



Adding the Missing Link to Language Assessment: LENA

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Conflict of Interest Disclosure

- Dr. Jill Gilkerson is the Director of Research at the LENA Foundation
- Dr. Christine Yoshinaga-Itano is on the LENA Scientific Advisory Board but has no financial relationship with the LENA Foundation

Data Collection and Processing

- Digital recorder children wear
- Records continuously for 16 hours
- Audio transferred to computer
- Speech recognition software processes file, automatically analyzing audio stream



Core Measures

1. **Adult Word Count** Adult Male + Adult Female
 - Adult words spoken near child
2. **Child Vocalizations** Key Child
 - Frequency of child vocalizations
3. **Conversational Turns** Key Child + Adult
 - Adult child interactions
4. **TV/electronic media** TV/Media
 - Amount of TV exposure

LENA Norms: Totals per Day (N=329, 82,389 hrs.)

<u>Percentile</u>	<u>Adult Words</u>	<u>Child Vocs*</u>	<u>Turns*</u>
99 th	29,428	4,406	1,163
90 th	20,824	3,184	816
80 th	17,645	2,728	688
70 th	15,516	2,422	603
60 th	13,805	2,174	535
50th	12,297	1,955	474
40 th	10,875	1,747	418
30 th	9,451	1,538	361
20 th	7,911	1,310	300
10 th	6,003	1,024	225

*Values represent percentiles for 24 month-olds

For intervention purposes: Assessing the child's "Auditory Diet"

- Robyn Cattle Moore, Ph.D. Royal Institute for Deaf and Blind Children, University of Newcastle, (2009) proposes using LENA to investigate the "auditory diet", exposure to spoken language in the daily routine of children with hearing loss.



Study 1: 48 to 87 months (Baca, Yoshinaga-Itano & Sedey)


- N= 135 children with longitudinal data (3 or more assessments) from 48 to 87 months of age
 - Children with non-verbal cognitive development within the normal range
 - English-speaking families
 - Hearing parents

4 to 7 year old study

- Four assessment occasions: 48, 60, 72, 84 (+/- 3 months)
- Median age of identification: 3 months
- Median age of intervention start: 8 months

Children with severe to profound HL: 48 to 87 mo.

- N= 87 had severe to profound HL
 - Children with cochlear implants (N=49)
 - Age of ID by 6 months: 55%
 - Age of ID by 12 months: 86%
 - Children with hearing aids (N=35)
 - Age of ID by 6 months: 68.4%
 - Age of ID by 12 months: 76%
- N=48 had mild to moderate HL



**DO INDIVIDUAL CHILD
CHARACTERISTICS
SYSTEMATICALLY
DIFFERENTIATE THE LANGUAGE
TRAJECTORIES IN YOUNG
CHILDREN WITH HEARING LOSS?**

Rosalinda Baca, 2009



Intercept & Slope Definitions

- Intercept: Language age equivalent at 84 months on EOWPVT-3
- Slope: Rate of language growth on EOWPVT-3

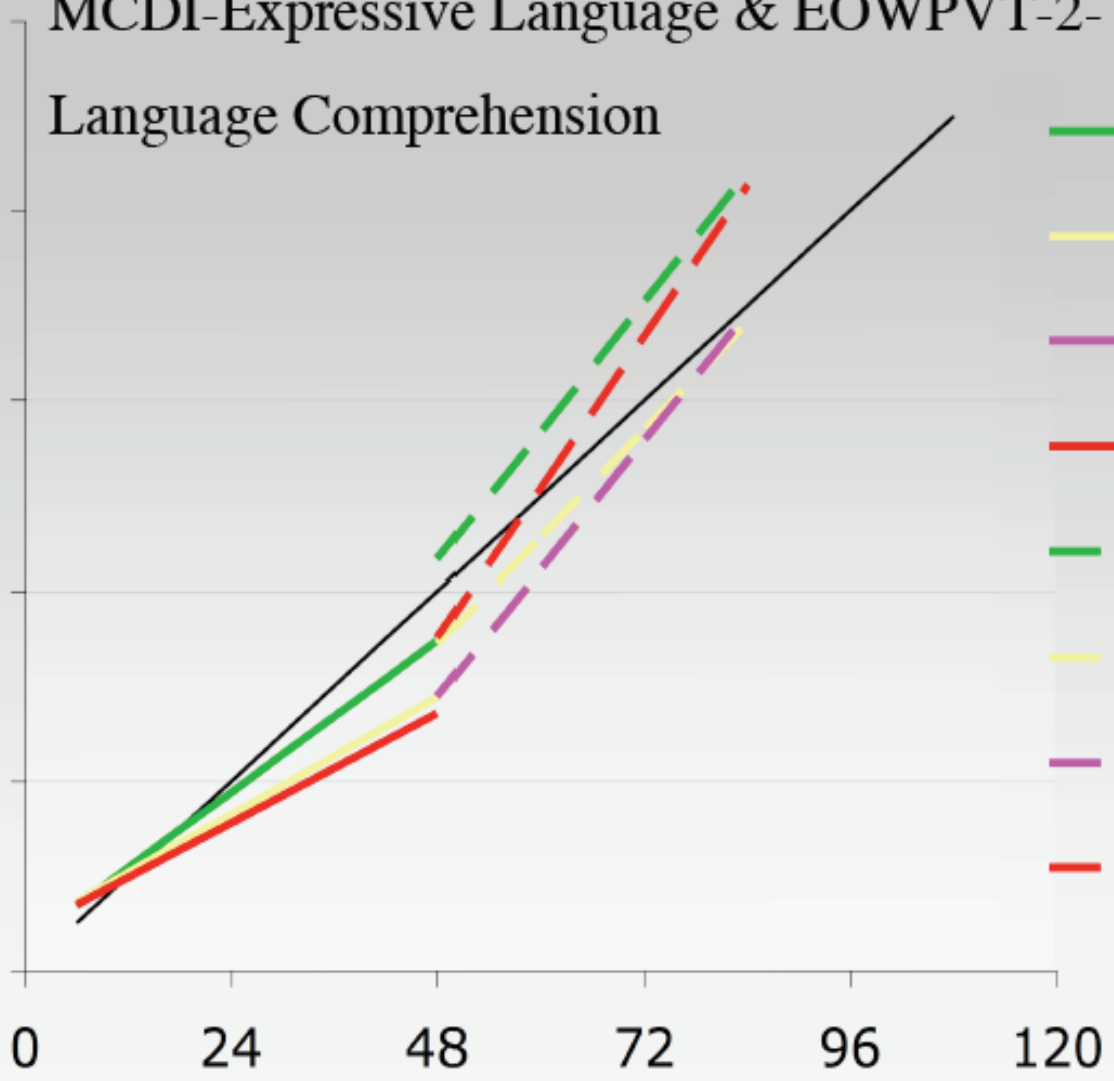
Final HLM Model

○ EOWPVT

- **Explained intercept 37% (language at 84 months)**
- Non verbal cognitive development
- Degree of Hearing Loss (***Severe, profound, or progressive HL (15, 31%)***)
- Age of Identification (by 3 months)
- Maternal Level of Education
- **Explained 39% in slope (rate) – excluded M EDUC**


MCDI-Expressive Language & EOWPVT-2-
Language Comprehension

Age Equivalent (months)



Chronological Age (months)

- Mild/Mod
- Severe
- Profound
- Progressive
- Mild
- Severe
- Profound
- progressive



**UNCHANGABLE
CHARACTERISTICS: DEGREE OF
HEARING LOSS, NON-VERBAL
COGNITIVE DEVELOPMENT, AGE
OF IDENTIFICATION, MATERNAL
LEVEL OF EDUCATION**

Yoshinaga-Itano, Baca &
Sedey, 2009

Degree of HL: HA/ CI comparison

- Children with HAs – N= 38
 - 60.5% had severe HL
 - 7.9% had profound HL
 - 31.6% had progressive HL
- Children with CIs – N= 49
 - 16.3% had severe HL
 - 34.7% had profound HL
 - 34.7% had progressive HL

Maternal Level of Education: HA/CI comparison

- Children with HAs
 - 5.3% - Less than 12 years
 - **44.7%** - 12 years (high school diploma)
 - 13.5% - 13 – 15 years (some post-secondary)
 - **36.8%** - 16 years or greater (Bachelors +)
- Children with CIs
 - 8.2% - Less than 12 years
 - **26.5% - 12 years**
 - 18.4 - 13 – 15 years
 - **46.9% - 16 + years**

Intercept & Slope

- EOWPVT III Slope – Rate of Language Development
 - HA = 1.15 CI = 1.33
- EOWPVT III Intercept – Language Age at 84 months
 - HA = 73.8 months CI = 80 months

Model A: EOWPVT without MLE

- Age of Identification
- Degree of Hearing Loss
- Non-verbal cognitive Quotient
- Mothers level of education and Number of Parent Words not included in Model A
- **Model A accounts for 26.3% of the variance of the language age at 84 months (intercept)**
- **Model A accounts for 33.5% of the variance of the rate of language growth (slope).**

Model B1 – Add High Maternal Level of Education to Model A

- Number of Parent Words not included
- Model B1 accounts for an additional 10.81% of the variance of the intercept and 7.48% of the variance of the slope
- Total Variance accounted for by Model A + Model B1
- **37.14% of the language outcome (intercept)**
- **40.98% of the rate of language growth (slope)**

Model B2 – Adds Total Number of Parental Words (no MLE) to Model A

- High Maternal Level of Education not included in Model B2
- Model B2 accounts for an additional 11.07% of the intercept and 14.04% of the slope
- Total variance accounted for by Model A + Model B2
- **37.5% of the language outcome (intercept)**
- **47.54% of the rate of language growth (slope)**



Relationship Maternal Level of Education and Number of Parental Words

- Amount of variance accounted for by the variables High Maternal Level of Education and Number of Parental Words spoken to the Child appear to be accounting for overlapping variance
- Number of Parental Words accounts for more variance

Model C = Model A + Maternal Level of Education + Number of Parental Words

- Accounts for 16.38% more variance of the intercept and 13.71% of the slope than Model A alone
- Total variance accounted for by Model C
- 42.7% of the language outcome at 84 mo. (intercept)
- 47.1% of the rate of language growth (slope)

Maternal level of education and other socio-economic factors- birth through 36 months

- Colorado studies indicate that Maternal level of education does not predict language outcomes of children with hearing loss – birth through 36 months

EOWPVT differences by Maternal Level of Educational Level (Baca, 2009)

- 35 month language age difference at 84 months of age between group with mean age level for mothers with educational level less than 12 years (HS grad) as compared to group for mothers with educational level 16 years or greater (college)
55.75 months versus 91.33 months



Client Manager



LENA Reports



Developmental Snapshot



Digital Language Processor



Settings

Adult Words

HOURLY
September 17, 2009



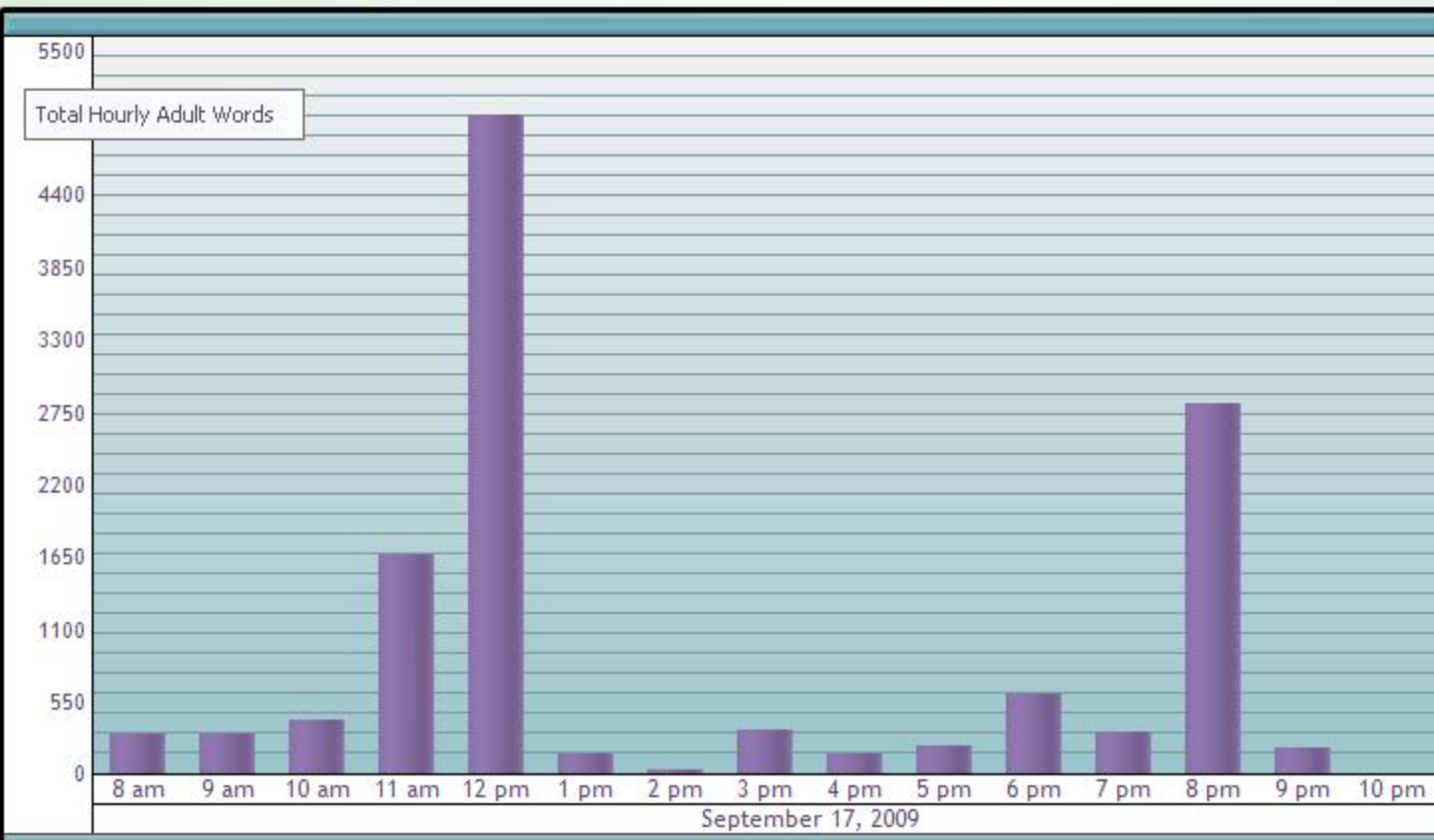
(C007) - xxxxxx, xx

The Adult Words report displays number of words spoken to and in the vicinity of the child during the course of a recording.

Roll over data bars, data points, or legend icons for more detail.

Please see User Guide for additional information.

[View Adult Word Normative table and Average Daily Pattern of Talk table here.](#)



Total Hourly Adult Words



Reliability of scores

- Average of three recordings of 16 hours each day resulted in stability of scores for normal hearing dyads– i.e. avoiding the Hawthorne effect
- Reliability not yet demonstrated with deaf and hard of hearing children
 - Could hypothesize that reliability is better because families and children are accustomed to video and audio recordings
 - In our research laboratory we are currently collecting data for check on reliability
- Interactor/s would need to be similar, i.e. parents with multiple recordings versus day care or school
 - Language levels can differ dramatically for the same child, in the same week in different language environments –
 - i.e. with parents or in daycare



Norms for typically developing children

The computer counts as meaningful sounds that are 35 dB HL or greater.

With children who have hearing loss with appropriate amplification, we typically use 50 dB HL as meaningful volume.

It is possible that LENA may overestimate the number of words that are auditorially accessible for a child with hearing loss



LENA Calculations

- LENA norms are not intended to be able to look at the validity of a single half hour or hour segment.
- Reliability of the percentile ranking is based upon 10+ hours of recording
- However, across any 16 hour day, it is possible to identify trends in the data such as periods of the day with the highest quantities of any of the calculations

What do we know about children with hearing loss

- Language development for many children with hearing loss may be multi-modality
- Focus exclusively on vocal/verbal language development as an index of language skills can significantly underestimate the language skills of the child if the child also uses a visual communication system or communicates exclusively through a visual communication system



Research possibilities with LENA

- Provides an easy and quick indicator of the amount of adult language that is accessible to the child – some adaptation for children with hearing loss may need to occur if dB levels of adult input are too quiet.
- Provides an important piece of information about the language environment of the child when not in therapy.



Research potential with LENA

- Provides a vehicle that can compare the impact of different language environments upon the child's expressive spoken language.
- The amount of child vocalization is directly related to the language environment in which the child lives.
- Therefore, the same child could demonstrate significantly different language dependent upon the conversational partners in the environment or the style of interaction used by the conversational partner

Comparisons of different environments

- Child in daycare
- Child at home with parents
- Child in therapy
- Child in preschool or toddler group
 - Wiggins, Thompson, Yoshinaga-Itano (2011) 50% of AWC, CT, CV occur in 3 hours of oral preschool - all children at 95%ile +
- Child at a family gathering
- Child in noisy environments



Research possibilities

- LENA analysis could provide parents with sufficient feedback that they will increase the amount of meaningful adult conversation with their child.
- LENA data indicates that parents increased their average use of meaningful conversation using LENA recordings and analyses.



Implementation of new interventions

- LENA may be used as an assessment to compare a new intervention strategy with traditional strategies by examining the change in the child's vocalizations, conversational turns, and diversity of their vocalizations.
- LENA is particularly useful when comparing short-term interventions (i.e. 6 weeks), durations not long enough to show change in standardized clinical assessments.
- LENA could also demonstrate the difference between a child's functioning within the intervention session and in a normal conversational interaction that is not therapeutic.