

Language Outcomes and Predictors of Success in Young Children Who Are Deaf or Hard of Hearing: A Multi-Site Perspective

WREIC

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Disclaimer

The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC).

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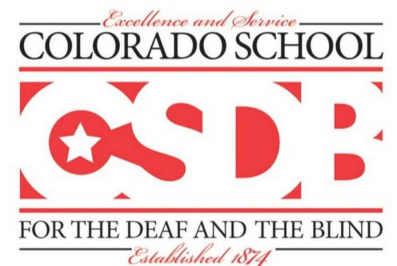
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Today's Topics

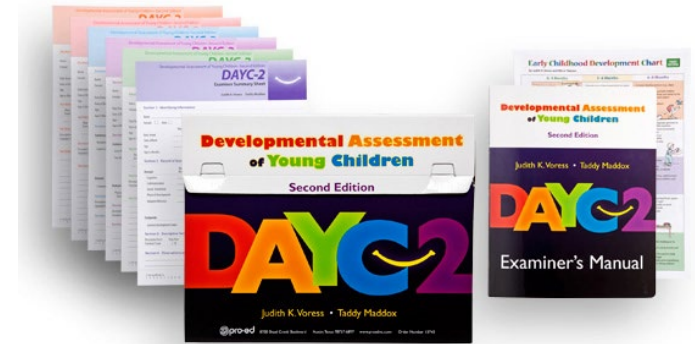
- Describe the language levels of young children who are D/HH
- Identify factors associated with better language outcomes
- Identify factors that put some children at more risk for language delay
- Propose clinical implications of findings



Assessment Instruments

Developmental Assessment of Young Children - DAYC-2

- Based on observation and parent report
- Examined Receptive and Expressive Language subscales
- Adapted to reflect abilities in both spoken and sign language



MacArthur-Bates Communicative Development Inventories

- Assesses diversity of vocabulary
- Parent-report instrument
- Includes both spoken and signed expressive vocabulary





Description of Database:

- Public health surveillance project
- Supported by the CDC
- Language outcome data collected on children who are D/HH, birth to 3 years
- Data collected from 9/1/2020 to present
- Data obtained from 17 different programs in 15 different states
- www.colorado.edu/center/oddace

Participating States (ODDACE)

- Arizona
- Colorado
- Florida
- Idaho
- Illinois
- Indiana
- Maine
- Massachusetts
- North Dakota
- South Dakota
- Tennessee
- Texas
- Vermont
- Wisconsin
- Wyoming

Question 1

What factors are associated with better language outcomes in children with bilateral and unilateral hearing differences?

Number of Participants

- 597 children (DAYC-2 outcomes)
 - Bilateral = 404
 - Unilateral = 193
- 532 children (MacArthur outcomes)
 - Bilateral = 358
 - Unilateral = 174

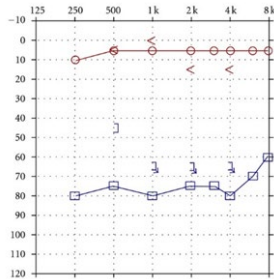
Participant Criteria for Language Outcomes Analysis

- Birth to 3
- Unilateral or bilateral hearing differences
- All levels of hearing difference
- Any home language
- Any communication mode
- No disabilities thought to affect speech or language development
- Most recent assessment

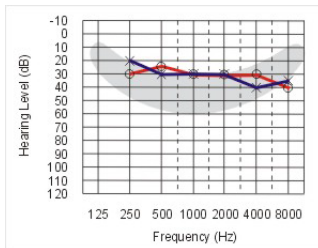
Language Outcomes Analysis: Participant Characteristics

- Chronological age
 - Range = 2 to 36 months
 - Mean = 22 months
- Gender
 - Boys = 53%
 - Girls = 47%

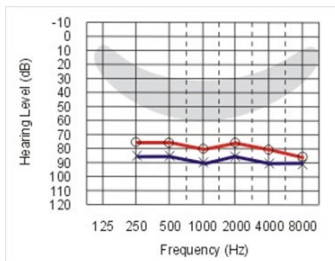
Hearing Levels



Unilateral = 32%



Bilateral: Mild & Moderate = 45%



Bilateral: Mod-Sev to Prof = 23%

Participant Characteristics

- English is spoken and/or written language of the home = 90%
- Hispanic ethnicity = 41%
- White race = 87%
- Hearing parents = 90%
- Average # of EI sessions per month = 4.2

Meeting EHDI Guidelines

EHDI guideline category	Percentage
Identification by 3 months	77%
Intervention by 6 months	69%
Meets 1-3-6	62%

Determining Predictors of Language Outcomes

- Model selection approach
 - Forward-backward stepwise
 - Determines which predictors contribute significantly to the model, balancing model fit with complexity
- Statistical Analysis:
 - Linear regression

Three Models: Outcome Variable

- Three predictive models each examining a different language outcome
 - DAYC-2 Expressive Language
 - DAYC-2 Receptive Language
 - MacArthur Expressive Vocabulary
- Used percentile scores for each measure

Significant Predictors of Language Outcomes

Significant predictors of all 3 language measures ($p < .01$)

- Primary caregiver years of education
- Mild and Mod hearing levels vs. Mod-Sev to Profound
- Meeting EHDI 1-3-6 guidelines
- Not significant:
 - Unilateral vs. Mild and Mod bilateral

Significant Predictors Language Outcomes

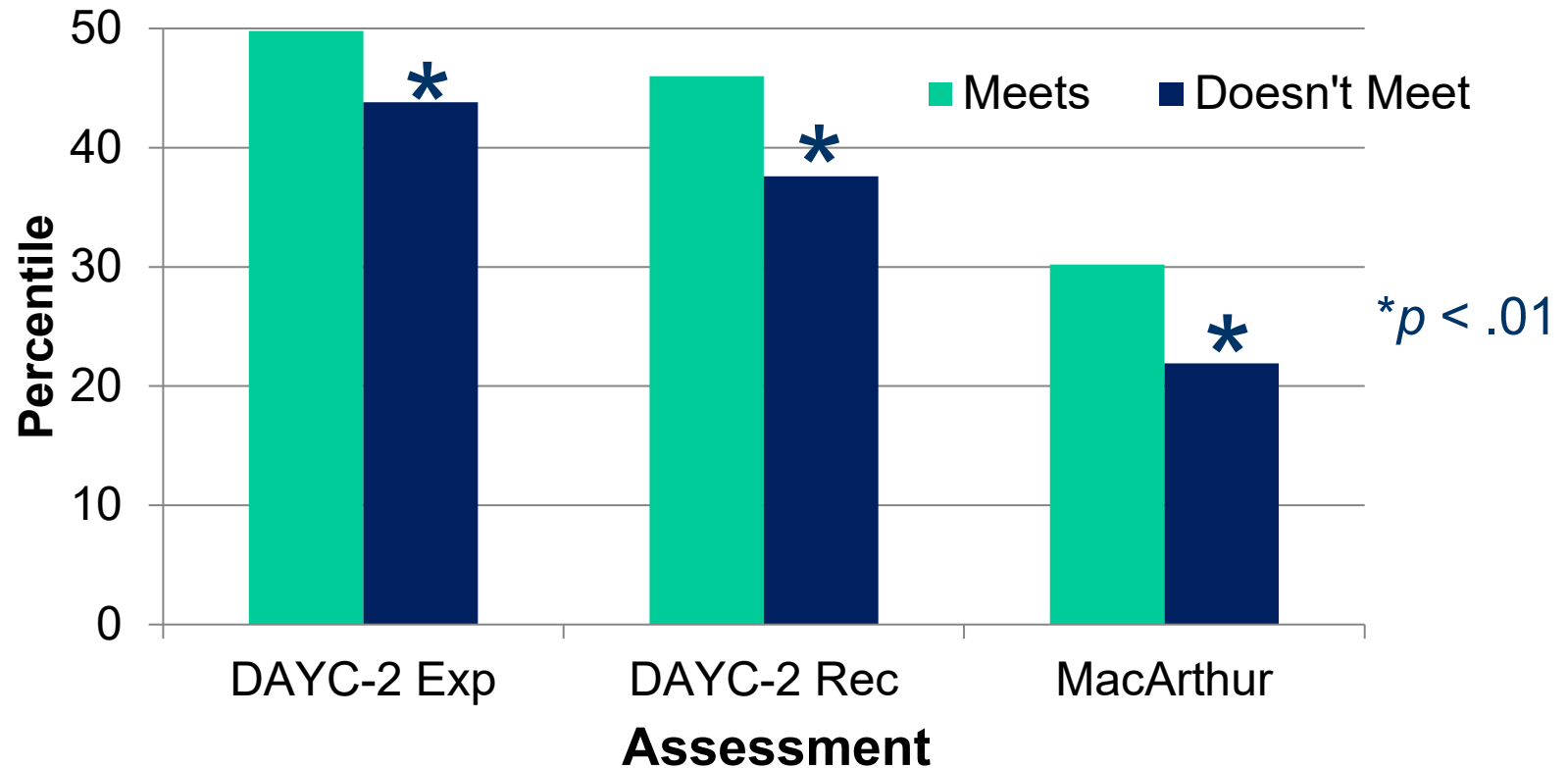
Significant predictor ($p < .01$) of DAYC-2 but not MacArthur

- Girl vs Boy (girls higher percentile scores)
- MacArthur has separate norms for girls and boys so accounts for sex differences

Significant predictor ($p < .01$) of MacArthur but not DAYC-2

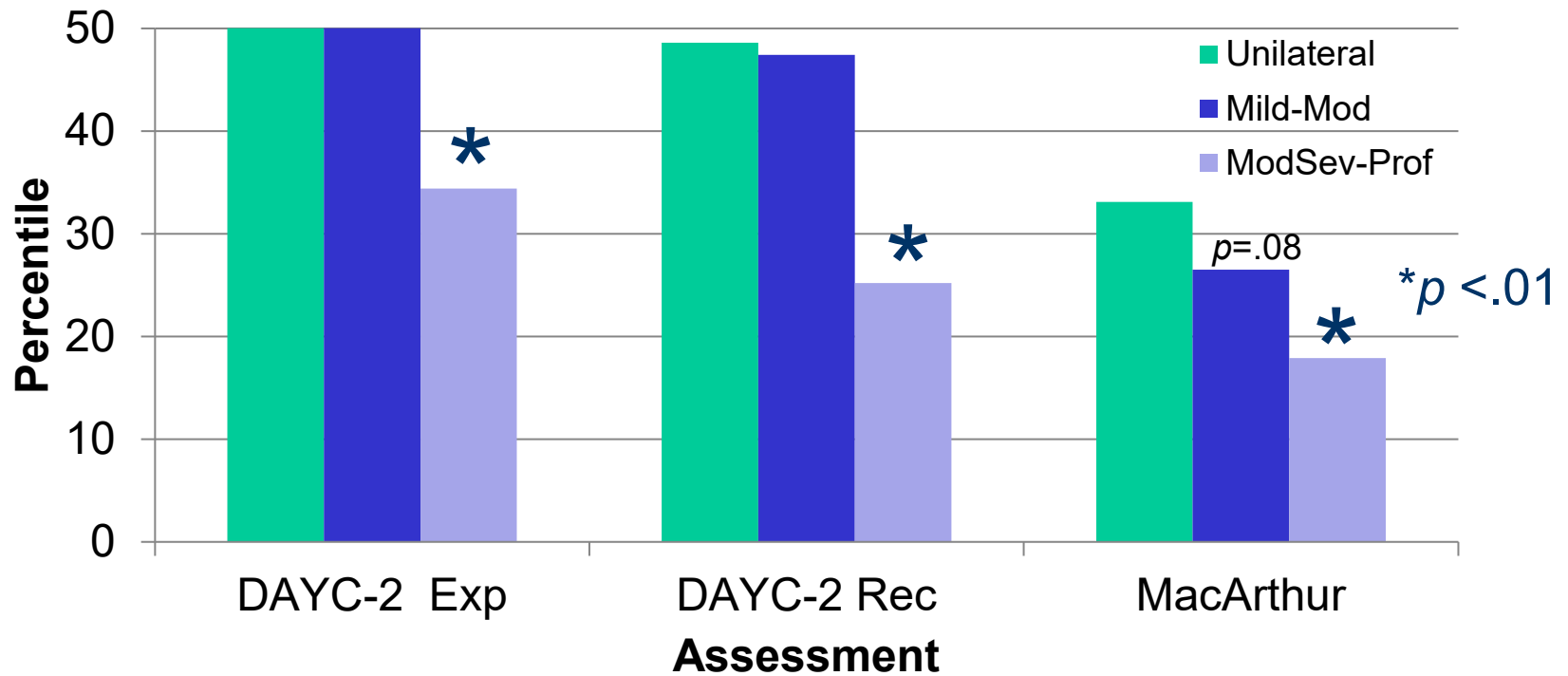
- As chronological age increases, vocabulary percentile decreases (gap widens with age)

Mean Language Percentiles: Meets EHDI 1-3-6 Guidelines



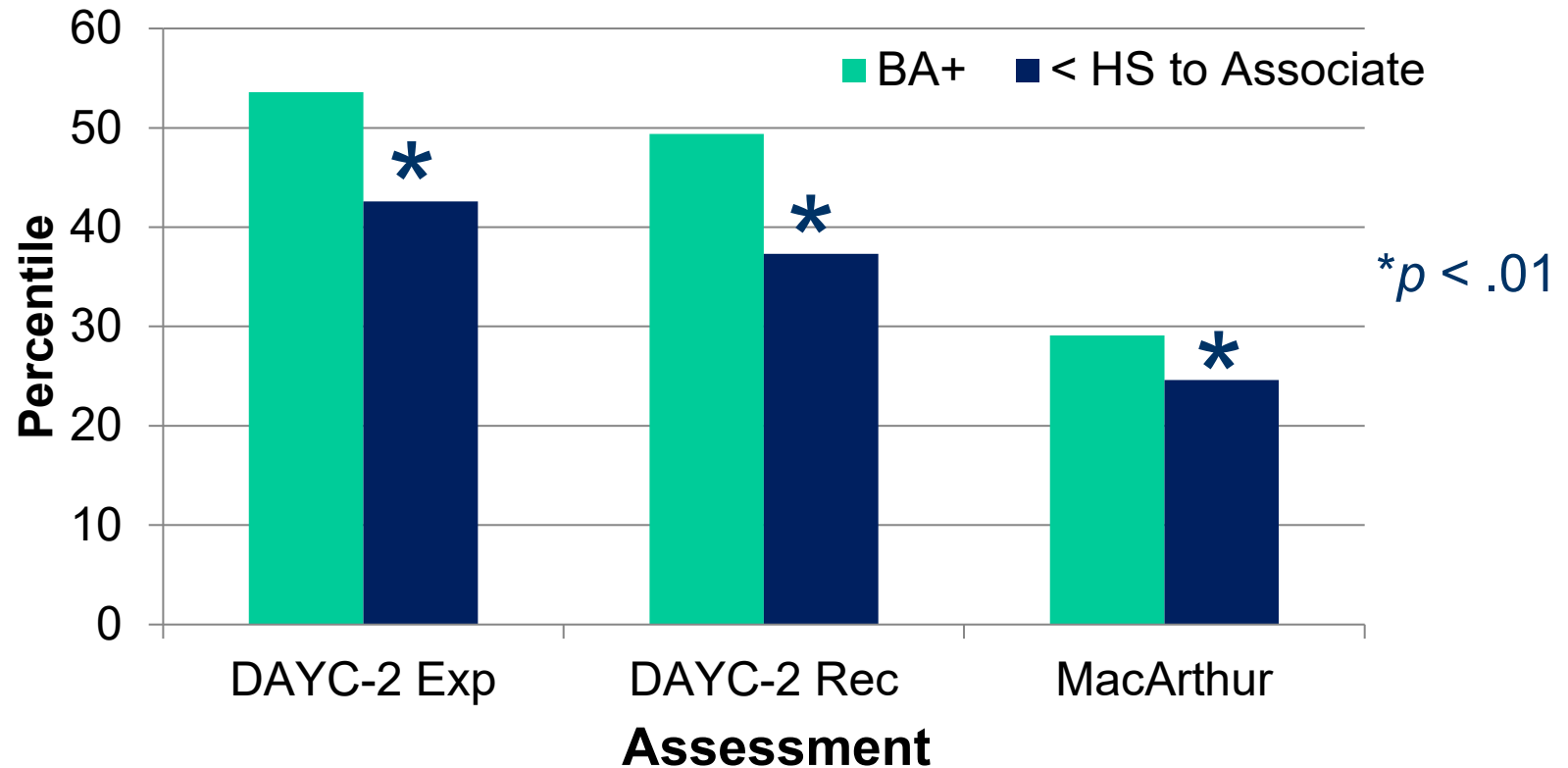
Mean percentile for hearing children in the normative sample = 50

Mean Language Percentiles: Unilateral and Bilateral



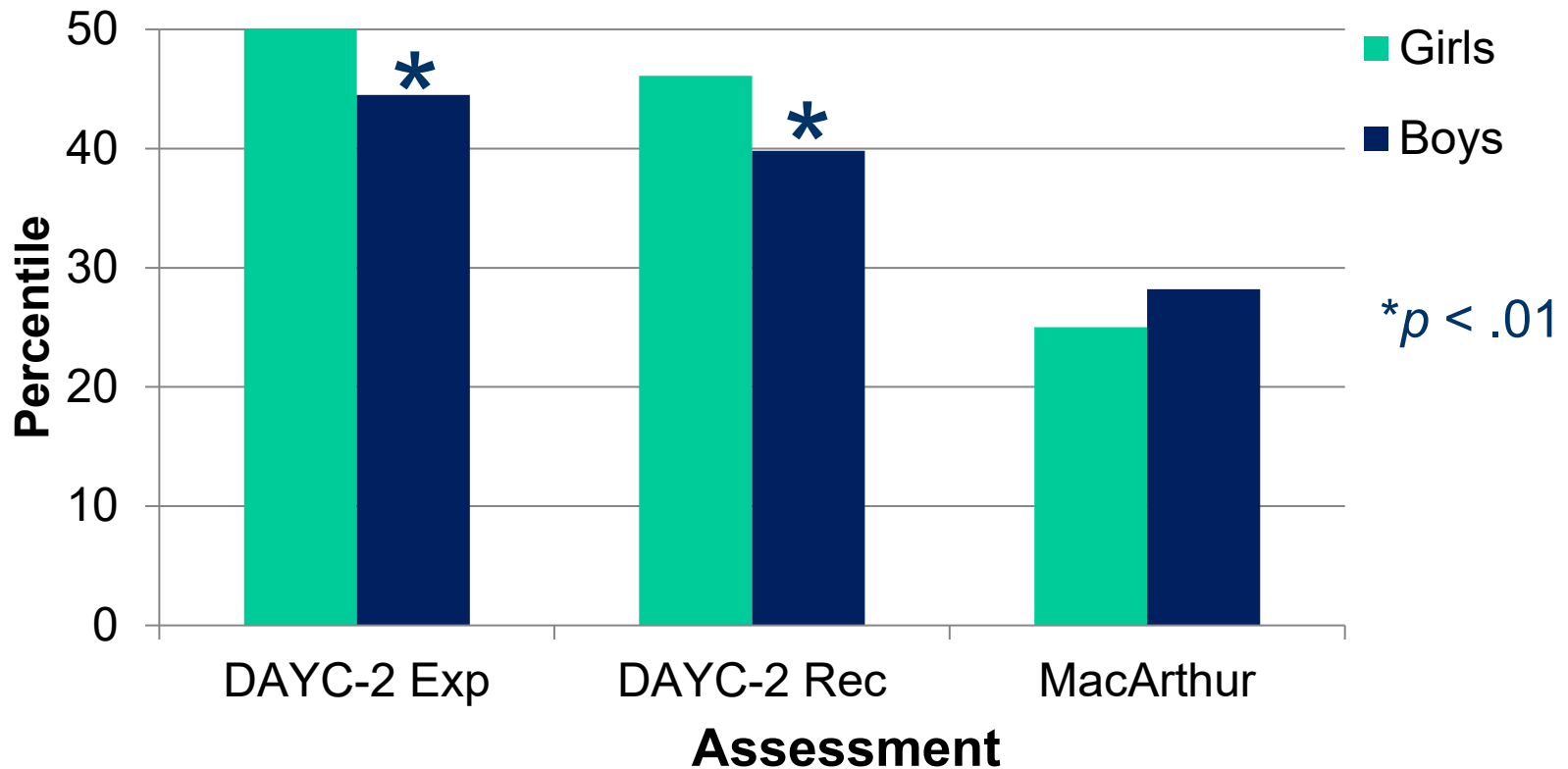
Mean percentile for hearing children in the normative sample = 50

Mean Language Percentiles: Primary Caregiver's Level of Education



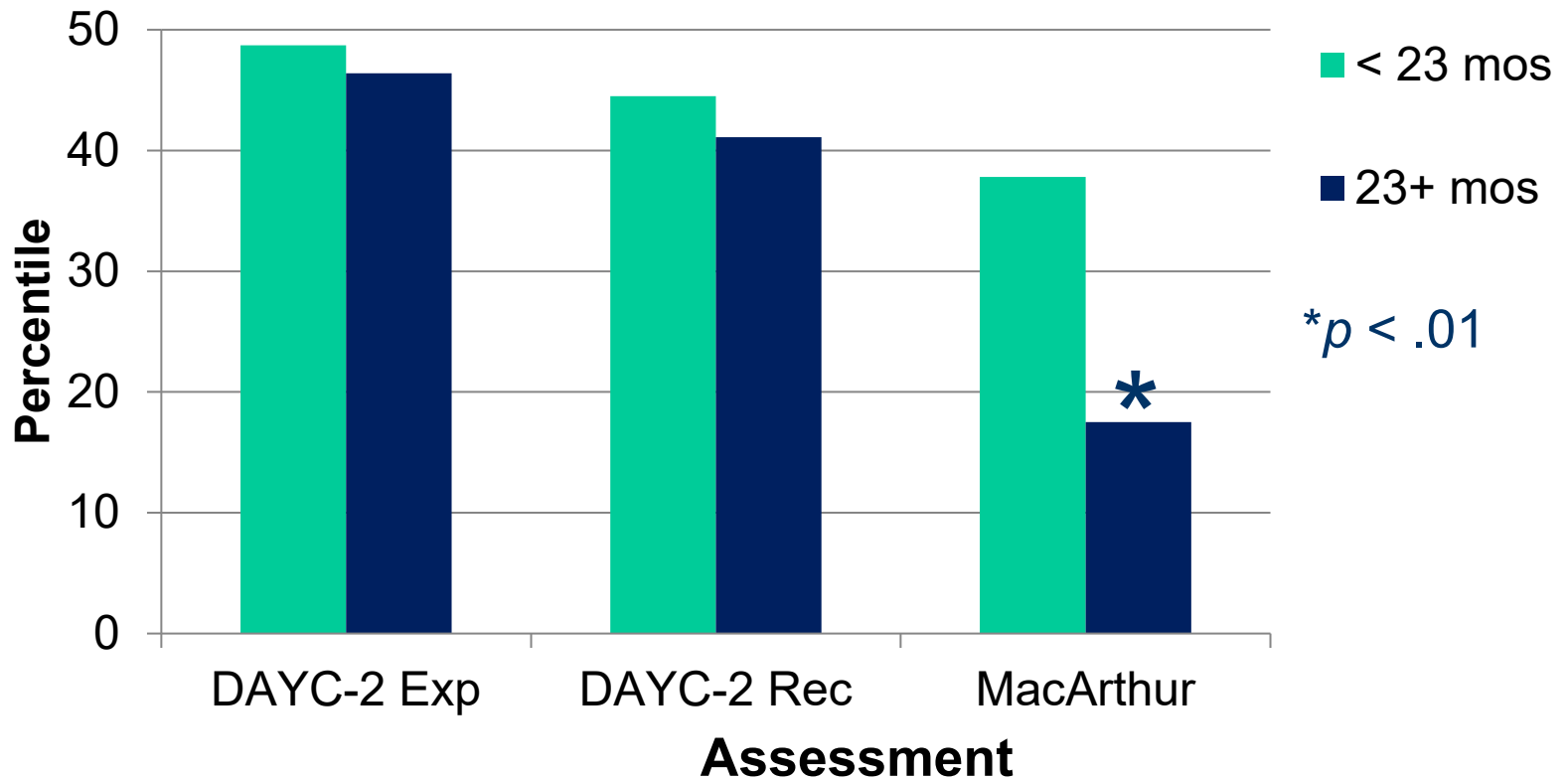
Mean percentile for hearing children in the normative sample = 50

Mean Language Percentiles: Boys vs. Girls



Mean percentile for hearing children in the normative sample = 50

Mean Language Percentiles: Younger vs. Older



Mean percentile for hearing children in the normative sample = 50

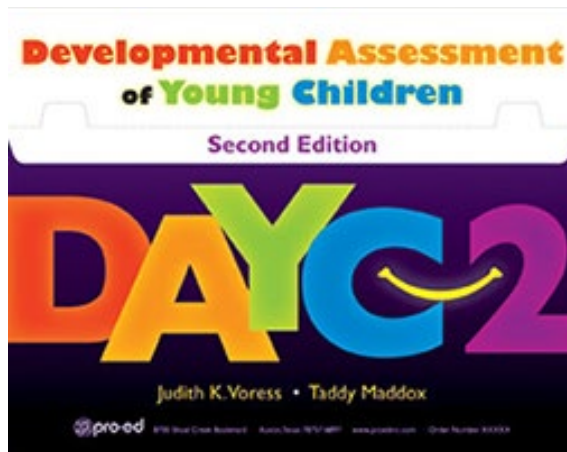
Question 2

Do children who meet 1-2-3 demonstrate better language outcomes than children meeting 1-3-6 (but not 1-2-3)?



Number of Participants

DAYC- 2 = 369



MacArthur CDI = 311



EHDI 1-2-3 vs. 1-3-6

Controlling for sex, chronological age, degree/laterality of hearing levels, and primary caregiver's level of education...

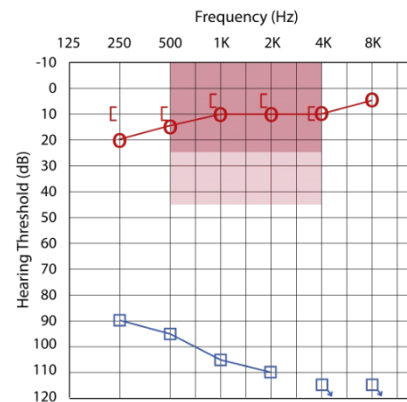
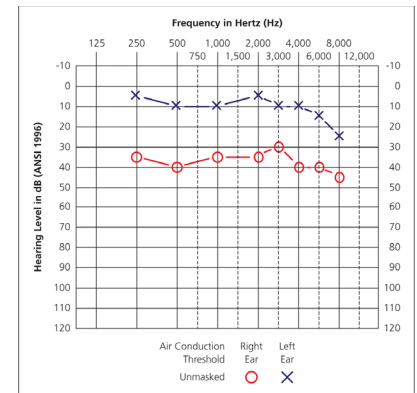
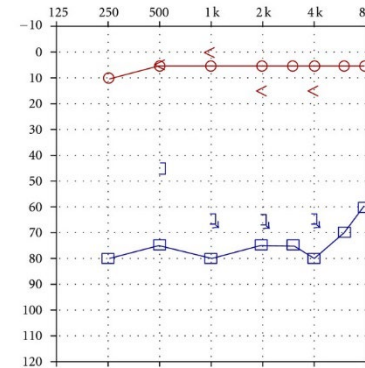
There were NO significant differences in percentile scores for any of the three language measures for children meeting 1-2-3 vs. 1-3-6

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Children with Unilateral Hearing Differences

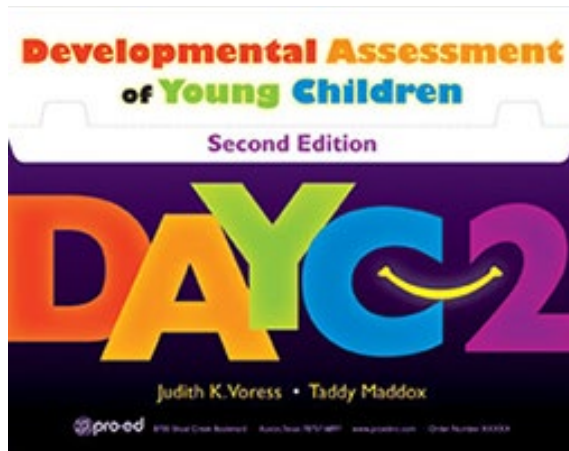
Question 3

What factors are associated with better language outcomes in children with unilateral hearing differences?

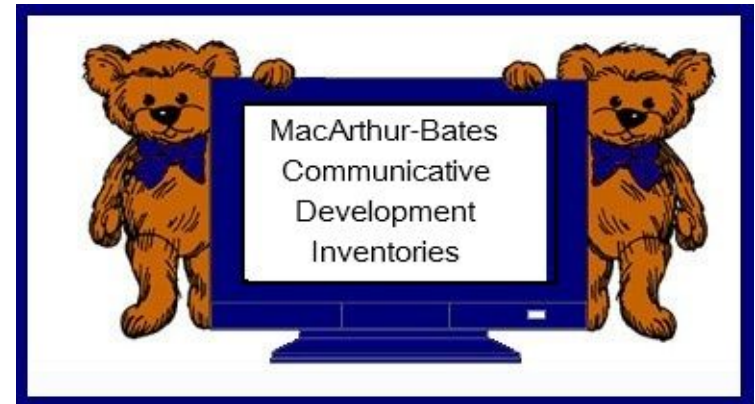


ODDACE: Number of Participants with Unilateral Hearing Difference

DAYC- 2 = 206



MacArthur CDI = 197



Participant Criteria for Language Outcomes Analysis

- No disabilities thought to affect speech or language development
- Most recent assessment

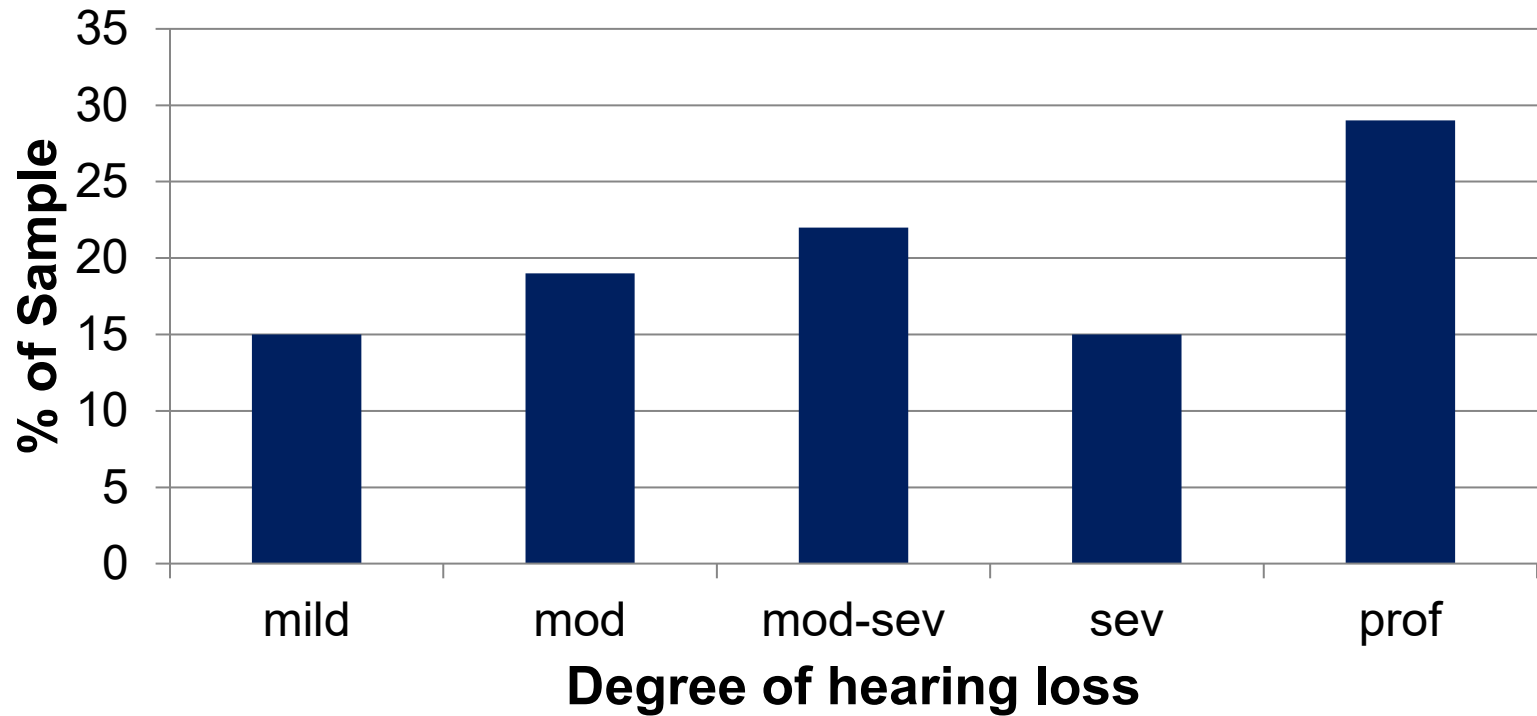
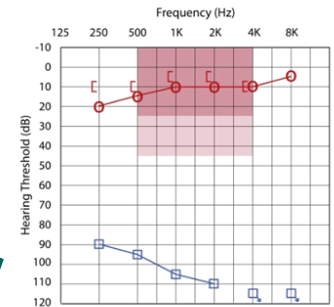
Language Outcomes Analysis: Participant Characteristics

- Chronological age
 - Range = 1 to 36 months
 - Mean = 21 months
- Gender
 - Boys = 52%
 - Girls = 48%
- Affected ear
 - Right = 56%
 - Left = 44%

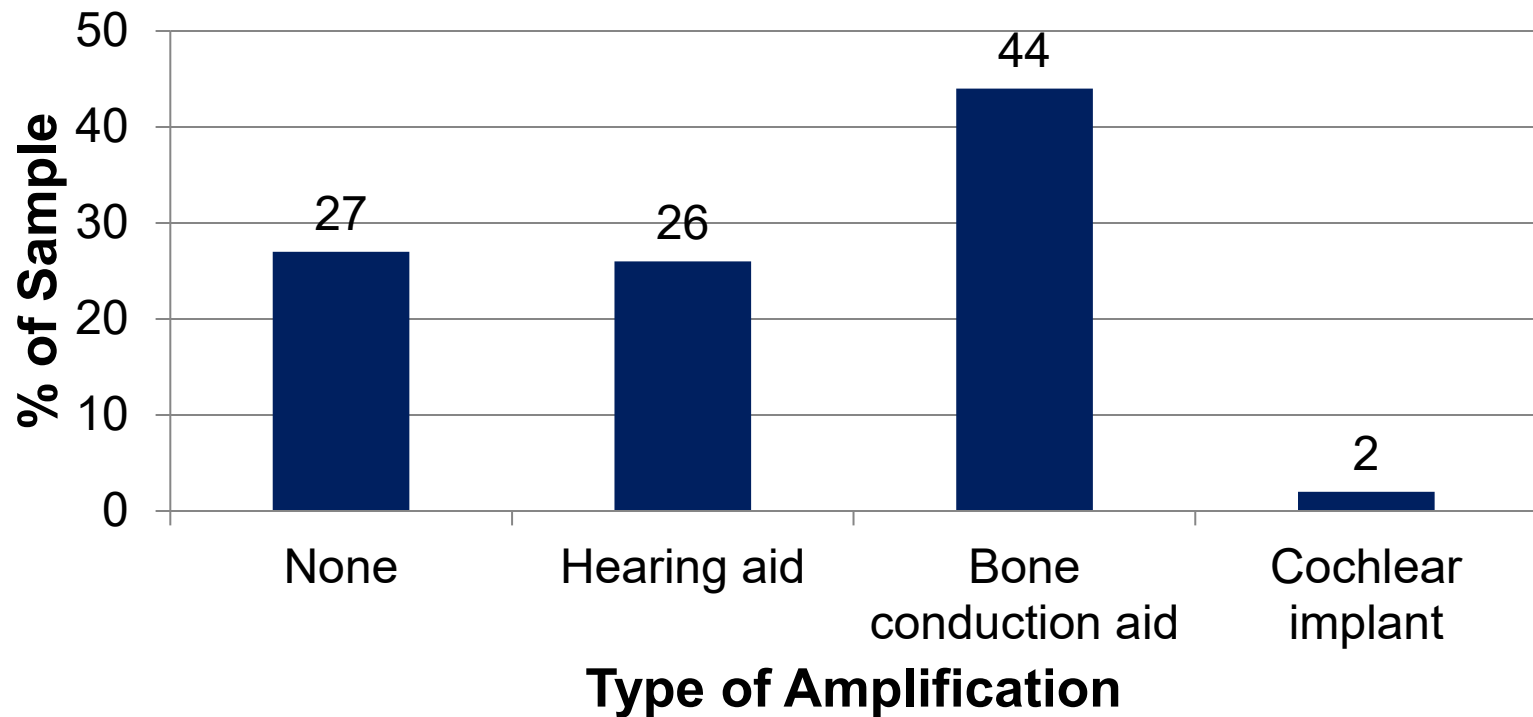
Participant Characteristics

- English is spoken and/or written language of the home = 87%
- Hispanic ethnicity = 44%
- White race = 84%
- Hearing parents = 95%

Hearing Level in Affected Ear



Amplification Use



Meeting EHDI Guidelines

EHDI 1-3-6 GUIDELINES

1

Screening by 1 month of age



3

Diagnosis of hearing loss by 3 months of age



6

Start Early intervention (EI) services by 6 months of age



EHDI guideline category	Percentage
Identification by 3 months	76%
Intervention by 6 months	61%
Meets 1-3-6	54%

Amount of Intervention



- 62% of families receive EI services once or twice a month
- Mean = 2.9 sessions per month
- Children with bilateral loss in ODDACE:
Mean = 5.1 sessions per month

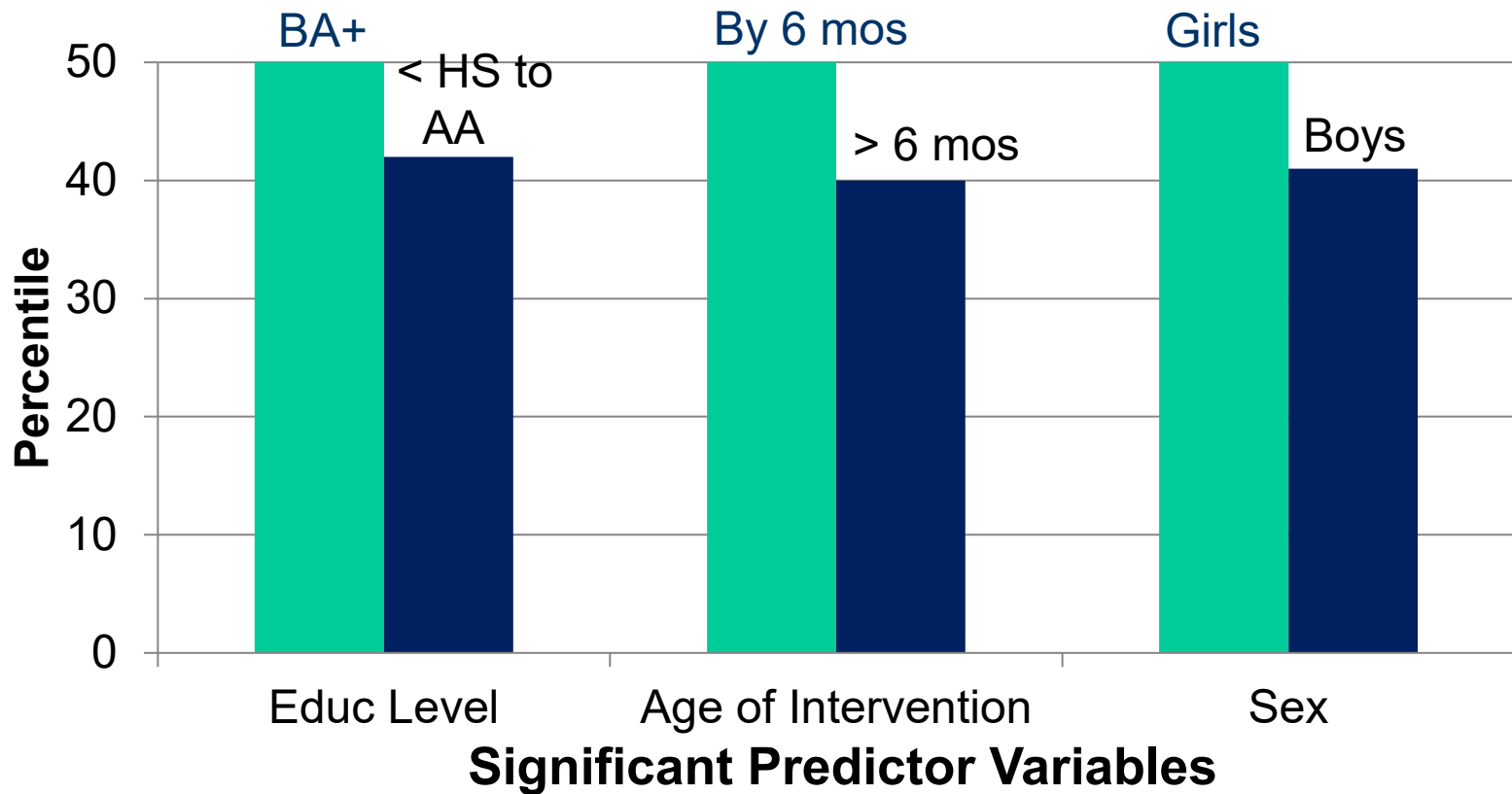
Factors NOT Associated with Language Outcomes

- Affected ear (right vs. left)
- Hearing level in affected ear
- Presence of auditory neuropathy
- Home language (English vs. Spanish)
- Parents' hearing status (deaf vs. hearing)
- Use of amplification (something vs. none)

Significant Predictors of DAYC-2 Language Outcomes

- Primary caregiver years of education
- Age of intervention
- Sex

Significant Predictors of DAYC-2 Receptive Language Percentile Scores

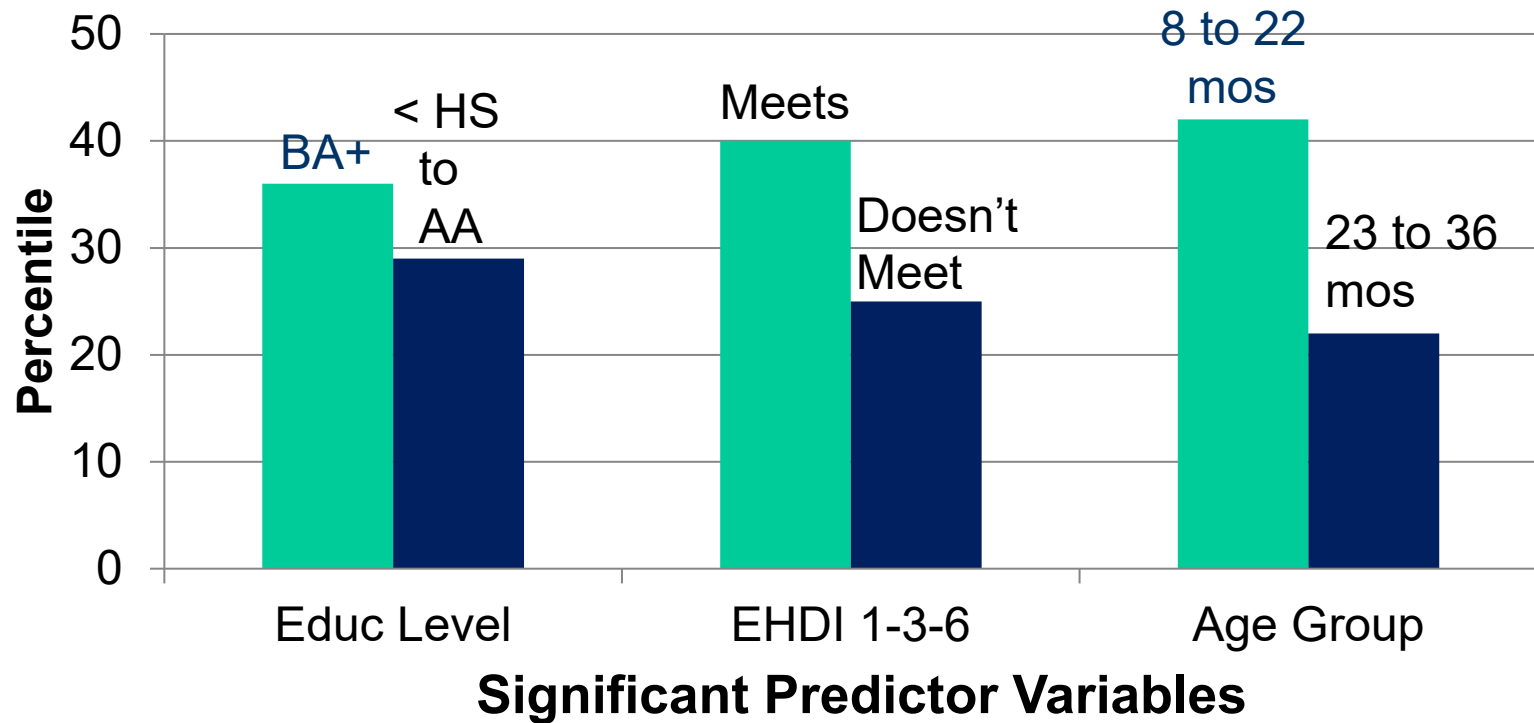


Mean percentile for hearing children in the normative sample = 50

Significant Predictors of MacArthur Vocabulary Outcomes

- Chronologic age
 - 8- to 22-month-olds had higher percentiles than 23- to 36-month-olds
- Meeting EHDI 1-3-6 guidelines
- Primary caregiver years of education

Significant Predictors of MacArthur Percentile Scores



Mean percentile for hearing children in the normative sample = 50

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Frequency of Intervention and Language Outcomes

Question 4

Does the number of early intervention sessions a child receives impact their expressive vocabulary scores?



Question 5

Does a child's language ability impact the number of early intervention sessions they receive?



Description of Database: NECAP

- Research project
- Supported by the CDC
- Language outcome data collected on children who are D/HH, birth to 3 years
- Data collected from 2005 to 2020
- Data obtained from 13 different programs in 12 different states

Participating States (NECAP)

- Arizona
- California
- Florida
- Idaho
- Indiana
- Maine
- New Mexico
- North Dakota
- Texas
- Utah
- Wisconsin
- Wyoming

Participant Criteria for Intervention Frequency Analysis

- Birth to 3
- Bilateral hearing differences
- All levels of hearing difference
- English is written language of the home language
- Any communication mode
- No disabilities thought to affect speech or language development

Participants

- Children assessed three times
- On average, 9 months between assessments

	Mean CA (mos)	n
Time 1	13.3	210
Time 2	22.3	164
Time 3	31.5	130

Outcome Measure

- Expressive vocabulary score on the MacArthur-Bates Communicative Development Inventory
- Calculated Language Quotient
 - Language age/CA



Language Quotients and Number of Sessions Over Time

	Mean Language Quotient*	Mean Sessions per Month
Time 1	94.3	3.4
Time 2	82.0	4.0
Time 3	73.7	4.0

*Language Quotient = Language Age/CA *100

Language Quotient of 100 means Language Age is exactly commensurate with CA

Statistical Analysis

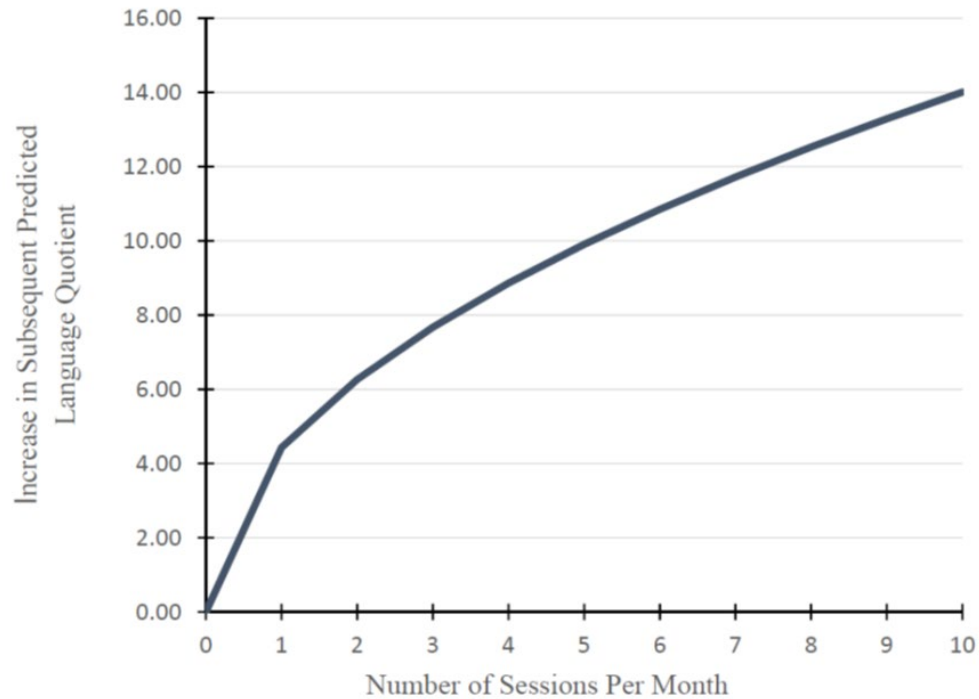
- Structural Equation Model
 - Three wave
 - Cross lagged
- Controlled for
 - Mother's level of education
 - Meeting EHDI 1-3-6 guidelines
 - Degree of hearing loss

Results: Do Number of Sessions Predict Later Language Ability?

- Number of sessions at Time 1 predicted language score at Time 2
- Number of sessions at Time 2 predicted language scores at Time 3

More sessions resulted in higher language scores approx. 9 months later

Relationship Between Number of Sessions and Later Language Quotients



Results: Does Language Ability Predict Number of Sessions?

- Language scores at Time 1 did NOT predict number of sessions at Time 2
- Language scores at Time 2 did NOT predict number of sessions at Time 3

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Summary of Conclusions and Implications for Practice

General vs. Specific Language Assessments

- Children typically scored higher on the DAYC-2 (a general measure of language) compared to the MacArthur (an in-depth look at vocabulary)
- General measures of language often do not measure quality/complexity of a skill
- For example, on the DAYC-2: “Tells you what he/she is doing”
 - “Eat” vs. “I’m eating a turkey and cheese sandwich”
 - Both get the same score

General vs. Specific Language Assessments

- Language scores on a general language test (the DAYC-2) were in the average range for children with UHL who did not have other factors known to negatively impact language
- However, the MacArthur CDI was sensitive to gaps in vocabulary diversity in children with unilateral hearing differences
 - 31% of children with UHL were significantly delayed (scoring at or below the 10th %ile)

Selecting Language Assessments: Clinical Implications

- Rigorous and specific language tests (e.g., the MacArthur CDI) should be part of the assessment battery with children who are deaf/hard of hearing
- This is especially important for children with unilateral hearing differences where gaps may be more difficult to detect

Expressive Vocabulary

- Acquiring an age-appropriate lexicon is a challenge for many children who are D/HH with 42% falling at or below the 10th percentile
- Gap between CA and vocabulary age increases over the birth to 3 period

Expressive Vocabulary Delay: Clinical Implications

- Understand vocabulary size benchmarks and share this info with families
- Average expressive vocabulary size in hearing children:
 - 12 months = 5 words
 - 18 months = 85 words
 - 24 months = 300 words

Expressive Vocabulary Delay: Clinical Implications

Even if a child is off to a great start...

- Assess language at 6-month intervals using norm-referenced instruments
- Include a rigorous and specific vocabulary test (e.g., the MacArthur CDI) in your test battery

Risk Factors for Language Delay

- Not meeting EHDI 1-3-6 guidelines
- More significant hearing levels (especially moderately-severe through profound)
- Lower levels of primary caregiver education

EHDI Guidelines

- Meeting EHDI 1-3-6 is associated with better language outcomes
- In this study, only 61% of children met EHDI 1-3-6 guidelines
- Effort to increase this percentage is well supported

EHDI Guidelines: Clinical Implications

- Share with prospective families the benefits of starting intervention early
- The ability of children to reach their full language potential is jeopardized by a “wait and see” approach
- This is true for both children with bilateral and unilateral hearing differences,

EHDI Guidelines: Clinical Implications

- The higher levels of burden and stress on families, professionals, and systems to achieve a new target of 1-2-3 does not seem warranted
- Instead, put effort toward increasing adherence to 1-3-6

Risk Factors: Clinical Implications

- Increased frequency of intervention for children with one or more characteristics associated with lower language skills
- Professional development focused on the most effective ways to work with:
 - Families with less formal education
 - Children with more significant hearing levels (especially moderately-severe through profound)

Frequency of Intervention Sessions

- Greater number of sessions per month predicted higher vocabulary scores 9 months later
- Vocabulary ability did not predict the number of sessions families received at subsequent points in time

Frequency of Intervention: Clinical Implications

- Consider objective measures of a child's language levels when determining frequency of service
- Share with families that research supports that a higher number of intervention sessions per month is associated with better child language outcomes

With Appreciation

*Thank
you*



- to the families who shared their children's information with ODDACE and NECAP
- to the interventionists who took the time to complete and send in the assessments
- to the ODDACE Assessment Coordinators
- to the ODDACE Project Assistants
- to our database manager Kory Karr
- to our statisticians Cait Berry & Craig Mason