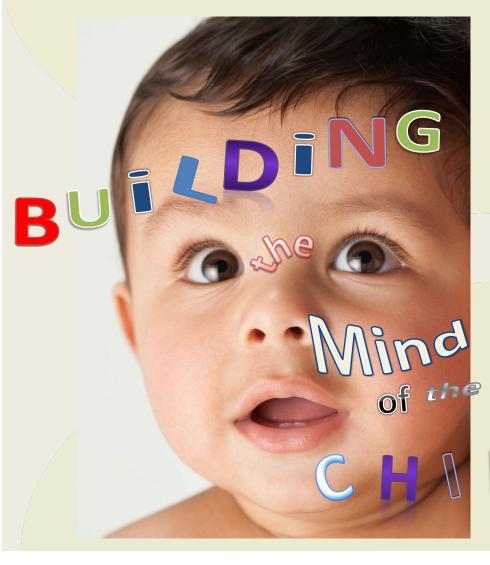
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Convergence: Neuroscience and Early Childhood Education

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Brain Function

Brain Structure

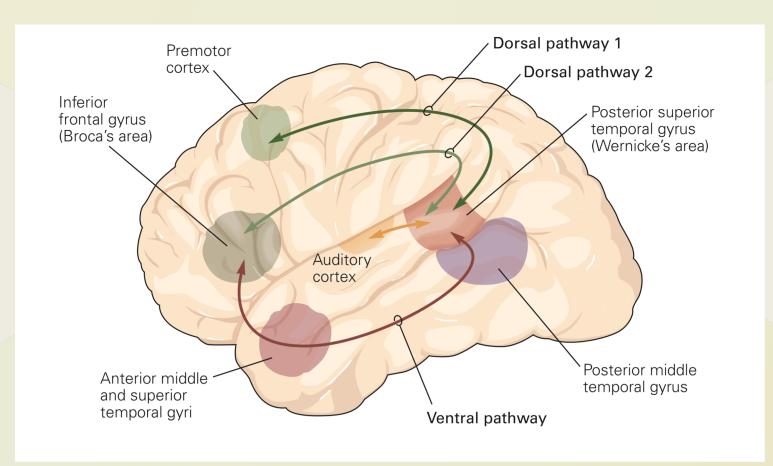




Neuroscience will explain how the brain is affected by experience and why it matters.



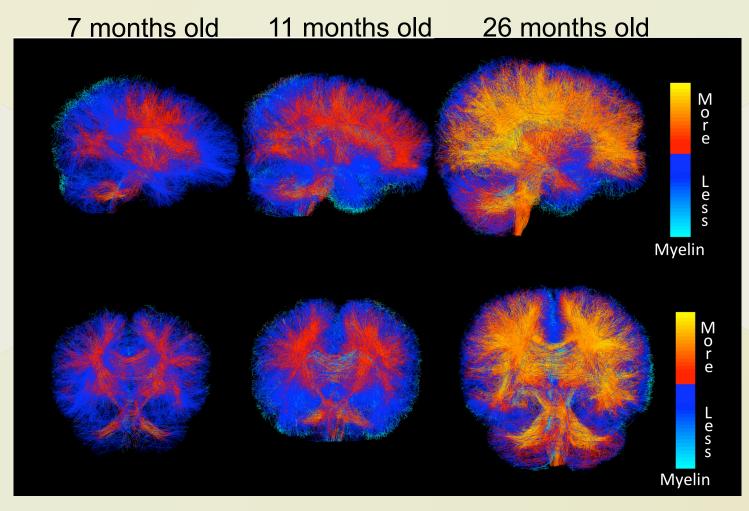
The Language Network



Kuhl, in Kandel et al. Principles of Neural Science, 6th Ed., 2021

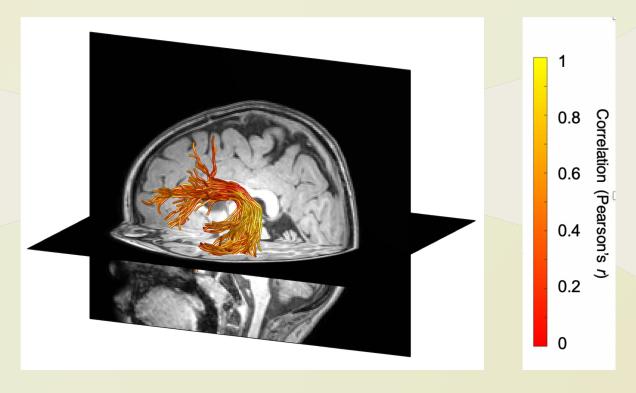


Maturation and Learning Increase Connectivity



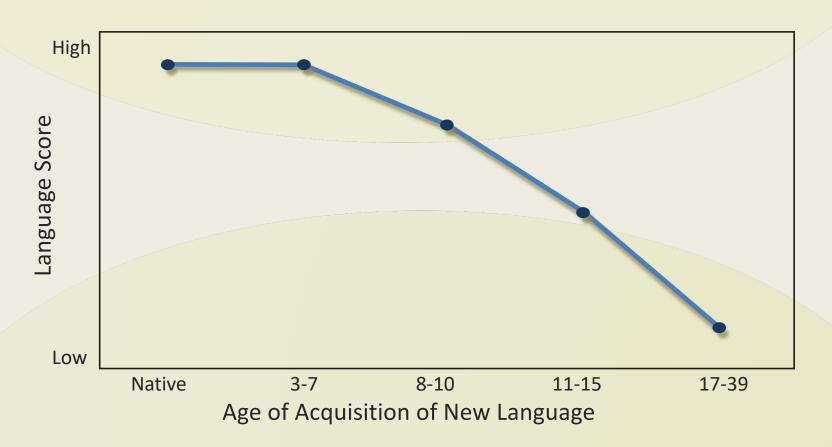
Kuhl, in progress

Verbal exchanges with children systematically strengthen network connections by 26 months



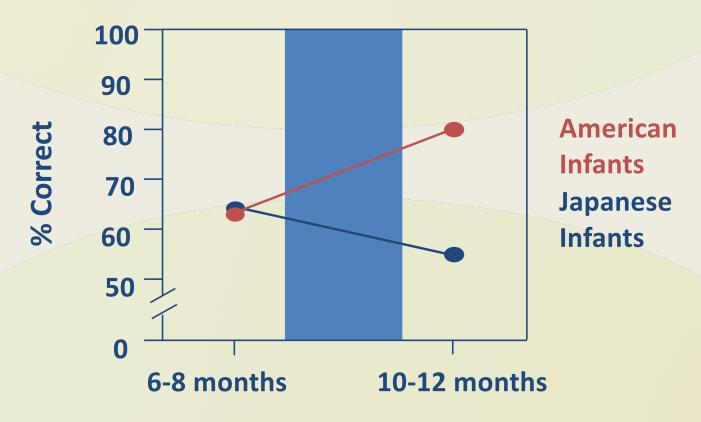
Huber, Ferjan Ramirez, Corrigan & Kuhl, in preparation, 2021

The 'Critical Period' for Language



A 'Sensitive Period' for Speech Learning

Infant discrimination of /ra/ vs. /la/



Kuhl et al., Developmental Science, 2006

Mandarin Chinese Exposure

12 sessions between 9 and 10.5 months of age



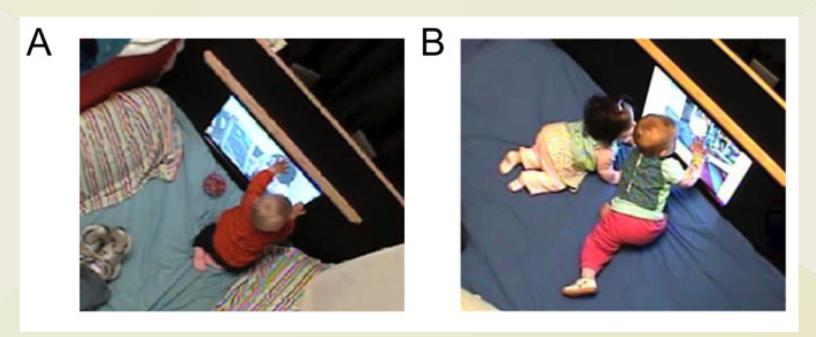
Kuhl, Tsao & Liu, Proceedings of the National Academy of Sciences, 2003

Do Infants Learn From a Machine?



Kuhl, Tsao & Liu, Proceedings of the National Academy of Sciences, 2003

Learning in Pairs Significantly Increases Neural Signatures of Learning



Lytle, Garcia-Sierra, & Kuhl, PNAS, 2018

Magnetoencephalography (MEG)

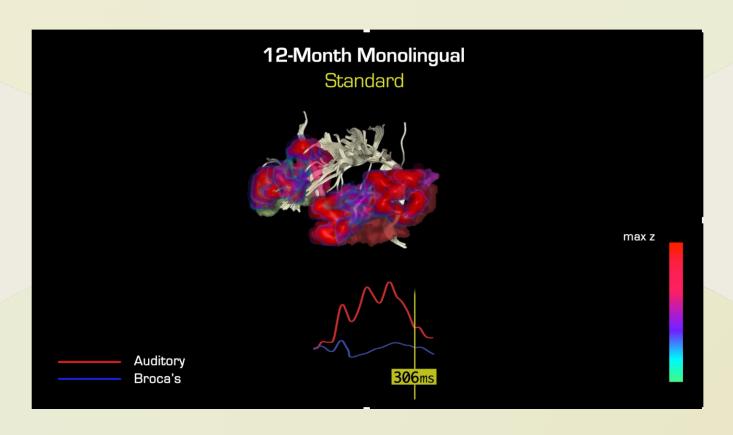


Baby MEG



Imada, et al., NeuroReport, 2006; Kuhl, et al., PNAS, 2014

Perception Activates Brain's Motor Centers



Kuhl et al., PNAS, 2014; Maggie Clark, UW PhD Dissertation, 2021

National Academy of Sciences, USA: Early Childhood Education Makes a Difference!



THE SCIENCE BEHIND IT



Does quality early childhood education lead to more successful lives as adults?

July, 2020

Convergence on the Science of Learning!



Foundations for a New Science of Learning

Andrew N. Meltzoff, 1,2,3* Patricia K. Kuhl, 1,3,4 Javier Movellan, 5,6 Terrence J. Sejnowski 5,6,7,8

Human learning is distinguished by the range and complexity of skills that can be learned and the degree of abstraction that can be achieved compared with those of other species. *Homo sapiens* is also the only species that has developed formal ways to enhance learning: teachers, schools, and curricula. Human infants have an intense interest in people and their behavior and possess powerful implicit learning mechanisms that are affected by social interaction. Neuroscientists are beginning to understand the brain mechanisms underlying learning and how shared brain systems for perception and action support social learning. Machine learning algorithms are being developed that allow robots and computers to learn autonomously. New insights from many different fields are converging to create a new science of learning that may transform educational practices.

Early Learning:

- Computational
- Implicit
- Social
- Informal contexts enhance learning
- Action oriented (agency/ sensorimotor)
- Humans show lifelong neural plasticity, but especially in the early period
- Language, math, reading abilities
 are highly malleable early, but require
 opportunities to learn

Meltzoff, Kuhl, Movellan, & Senjowski, Science (2009)