Early Learning and the Developing Brain

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Interventions that will help children and families

Brain Function

Brain Structure
Brain Growth: Birth to Adulthood

- **Birth**: 25%
- **1 year**: 70%
- **3 years**: 85%
- **5 years**: 92%
- **7 years**: 95%
- **10 years**: 98%
- **Adult**: 100%
Synapses proliferate, and then are “pruned”!
The ‘Critical Period’ for Language

Johnson & Newport, 1999
Language learning is inherently social:
Infants learn in context from people, not machines!

Infants learn foreign-language phonemes and words rapidly from live exposure, but *no learning occurs* when television or audio-only presentation is used

Kuhl et al., *Proceedings of the National Academy of Science*, 2003
Cumulative Differences in Language Heard by Age 4: 30 Million Word Gap!

- **Estimated Cumulative Words Heard by Child (in millions)**
- **Age of Child in Months**

**Lines represent:**
- Professional family
- Working-class family
- Welfare family

Hart and Risley, 1995
“Parentese” speech to children at home is linked to children’s later language skills

Ramirez-Esparza, Garcia-Sierra, & Kuhl, *Developmental Science*, 2014
Magnetoencephalography (MEG)
Baby MEG

Kuhl, Ramirez, Bosseler, Lin, & Imada  *Proceedings of the National Academy of Sciences, 2014*
12-Month Monolingual English Syllable
Whole Brain DTI: 12 month old
Timing of Neural Development Signals
When Children are “Ready” to Read

Jason Yeatman et al., 2012
Bilingual Learning and Cognitive Flexibility
Bilingual Brain Development

• More ‘open’ to new languages than monolingual peers

• More cognitively flexible!

• Equivalent vocabulary growth

• Brain responses to both languages

Garcia-Sierra & Kuhl, *J of Phonetics*, 2011
Tests of Executive Function: Monolingual child

Conboy, Sommerville, & Kuhl (2015)
Tests of Executive Function: Bilingual child

Conboy, Sommerville & Kuhl, 2015
Three Interventions That Will Help Our Children
(1) Early Language and Literacy Intervention for Low Income Families

Kuhl, 2015
(2) Bilingual Babies: Madrid!

Ferjan-Ramirez & Kuhl, 2015
(3) Musical Intervention for Pattern Perception

- The “waltz”
- Social environment
- 12 sessions over one month’s time
- Brain tests after exposure
- Track language development until 30 month of age

Zhao & Kuhl, 2015
Thank you