USING LENA TO SUPPORT PARENT-CHILD INTERACTIONS WITH SPANISH-SPEAKING FAMILIES

Christine Yoshinaga-Itano, PhD
Dinah Beams, MA
Christine Yoshinaga-Iano, PH.D.
Professor
University of Colorado Boulder
Department of Speech, Language, & Hearing Sciences
Marion Downs Hearing Center
Dinah Beams, M.A.
Program Coordinator
Colorado Home Intervention Program
Colorado School for the Deaf and the Blind
Special thanks to

- Families and Early Intervention Providers with the Colorado Home Intervention Program
- Miranda Aragon, Undergraduate Research Opportunity Program CU-Boulder
- Infoture
- LENA Foundation
• Data collected by the LENA Foundation and CHIP
• Use non-invasive technology to compare the language environment of TD and D/HH children in both English and Spanish-speaking homes
INSTRUMENTATION AND HEARING NORMS
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
LENA System Algorithm

Feature Extraction
Segmentation
Phone Decoder
Phone Decoder

Key Child
Adult Male
Adult Female
Other Child
Overlap
Noise
TV/Media
Core Measures

1. **Adult Word Count**
   - Adult words spoken near child

2. **Child Vocalizations**
   - Frequency of child vocalizations

3. **Conversational Turns**
   - Adult child interactions

4. **TV/electronic media**
   - Amount of TV exposure
LENA Norms: Totals per Day

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

*Values represent percentiles for 24 month-olds
What predicts language development of children who are D/HH (0- 7 years)

- Unchangeable characteristics:
  - Cognitive status
  - Degree of Hearing Loss
  - Age of identification of HL
  - Maternal Level of Education

- Maternal Level of Education is overlapping with the amount of language access provided by the parent
Children who are deaf or hard of hearing

TEST-RETEST

RELIABILITY
Reliability Pilot Study

3 recordings in one week

Recordings were reliable for Adult Word Count, Conversational Turns and Child Vocalizations.

Recording 1 and Recording 2 were reliable with Pearson Product Moment Correlations between .78 and .95 \( p<.05, p<.01 \)

Reliability for recording 2 and 3 dropped to \( r=.70 \) predominantly because parents began conducting their own experiments with different environments.
VALIDITY
Pilot study: Validity

Relationship between MacArthur Communicative Development Inventory and Conversational Turns: $r = .662$, $p < .05$

(children in pilot were ages 9 months to 18 months)
Pilot Study: Validity

Relationship between Minnesota Child Development Inventory and LENA

CDI with Child Vocalizations $r = .72$, $p = .02$

CDI with Conversational Turns $r = .69$, $p = .03$

CDI and AVA Standard Score $r = .70$, $p = .02$
DIFFERENCES BY HOUR

Intervention
Preschool
At home
RECORDED
The Adult Words report displays the 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.
The Adult Words report displays the 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 the User Guide for additional information.

View Adult Word Normative table and Average Daily Pattern of Talk table here.
COMPARISON OF D/HH IN ENGLISH-SPEAKING HOMES AND D/HH IN SPANISH-SPEAKING HOMES

Miranda Aragon, B.A.
Christine Yoshinaga-Itano, Ph.D.
Participants

Maternal Level of Education

- D/HH Spanish (N=13)
- TD Spanish (N=21)
- TD English (N=329)
- D/HH English (N=46)

% with some college or higher
Range: Child Vocalizations

Number of Child Vocalizations/day

Spanish D/HH

Typically Developing Spanish

Typically Developing English

English D/HH

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000

3rd Quartile

1st Quartile
Range: Conversational Turns

Number of Conversational Turns/day

- Spanish D/HH
- Typically Developing Spanish
- Typically Developing English
- English D/HH

3rd Quartile
1st Quartile

Range:
Range:
Adult Word Count

Number of Adult Words Spoken/day

Spanish D/HH  Typically Developing Spanish  Typically Developing English  English D/HH

3rd Quartile  1st Quartile
### Meaningful Language: Spanish D/HH vs English D/HH (in percent)

<table>
<thead>
<tr>
<th></th>
<th>Min:</th>
<th>Max:</th>
<th>Mean:</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spanish D/HH</strong></td>
<td>7%</td>
<td>25%</td>
<td>17%</td>
<td>5</td>
</tr>
<tr>
<td><strong>English D/HH</strong></td>
<td>5%</td>
<td>33%</td>
<td>20%</td>
<td>6</td>
</tr>
</tbody>
</table>
### TV: Spanish D/HH vs English D/HH (in percent)

<table>
<thead>
<tr>
<th></th>
<th>Min:</th>
<th>Max:</th>
<th>Mean:</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spanish D/HH</strong></td>
<td>2%</td>
<td>33%</td>
<td>14%</td>
<td>10</td>
</tr>
<tr>
<td><strong>English D/HH</strong></td>
<td>2%</td>
<td>28%</td>
<td>8%</td>
<td>6</td>
</tr>
</tbody>
</table>
# Distant Language: Spanish D/HH vs English D/HH (in percent)

<table>
<thead>
<tr>
<th></th>
<th>Min:</th>
<th>Max:</th>
<th>Mean:</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spanish D/HH</strong></td>
<td>10%</td>
<td>51%</td>
<td>30%</td>
<td>13</td>
</tr>
<tr>
<td><strong>English D/HH</strong></td>
<td>10%</td>
<td>39%</td>
<td>21%</td>
<td>7</td>
</tr>
</tbody>
</table>
### Noise: Spanish D/HH vs English D/HH (in percent)

<table>
<thead>
<tr>
<th></th>
<th>Min:</th>
<th>Max:</th>
<th>Mean:</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spanish D/HH</strong></td>
<td>1%</td>
<td>20%</td>
<td>4%</td>
<td>6</td>
</tr>
<tr>
<td><strong>English D/HH</strong></td>
<td>1%</td>
<td>11%</td>
<td>3%</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Min:</td>
<td>Max:</td>
<td>Mean:</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Spanish D/HH</strong></td>
<td>13%</td>
<td>59%</td>
<td>34%</td>
<td>14</td>
</tr>
<tr>
<td><strong>English D/HH</strong></td>
<td>20%</td>
<td>66%</td>
<td>47%</td>
<td>10</td>
</tr>
</tbody>
</table>
Averages in Typical Development
LENA Control

- N= 3384
- Meaningful Language  19%
- Distant Language     40%
- TV/Media             10%
- Noise                3%
- Silence              28%
Infoture Research Findings

• Parents talk more to daughters than sons
• Parents talk more to firstborns than to children born after
• Most parent talk occurs in the late afternoons and evenings
• Children of talkative parents are also talkative
• Parents overestimate the amount of talk they have with their children
Intervention Uses and Implications: Increased Adult Word Count

- LENA recording on a 13 month old with moderately-severe bilateral hearing loss
  - Adult Word Count: 6066, 3rd%ile
  - Conversational Turns: 185, 16th%ile

- LENA recording after 8 months of intervention
  - Adult Word Count: 21,048, 97th%ile
  - Conversational Turns: 1136, 98th%ile
Intervention Implications and Uses:

FM

- Family living in the mountains – hiking
- Family living in the mountains – excessive noise from river
- Preschool and daycare
Intervention Implications and Uses: Differential Diagnosis

- Child 30 months of age with profound bilateral loss
- Identified through NBHS, Progressive loss, CI at 27 months
- Good Auditory Performer
LENA

- LENA Adult Word Count  60\textsuperscript{th} %ile

- Red Flags:
  - Conversational Turns:  26\textsuperscript{th} %ile
  - Child vocalizations  7\textsuperscript{th} %ile
  - Automatic Vocalization Age
    - Standard Score  78.8
Intervention Implications and Uses: Distant vs. Meaningful Speech

- Infant of Mother who cleans hotels
- Busy households with multiple speakers
- Childcare facilities
LENA CAN BE USED TO DEMONSTRATE CHANGE OVER TIME

INCREASE IN AMOUNT OF PARENT WORDS
INCREASE IN CONVERSATIONAL TURN-TAKING
INCREASE IN SPEECH DEVELOPMENT - AVA
INCREASE IN CHILD VOCALIZATIONS
CHANGE IN HOME ENVIRONMENT:
  TIME IN SILENCE
  TIME IN NOISE
  TIME WITH TV
  TIME WITH MEANINGFUL LANGUAGE
Intervention Uses and Implications: Increased Adult Word Count

- LENA recording on a 13 month old with moderately-severe bilateral hearing loss
  - Adult Word Count: 6066, 3rd%ile
  - Conversational Turns: 185, 16th%ile

- LENA recording after 8 months of intervention
  - Adult Word Count: 21,048, 97th%ile
  - Conversational Turns: 1136, 98th%ile
LENAN CAN BE USED FOR DIFFERENTIAL DIAGNOSIS

DOES THE DEAF/HH CHILD LACK AWARENESS TO SPEECH
IS THE DEAF/HH CHILD NOT ABLE TO DISCRIMINATE
NOT ABLE TO COMPREHEND
NOT BE ABLE TO PRODUCE THE SPEECH
MOTOR COORDINATION
IS THE FREQUENCY OF PARENT WORDS NOT SUFFICIENT
IS THE CONVERSATIONAL TURN-TAKING TOO LOW
IS THE FREQUENCY OF THE VOCALIZATIONS TOO INFREQUENT
IS THE QUALITY OF THE SPEECH APPROXIMATING INTELLIGIBLE SPOKEN ENGLISH
Case 1

Spanish-speaking

Early ID – 8 weeks

Enlarged Vestibular Aqueduct EVA

Significant Motor Delays 1st year OT PT

Progressive HL – 18 mo. +
Differential Diagnosis

Case 1

Good auditory performer
CA Developmental Evaluations = 22, 27 & 30 mo.
CI 27 months
Cognitive Quotient: Normal

Cortical Auditory Evoked Potential (CAEP) P1 – delayed pre CI - not present post-CI
Case 1: Language – progressively poorer (parent report) – EOWPVT - picture ID good – not consistent with parent report

<table>
<thead>
<tr>
<th>CA 22</th>
<th>MINN ELQ 91</th>
<th>MINN RLQ 82</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA 27</td>
<td>MINN ELQ 82</td>
<td>MINN RLQ 72</td>
</tr>
<tr>
<td>CA 32</td>
<td>MINN ELQ 66</td>
<td>EOWPVT 84</td>
</tr>
</tbody>
</table>
Case 1: Auditory Skills

Visual Reinforcement Infant Speech Discrimination: Excellent (vowels, place, voicing)

Cincinnati Auditory Skills Checklist: 41/70  3 mo. Post CI
good
Case 1: LENA

Adult Words: 60%ile

RED FLAG:
Conversational Turns: 26%ile
****Child Vocalizations: 7%ile

Automatic Vocalization Age:
Standard Score 78.8

Apraxia
Case 1

• Pre-Implant
• VEMP (Vestibular Evoked Myogenic Potentials) – measures organ of balance (saccule)- Normal Pre and Post
  • OT concerns – delayed motor development
• LittleEars did not indicate implantation
• VRISD – could discriminate Ling phonemes pre-linguistically
• P1=Delayed
Post Implant

- Support for good auditory performance
  - VRISD
  - ASC
  - LENA

- **Benefit** of differential diagnosis: Rule out maternal input & auditory abilities for poor performance; able to diagnose Apraxia earlier and initiated appropriate motor planning therapy
Show video clip
Christie.yoshi@Colorado.EDU
dbeams@csdb.org