

# Language Characteristics & Environment of Children with Hearing Loss at 6-7 Years of Age



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# Background

- Children with congenital hearing loss (HL) are at ↑ risk of receptive and expressive speech and language delays.
- Children with HL identified early and who receive EI services have been shown to have improved outcomes compared to children identified late.

Yoshinaga-itano; Moeller, Vohr

# Objectives: To evaluate:

- The language environment and language skills at 6-7 years of age of children with HL enrolled in EI  $\leq 3$  m and  $> 3$  m compared to hearing controls

# Hypotheses: At 6-7 years Children with HL who received EI by 3 months of age

- will have better language scores than children enrolled in EI > 3 m and
- will have a more optimal language Environment than children with EI enrolled > 3 m and
- a more optimal language environment will be associated with better language skills

# Methods

- Language and LENA outcomes of children identified in the RI newborn hearing screening program who were born between 10/15/02 and 1/31/05 were evaluated at 6-7 years
- 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.
- Informed Consent was obtained

# Methods

- The visit included:
  - LENA 16 hour recording
  - Reynell Developmental Language Scales with comprehension and expressive subscores
  - Kaufman Assessment Battery for Children( KABC) asesesses both verbal and non verbal intelligence.

LENA Variable	Coded	Definition
Key Child Vocalization (CV)	Counts	Estimated # of words or vocalizations :babbling, squeals, growls of at least 50 msec. duration surrounded by 300 msec of silence or other non-voc.
Adult word count( AWC)	Counts	Estimated # of words spoken within the range of the DLP
Conversational Turns(CTs)	Counts	Reciprocated speech segments between any adult and child within $\leq 5$ sec. - Separated by $> 5$ sec.
Meaningful Language	% Time	Distinguishable language includes segment durations of adult, index child and other child language/vocalizations; not distant language at least 6 feet from the DLP or unclear speech which is difficult to decipher by the DLP.
Language	% Time	Adult & child words & vocalizations, distant and unclear speech, CTs and monologues; A combination of meaningful and distant language.
Silence and background	% Time	Background sounds or electronic media with an average dB sound pressure level $< 32$ dB.

# Statistical Analyses

- Bivariate analyses included chi-square for categorical variables and t-tests for continuous variables.
- Linear regression analyses were done to explore relationships between LENA Language variables and child outcomes adjusting for non-verbal intelligence.
- Multiple regression analyses were used to test the associations of LENA Variables on Language Outcomes



# Maternal Characteristics

<b>Group</b>	EI $\leq$ 3m n = 11	EI > 3m n = 9	Controls (35)
Maternal age @ Recording	37 $\pm$ 7	43 $\pm$ 7	41 $\pm$ 6
White Race	10 (91%)	10(100%)	34 (97%)
<u><math>\geq</math> High School Graduate *</u>	9(82%)	10(100%)	35 (100%)
Private Health Insurance	8 (73%)	8(80%)	29 (83%)
Primary Language English	10(91%)	9(90%)	33(94%)

p = 0.01

# Child Characteristics

Group	EI $\leq$ 3m	EI $>$ 3m	Controls
N	n = 12	n = 11	(41)
<u>BWT &lt; 1500g*</u>	4 (33%)	8(73%)	8 (20%)
Female	3 (25%)	8(73%)	18 (44%)
NICU	5 (42%)	8(73%)	24 (59%)
Age of Evaluation (m)	83 $\pm$ 6	82 $\pm$ 7	82 $\pm$ 7

\*p=0.003

# Characteristics of Children by degree HL HL

Characteristics	Unilateral or Mild Bilateral	Bilateral Moderate to Profound
N(%)	7 (30%)	16 (70%)
Early Intervention < 3 m	<u>4(56%)</u>	8(48%)
Mild HL*	3	0
Moderate HL	0	4
Moderate –Severe HL	2	6
Severe HL	1	1
Profound HL	1	3
Auditory Neuropathy	0	2
<b>Uses Some Sign Language</b>	<b>1</b>	<b>6</b>
<b>Age of Amp. ≤6 months</b>	<b>1 (12.5%)</b>	<b>13 (76.4%)</b>
16-24m	2	2
36 m	1	0
42-56 m	1	1**
None++	2	0
Amplified at time of study	5/7 (71%)	16/16 (100%)

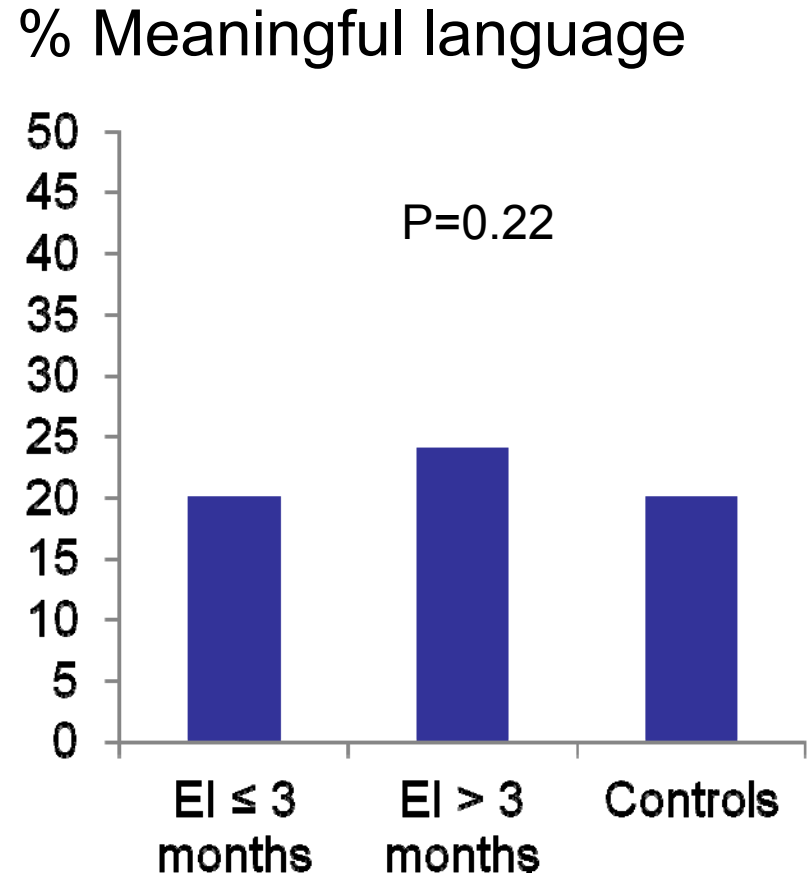
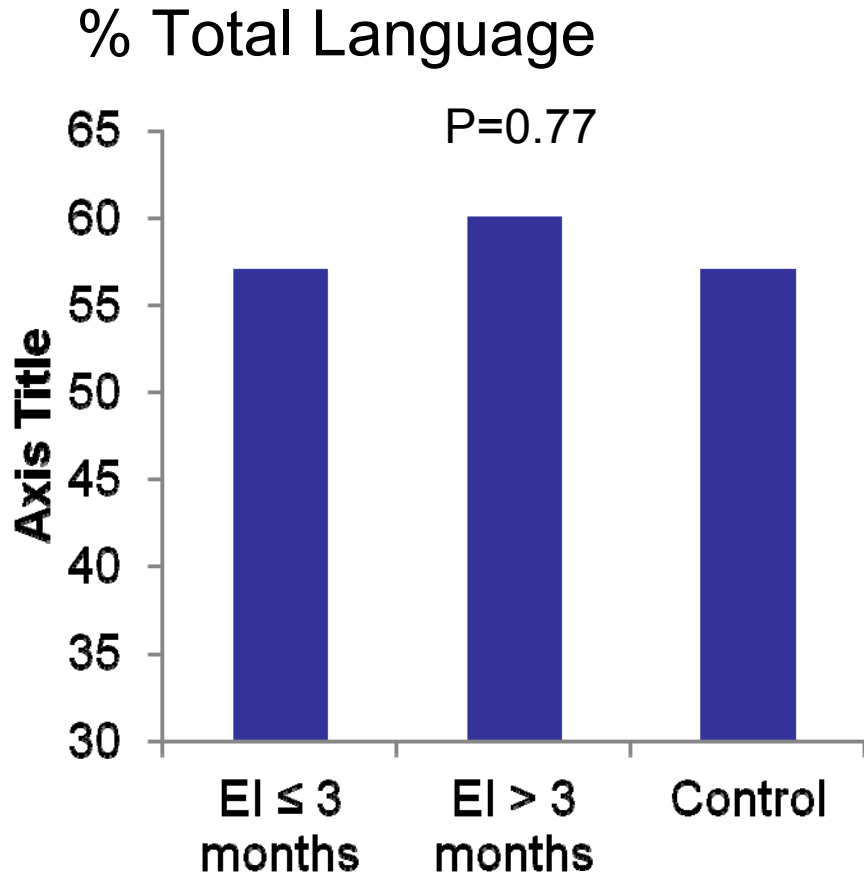
# Child Cognitive & Language Scores

Group	<b>EI <math>\leq</math> 3m</b> <b>(12)</b>	<b>EI &gt; 3m</b> <b>(11)</b>	<b>Control</b> <b>(41)</b>	<b>p</b>
Kaufman Non-verbal Intelligence (NV I)	93.2 $\pm$ 15 <sup>*+</sup>	78.3 $\pm$ 17*	103.6 $\pm$ 12	0.0001
Kaufman NVI < 70	1 (8%)	3 (27%)	0 (0)	0.0039
Reynell Verbal Comprehension	85.6 $\pm$ 18*	75.5 $\pm$ 15*	100.2 $\pm$ 13	0.0001
Reynell Expressive Language	95.2 $\pm$ 15	88.7 $\pm$ 21	101.8 $\pm$ 18	0.0878
	* vs Control + vs EI>3m			

# Child Cognitive & Language Scores

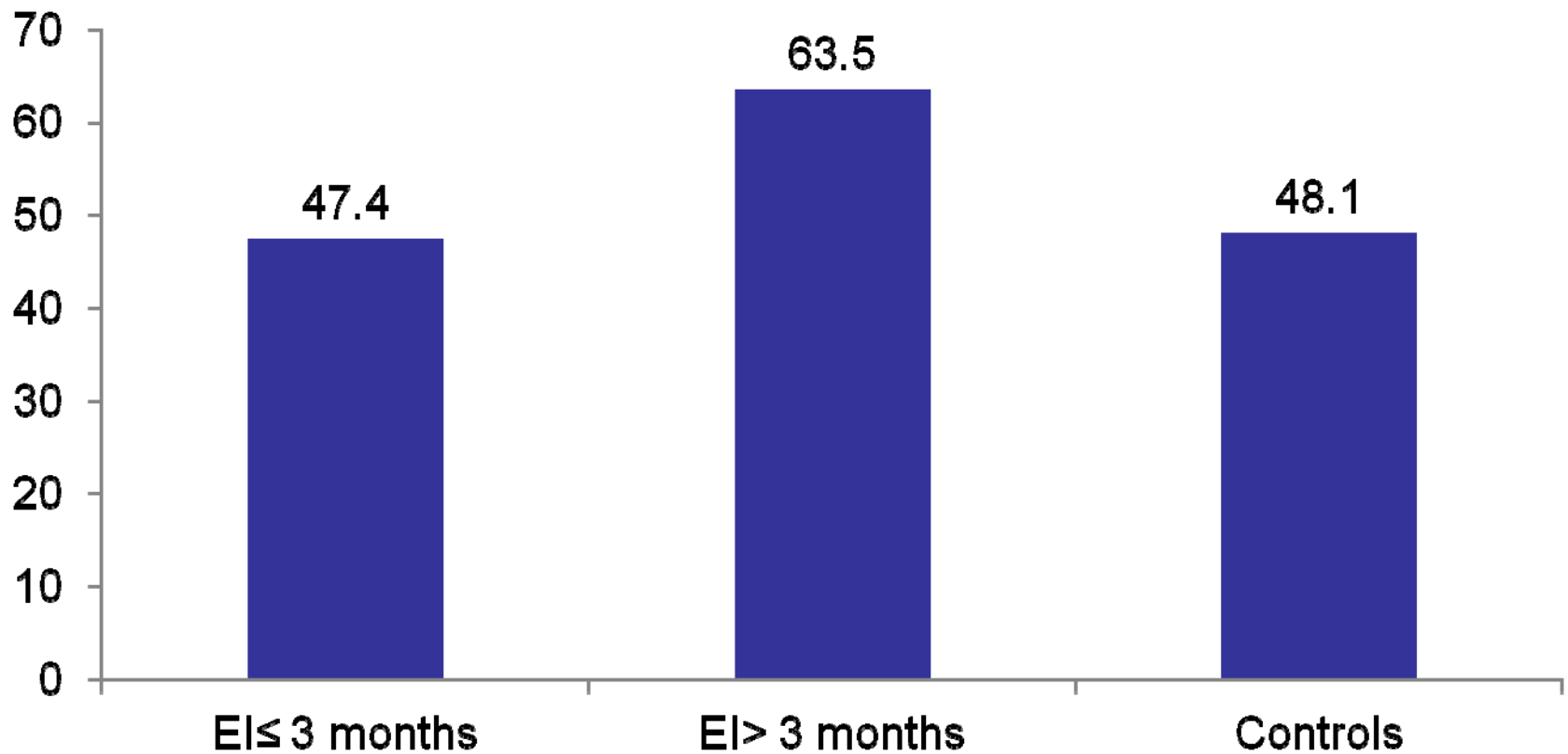
Group	Unilat /Mild Bilateral (7)	Mod/Sev Bilateral (16)	Control (41)	p
Kaufman Non-verbal Intelligence (NV I)	85.4±18*	86.3±18*	103.6 ± 12	<0.0001
Kaufman NVI < 70	2(29%)	2(13%)	0 (0)	0.007
Reynell Verbal Comprehension	82.9±20*	79.9±16*	100.2 ± 13	<0.0001
Reynell Expressive Language	90.3±20	92.9±18	101.8 ± 18	0.1211
				* vs Control

# % Language by Entry to EI



# Conversation Turns/Hour by Study Group

**P=0.13**

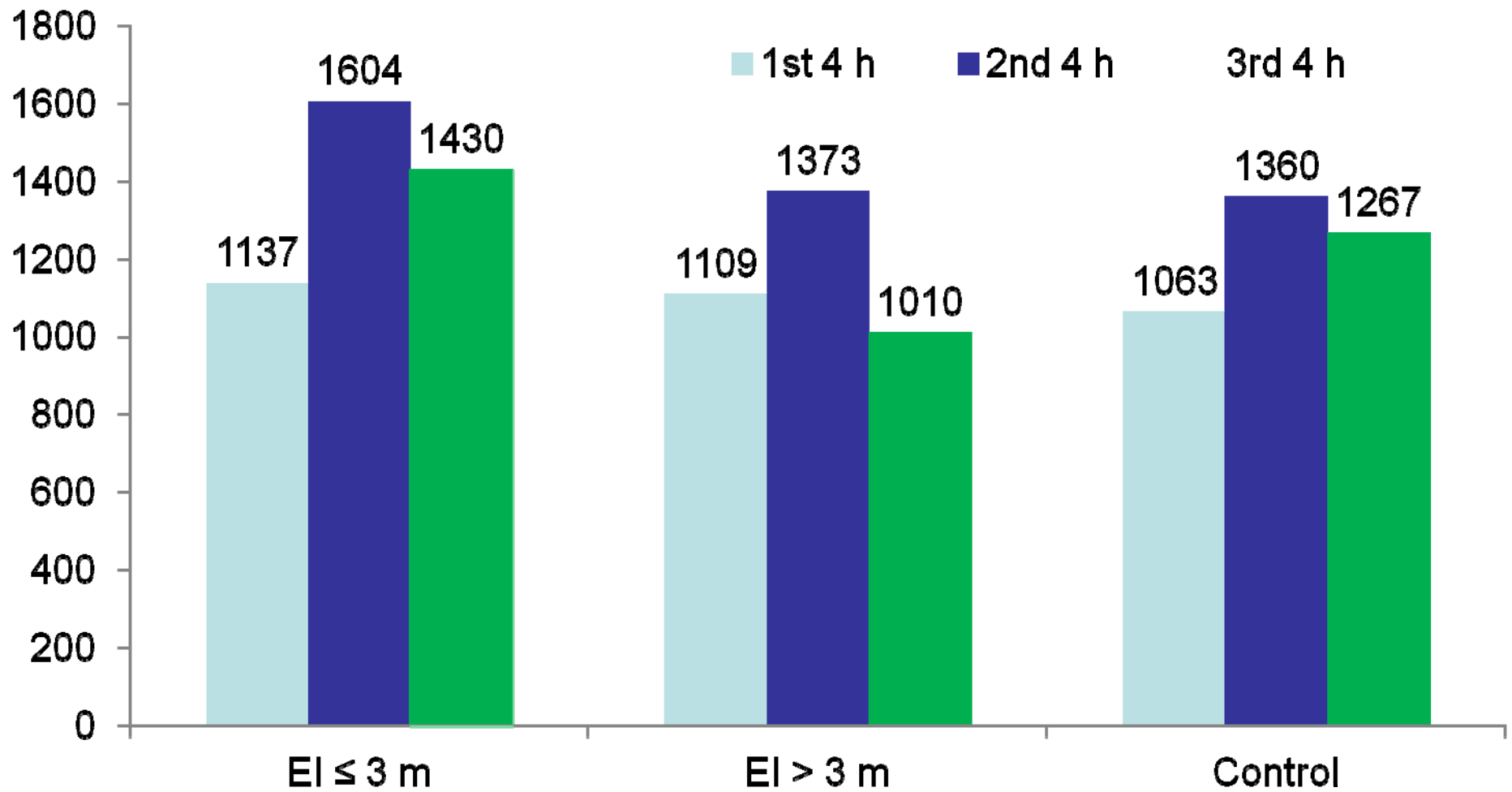


# Are there Factors Other than Age of Entry to EI that may mediate the LENA Language Environment ?

- Time of Day
- Degree of HL
- Neonatal Stay in the NICU



# Median AWC during 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> part of recording.



# Lena Variables by NICU vs Non NICU

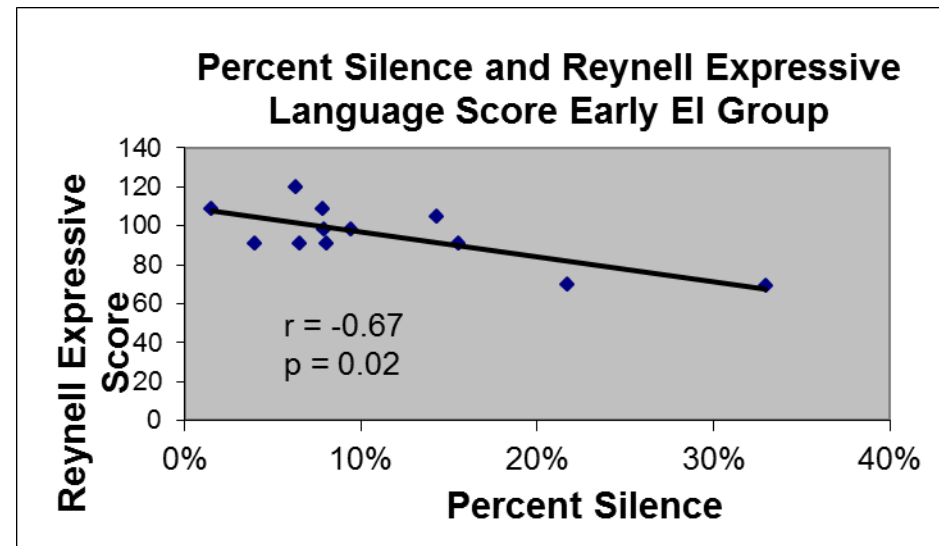
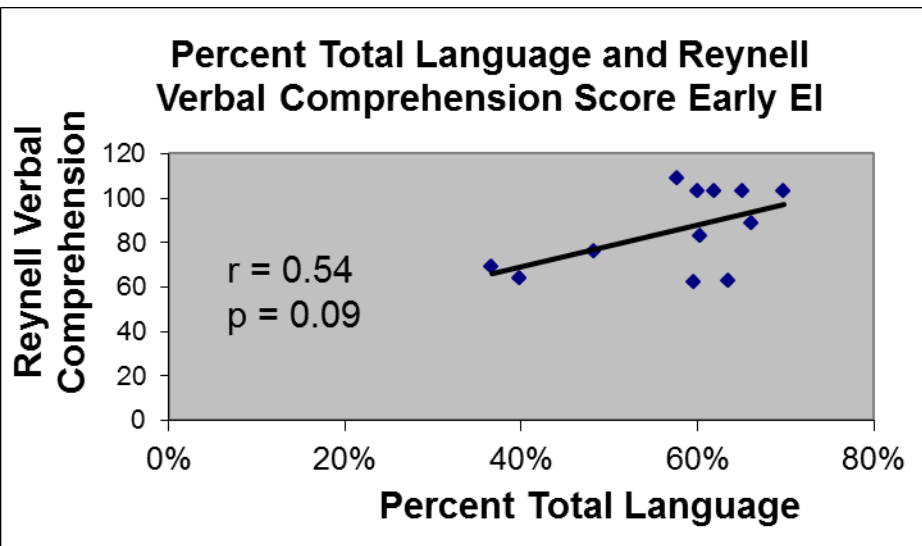
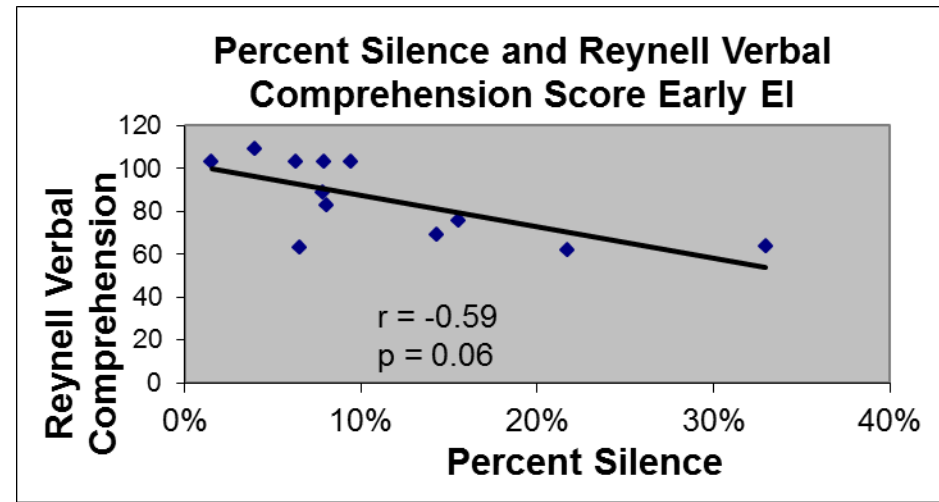
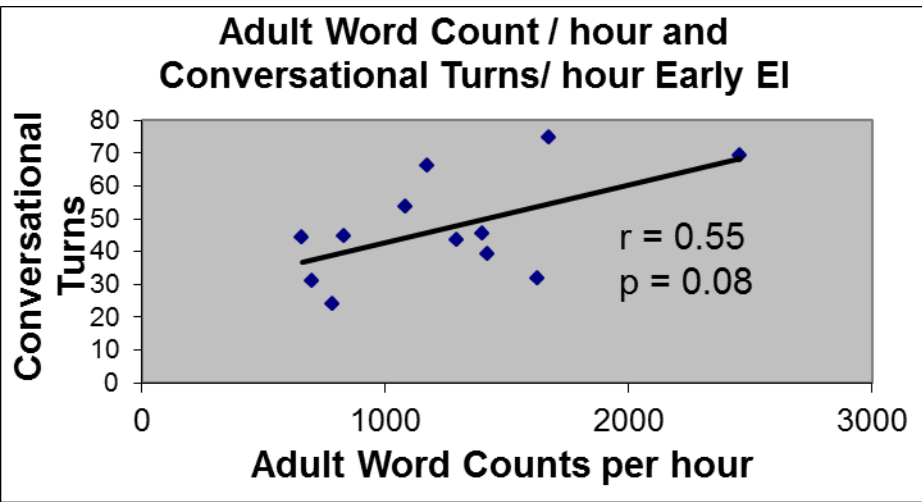
<b>LENA</b>	<b>NICU yes</b>	<b>NICU no</b>
Adult Word Count	1317±542	1463±626
Conversation Turns	50.9±26	50.1±20
Child vocalizations	199.5±105	170.7±83
% Meaningful Language	20.9±7	19.7±7

# Lena Variables by Degree of HL

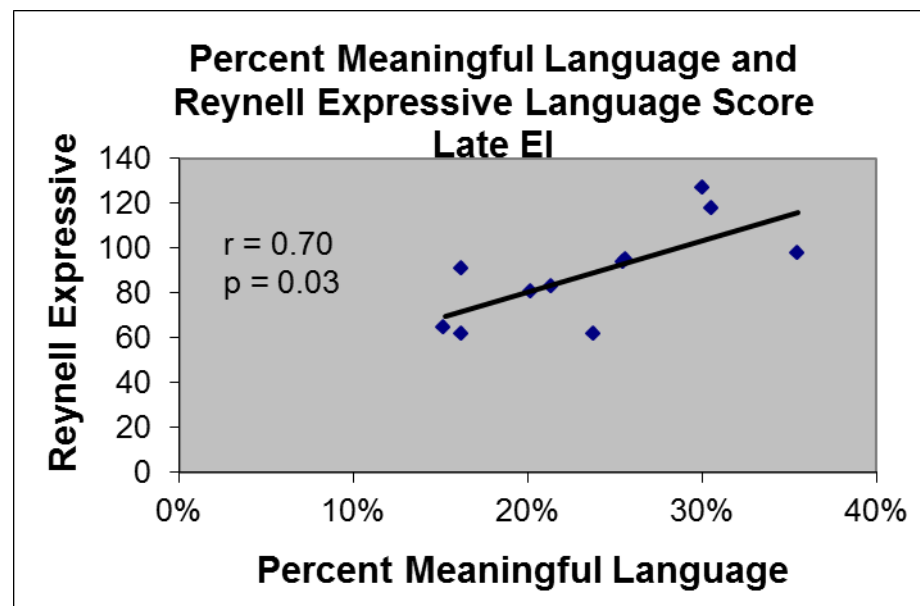
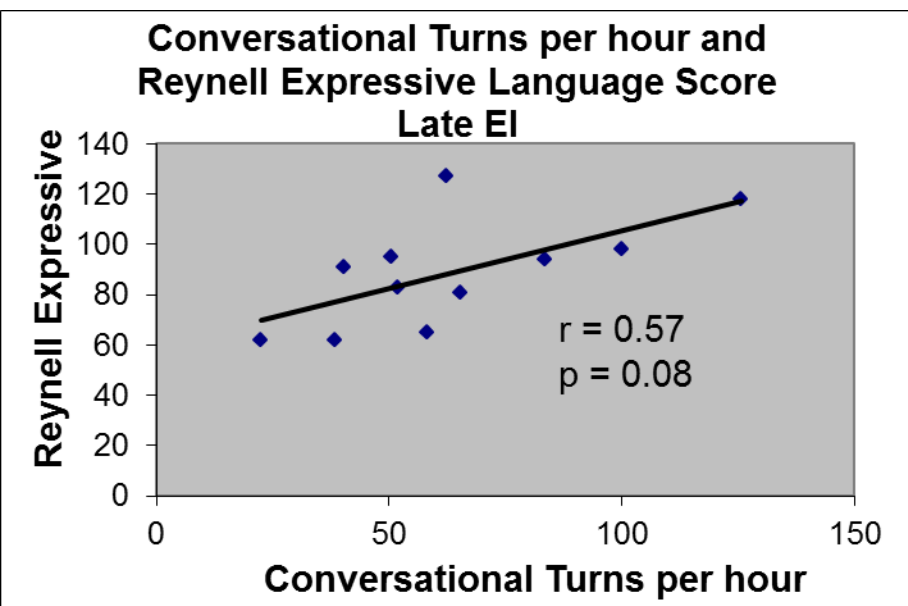
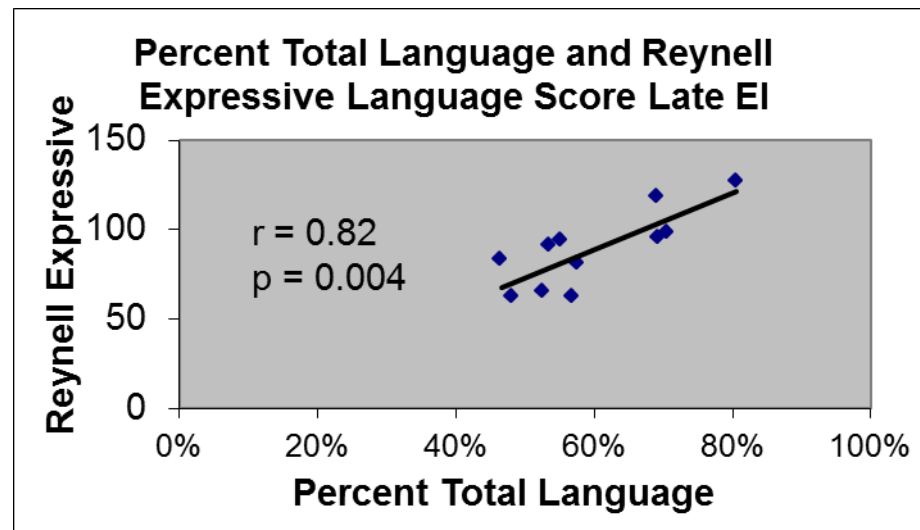
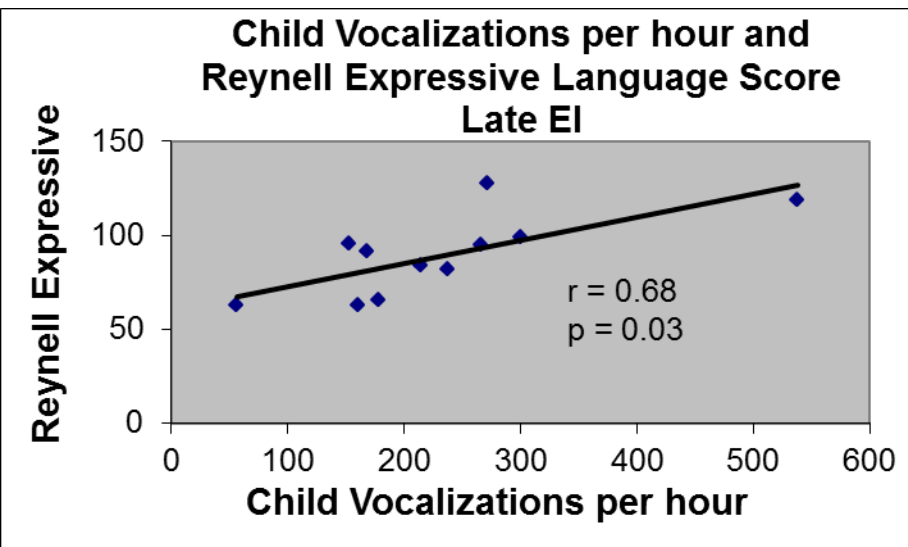
<b>LENA</b>	Unilateral or Mild Bilateral	Bilateral Moderate to Profound
Adult Word Count	1386±621	1429±457
Conversation turns	60.0±12	52.9±28
Child vocalizations	229.5±74	202.8±109
% Meaningful Language	21.7±8	21.6±6

# Relationship Between LENA Variables & Outcomes.

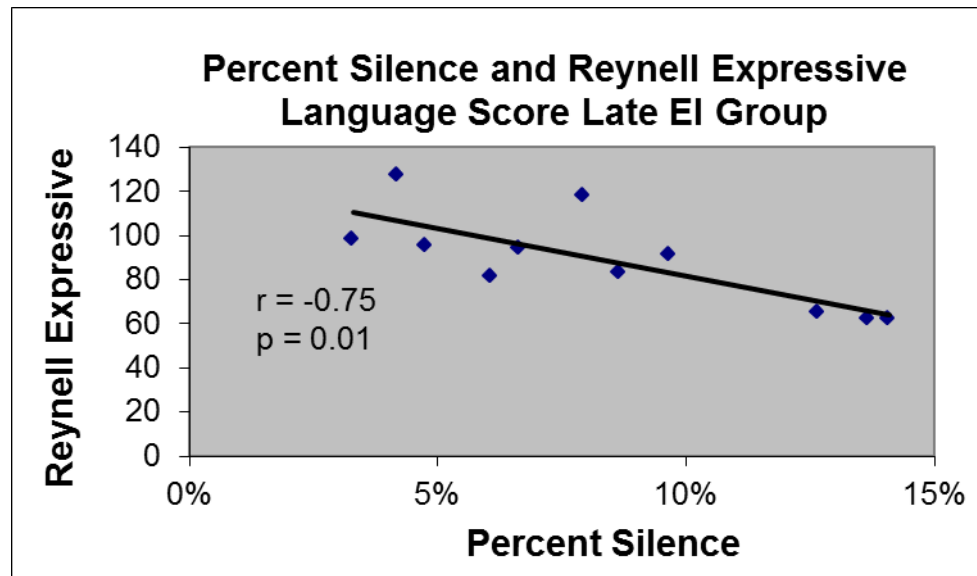
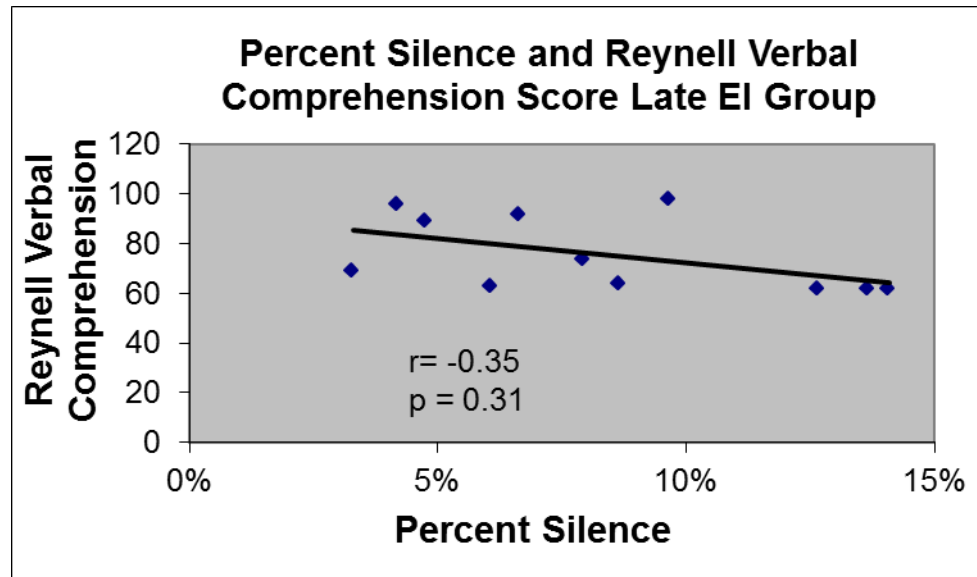
# Children with HL in EI ≤ 3 Months



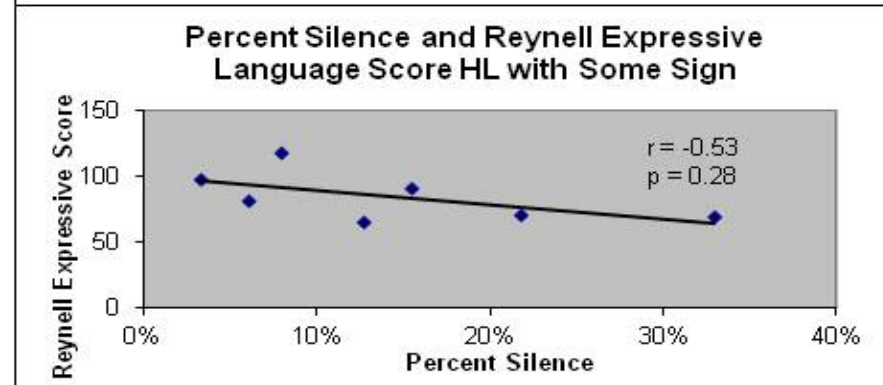
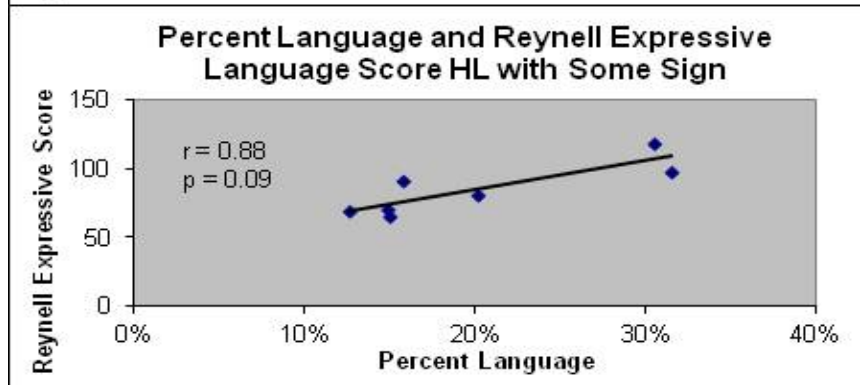
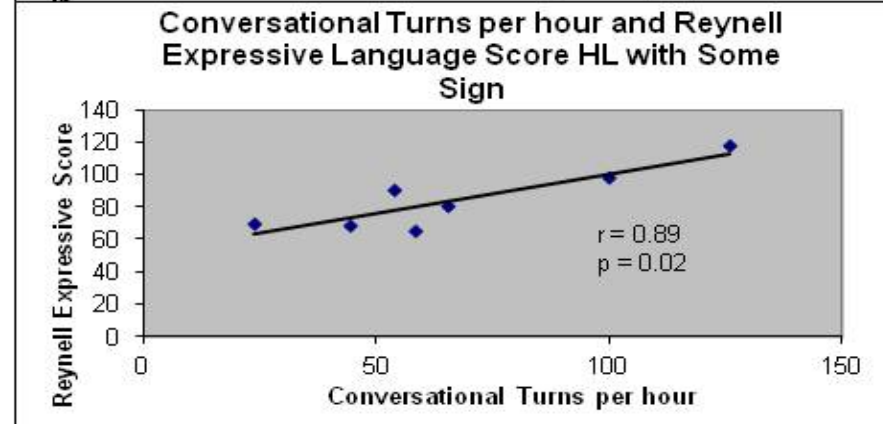
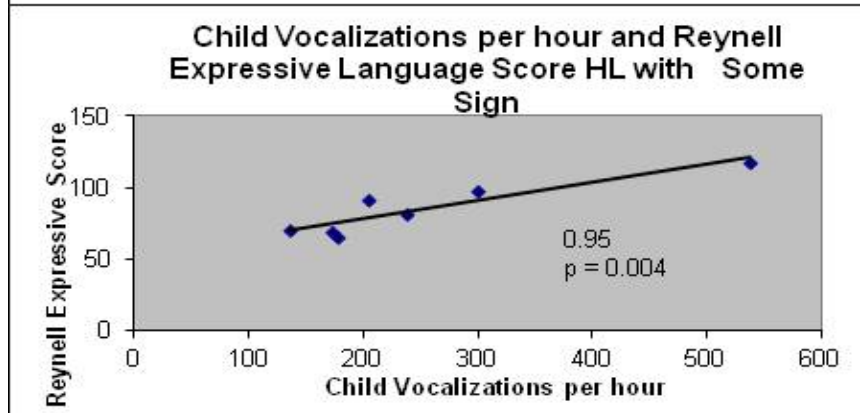
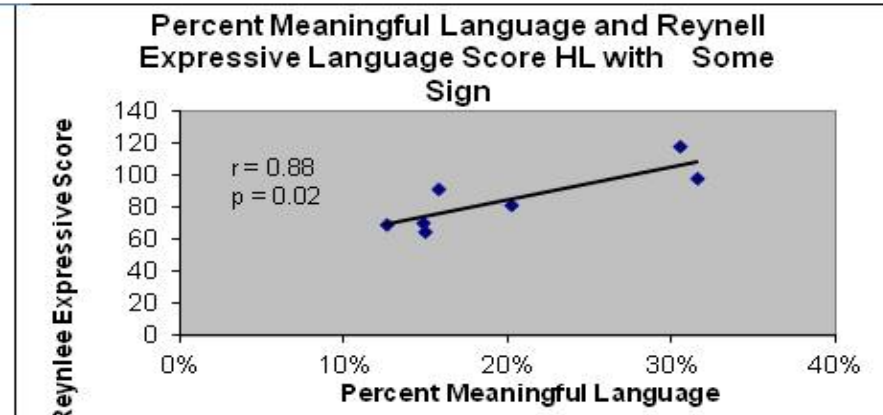
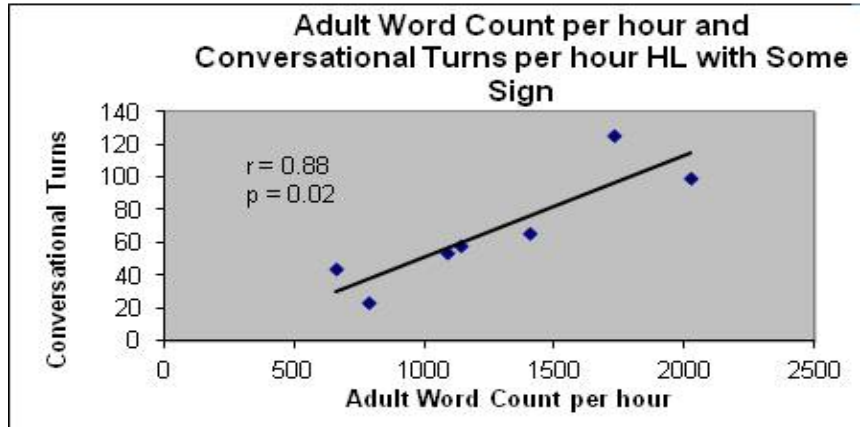
# Children with HL in EI > 3 Months



# Children with HL in EI > 3 Months

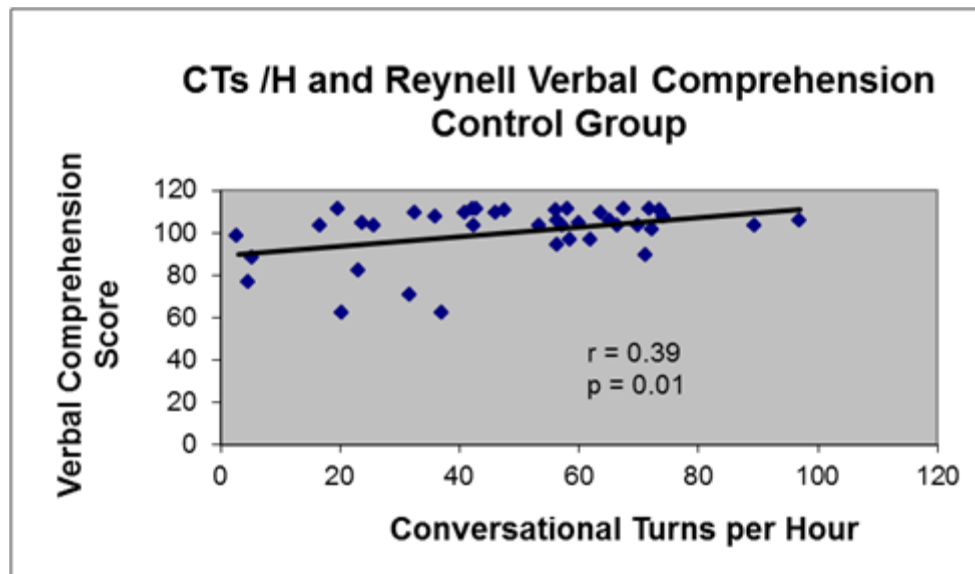
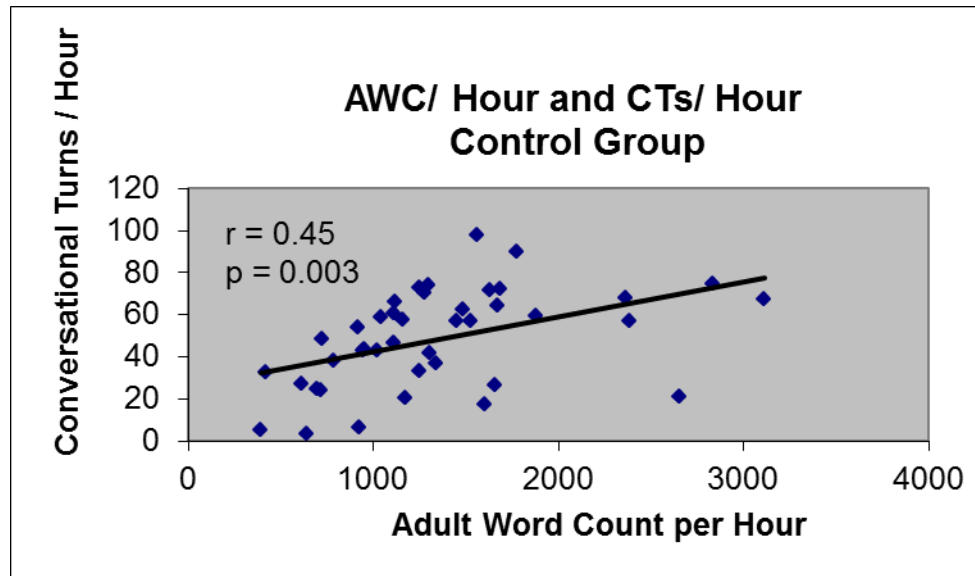


# Children with Hearing Loss Using Some Sign





# Hearing Controls



# Regression Model to Predict Reynell Comprehension scores for Children with HL

Predictors	Beta	P value
EI ≤ 3 months	8.7	0.15
Non-NICU	10.4	0.122
<b>↑ 10 Percentage pts of total language</b>	7.2	0.027
Total Model R Square	.394	0.02

# Regression to Predict Reynell Expressive Language scores for Children with HL

Predictors	Beta	P value
EI ≤ 3 months	8.8	0.22
Non-NICU	0.81	0.37
<b>↑ 10 percentage pts of Total Language</b>	9.99	0.006
Total Model R Square	.358	0.03

# Regression to Predict Reynell Expressive Language scores for Children with HL

Predictors	Beta	P value
EI ≤ 3 months	7.2	0.27
Non-NICU	7.26	0.37
<b>↑ 100 Child Vocalizations/hour</b>	9.89	0.013
Total Model R Square	.205	0.06

# Regression to Predict Reynell Expressive Language scores for Children with HL

Predictors	Beta	P value
EI ≤ 3 months	11.1	0.185
Non-NICU	2.69	0.73
↑ <b>10 Conversation turns/ hour</b>	3.39	0.048
Total Model R Square	.176	0.10

# Summary: At 6-7 years

- Children with HL in both EI groups had verbal comp. scores lower than H controls. Children with HL enrolled in EI  $\leq 3$  m had verbal comp scores 10 pt  $\uparrow$  than children enrolled in EI  $> 3$  m.
- Verbal Expressive scores were 7-13 pts lower for children with HL than H children ( NS).
- Children with HL in EI  $> 3$ m vs  $\leq 3$  m had similar Language environments, although children with HL in EI  $> 3$ m vs  $\leq 3$  m trended to have higher CTs/hour(=0.12).
- Silence was not assoc with  $\downarrow$  expressive language skills for children who used some sign

# Summary at 6-7 years

- After adjusting for age of entry to EI and for NICU admission, every  $\uparrow$  in 10 percentage pts of Total Language was associated with both a 7.2 higher Reynell Comprehension score and a 9.98 higher Reynell Expressive score.
- $\uparrow$  CV and CTs were independently associated with  $\uparrow$  expressive language scores and
- There were trends for enrollment in EI  $\leq$  3 months to be assoc. with  $\uparrow$  Reynell scores.



# Conclusions



- Tremendous variability in language environment was identified at 6-7 years of age with AWC/h ranging from 400 to >3000 words.
- A rich language environment is beneficial for **all** children.
- LENA provides a non-invasive mechanism to examine the language environment of children  $\pm$  hearing, providing professionals and parents with information that guides the choice for effective intervention.