## Language in the Home Environment of Children with Hearing Loss Compared to Hearing Controls at 6-7 Years of Age





BROWN Alpert Medical School

Betty Vohr, Deborah Topol, Nicole Girard, Lucille St. Pierre, Victoria Watson, and Richard Tucker

> Women & Infants Hospital Alpert Medical School of Brown University

# Background

- Children with HL identified early are known to have improved outcomes compared to children identified late.

Yoshinaga-itano; Moeller, Vohr

### Objectives: To evaluate:

- The language environment at 6-7 years of age:
- The language, cognition and behavior of children with HL compared to hearing controls
- The effects of the language environment on language, cognitive skills, and behavior for children with HL and hearing.
- The effects of age of entry to early intervention (EI) for children with HL on parent speech, child vocalizations, and conversational turns.

# Hypotheses

- ↑ Child Vocalizations and Conversational Turns will be associated with ↑ Language and Cognitive skills and more optimal Behaviors.
- Children with HL who received EI by 3 months will have more optimal Conversational Turns and Language scores than children enrolled> 3 months.

## Methods

- This is a prospective study of the Language and Behavior outcomes of children identified in the RI newborn hearing screening program who were born between 10/15/02 and 1/31/05.
- The cohort consists of children who were screened in either the NICU or well-baby nursery and diagnosed with HL, and hearing controls who passed the newborn screen.

# Methods

- Hearing controls were matched for NICU vs. non-NICU status and hospital of birth.
- Subjects were evaluated at 6, 12, and 18 months and 3, 4-5, and 6-7 years.
- Informed consent was obtained.
- The 6-7 year visit included:
  - LENA 16 hour recording
  - Reynell Developmental Language Scales
  - Kaufman Assessment Battery for Children
  - Child Behavior Checklist

### Reynell Developmental Language Scales

- The assessment is a 134 item standardized, individualized language test that utilizes toys and objects as manipulatives to assess Verbal Comprehension and Expressive Language.
- It is for children 12 ms through 6 years, 11 ms.
- There are two separate, normed versions, one for use with oral children and one for use with children with motor and/or communicative disabilities.

#### The Child Behavior Checklist (CBCL) 6-18 Years

- This is a comprehensive measure of children's behaviors designed to assess the Social Competencies and Behavioral Problems of children, as reported by their parents.
- Norms are based on 700 non-referred children. There are sub-scores and summary scores for Internalizing, Externalizing, and Total Behavior Problems.

# Kaufman Assessment Battery for Children Second Edition (KABC-II)

• The KABC-II is used for ages 3-18 to measure both verbal and non-verbal cognitive ability.

• We are using the test to measure non-verbal cognitive ability with a derived Nonverbal Index (NVI).

# **Statistical Analyses**

- Bivariate analyses included chi-square for categorical variables and t-tests for continuous variables.
- Correlation analyses were done to explore relationships between Lena Language variables and child outcomes.

#### **Child Characteristics**

Group	HL	Controls
Ν	(18)	(36)
BWT < 1500g*	9 (50%)	8 (22%)
Female	8 (44%)	15 (42%)
NICU	10 (56%)	20 (56%)
Unilateral/Mild HL	7 (39%)	NA
Moderate/Profound HL	11(61%)	NA

\*p=0.03

### **Maternal Characteristics**

Group	HL	Controls
Ν	(17)	(31)
Maternal age @ Recording	39 ± 5	42 ± 6
White Race	16 (94%)	30 (97%)
< High School Education	1(6%)	0 (0%)
High School Graduate	3 (18%)	1(3%)
≥ College	13 (76%)	30 (97%)
Private Health Insurance	14 (82%)	24 (90%)
Hollingshead SES*	37 ± 11	47 ± 12

## Child Cognitive and Language Scores

Group	HL	Controls	2
Ν	(18)	(36)	ρ
Mean Age (months)	83 ± 6	82 ± 7	0.6433
Kaufman NVI	90 ± 15	102 ± 16	0.0097
NVI < 70	11%	3%	0.2293
Reynell Receptive	87 ± 17	99 ± 14	0.0099
Reynell Expressive	97 ± 18	99 ± 18	0.8197

### **Child Behavior Checklist Scores**

Group	HL	Controls	n
Ν	(18)	(36)	ρ
Social Problems	56 ± 6	53 ± 7	0.1355
Internalizing	46 ± 9	45 ± 10	0.9534
Externalizing	51 ± 9	48 ± 12	0.3528
Total Behavior Problems	50 ± 7	45 ± 12	0.0851

### LENA Language Environment in the Home

Group N	HL (18)	Controls (36)	р
% Language	18 ± 7	16 ± 4	0.3088
% TV	16 ± 8	12 ± 8	0.1591
% Silence	21 ± 11	25 ± 13	0.3993
Average dB Spl Noise Level	72 ± 3	71 ± 13	0.2283

## Mild Bilateral Hearing Loss; Amplified



## Child Vocalizations per Hour for Children with and without HL



## Conversational Turns per Hour for Children with and without HL



## Adult Word Count Per Hour

Group	HL	Controls	р
AWC per Hour	1239 ± 473	1241 ± 602	0.9883

Associations of % Silence and % Language with Reynell Expressive Language Scores

Group	Total Cohort	HL	Controls
N	54	18	36
% Silence in	r= -0.307	r= -0.394	r= -0.227
Environment	p= 0.028	p= 0.100	p= 0.118
% Language in	r= 0.165	r= 0.440	r= 0.020
Environment	p= 0.247	p= 0.060	p= 0.910

# Associations of % Silence with Behavior for Children with HL

Behavior Type	<b>Correlations with % Silence</b>
Social Problems	r= 0.420
	p= 0.08
Dulo Prosking	r= 0.499
Rule Breaking	p= 0.03
Aggregation	r= 0.365
Aggression	p= 0.137
Externalizing Pabayiar	r= 0.417
Externalizing behavior	p= 0.08
Total Droblomo	r= 0.371
rotal Problems	p= 0.12

# For Children with HL: ↑ % Silence was associated with ↑ Rule Breaking Behavior



# For Children with HL: ↑ Conversational Turns were assoc. with ↓ Total Behavior Problems



# Hearing Children

Predictor	Verbal Comprehension	Thought Problems
↑Conversational Turns	r=0.359 p=0.04	r=-0.295 p=0.02

### For Hearing Children: $\uparrow$ % TV with $\uparrow$ Rule Breaking and $\uparrow$ Externalizing Behavior





# For Hearing Children: $\uparrow$ % TV was assoc with $\uparrow$ Attention and Thought Problems



# Effects of Age of Entry to EI for Children with HL

# Child Cognitive and Language Scores of Children Enrolled in EI $\leq$ and > 3 Months

Group	HL ≤ 3 Months	HL > 3 Months	р
Kaufman NVI	92 ± 17	86 ± 14	0.4121
Kaufman NVI < 70	1 (10%)	1 (13%)	0.8668
Verbal Comprehension	88 ± 19	86 ± 15	0.7604
Expressive Language	95 ± 16	101 ± 20	0.4721

### Child Behavior Checklist Scores for Children Enrolled in EI $\leq$ and > 3 Months

Group	EI < 3 Months	EI > 3 Months	р
Internalizing	49 ± 8	41 ± 9	0.0509
Externalizing	54 ± 9	46 ± 6	0.0579
Total Behavior Score	53 ± 7	46 ± 5	0.0157

### Adult Words for Children with HL in EI ≤ and > 3 Months



Adult Words

# Conversational Turns/Hour for Children Enrolled in EI $\leq$ and > 3 Months



**Conversational Turns** 

# Child Vocalizations/Hour for Children Enrolled in EI $\leq$ and > 3 Months



**Conversational Turns** 

# % Language and % Silence for Children Enrolled in EI $\leq$ and > 3 Months



# Summary of Findings

- At 6 years of age, the Language Environment was similar for children with HL and controls.
- Reynell Expressive Language scores of children with HL were similar to but their verbal comprehension scores were sig. lower than those of hearing children.
- Children with early identified HL had more vocalizations per hour than children with hearing.
- AWC did not differ in households of children with and without hearing.

### Summary for Total Cohort (LENA) :

 Increased % Silence in the home was associated with ↓ Expressive Language scores.

### Summary for Children with HL (LENA)

- ↑ % Language in the home was associated with a
   trend for 
   ↑ Expressive Language scores (p=0.06)
- In contrast, ↑ Conversational Turns were associated with ↓ Behavior Problems.

### Summary for Hearing Children (LENA)

- \% time watching TV was associated with a
   spectrum 
   \)
   Behavior Problems including Thought,
   Attention, Rule Breaking, Aggression, and
   Externalizing Behavior.
- In contrast, ↑ Conversational Turns and ↑ Child Vocalizations were associated with ↓ Thought Behavior Problems.

### Summary: Age of Entry to El

- Children enrolled ≤ and > 3 months in EI had similar IQ and Language scores. However, all children were enrolled in EI in the first year of life and the similarities may reflect benefits of EI on Language for both early identified groups.
- In addition, the variance contributed by age of entry to EI may diminish with ↑ age as educational demands ↑.
- The sample size of our HL group is small to date and limits the opportunity to examine sub-group effects.

### Summary: Age of Entry to EI

- However, children enrolled ≤ 3 months had ↑ rates of Behavior Problems.
- They also had ↑ Silence and ↓ rates of Conversational Turns.
- The association of ↑ % Silence and ↓ rates of Conversational Turns with ↑ rates of Behavior Problems are similar to those of the total HL cohort.

## Conclusions

- The Language **Environment** has powerful effects on the Language and Behavior outcomes of children with and without HL at 6-7 years of age.
- Our findings support the concept of ongoing opportunities for educational intervention studies that make a difference in the lives of children.