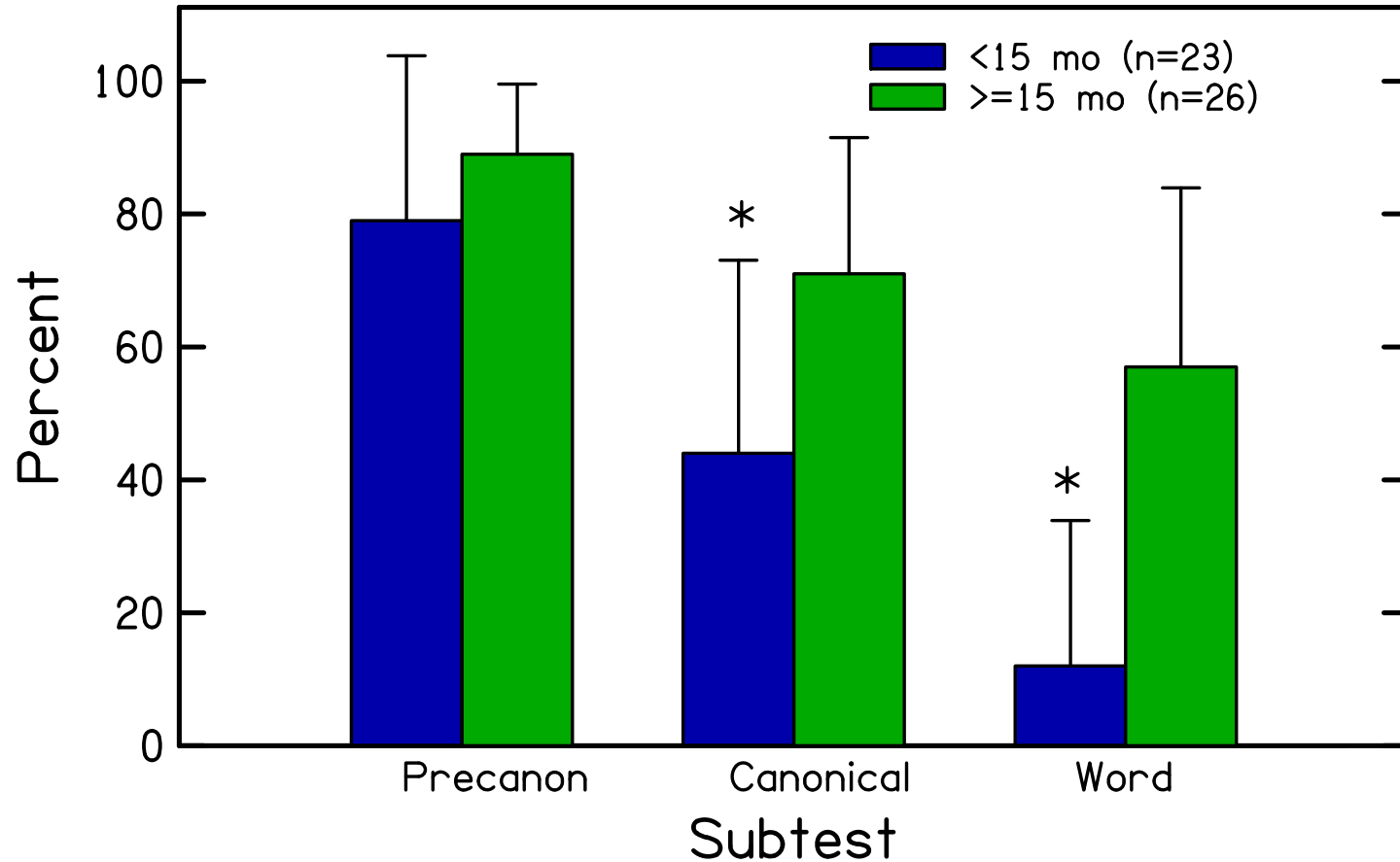
Item 2-6 (canonical)



Jargon or
jabber



Vocal Interview



M age younger = 11.0 mos (SD = 2.32); *M* age older = 18.7 months (SD = 1.29)

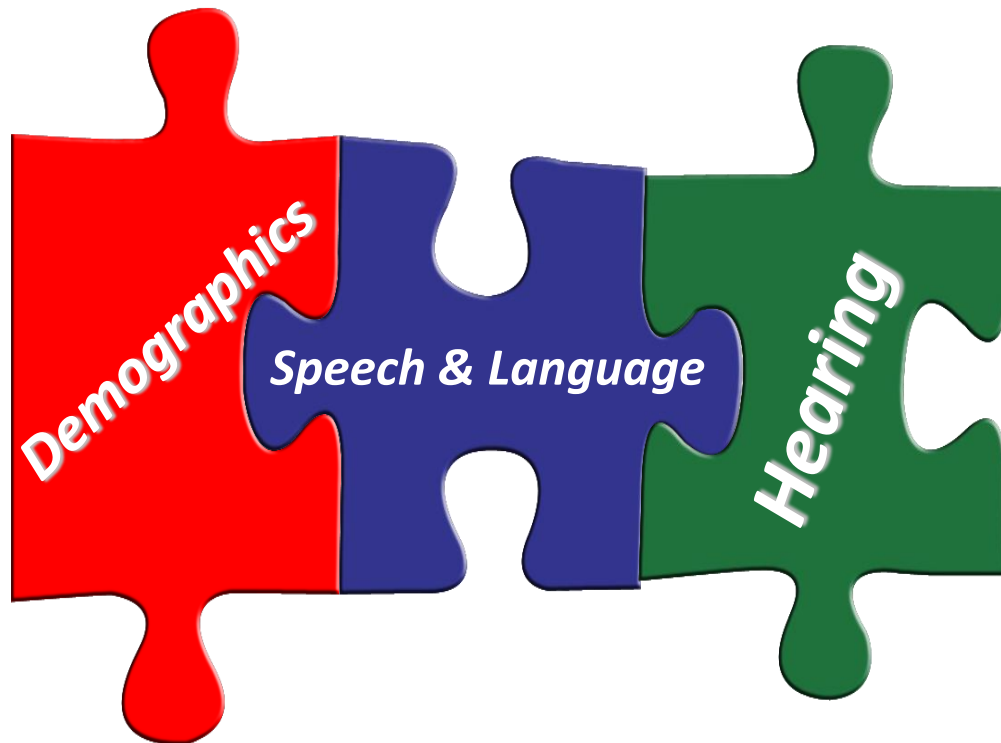
Key points: Speech production



- GFTA: Older children have increased accuracy, but still large variance. Seven year olds within average range, although small number tested.
- Vocal Interview: Advances in canonical babbling and word formation from 12 to 18 months.
- Children with HL significantly delayed on phonology and word production
- Phonology may be vulnerable until older ages



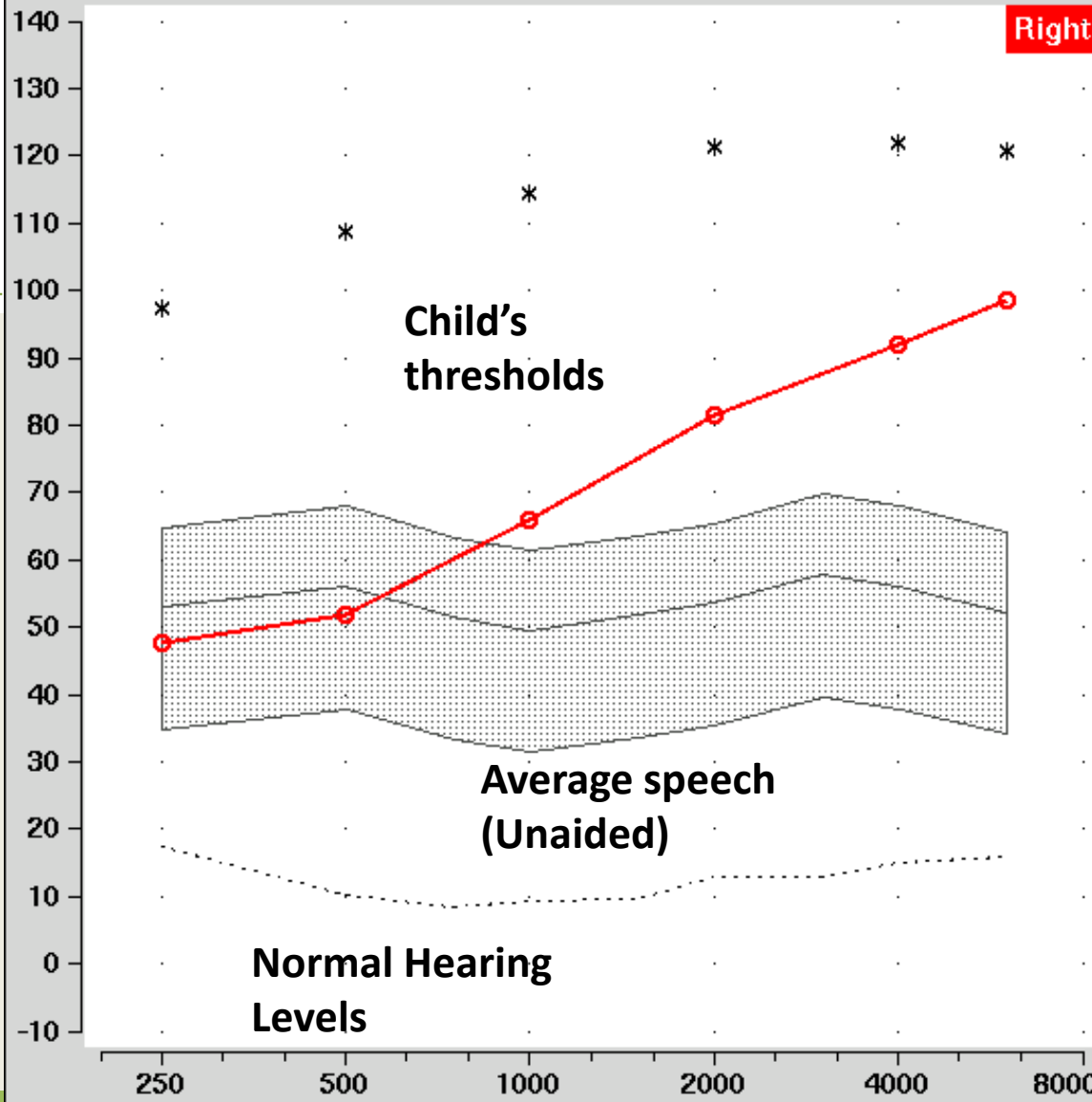
Hearing aid fitting & audibility



Speechmap/DSL 5.0a child

Sep 9, 2008 6:51pm

audioScan



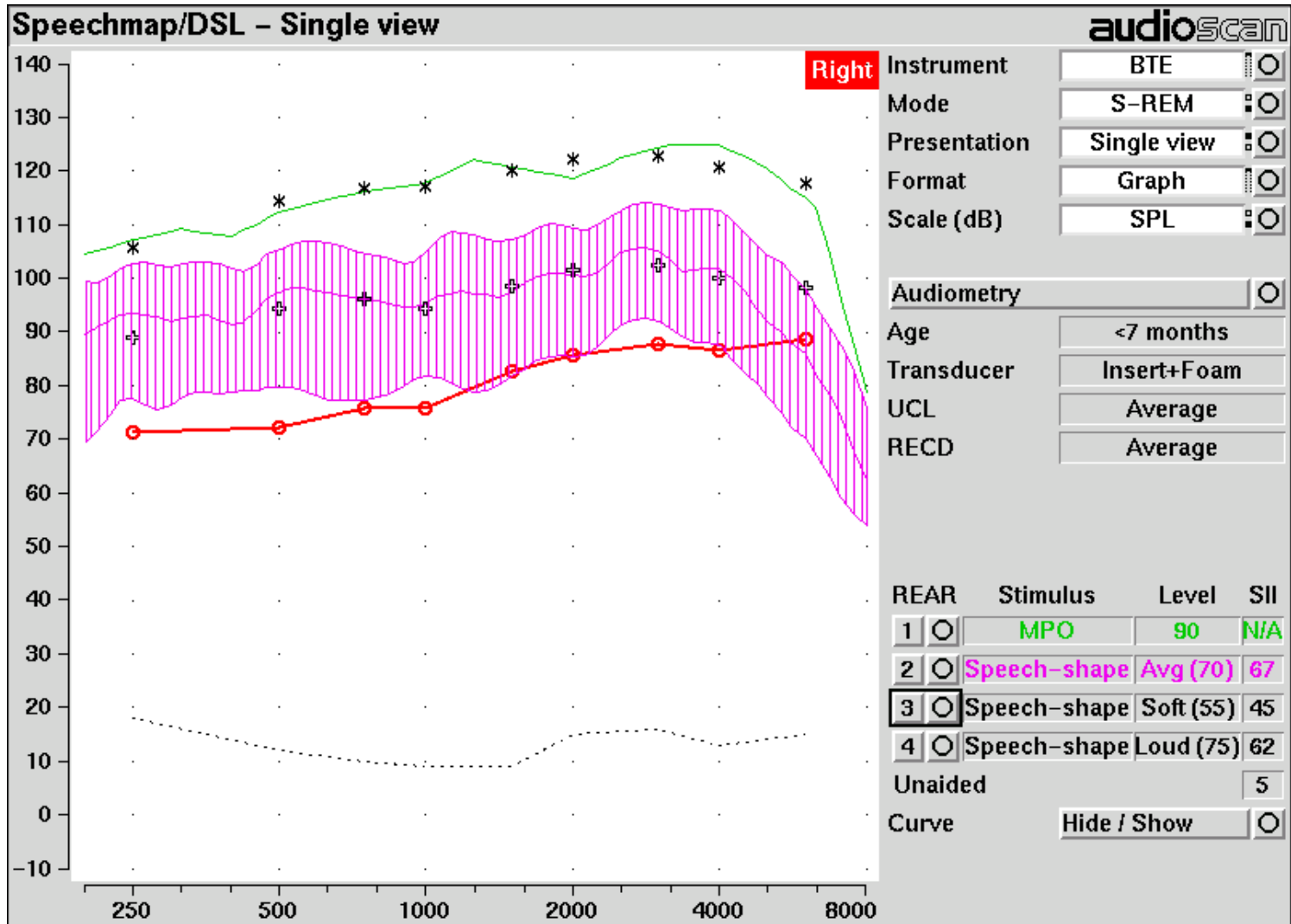
Right

- Instrument: BTE
- Mode: Test box
- Presentation: Single view
- Format: Graph
- Scale (dB): SPL

- Audiometry:
- Age: 15 months
- Transducer: Insert+Foam
- UCL: Average
- RECD: Average
- BCT: N/A
- Binaural: No

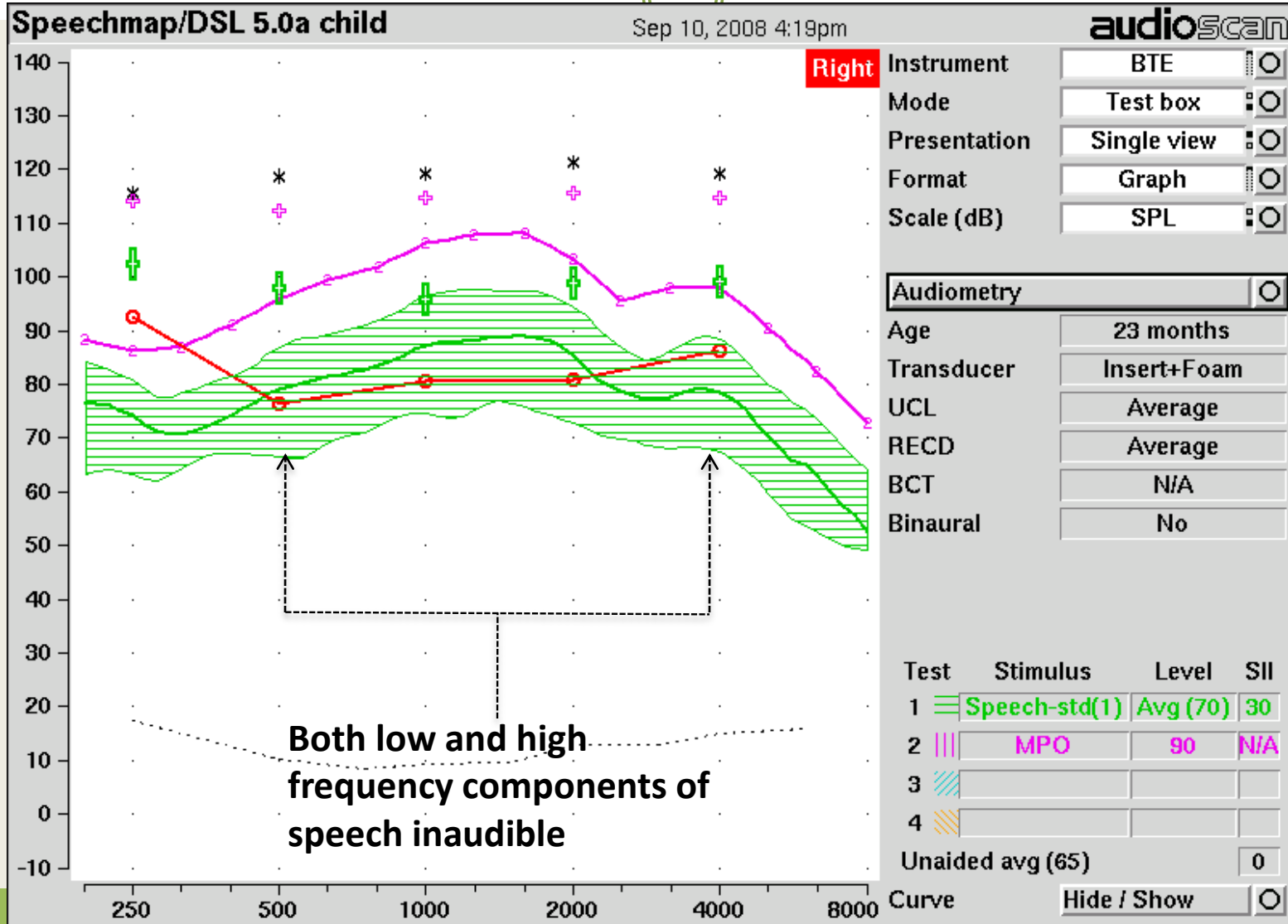
| Test | Stimulus | Level | SII |
|------|----------|-------|-----|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |

Unaided avg (65) 13
Curve Hide / Show

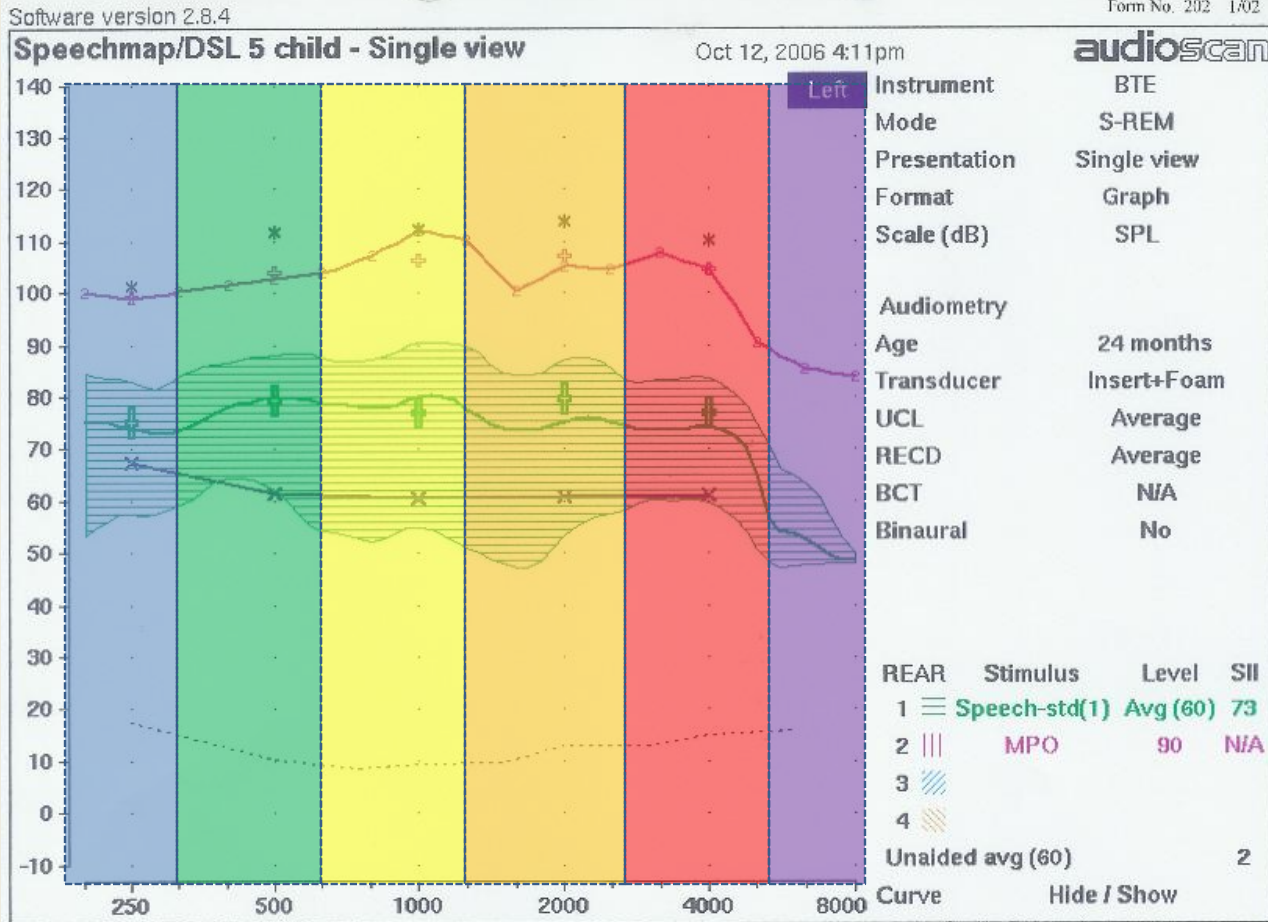


Connect coupler and instrument to coupler microphone. Select one of REAR 1 through REAR 4.

Results of HA verification



Hearing loss and audibility



For each band –
 $\text{Audibility} \times \text{FIW} =$
 weighted audibility

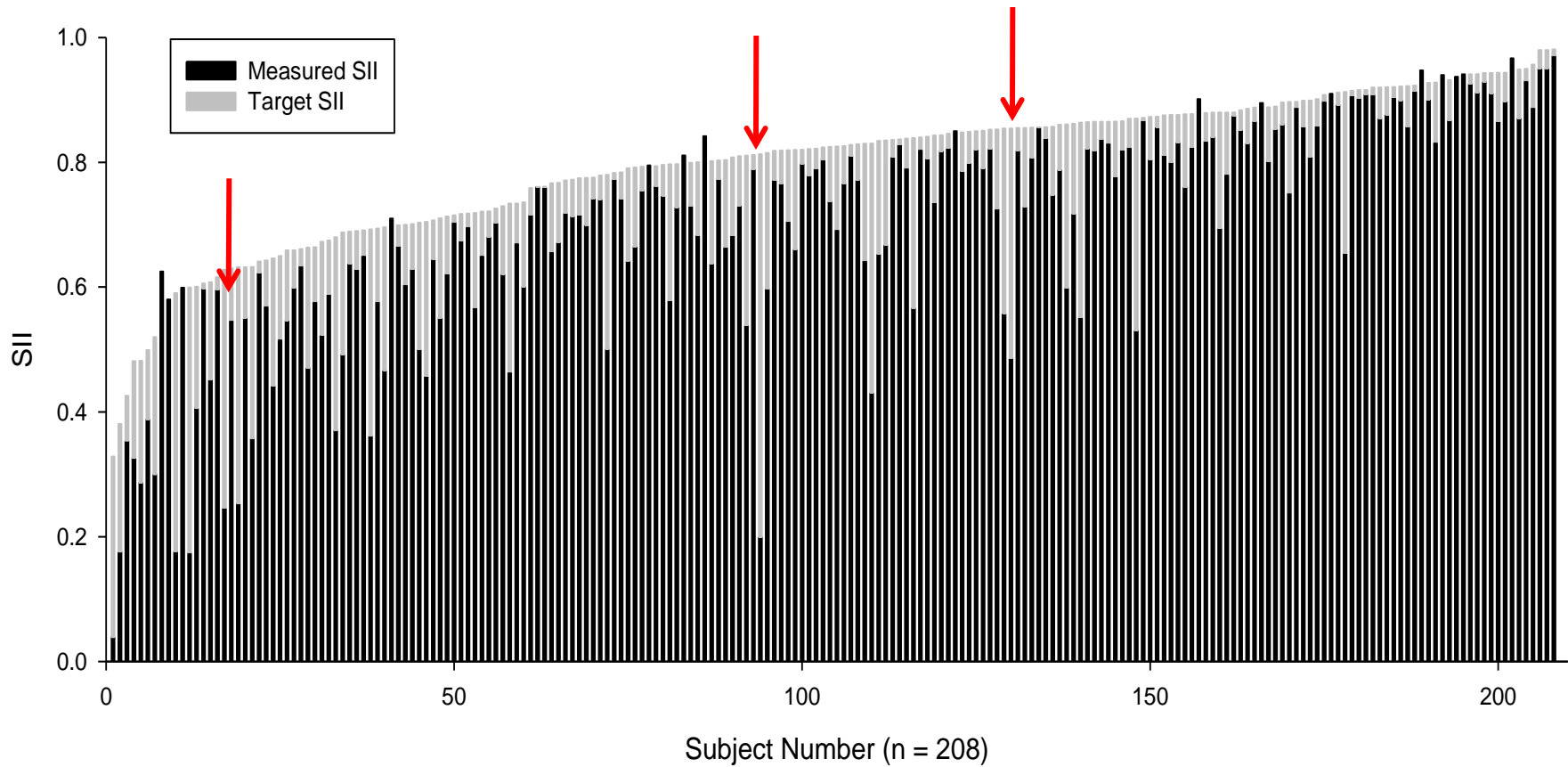
SII = Sum of
 weighted audibility
 of all frequency
 bands



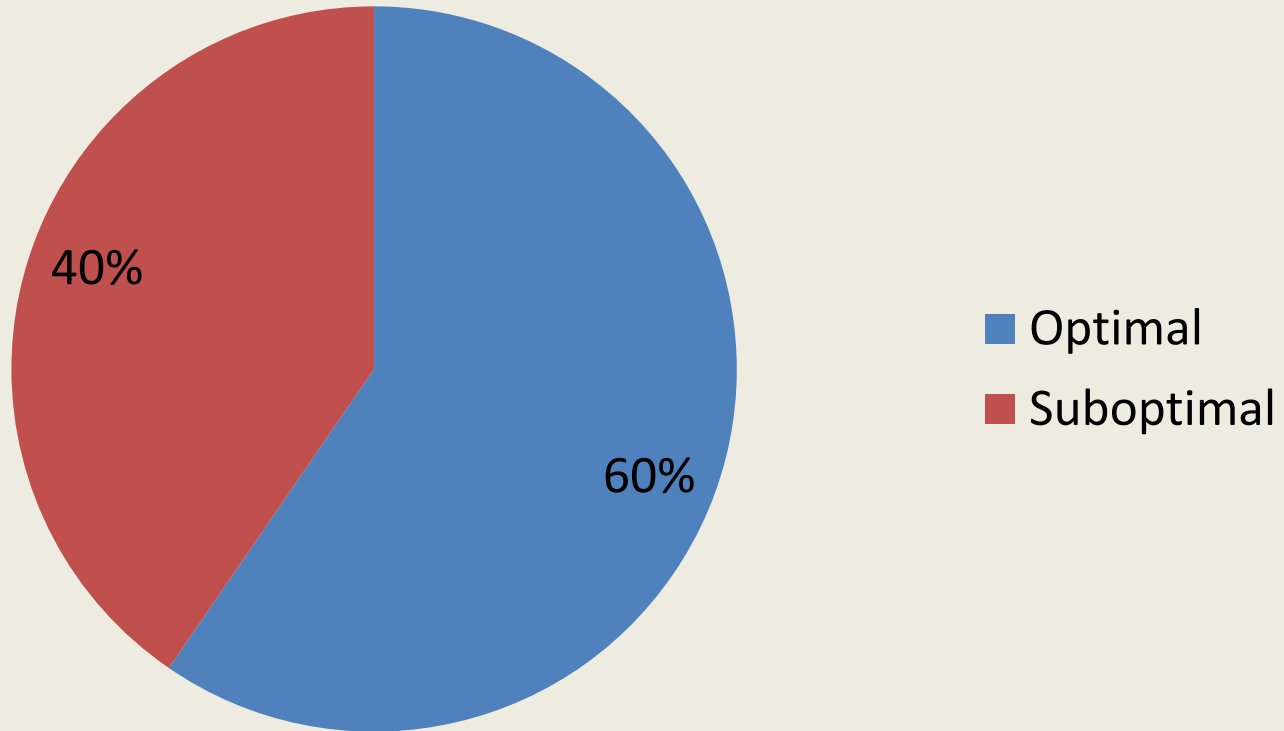
Hearing Aid Match to Targets



Target vs. Measured SII



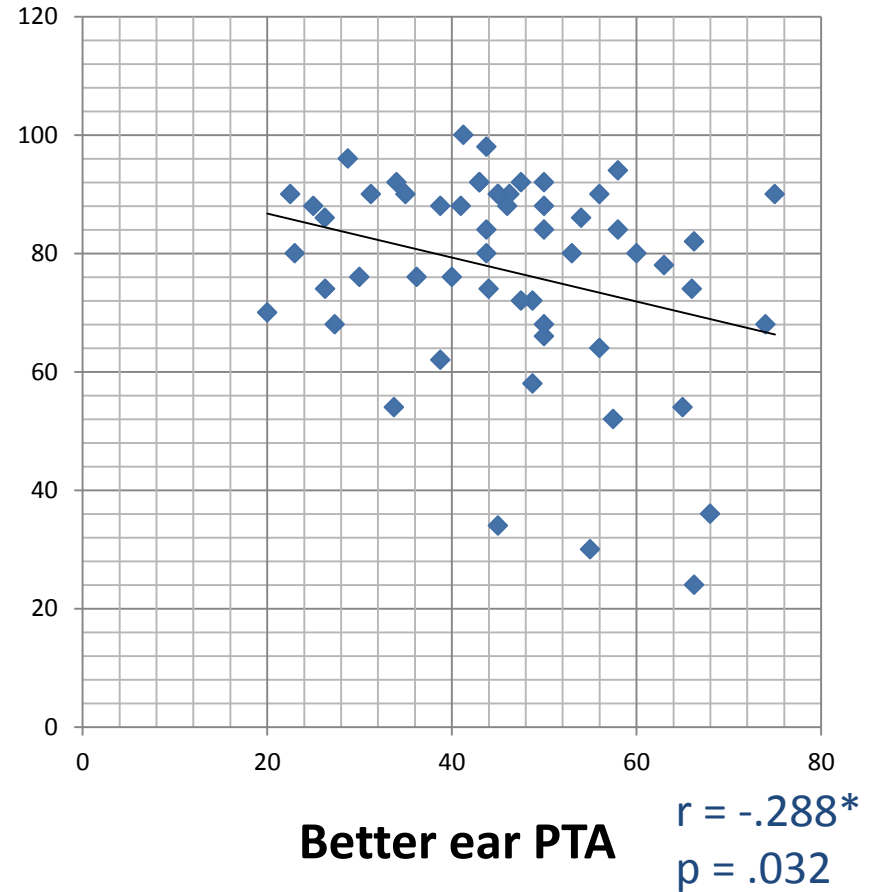
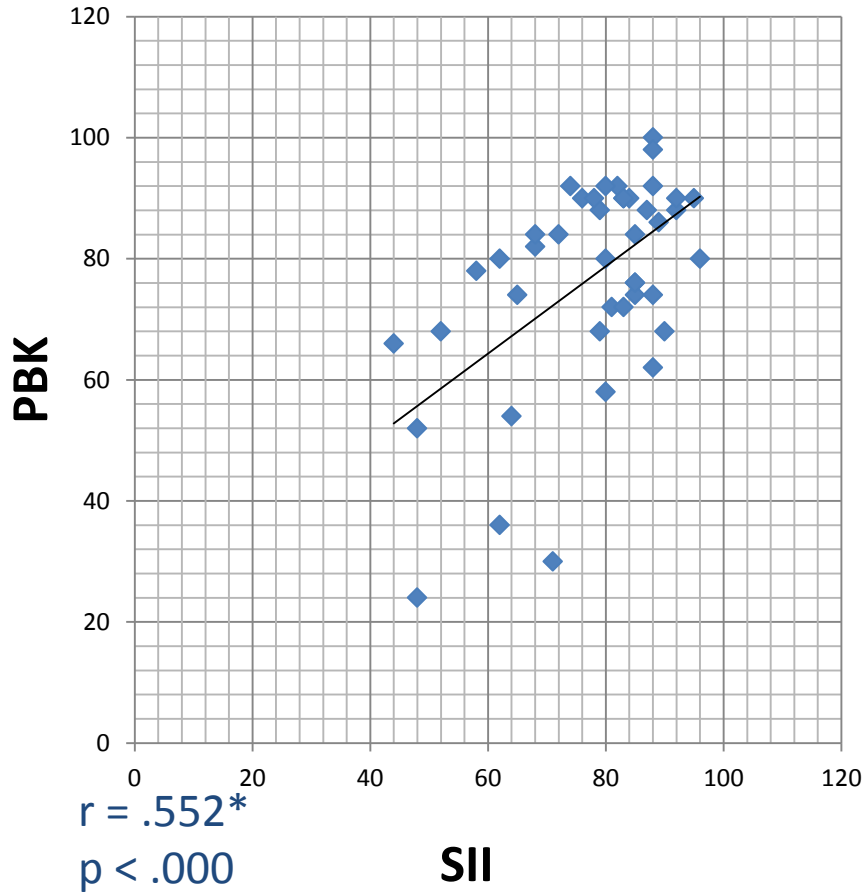
Hearing aid fit



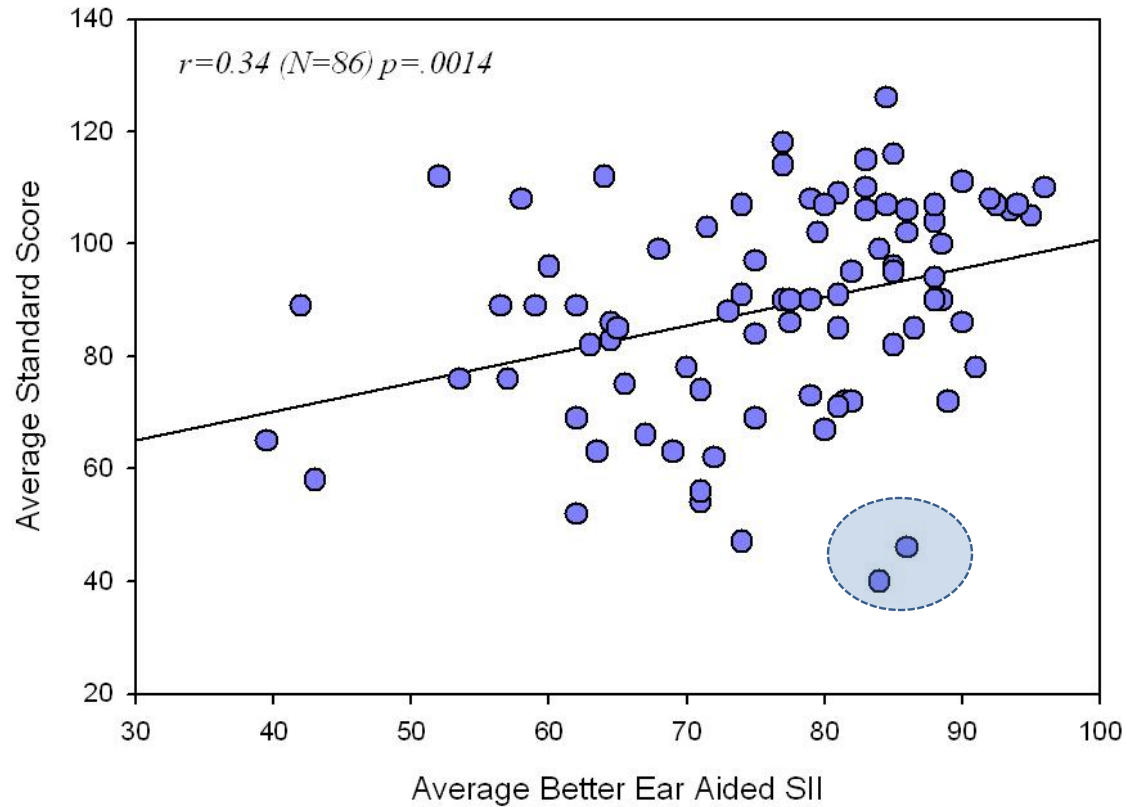
Word Recognition: Aided and Unaided



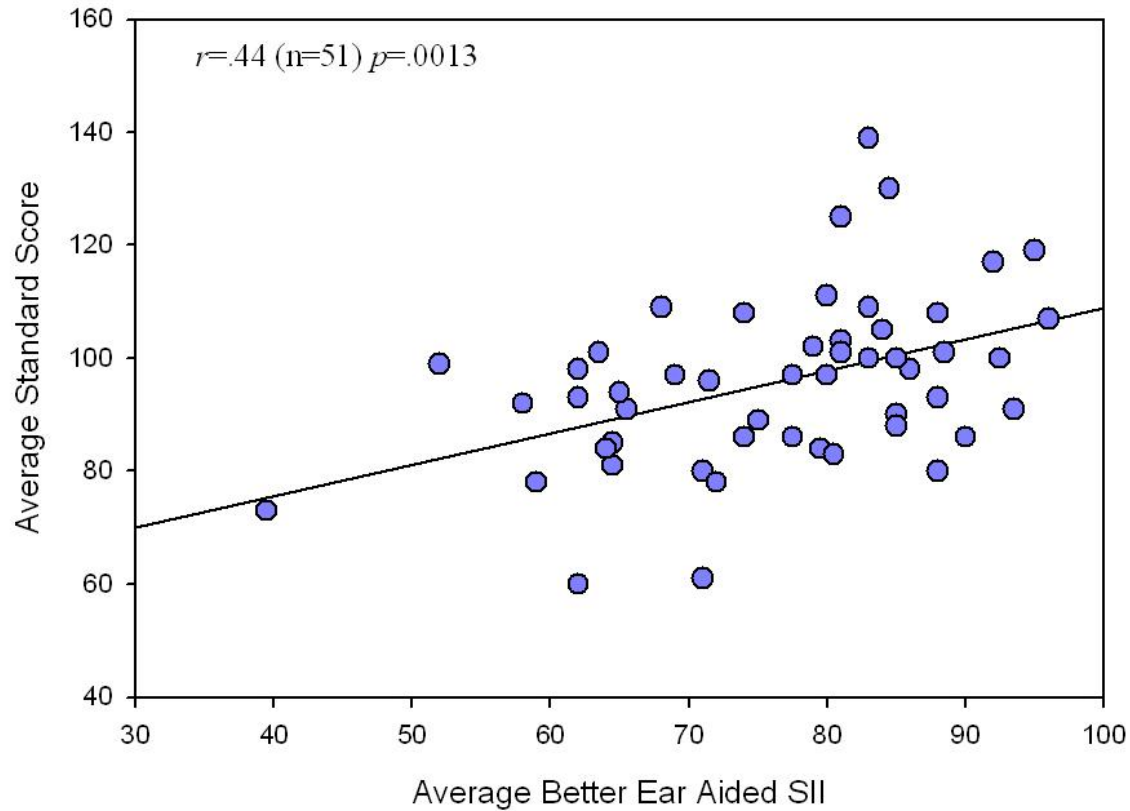
Age >4



Audibility and Speech Production



Audibility and Vocabulary



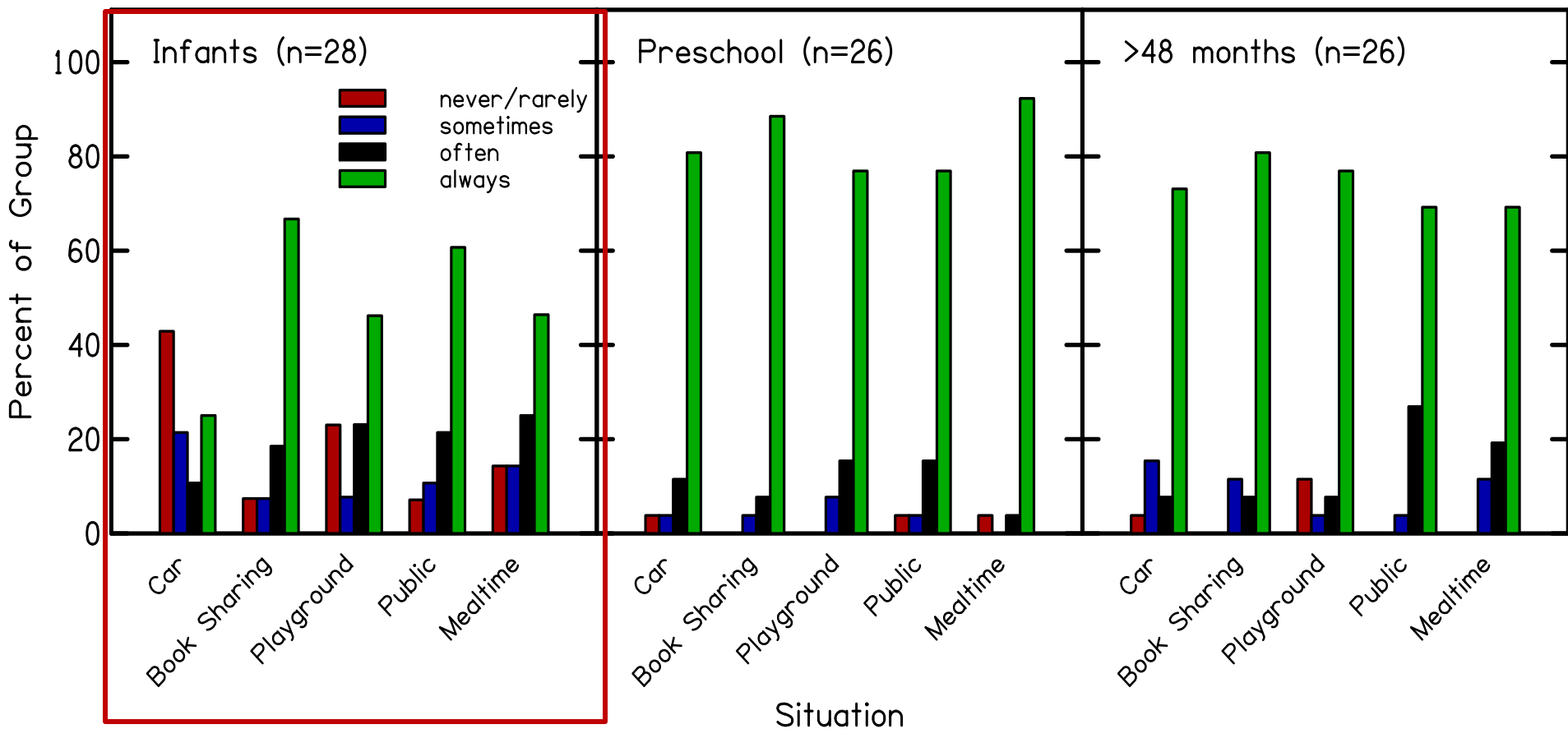
Hearing aid use consistency



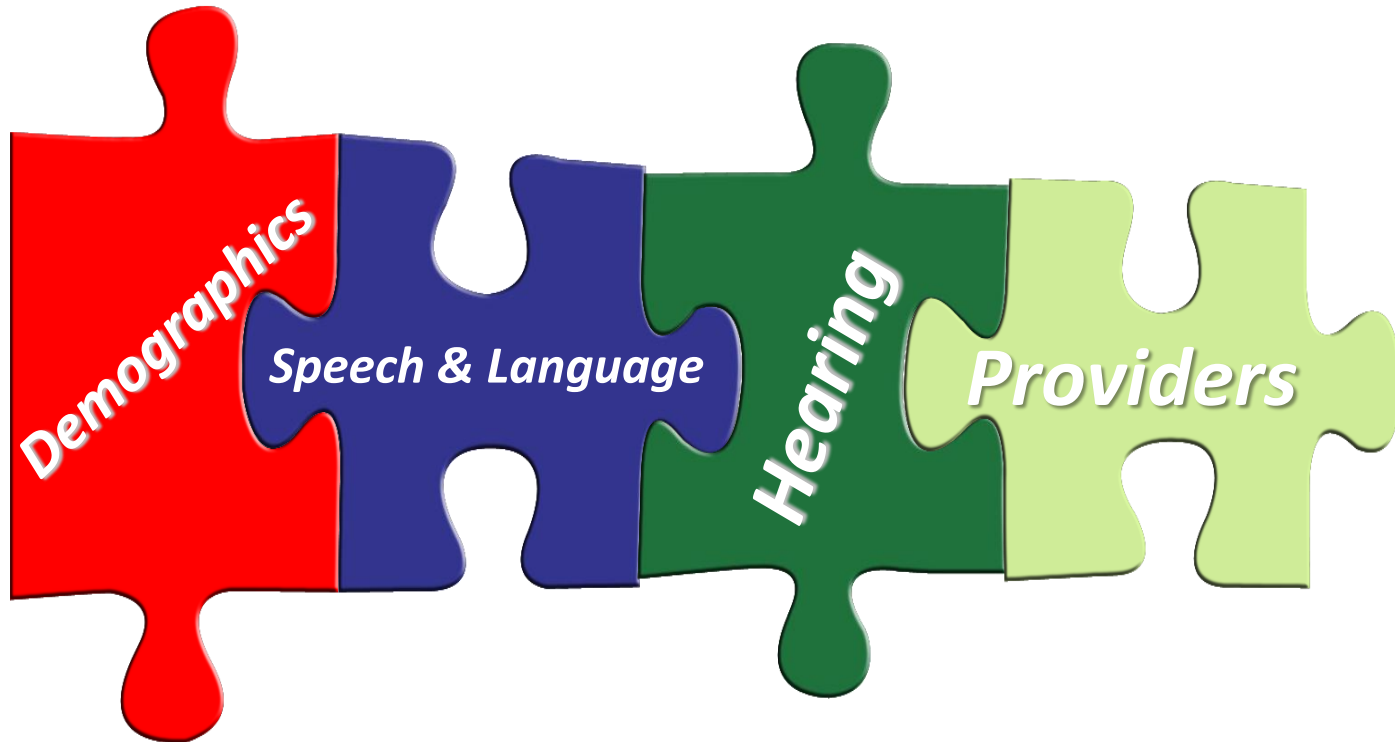
Put an X in the boxes below to indicate how consistently your child uses HAs in the situations listed:

| Situation | Never (0) | Rare (1) | Sometimes (2) | Often (3) | Always (4) | N/A |
|---------------------|------------------|-----------------|----------------------|------------------|-------------------|------------|
| Car | | | | | | |
| Pre-School/School | | | | | | |
| Day Care | | | | | | |
| Meal Time | | | | | | |
| Playing Alone | | | | | | |
| Book Sharing | | | | | | |
| Playground | | | | | | |
| Public (store, zoo) | | | | | | |

Hearing aid use consistency



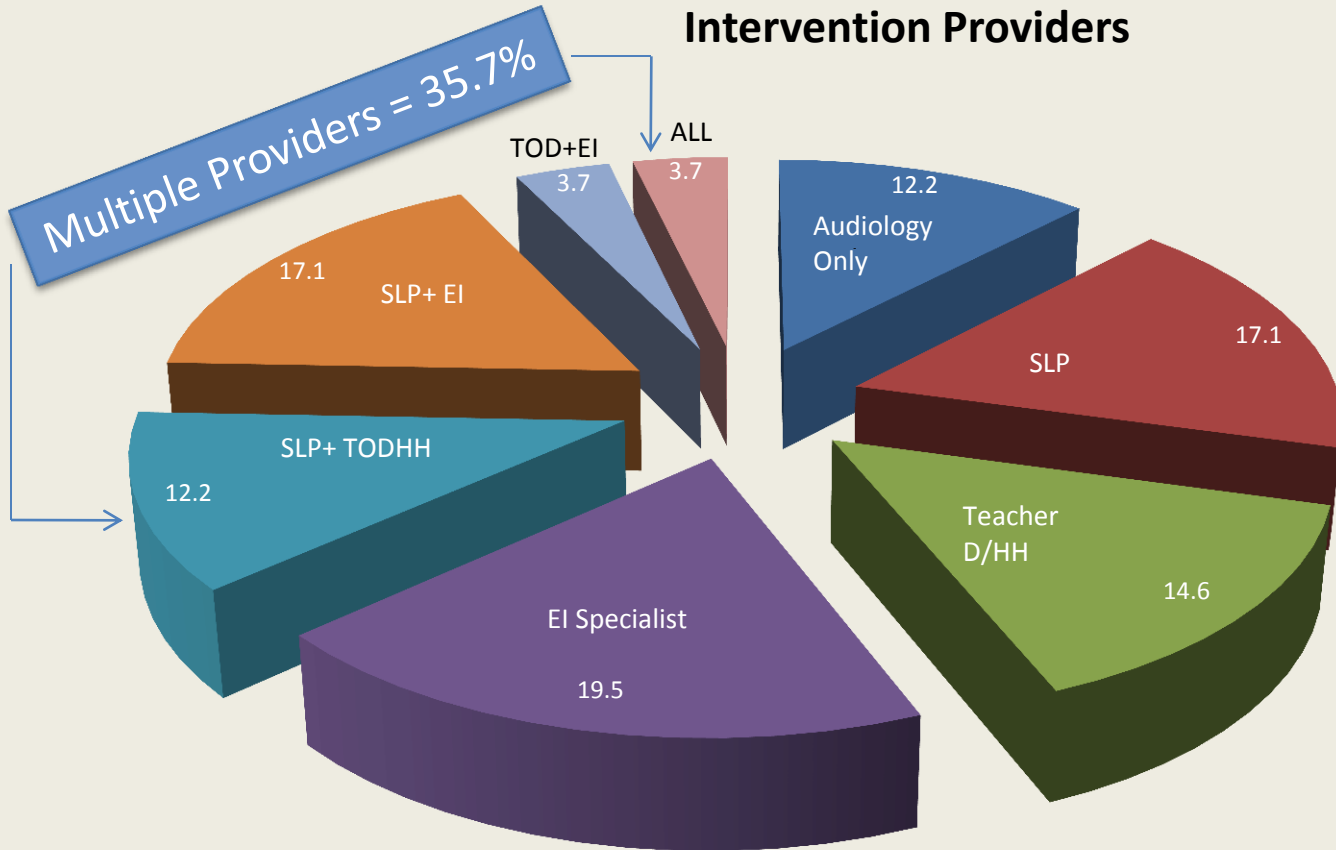
Audiology & EI Service provider info



Service Provision: Birth to Three



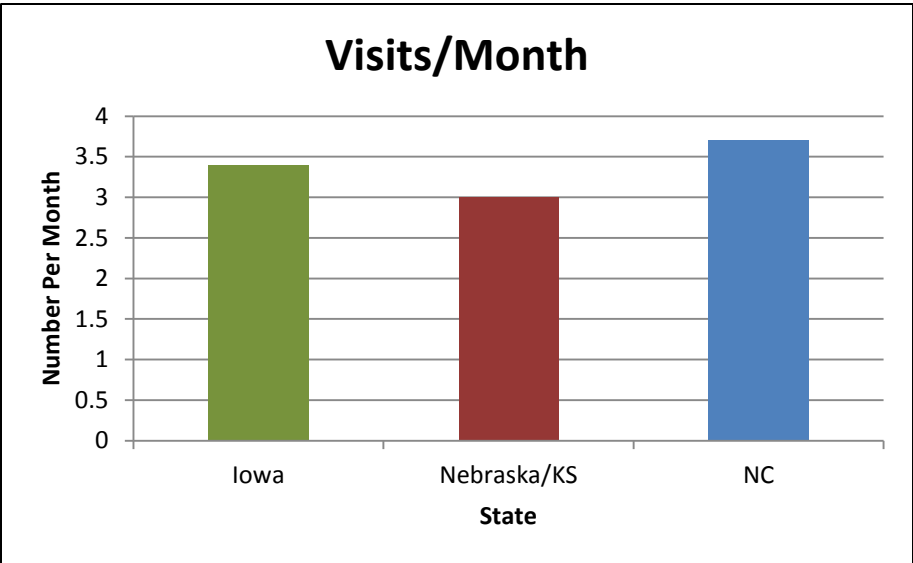
Intervention Providers



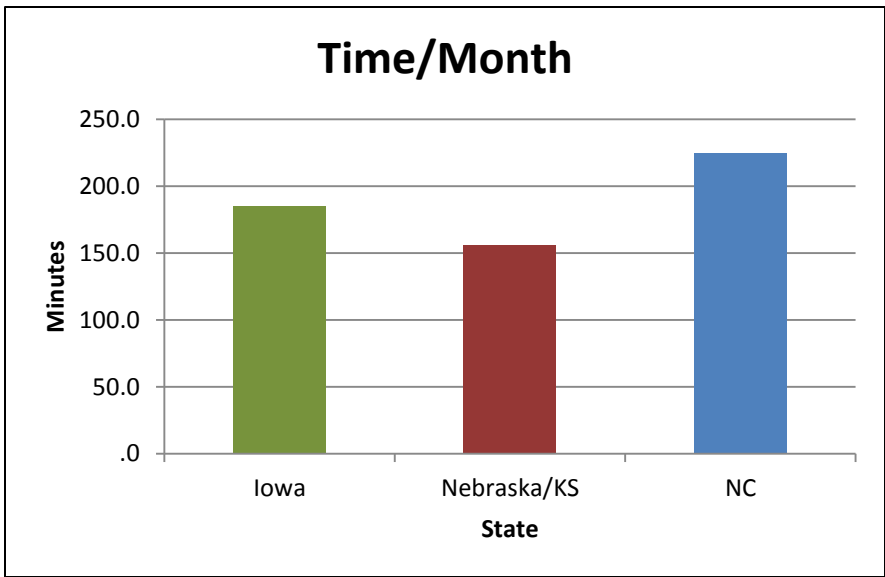
SLP Involved = 50.1%

Audiological Care = 100%

Average Monthly Service Provision (0-3)

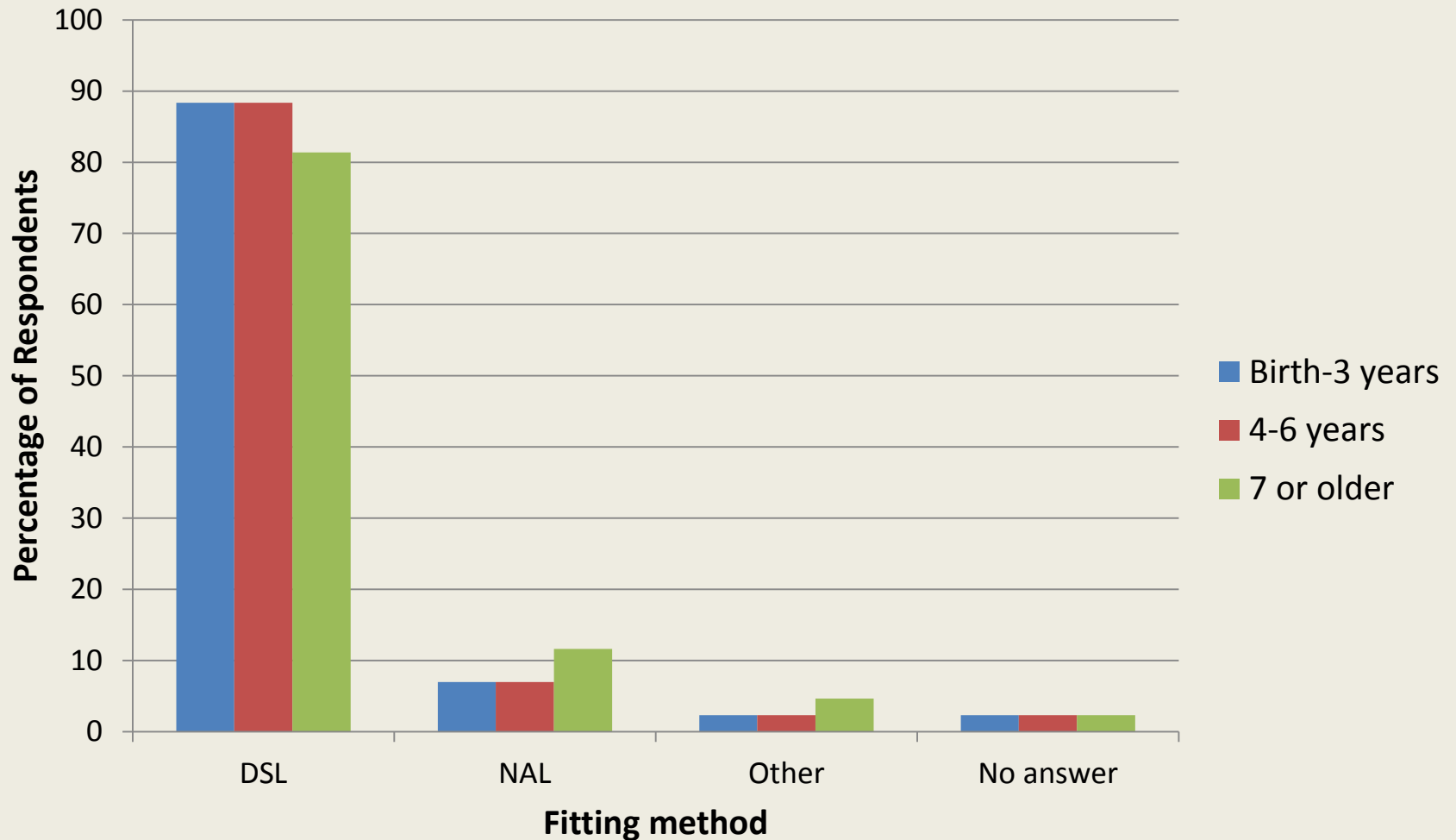


Range = 0 to 11

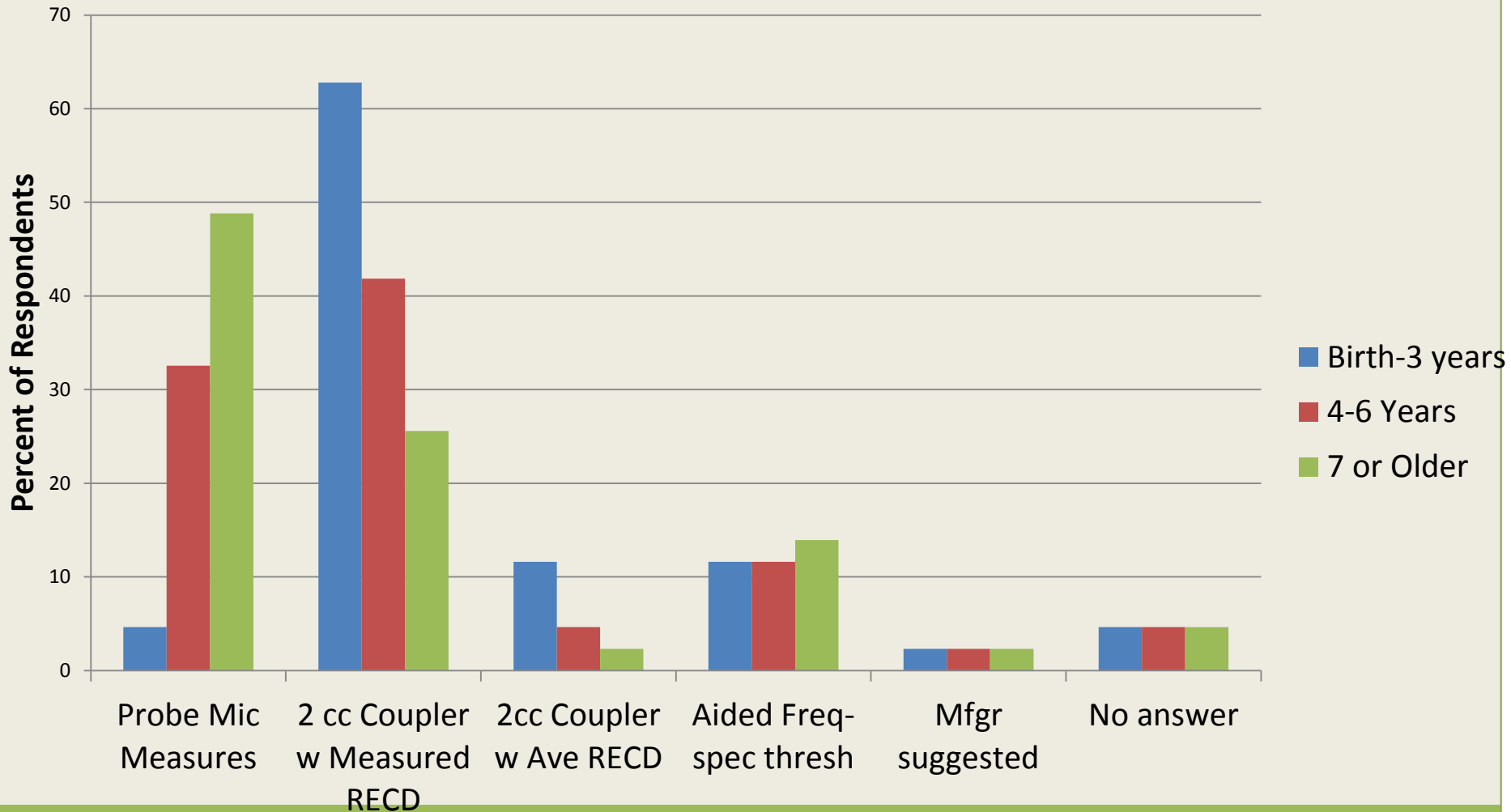


Range = 0 to 660 minutes

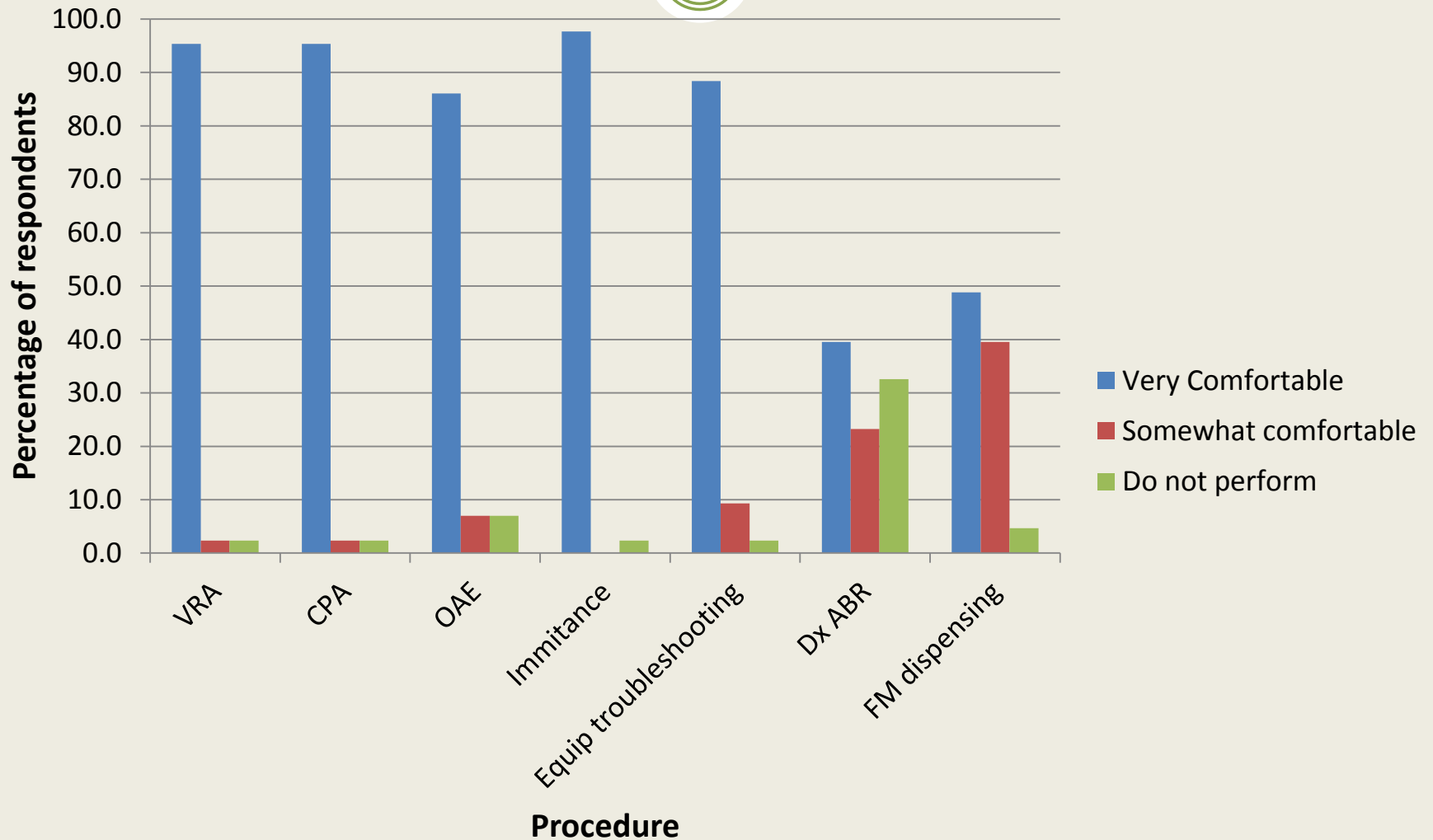
Hearing aid fitting method



Hearing aid verification



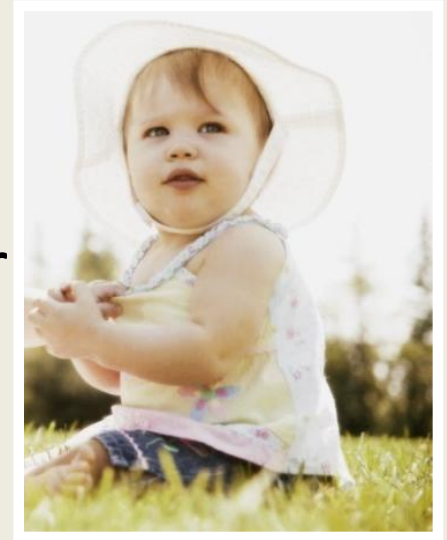
Comfort level of Audiologists



Key points: Audiology



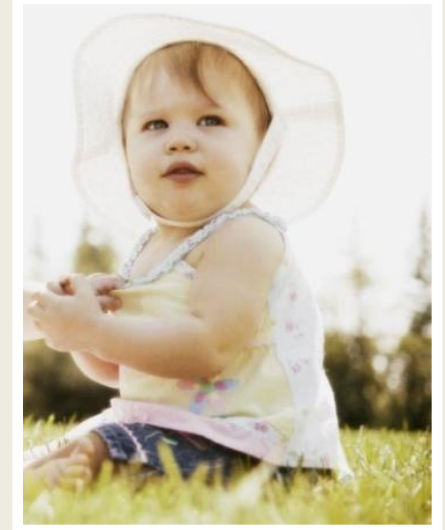
- **Beyond PTA, better speech production and vocabulary with increased audibility.**
- Children have longer wear time and better use consistency once they are preschool age, although once in school some do not wear as often.
- Most audiologists report they are comfortable with pediatric evaluation and fitting techniques except ABR and FM.



Key points: Audiology



- Most audiologists indicate they use DSL prescriptive fitting method
- Regarding Verification:
 - For children under 3, 2/3s of audiologists reported they verify HAs with 2cc coupler w/ either measured or average RECD.
 - Some still report using aided detection thresholds or manufacturer suggested settings.



Take home messages



- Many early-identified children score within the average range or better on speech and language tests, but approximately 1/3 of the children are lagging behind their NH peers.
- While many children are delayed at younger ages, they may catch up as they get older.
- Better audibility is associated with better speech and language scores.
- Need to be vigilant over children's speech/language evaluations and hearing aid use as they age.

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Thanks



Any
questions?