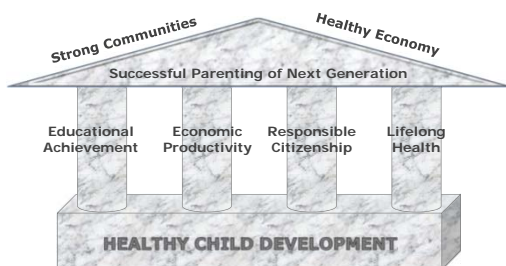


Early Learning and Brain Development

Megan R. Gunnar, Ph.D.
Regents Professor and Distinguished McKnight University Professor
Director, Institute of Child Development
Institute of Child Development
University of Minnesota

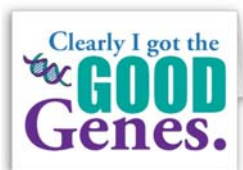


The Foundation of a Successful Society is Built in Early Childhood



Building Healthy Brain Architecture – The Ingredients

- Takes more than having the right genes
- Takes the right, supportive experiences
- Experience literally writes on our genes, determining how well our genes work



How Early Experiences Alter Gene Expression and Shape Development

Neuron

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Genes Carry Instructions that Tell Our Bodies How to Work

Nucleus

Gene

DNA

Chromosome

SOTA ENT

Early Experiences Leave Lasting Chemical "Signatures" on Genes

External Experience

Gene Regulatory Proteins

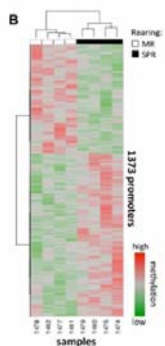
Epigenetic "Signature"

Turns Gene On or Off

SOTA ENT

Early Adversity and DNA Methylation

- Monkeys reared with and without their moms
- Piece of the Prefrontal Cortex helps you control and guide your behavior
- Red=more methylated
- Green=less methylated
- Each row is a different gene; columns are different animals



Provençal et al., 2012

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Experience Shapes Brain Architecture by Over-Production Followed by Pruning

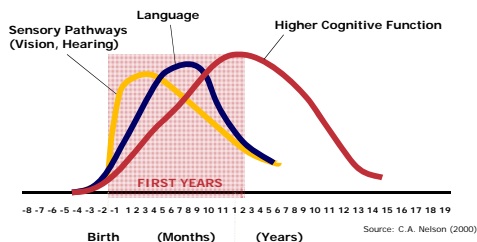
(700 synapses formed per second in the early years)




birth

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Neural Circuits are Wired in a Bottom-Up Sequence



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Major Parts of the Brain

Cerebellum
Cerebrum
Brainstem

Stimulation is Needed In Order for the Brain To Develop


Human Infant is Unable to Provide Itself Adequate Stimulation for Normal Brain Development

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The Brain Develops in the Context of Relationships

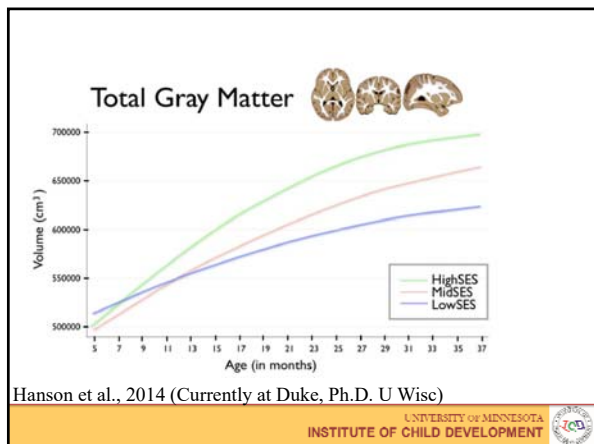


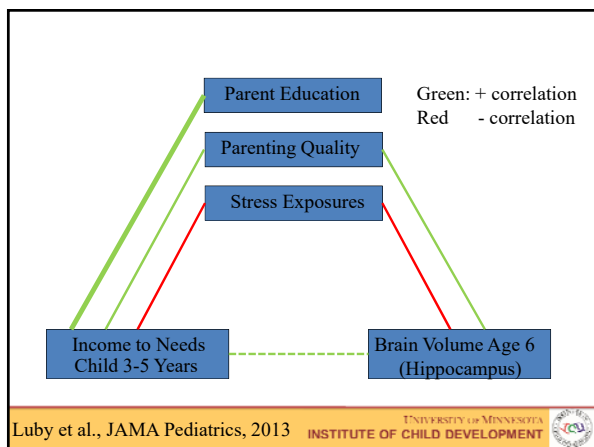
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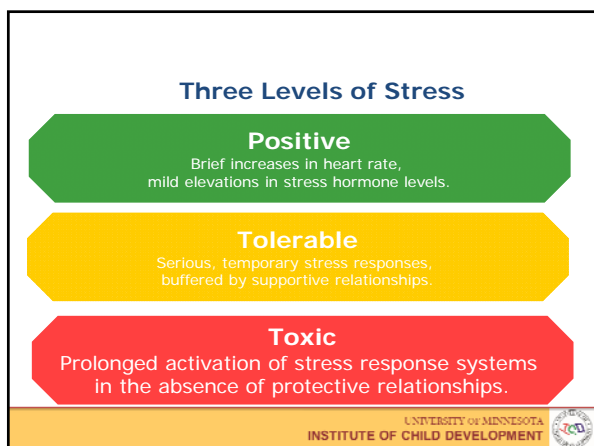


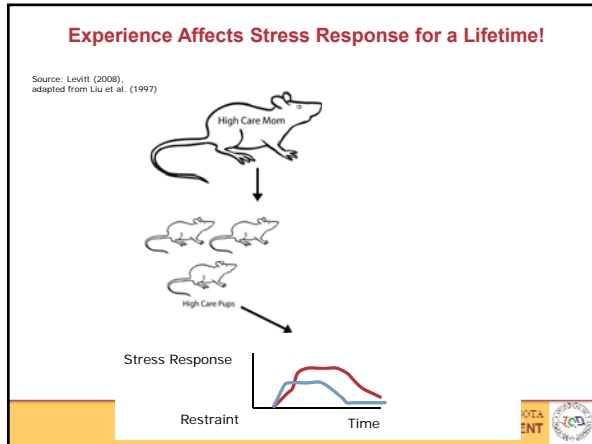
Serve and Return

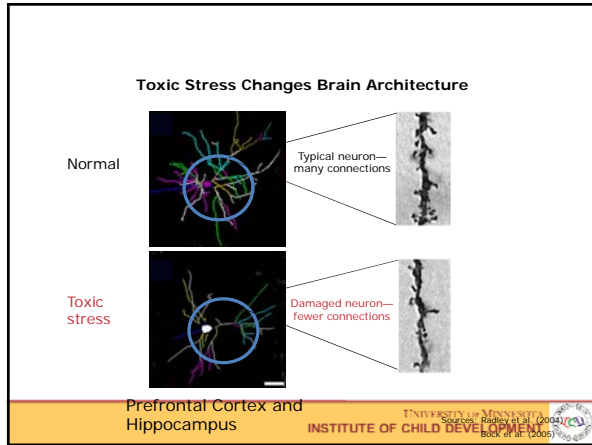
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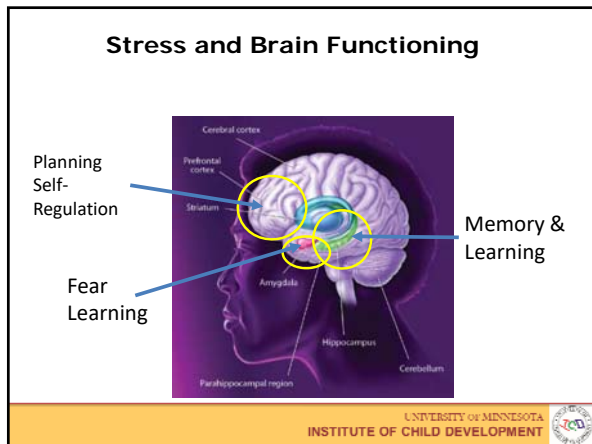


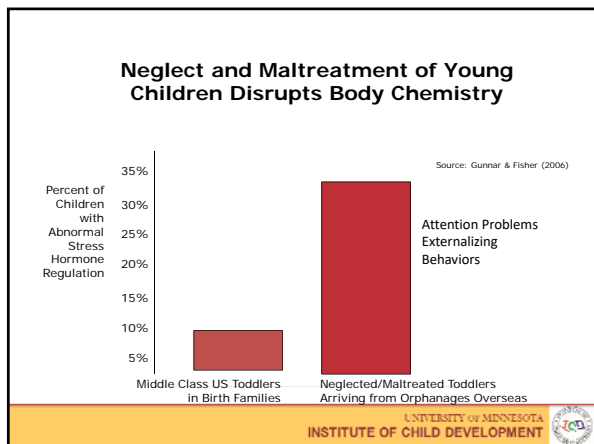


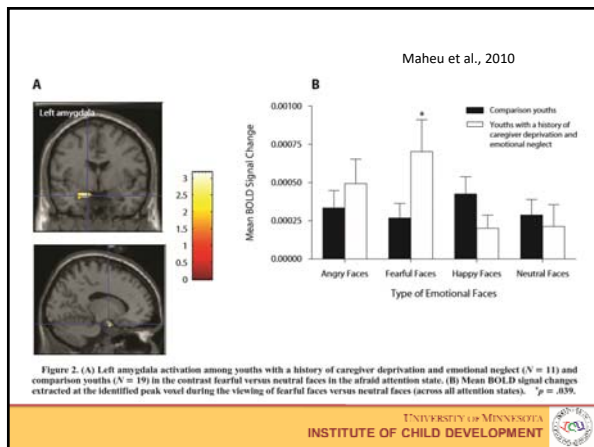


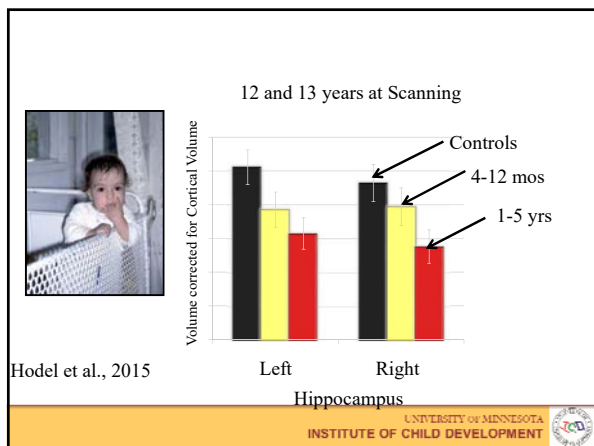












Interim Summary

- The architecture of the brain is shaped by our experiences
- Skills beget skills, simpler skills support later developing skills
- A poor early foundation affects all that comes after
- Brain architecture develops in the context of relationships
- Serve and Return provides the experiences that literally build the brain and establishes secure relationships that protect the brain from stress.
- Toxic stress can literally shape an anxious/fearful brain that acts first and thinks later.
- The achievement gap begins early in life

How Can We Act On the Science?

Get It Right the First Time

The basic principles of neuroscience indicate that creating the right conditions for early childhood development will be more effective and less costly than addressing problems at a later age.

Brains: more physiological energy needed to compensate for poorly formed neural circuits.

Society: higher cost of remedial education, clinical treatment, crime.

Help Children Build Resilience

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What Builds Resilience?

Poor Good

Outcomes

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Recipe for Resilient Citizens

Adequate Stimulation for the Development of Healthy Brain Architecture from the Beginning

Reduce/Eliminate Toxic Stress in Childhood

Increase/Support Protective Factors for Children and Families

Don't overprotect from slings and arrows of typical development

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For More Information

<http://www.cehd.umn.edu/icd/>

<http://www.developingchild.net>

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