

A Need for Language Intervention in the NICU for Preterm Infants

LENA Conference 2015

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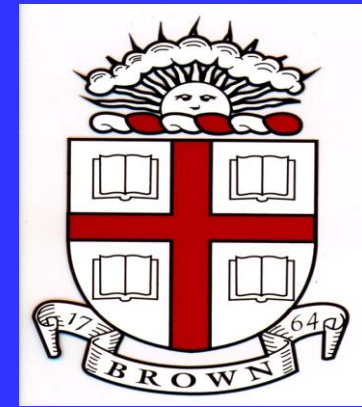
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Disclosure: I am a member of the LENA Foundation
Scientific Advisory Board

Objectives are to describe:

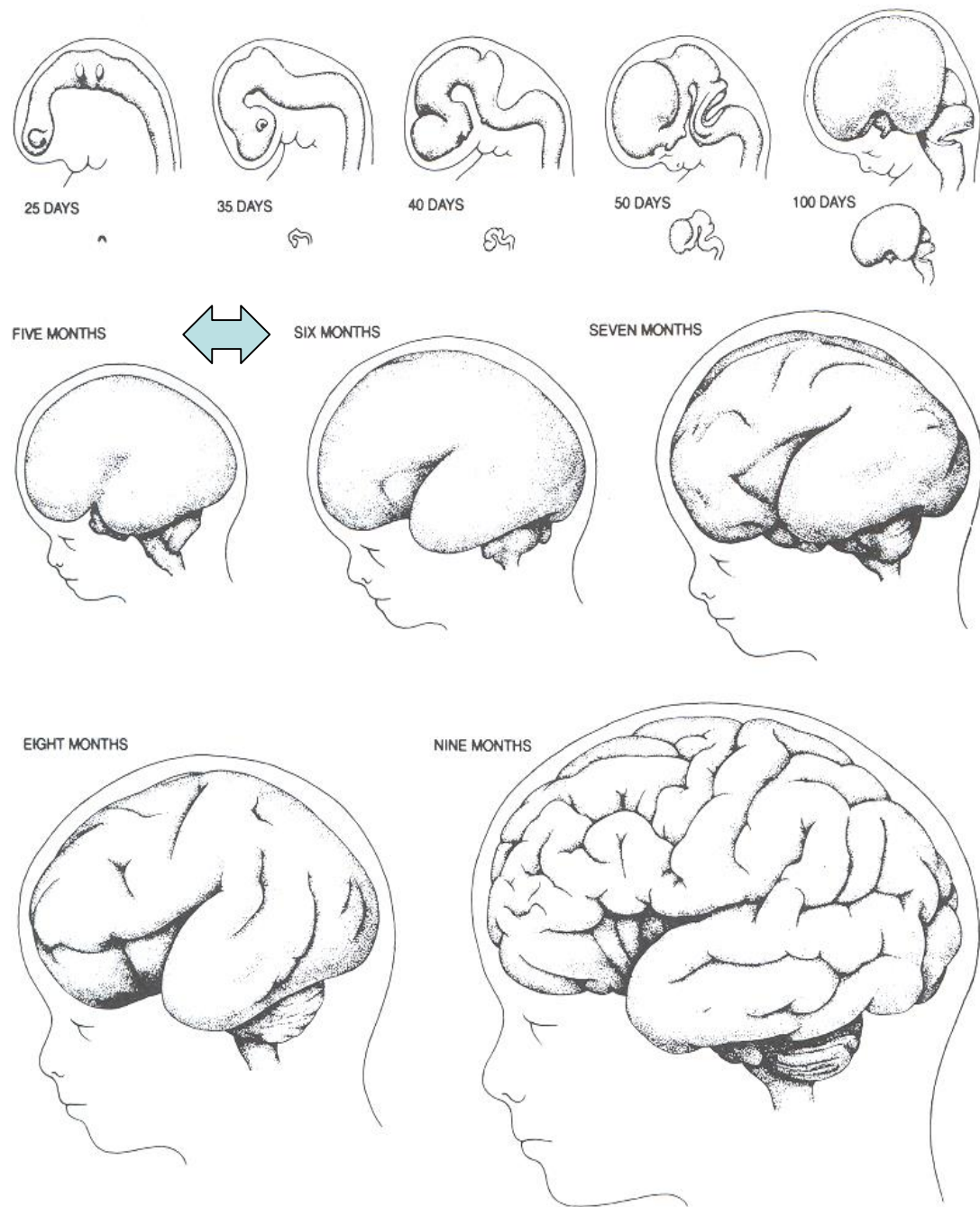
- Known speech and language Outcomes or PT Infants
- LENA Intervention in the NICU
- Factors Contributing to Language Outcomes of PT Infants

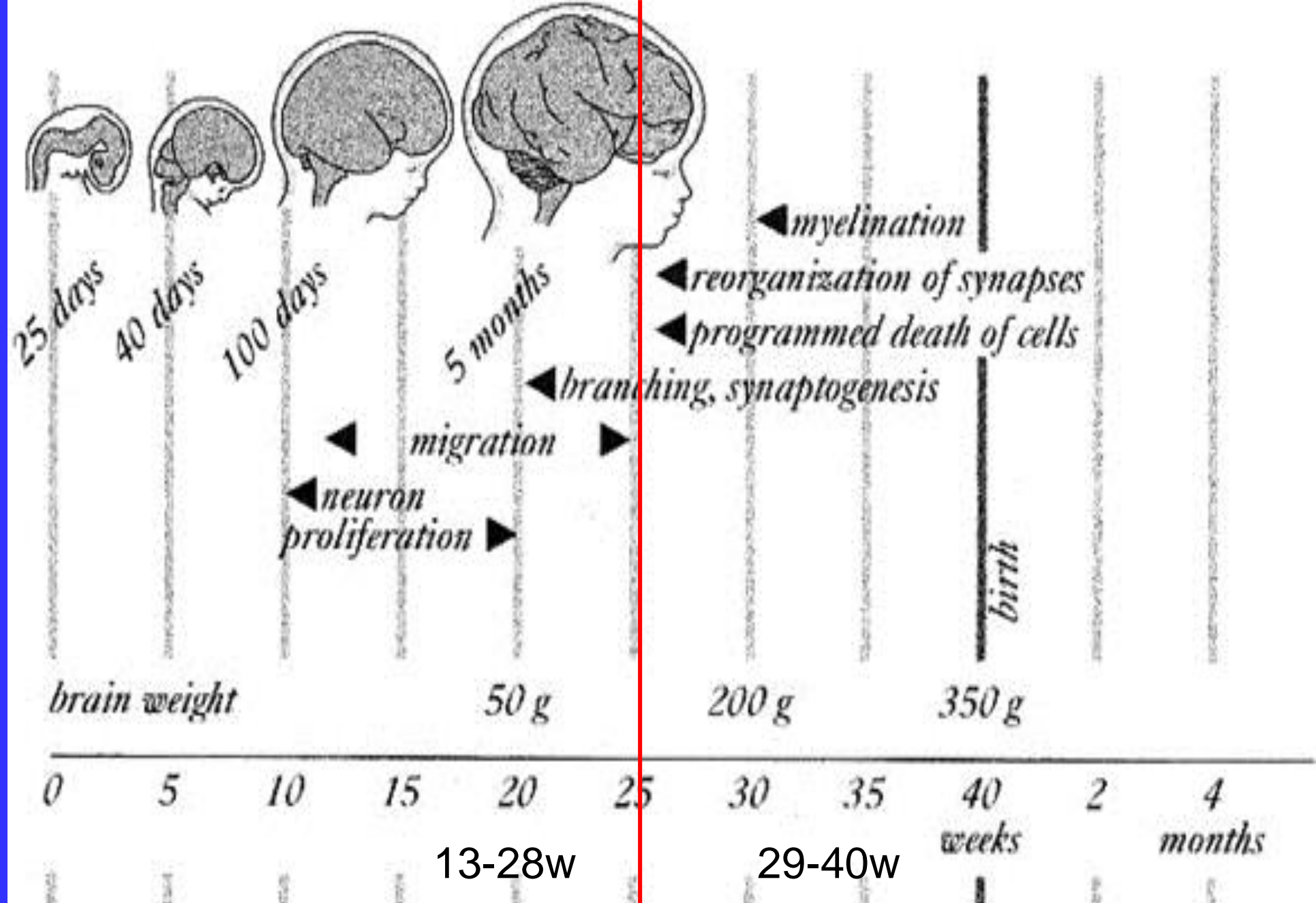


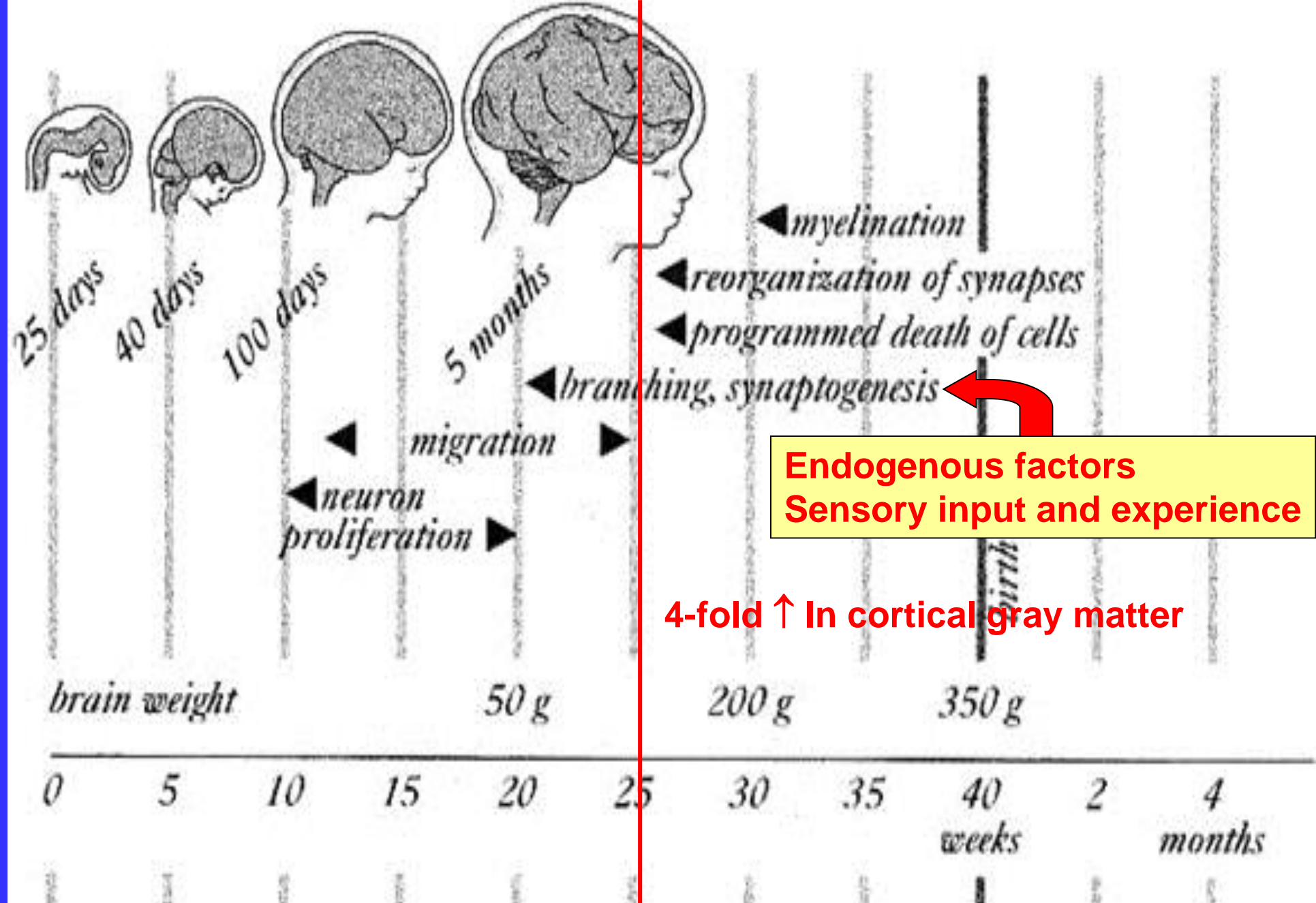
Brain development during the 2nd & 3rd trimester involves a complex sequence of maturational events

Between 10-40w production of neurons, migration, maturation, apoptosis, formation of inter-neuronal connections and pruning occur in rapid progression.

Volpe J, Neurology of the Newborn p 59,1995

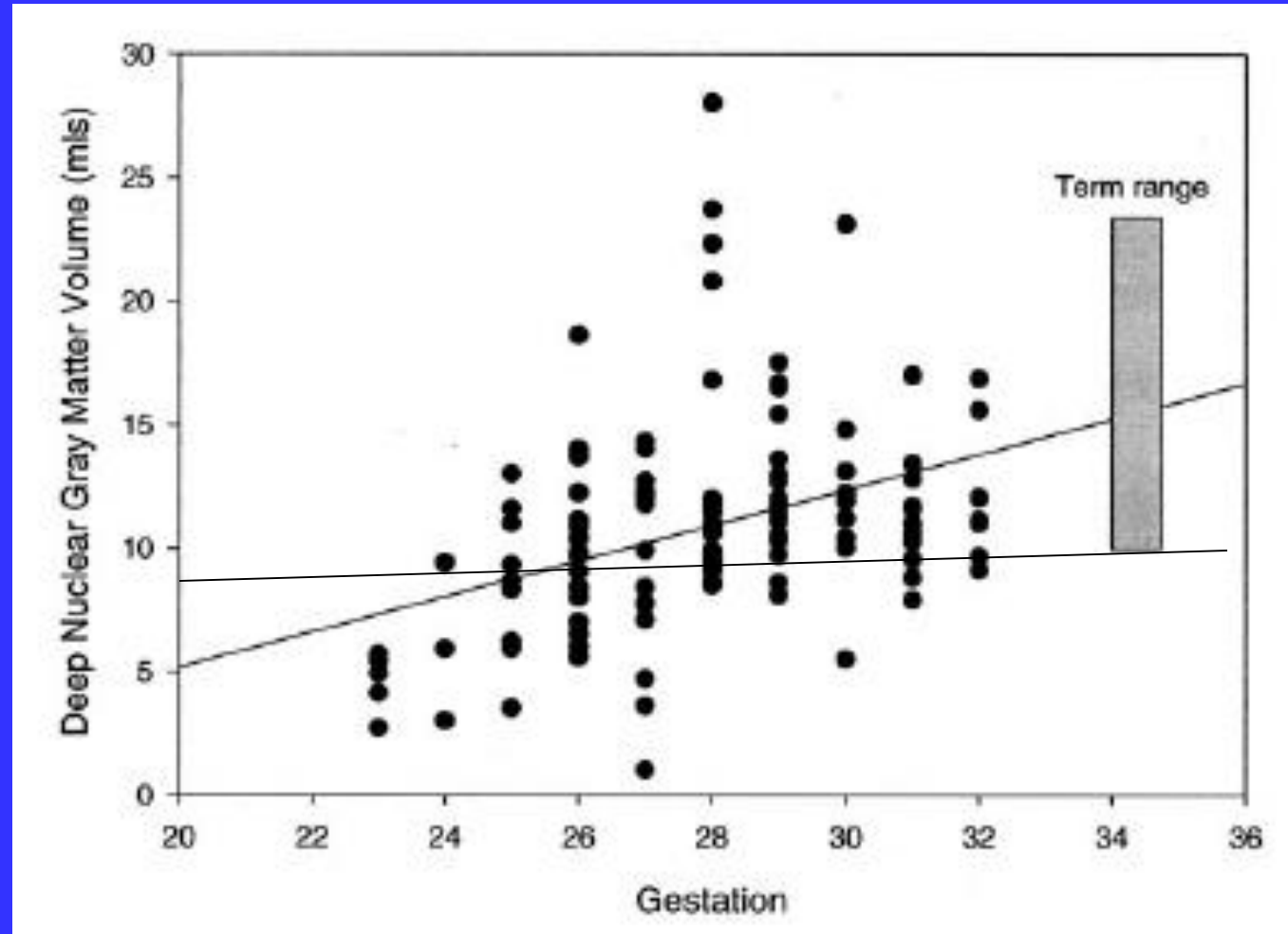




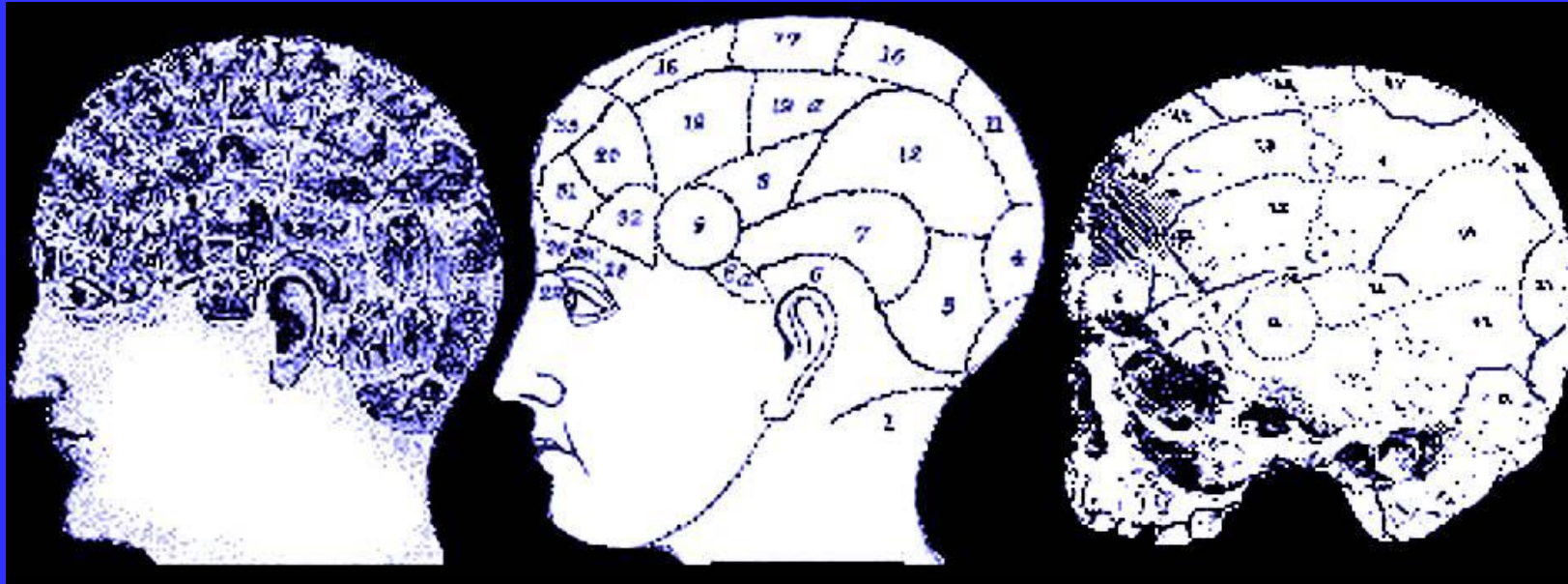


Correlation between deep nuclear GM volumes and gestational age **at Term**

Inder et al
showed the
relationship
between GA at
birth and deep
nuclear GM vol.
at term. (Peds
2005)



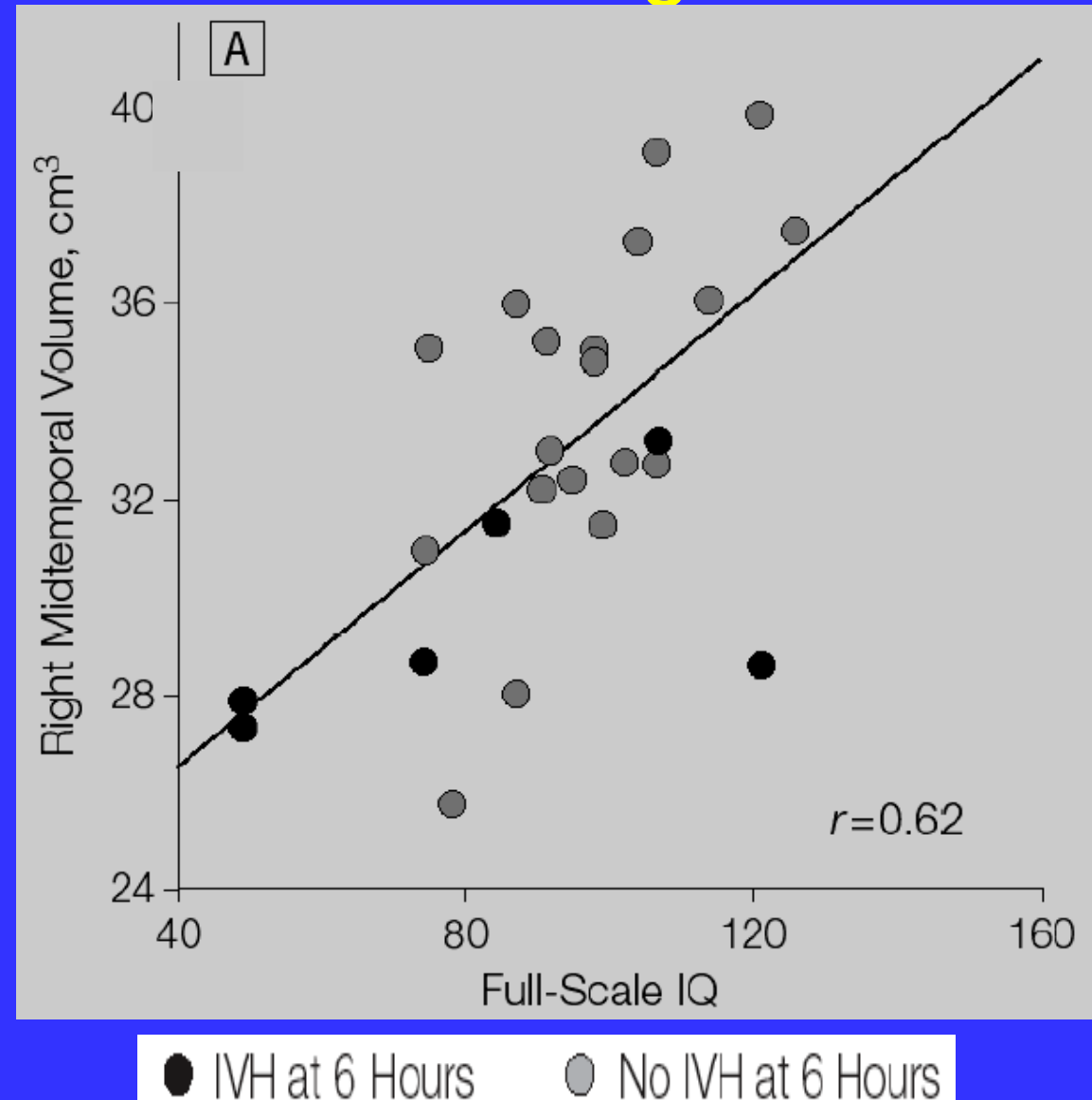
How much does brain size matter for cognitive and Language development ?



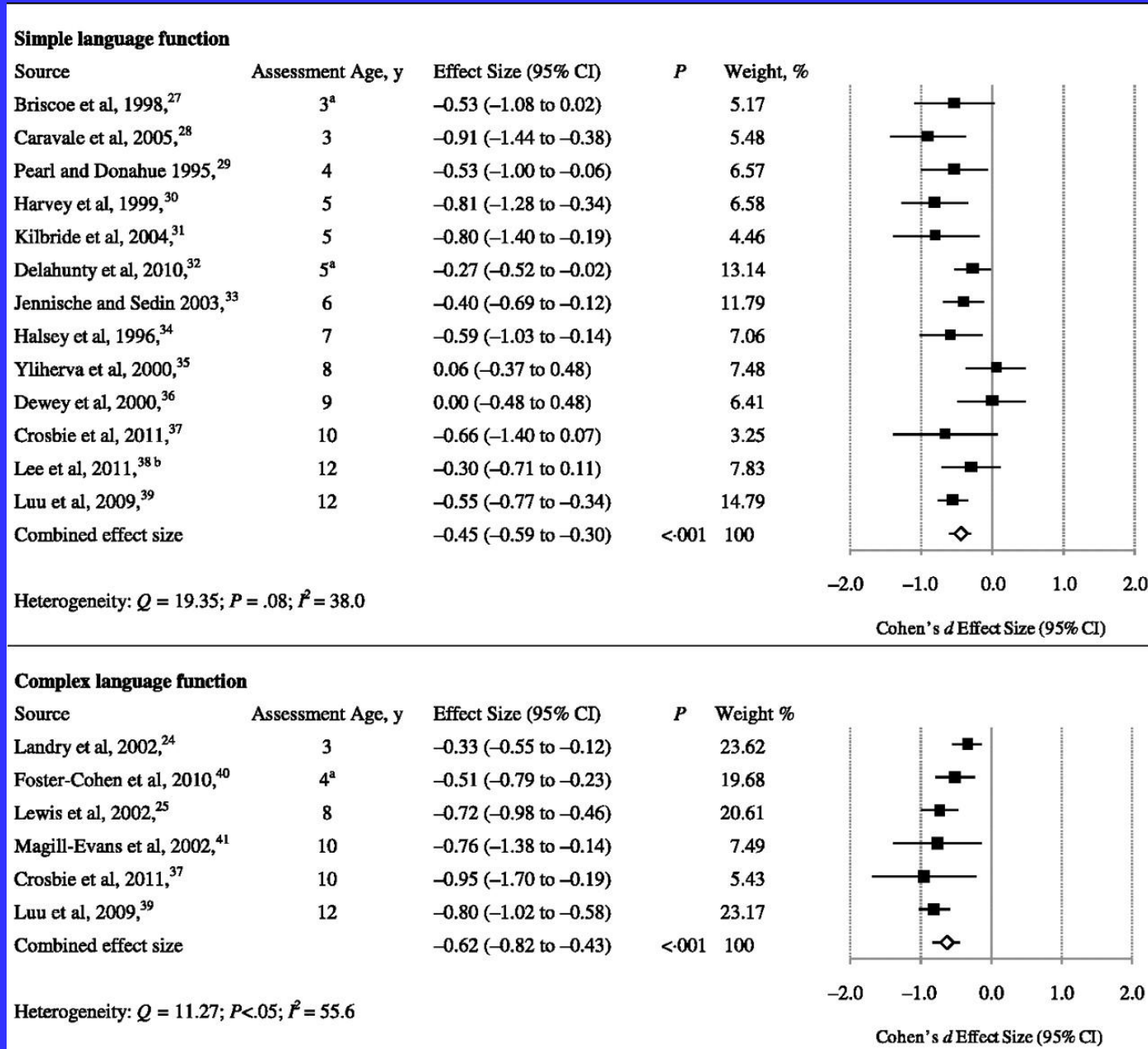
JJ Neil, 12-02

Relationship of Brain Volume and Cognitive Outcomes at 8 Years of Age.

- Cerebral volumes were linearly related to Full Scale IQ, Verbal IQ, Performance IQ & PPVT for preterm subjects
- Peterson BS, Ment L et al, 2000
- This is worrisome, but does recovery of verbal and cognitive function continue after 8 y ?



Random-effects sizes and heterogeneity statistics for A, simple language function (receptive vocabulary measured by PPVT) and B, complex language function language measured by CELF).

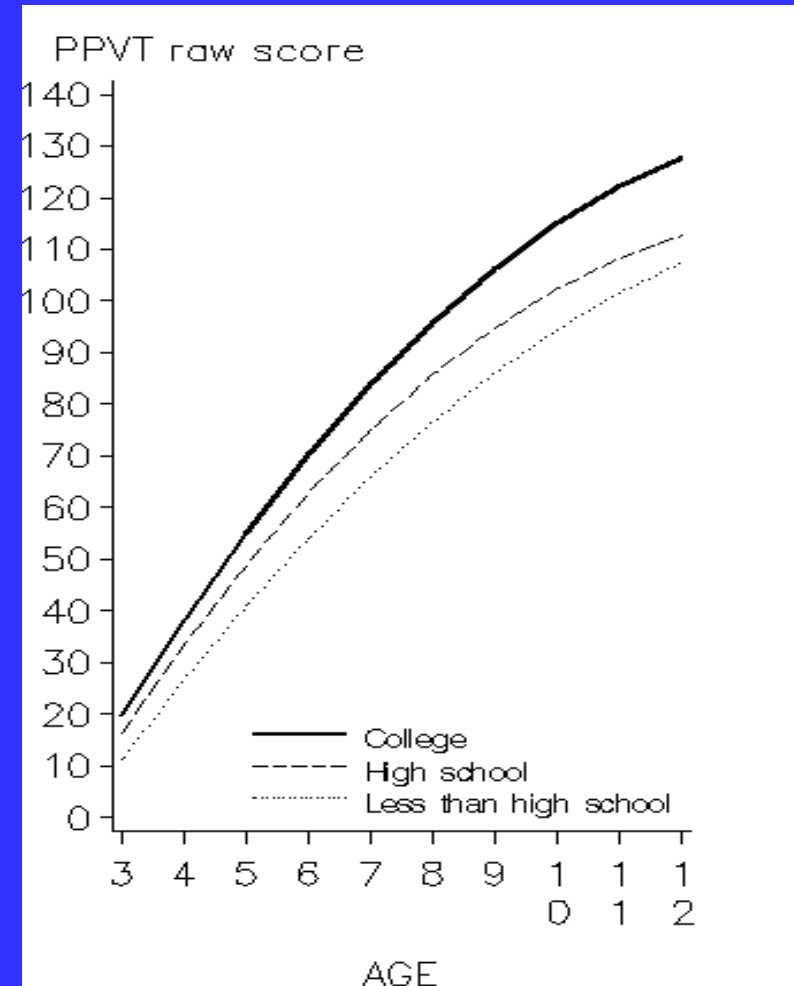
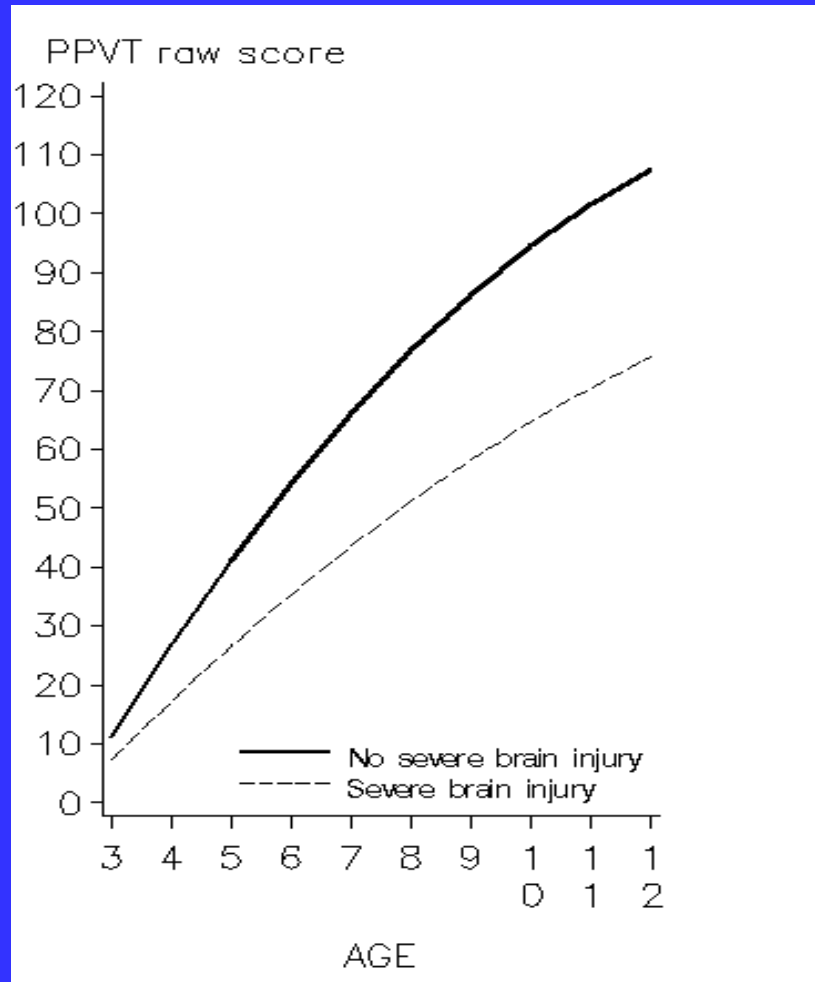


This meta analysis shows studies of PT compared to T infants have deficits in both simple and complex language skills between 3 & 12y after excluding children with scores > @SD↓

Can Premies Catch up ?

Raw Scores on PPVT from 3-12 y Indo cohort

Luu et al Pediatrics 2009



Multivariate regression of Full Scale IQ @ 12y

Birth weight (100 g increment)	0.5 (-0.5, 1.6)
Small for gestational age	-0.4 (-4.3, 3.4)
Male sex	-0.7 (-4.0, 2.5)
Antenatal steroids	3.7 (0.3, 7.1)*
BPD	-2.4 (-6.1, 1.4)
Severe brain injury	-22.1 (-28.1, -16.2)*
Maternal age < 20	-0.4 (-5.4, 4.6)
Maternal years of education	2.0 (1.3, 2.7)*
Single-parent household	-5.9 (-9.4, -2.3)*
Minority status	-8.4 (-12.2, -4.5)*

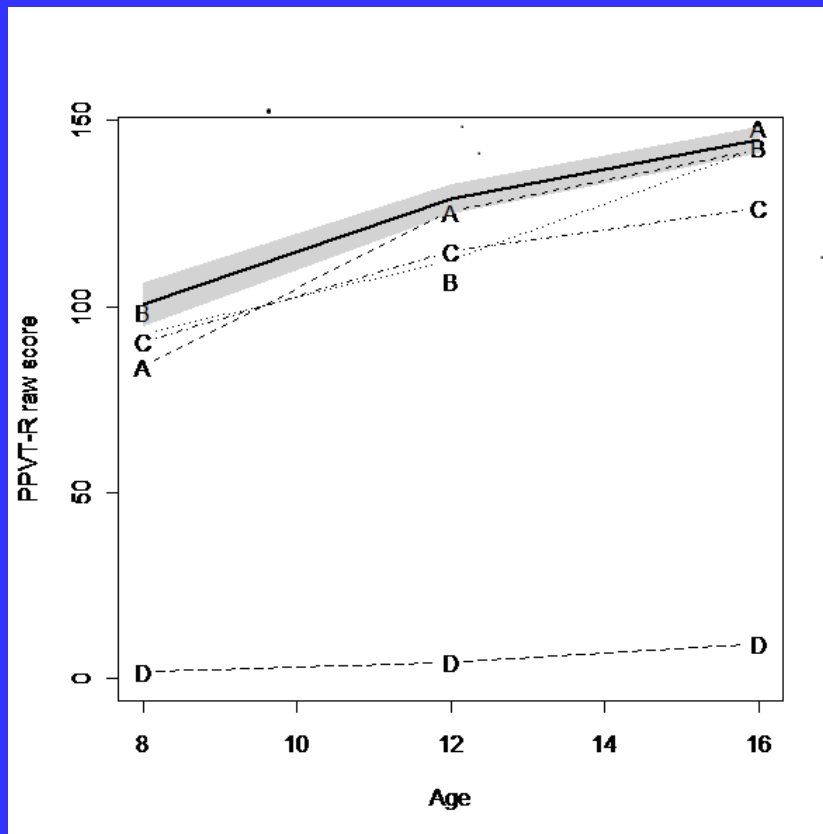
*p-value < 0.05

Luu et al Pediatrics 2009

Patterns of receptive language development from 8 to 16 years

Luu T M et al. Pediatrics 2011;128:313-322

PT clusters ABCD



Who catches up ?

Clusters A, B, C, and D

No diff in bwt, BPD, bilingual household

Maternal education A > B, C, D

D was all children with NSI

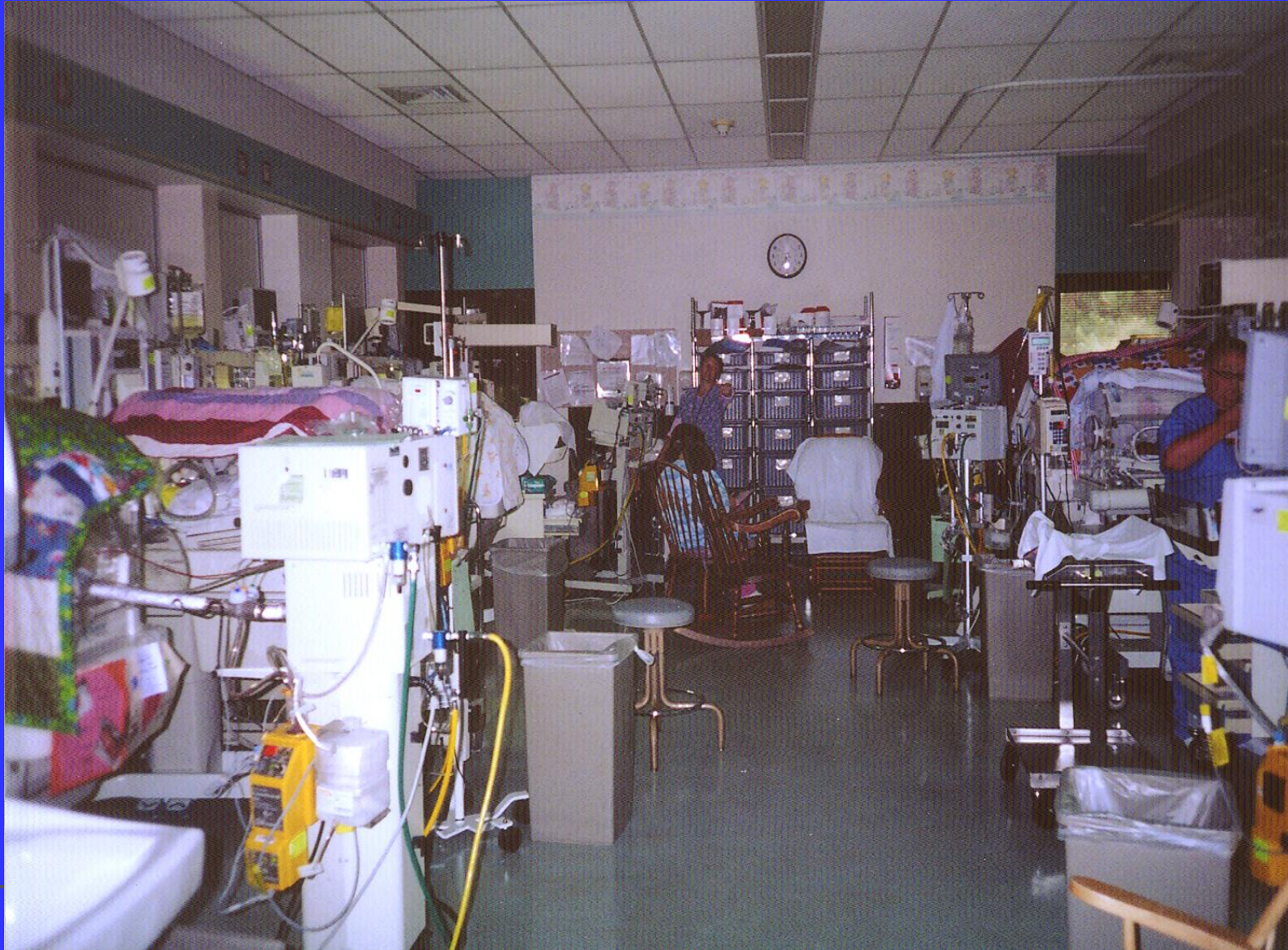
CP, seizure disorder, blind, HA, shunt

The Language Environment of a Term pregnancy

- In womb-
 - Mother's voice
 - Low frequency, high intensity sounds
- FT infants prefer human voice to other acoustic stimuli
Butterfield 1972
- 3 day old T infants prefer mothers' voice to other female voices; De Casper et al 1980



What is the sensory environment of the Isolette (Uterus) in the NICU ?



Why might there be a problem with the sensory input in the NICU ? VLBW Infants are exposed to the atypical environment for weeks to months

- Prolonged exposure to noise levels > 45 dB
- ↑ ambient light, often 24 h/day
- ↑ Stressful manipulation
- ↑ Painful procedures
- ↓ soothing tactile stimulation
- ↓ developmentally appropriate stimulation
- Multiple caregivers

What can PT preterm “brain” experience ?

- Consciousness emerges with the establishment of the cortico-thalamic connections which relay sensations & motor signals to the cortex. (24-32 w)

Lagerkrantz et al. Acta Paediatrica 2007

- Begin to respond to auditory stimuli by 24 weeks ; 16 weeks before their due date. Bernholz et al 1983
- Consistent auditory & visual responses by 28 weeks

The NICU Environment

- Can the NICU Language and Sound Environment be modified and incorporate the importance of parent talk ?



Study: Preterm and LENA:

Caskey et al. Pediatrics 2011

- This was a prospective study of infants ≤ 1250 g (2lb 8 oz) with recordings at 32w and 36 weeks gestation.



Objectives

- To determine the presence of AWCs, child vocalizations and CTs in the NICU.
- To test the association of AWC with CV and CT
- To test the associations of AWCs, CTs and CVs at 32w & 36w post-menstrual age (PMA) in the NICU with Bayley-III Cognitive and Language scores at 18m corrected age (CA)

Design

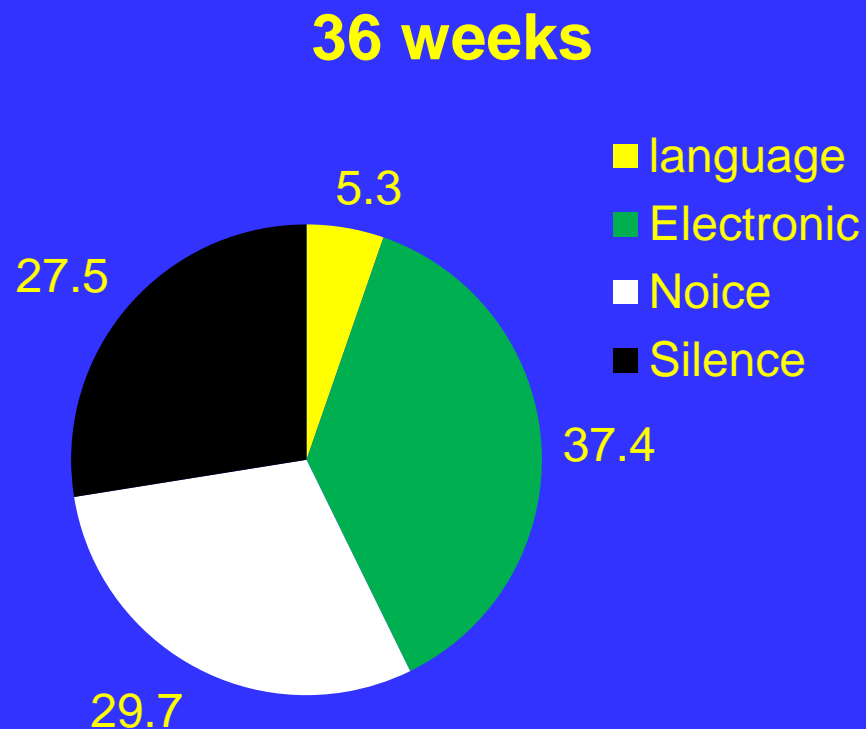
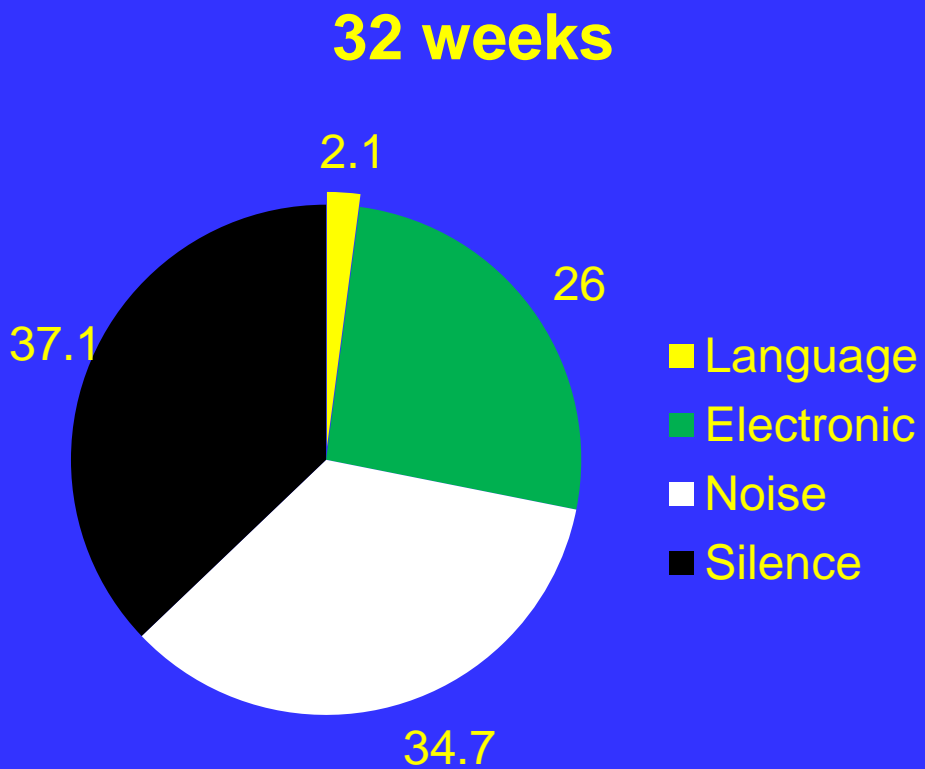
- 36 medically stable and non-intubated infants \leq 1250 grams birth weight were enrolled
- 16 hour LENA recordings were made using the digital language processor inserted into a vest worn by the infant at 32w and 36w (PMA)
- Bayley-III was completed at 7 and 18 months CA

Demographics of ELBW Infants

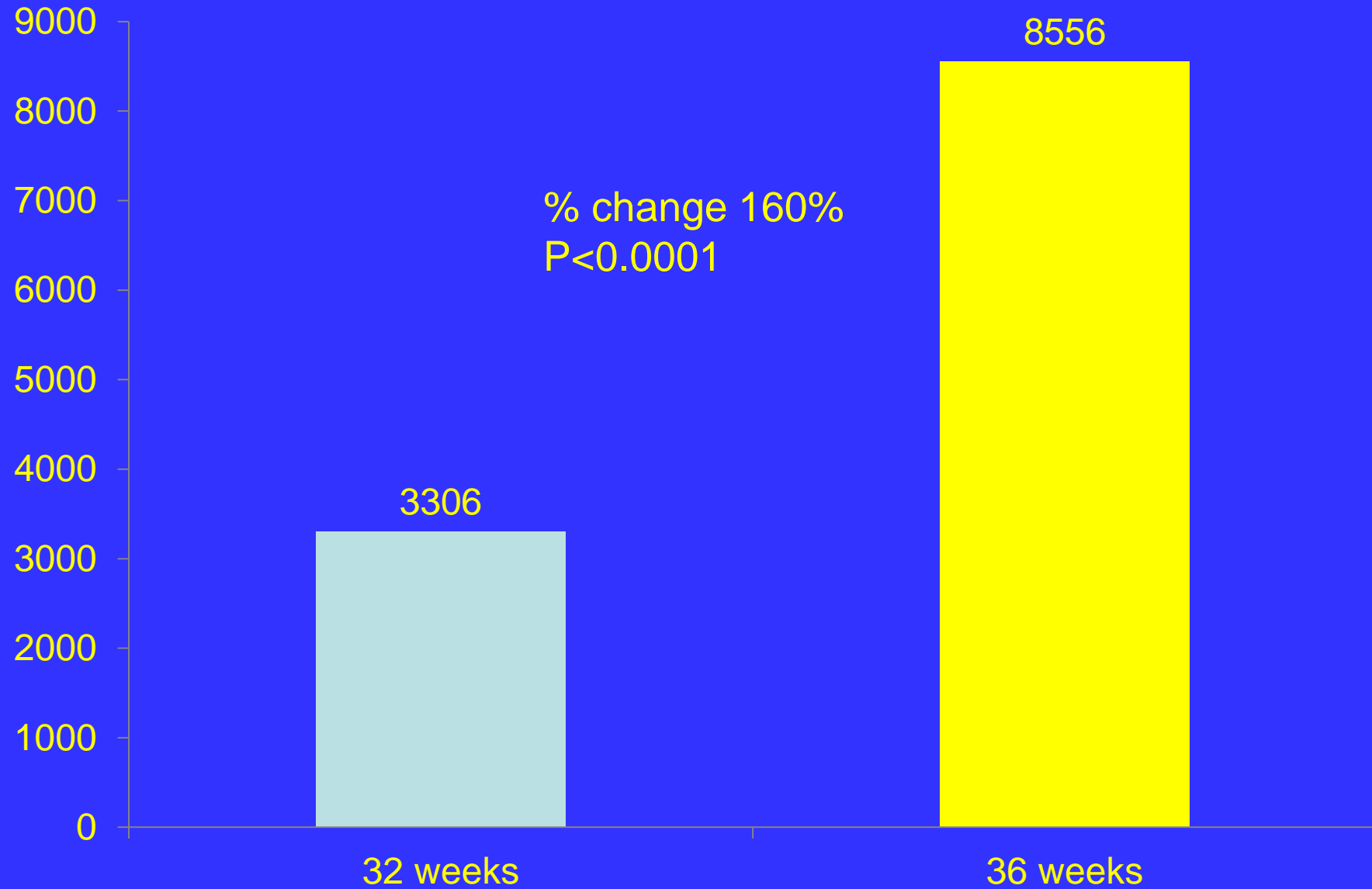
Variable	N=36
Males, n, (%)	15 (42)
Average Gestational Age (weeks)	27 \pm 2
Average Birth weight (grams)	896 \pm 195
Maternal age (years)	30.8 \pm 7
Gravida 1 (%)	44

1 lb 15 ounces

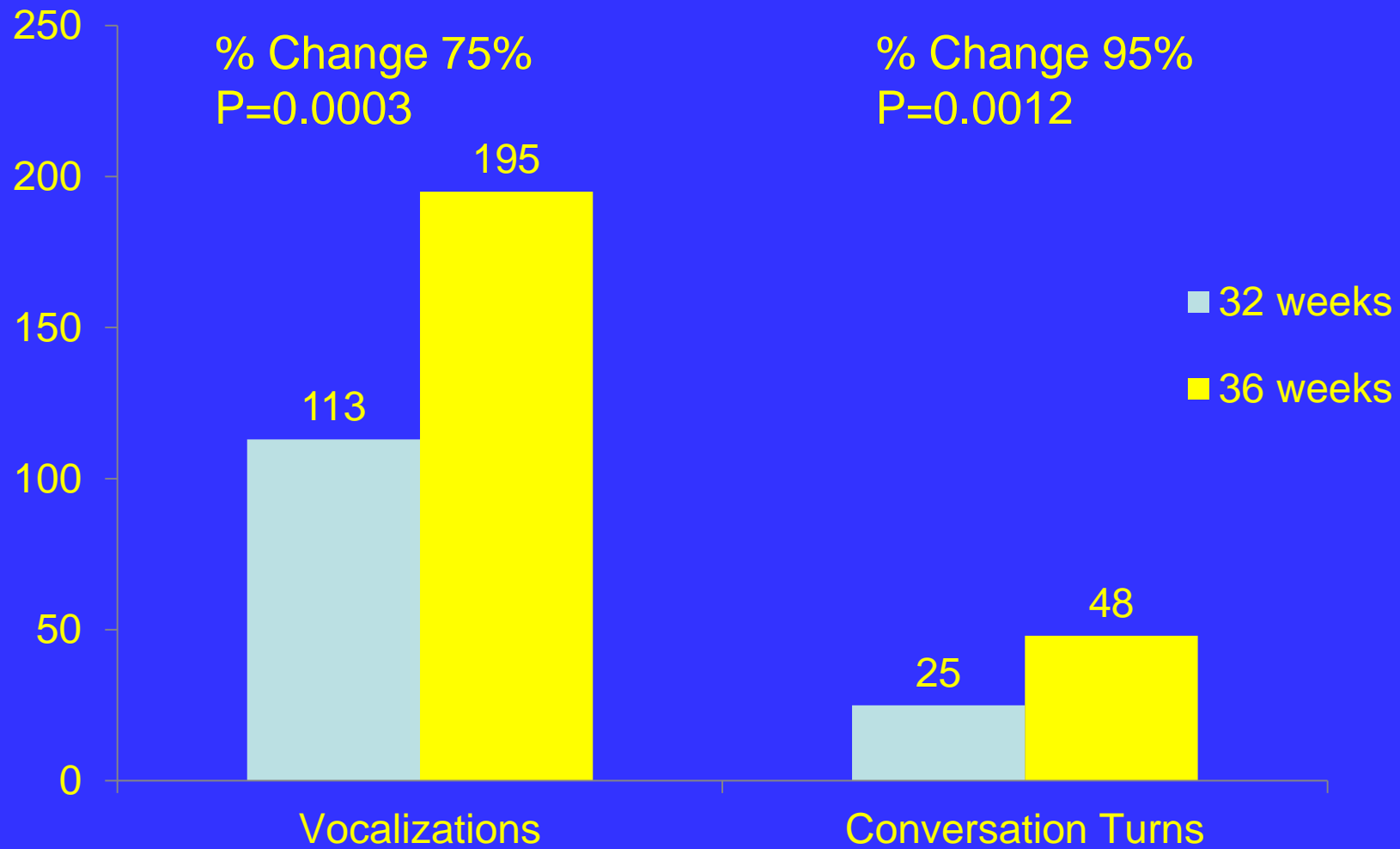
% Language in Environment of Open Bay NICU

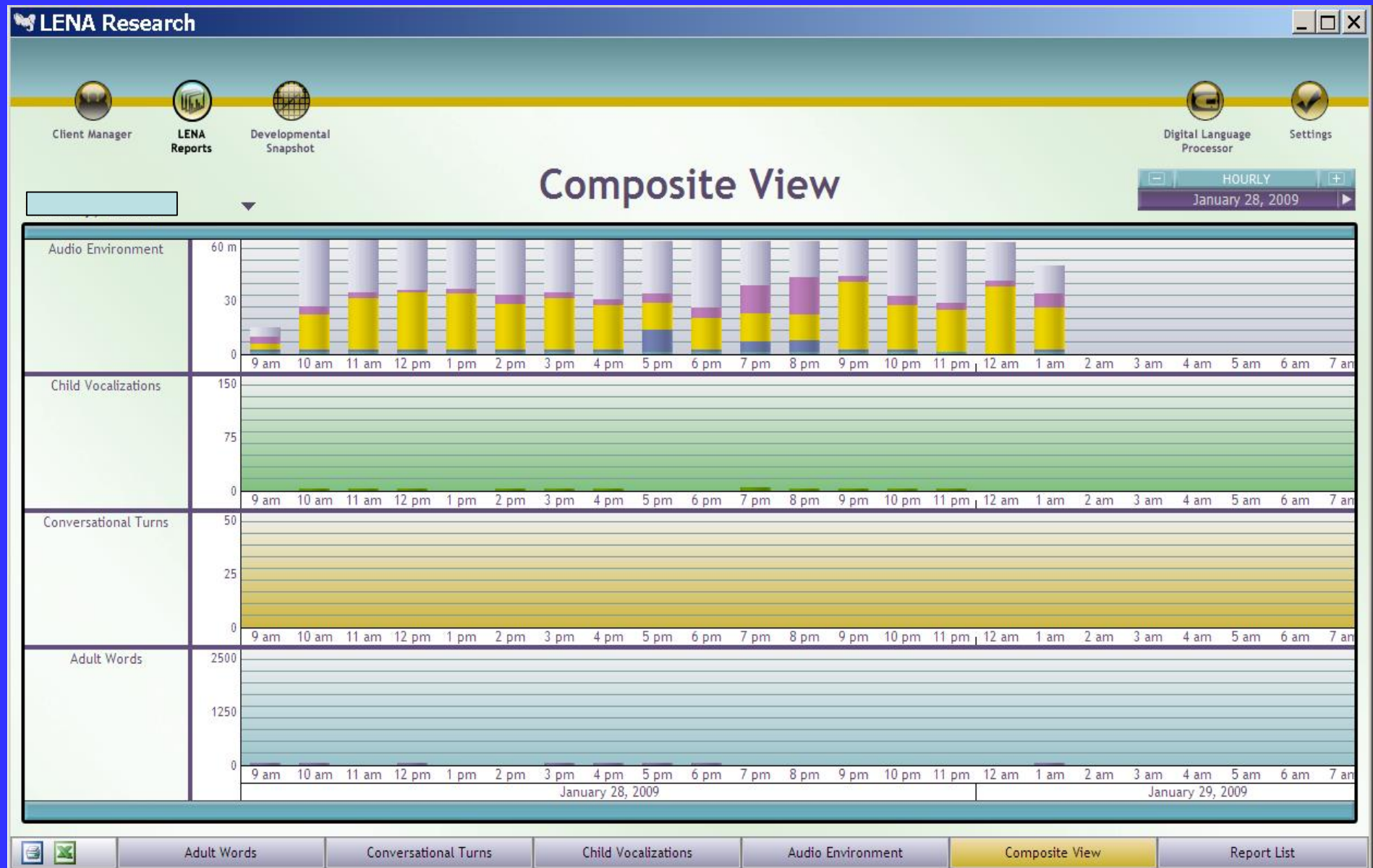


Total Adult Word Count at 32 and 36 weeks

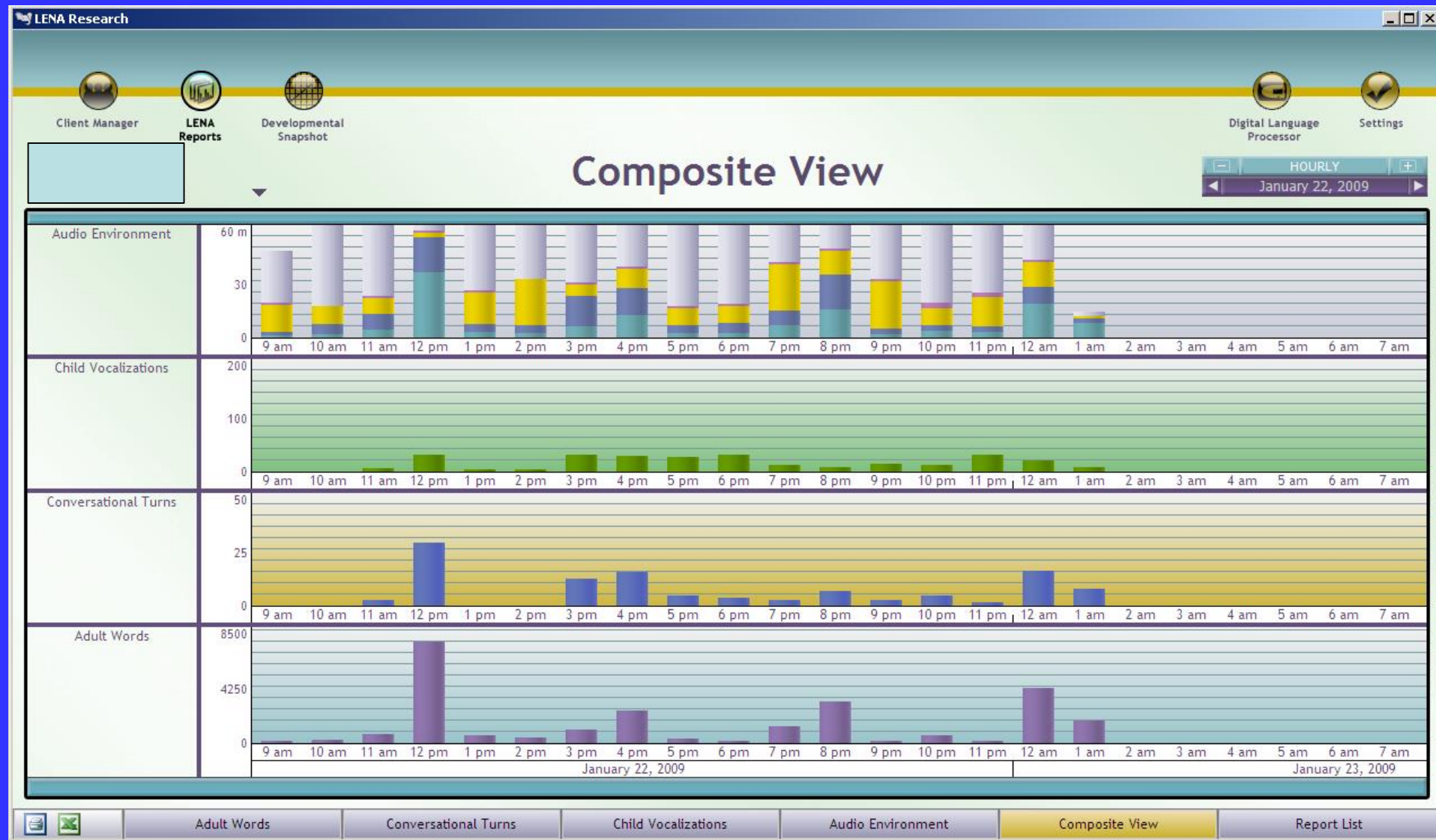


Total Child Vocalizations & CTs at 32 and 36 w





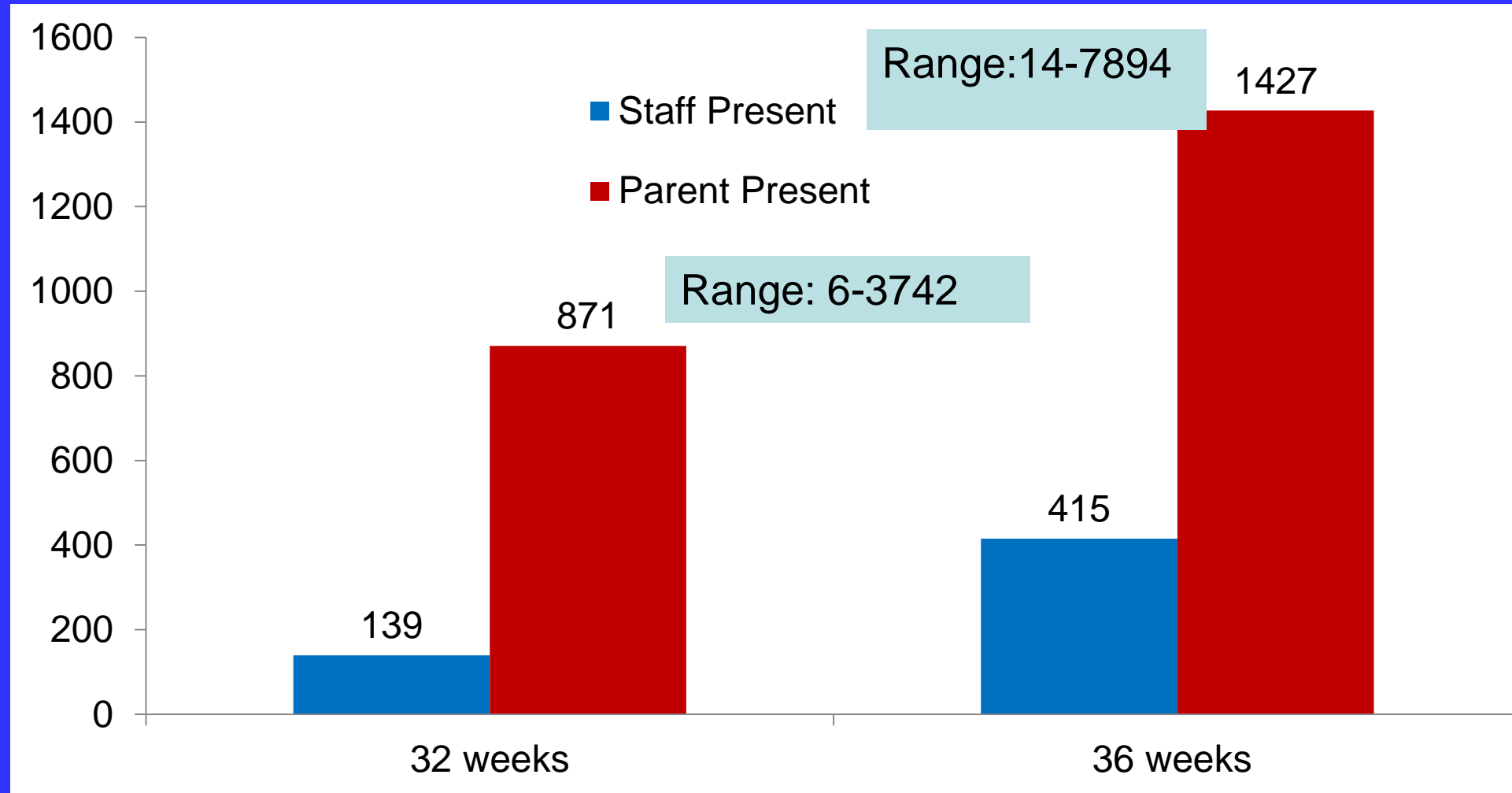
29w now 32 weeks, Giraffe bed, continuous feeds, no visits,
room air



25w infant, at 36 weeks. Room air, crib, feeds all po, mom visited at noon, 4pm 8pm and 12am.

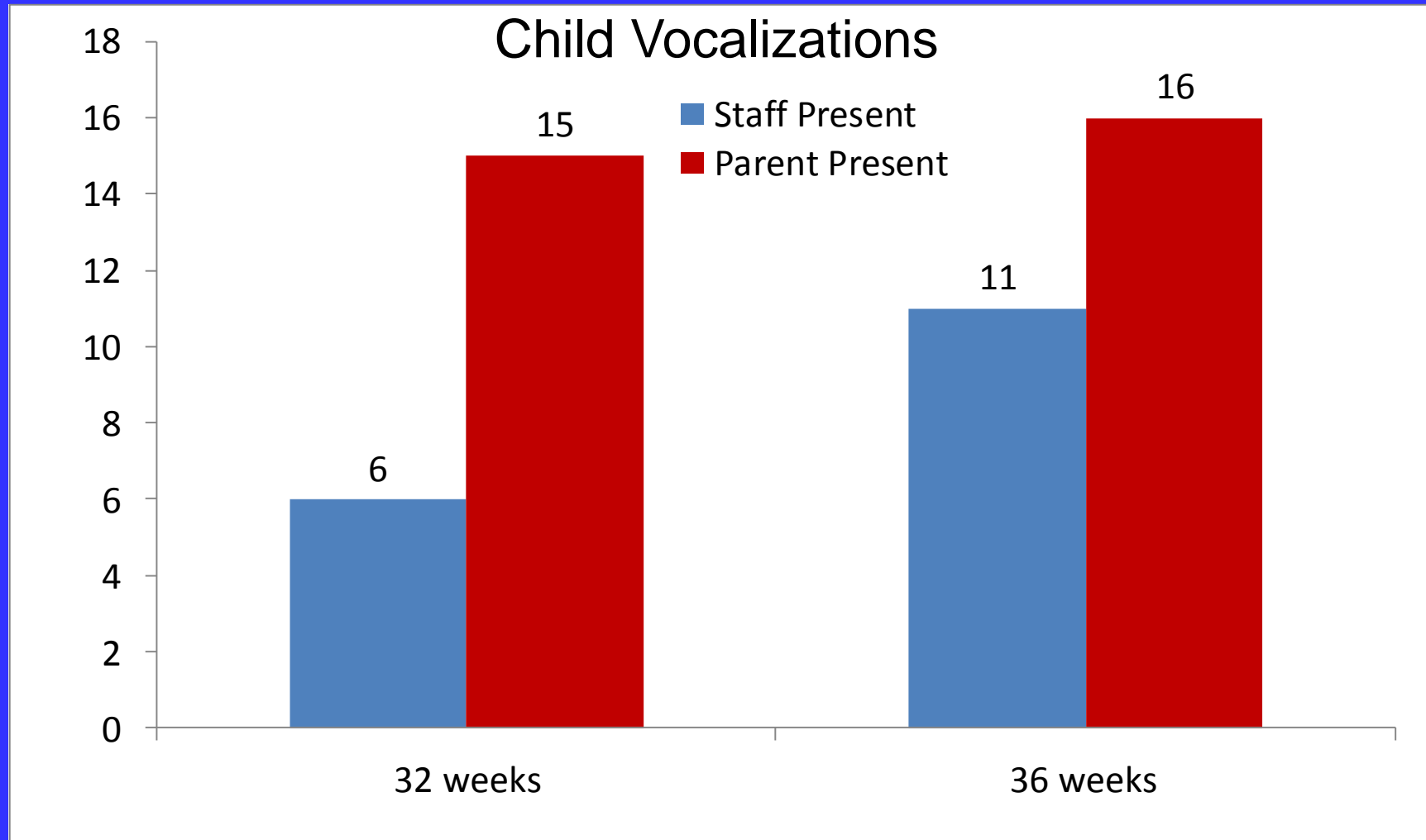
Hourly Adult Word Counts during a Parent Visit versus No Parent Visiting

Caskey M, Ped 2013



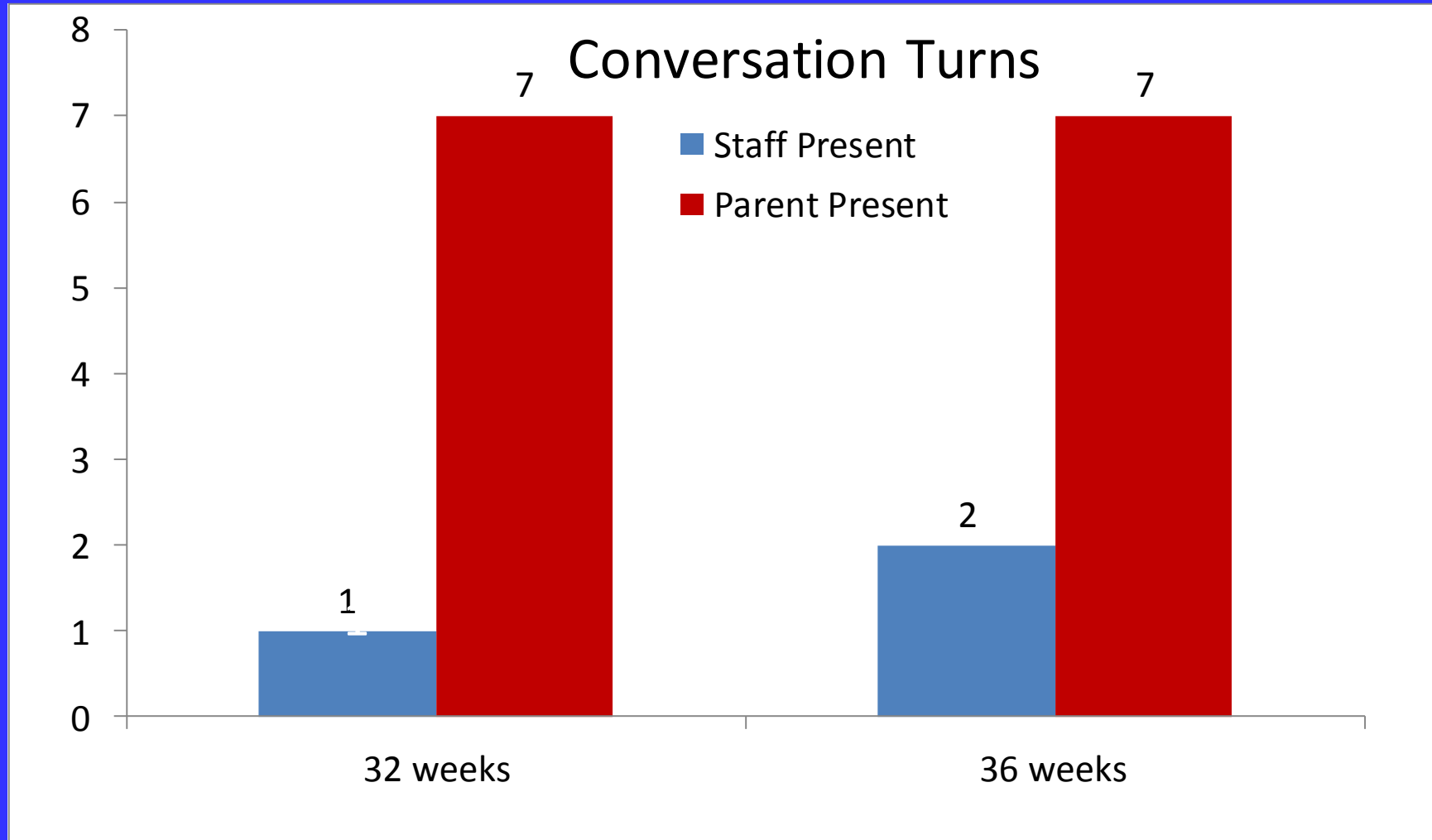
Hourly Child Vocalizations during a Parent Visit versus No Parent Visiting

Caskey M, Ped 2013



Hourly Conversational turns during a Parent Visit versus No Parent Visiting

Caskey M, Ped 2013



Word & Vocalization Counts

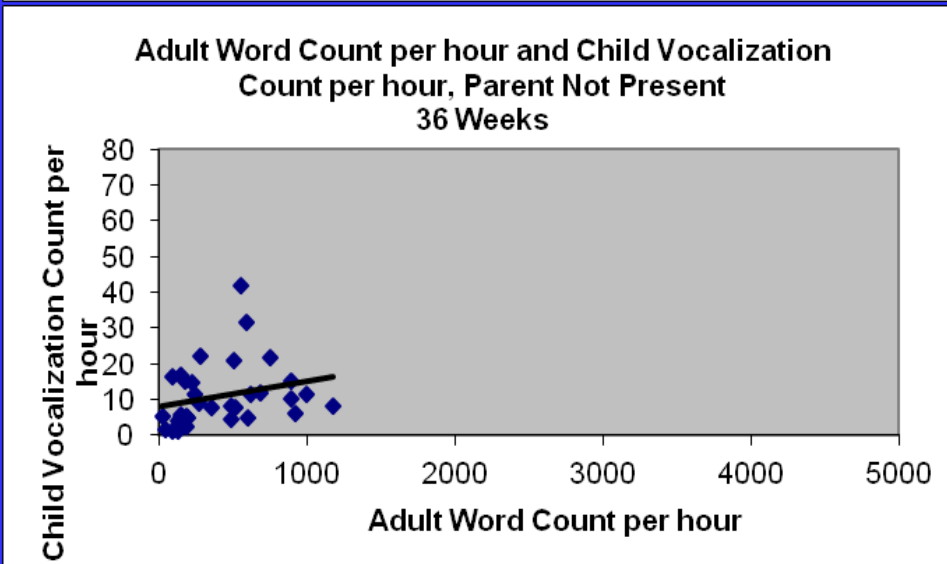
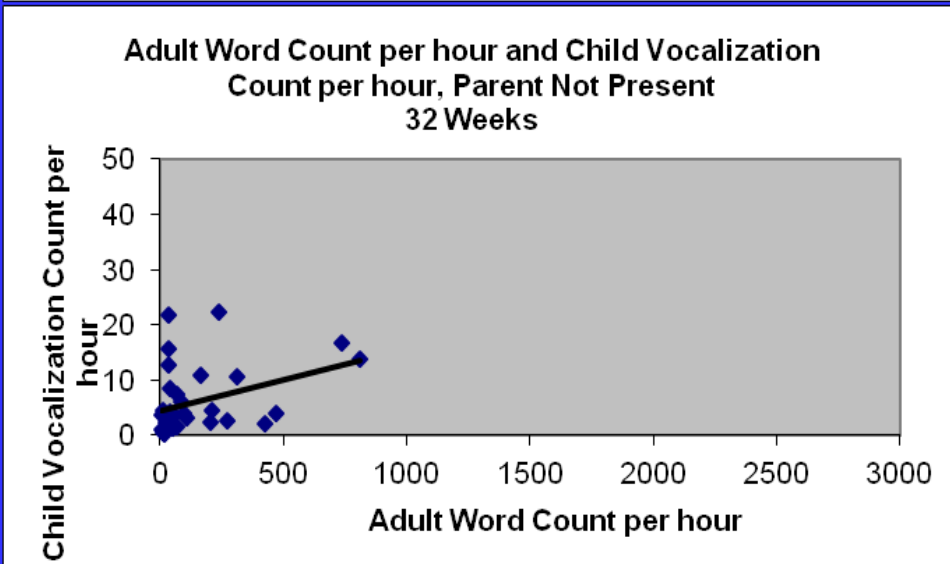
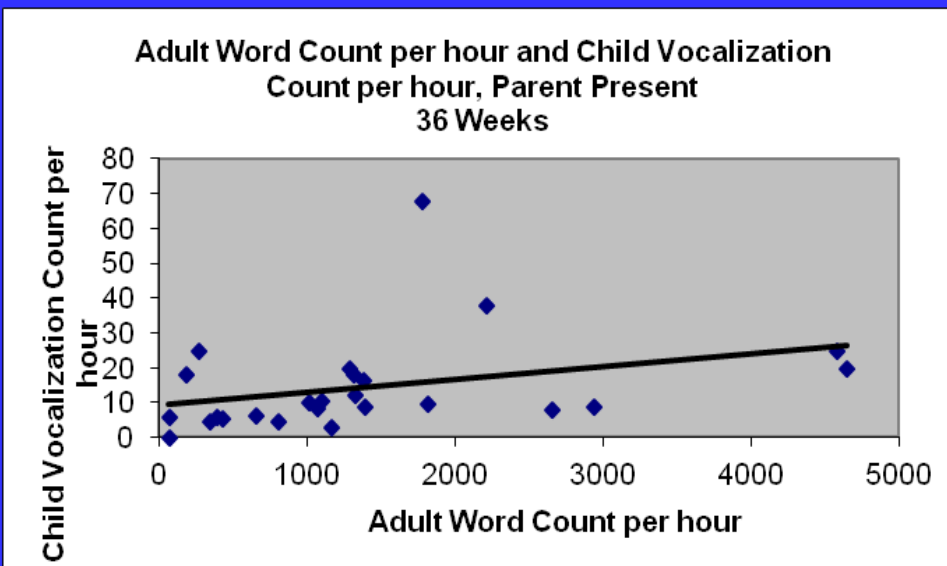
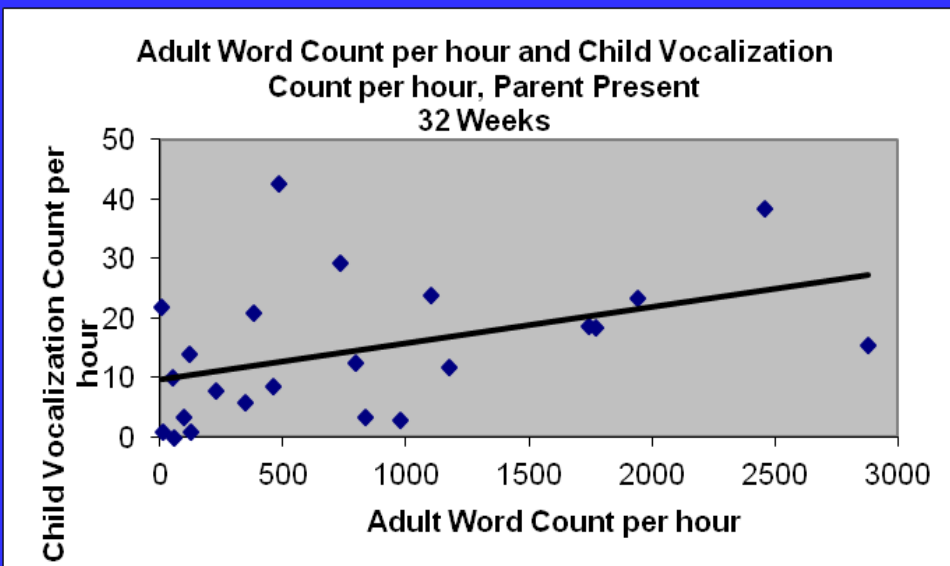
Effects of Parent Visits at 36 wks PMA

Caskey M et al. Pediatrics 2011

Variable Time in minutes	Parent Visiting 91	No Parent Visiting 929
Mean Hourly Adult Word Count	1427* (14-7894)	415 (0-5480)
Mean Hourly Conversational Turns	7* (0-43)	1 (0-59)
Mean Hourly Child Vocalization count	16 (0-107)	11 (0-213)

* P<0.0001

The graphs depict the paired analyses of raw data. A regression line is shown, the coefficient is not presented since data are not normally distributed. Caskey M. Ped. 2014

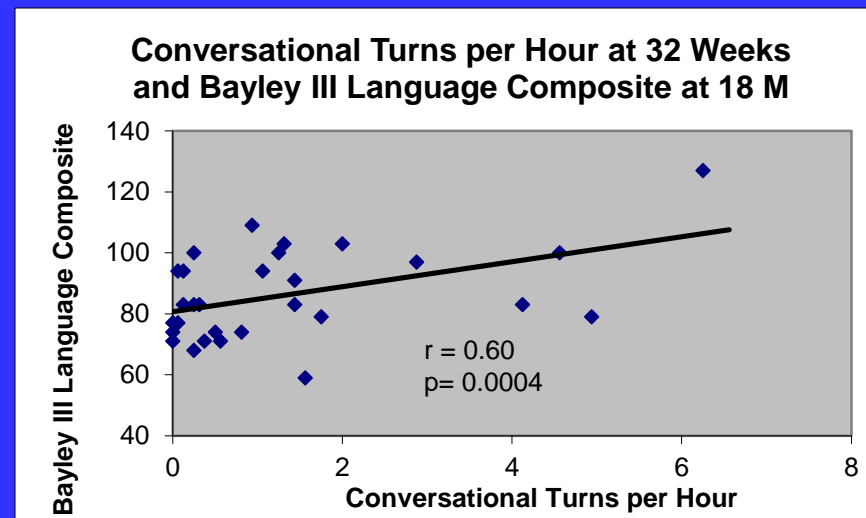
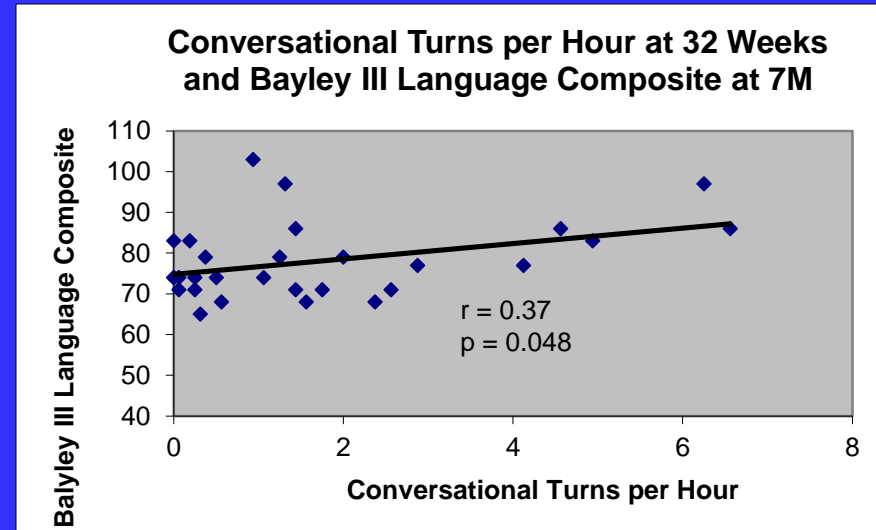
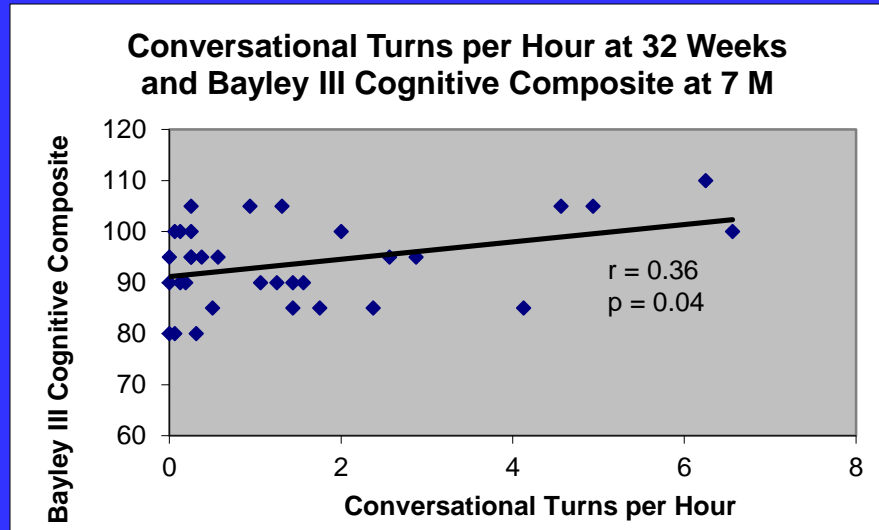


Mean Bayley III Scores at 7 and 18 months

Caskey M et al. Pediatrics, Feb. 2014

Bayley III Scores	7 months	18 months
N	32	31
Cognitive Composite Score	94±8	91±10
Language Composite Score	78±9	85±15
Receptive Communication Scaled Score	6±2	7±3
Expressive Communication Scaled Score	7±2	8±3

Associations of CTs at 32 weeks and Bayley scores at 7 and 18 months



Regression Analyses of LENA at 32 and 36 w with Bayley III scores at 18 m CA (after adjustment for bwt).

Caskey M et al. Pediatrics, Feb. 2014

LENA Measure/Bayley-III	b	P	Model R^2	LENA Partial r^2 Variance
32 weeks, 100 AWC/hour				
Receptive communication, 7 m	0.3	.0413	0.14	0.14
Language composite, 18 m	2.0	.0404	0.25	0.12
Expressive communication, 18 m	0.5	.0081	0.30	0.20
36 weeks, 100 AWC/hour				
Cognitive composite, 7 m	1.2	.0049	0.26	0.26
Expressive communication, 18 m	0.3	.0701	0.24	0.10

Regression Analyses At 18m Caskey M. Ped. 2014

- **AWC/h @ 32w** accounted for 12% variance in language composite and 20% of variance in Expressive Communication at 18m
- Every \uparrow in 100 **AWC/h@32 w** was assoc with a 2 pt \uparrow in lang. comp. score.($p=.04$) @ 18m and 0.5 pt \uparrow in expressive communication score @ 18m($p=0.008$).
-
- Every \uparrow in 100 **AWC/h@36 w** was assoc with a 1.2pt \uparrow in Cog Comp score @ 7m ($p=.004$) @ and a .3 pt \uparrow Exp Communication @ 18m ($p=0.07$)

Results Continued for CT

- For every increase in CT count per hour at the 32 week recording
 - the cognitive composite score increased on average by 1.7 points ($p = 0.005$) at 7 months
 - the language composite score increased by 5.3 points ($p=0.005$) at 18 months

Summary

- Daily AWC are highly variable among infants cared for in the NICU
- Preterm infants begin to make vocalizations 8 w prior to their projected due date and ↑ the number of vocalizations significantly over time.
- Language exposure increases over time, however accounts for only a small percent of the sounds to which an infant is exposed in the NICU
- Parent talk in the NICU has a strong positive effect on infant vocalizations and conversational turns

Summary

- PT Infants are at increased risk of language delays.
- PT infants exposure to ↑AWC & CTs in the NICU is associated with ↑ **cognitive and language scores at 18 months** corrected age.
- Parents should be encouraged to visit, talk, and sing to their infants in the NICU.
- Language Exposure in the NICU is a powerful predictor of language outcomes.
- An optimal home language environment is associated with continued recovery of language skills with ↑ age.

The Research Team

THANK YOU
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