Current Status of Newborn Hearing Screening: Are We Closing the Gap?: National Early Childhood Assessment Project: Deaf/Hard of Hearing English/Spanish-Speaking

Christine Yoshinaga-Itano, Ph.D.
Professor
University of Colorado, Boulder
Department of Speech, Language & Hearing Sciences
Christie.Yoshi@colorado.edu

Allison Sedey, Ph.D.
Anna Clark, Ph.D.
Rosalinda Baca, Ph.D.
Alison Meagher, B.A.
Miranda Aragon, M.A.
States Represented in Results

ENGLISH SPEAKING
- Arizona
- California
- Colorado
- Idaho
- Indiana
- Maine
- Minnesota
- New Mexico
- Oregon
- Texas
- Utah
- Wisconsin
- Wyoming

SPANISH SPEAKING
- Arizona
- California
- Idaho
- Indiana
- Texas
- Wyoming
Assessments Completed

ENGLISH SPEAKING
• 1,077 assessments completed (not including Colorado)
• 649 children assessed 1 to 6 times each
• Colorado: 300 assessments per year

SPANISH SPEAKING
• 142 assessments completed (not including Colorado)
• 97 children assessed 1 to 4 times each
Participant Criteria for Language Outcomes Analysis

- Bilateral hearing loss
- English-speaking or Spanish-speaking home
- No other disabilities that would affect speech or language development
Language Outcomes Analysis:
Number of Assessments

ENGLISH SPEAKING
• Number of Children = 359
• Minnesota Child Development Inventory = 370 assessments
• MacArthur-Bates Communicative Development Inventory = 560 assessments

SPANISH SPEAKING
• Number of Children = 55
• Minnesota Child Development Inventory = 28 assessments
• MacArthur-Bates Communicative Development Inventory = 71 assessments
Language Outcomes Analysis: Participant Characteristics

ENGLISH SPEAKING
• Chronological age
  • Range = 6 to 60 months
  • **Mean = 24 months**
  • 94% of sample: 6 to 36 months of age
• Boys = 55%; Girls = 45%

SPANISH SPEAKING
• Chronological age
  • Range = 14 to 63 months
  • **Mean = 26 months**
  • 98% of sample: 14 to 36 months of age
• Boys = 49%; Girls = 51%

COCHLEAR IMPLANTS: AGE OF IMPLANTATION - MEDIAN 15 MO. MEAN 17 MO (n=99)
# Language Outcomes Analysis: Participant Characteristics

<table>
<thead>
<tr>
<th>Age at...</th>
<th>ENG DHH Median (mos)</th>
<th>SPAN DHH Median (mos)</th>
<th>ENG DHH Range (mos)</th>
<th>SPAN DHH Range (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification</td>
<td>2.3*</td>
<td>3**</td>
<td>.25 to 48</td>
<td>.25 to 30</td>
</tr>
<tr>
<td>Amplification</td>
<td>5</td>
<td>6</td>
<td>1 to 48</td>
<td>1.5 to 32</td>
</tr>
<tr>
<td>Intervention</td>
<td>5*</td>
<td>6**</td>
<td>.25 to 44</td>
<td>1 to 31</td>
</tr>
</tbody>
</table>

*67% of ENG DHH children were identified by 3 months of age
*66% of ENG DHH children were in intervention by 6 months of age
**59% of SPAN DHH children were identified by 3 months of age
**57% of SPAN DHH children were in intervention by 6 months of age
## Language Outcomes Analysis: Participant Characteristics

<table>
<thead>
<tr>
<th>Highest degree completed</th>
<th>% of ENG primary caregivers</th>
<th>% SPAN Primary caregivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than HS</td>
<td>8%</td>
<td>47%</td>
</tr>
<tr>
<td>High school diploma</td>
<td>46%</td>
<td>33%</td>
</tr>
<tr>
<td>Vocational or Associates</td>
<td>16%</td>
<td>9%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>18%</td>
<td>11%</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>12%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Degree of Hearing Loss
(available for 256 ENG DHH children and 46 SPAN DHH children)

<table>
<thead>
<tr>
<th>Degree of hearing loss</th>
<th>% of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>mild</td>
<td>29</td>
</tr>
<tr>
<td>mod</td>
<td>24</td>
</tr>
<tr>
<td>mod-sev</td>
<td>23</td>
</tr>
<tr>
<td>sev</td>
<td>26</td>
</tr>
<tr>
<td>prof</td>
<td>24</td>
</tr>
</tbody>
</table>
Assessment 1: Minnesota Child Development Inventory (1992)

- 8 areas of development assessed
  - Language, Motor, Social, Self Help, Pre-Literacy
- Parent report
  - Parents respond “yes” or “no” to a variety of statements about their child
  - Example: “Has a vocabulary of 20 or more words”
- Scales adapted to reflect abilities in both spoken and sign language
- Translated into Spanish; English norms
Assessment 2: MacArthur-Bates Communicative Dev. Inventories

- Assesses spoken and sign vocabulary
  - Expressive and receptive for younger children
  - Expressive vocabulary for older children
- Parent-report instrument
- Norms reported for children from English-speaking families
- Norms reported for children from Spanish-speaking families
Determining Language Quotient

- Language Age/Chronological Age \times 100
  - If LQ = 100, Language Age = CA
  - If LQ < 100, Language Age < CA
  - If LQ > 100, Language Age > CA

- LQs of 80+ are within the normal range compared to hearing children
Median Language Quotients: English vs. Spanish, HA vs. CI

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>Spanish</th>
<th>HA Eng Sev/Pro</th>
<th>CI Eng Sev/Pro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minn Exp</td>
<td>92</td>
<td>78</td>
<td>83</td>
<td>79</td>
</tr>
<tr>
<td>Minn Concept Assessment</td>
<td>84</td>
<td>67</td>
<td>71</td>
<td>67</td>
</tr>
<tr>
<td>Mac Vocab</td>
<td>81</td>
<td>74</td>
<td>73</td>
<td>67</td>
</tr>
</tbody>
</table>
Percent of Scores in the Average Range (LQ = 80+)

<table>
<thead>
<tr>
<th>Assessment</th>
<th>English</th>
<th>Spanish</th>
<th>HA ENG S/P</th>
<th>CI ENG S/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minn Exp</td>
<td>72</td>
<td>43</td>
<td>49</td>
<td>21</td>
</tr>
<tr>
<td>Minn Concept</td>
<td>59</td>
<td>29</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Mac Vocab</td>
<td>53</td>
<td>44</td>
<td>36</td>
<td>21</td>
</tr>
</tbody>
</table>
Minnesota CDI: Median ENG Language Quotients (n = 370)
MacArthur: Median ENG Vocab Prod. Quotients (n = 560) by State

<table>
<thead>
<tr>
<th>State</th>
<th>Language Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>2</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>74</td>
</tr>
<tr>
<td>4</td>
<td>82</td>
</tr>
<tr>
<td>5</td>
<td>71</td>
</tr>
<tr>
<td>6</td>
<td>78</td>
</tr>
<tr>
<td>7</td>
<td>76</td>
</tr>
<tr>
<td>8</td>
<td>83</td>
</tr>
</tbody>
</table>
Bates-MacArthur Exp Vocabulary: Sub-Group Comparisons

• All group comparisons examine the MacArthur expressive vocabulary LQ
  • Insufficient number of participants with the Minnesota for group comparisons
  • Unilateral vs. Bilateral and Additional Disabilities vs. No Disabilities examined with most recent assessment from all participants (n = 72)
  • Other comparisons made with most recent assessment from children with bilateral loss and no additional disabilities (n = 32 to 42)
Bates-MacArthur Exp Vocabulary: Sub-Group Comparisons

• No significant difference (p > .05) between:
  • Boys vs. girls
  • Mothers with vs. without a high school diploma
Bates-MacArthur Exp Vocabulary: Sub-Group Comparisons

• Significant differences ($p < .05$):
  • Unilateral vs. bilateral hearing loss
  • No additional disabilities vs. having additional disabilities
  • Mild/Mod vs. mod-severe to profound hearing loss
  • Identification of hearing loss by vs. after 6 months of age
Deaf vs. Hearing Parent(s)

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Deaf</th>
<th>Hearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minn Exp</td>
<td>98</td>
<td>88</td>
</tr>
<tr>
<td>Minn Concept</td>
<td>87</td>
<td>80</td>
</tr>
<tr>
<td>Mac Vocab</td>
<td>86</td>
<td>78</td>
</tr>
</tbody>
</table>
Unilateral vs. Bilateral Hearing Loss

MacArthur Expressive Vocabulary Assessment

Language Quotient

<table>
<thead>
<tr>
<th></th>
<th>Unilateral</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>93</td>
<td>68</td>
</tr>
</tbody>
</table>

93
93
MacArthur Bates Vocabulary Quotient Additional Disabilities vs. HL Only

- SPANHL only: 78
- SPANAddDis: 62
- ENG only: 80
- ENGAddDis: 64
MacArthur-Bates Expressive Vocabulary Identification by 6 months vs. Later

Language Quotient

SPAN by 6 mos  | SPAN > 6 mos  | ENG by 6 mo  | ENG > 6 mo

76  | 56  | 84  | 74

MacArthur Expressive Vocabulary Assessment
MacArthur-Bates Expressive Vocabulary
Mild to Mod HL vs. Mod-Sev to Profound HL

MacArthur Expressive Vocabulary Assessment
Conclusions

• More than half of the children demonstrated significant language delays
• Median language quotients were lower for children from Spanish-speaking compared to English-speaking homes
• Typically children scored more poorly on cognitive-linguistic items compared to both vocabulary and more concrete/routine language items
Conclusions

Expressive vocabulary quotients were higher (on average by 20-25 points) for children who had:

- Unilateral hearing loss
- Intervention by 6 months of age
- No additional disabilities
- Mild or moderate hearing loss
ASC Subscale Scores by Degree of Hearing Loss

Detection  Discrimination  Identification  Comprehension

ASC Total Score

Degree of Hearing Loss

No HL  HF  Mild  Mod  Mod-Sev  Sev  CI
CINN Auditory Skills Checklist (Meagher et al., 2013)
Colorado data

Subscale Scores by HL and DQ

ASC Total Score

Developmental Quotient

No HL  HF  HF < 80  Mild  Mild < 80  Mod  Mod < 80  Mod-Sev  Mod-Sev < 80  Sev  Sev < 80  CI  CI < 80

Comprehension  Identification  Discrimination  Detection
Comparison of Subscale Scores Based on MLE and HL – Group 1 (Mild-Mod)  Group 2 (Mod-Sev/Sev)  Group 3 (CI)

Maternal Level of Education

Detection  Discrimination  Identification  Comprehension
CINN Auditory Skills Checklist (Meagher et al., 2013) Colorado data

Subscale Scores by MLE

Maternal Level of Education

ASC Total Score

- Detection
- Discrimination
- Identification
- Comprehension
Conclusions

• Different developmental outcomes depending upon state system
• Children with cochlear implants an average of 1 year from implantation, still need to close the developmental gap, especially for abstract language and vocabulary.
• Children from Spanish-speaking homes, have lower maternal level of education, and benefit from earlier identification and earlier intervention enrollment even more than children from English-speaking homes.
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