

**BRAIN SCIENCE:
INTERVENTIONS AND
POLICY IMPLICATIONS
FOR SERVING PARENTS
AND CHILDREN**

THURSDAY, APRIL 27, 2017

**2:00 PM ET/ 1:00 PM CT/NOON MT/
11:00 AM PT**





Sarah E. Watamura is the director of the Child Health & Development (CHaD) lab and an associate professor at the University of Denver. Watamura has long-standing interests in children's physiologic regulation, their development within care giving contexts, and relations between physiologic regulation and developing physical and psychological stress. She has recently expanded her work to include the unique stressors and buffers that may be important for physiologic stress among families experiencing poverty and among newcomer Mexican-origin families. She received her doctorate from the Department of Human Development at Cornell University.





Four Top Lines of Research Relevant for Policies and Investments for Children & Families

Sarah Enos Watamura, Ph.D.



SEED

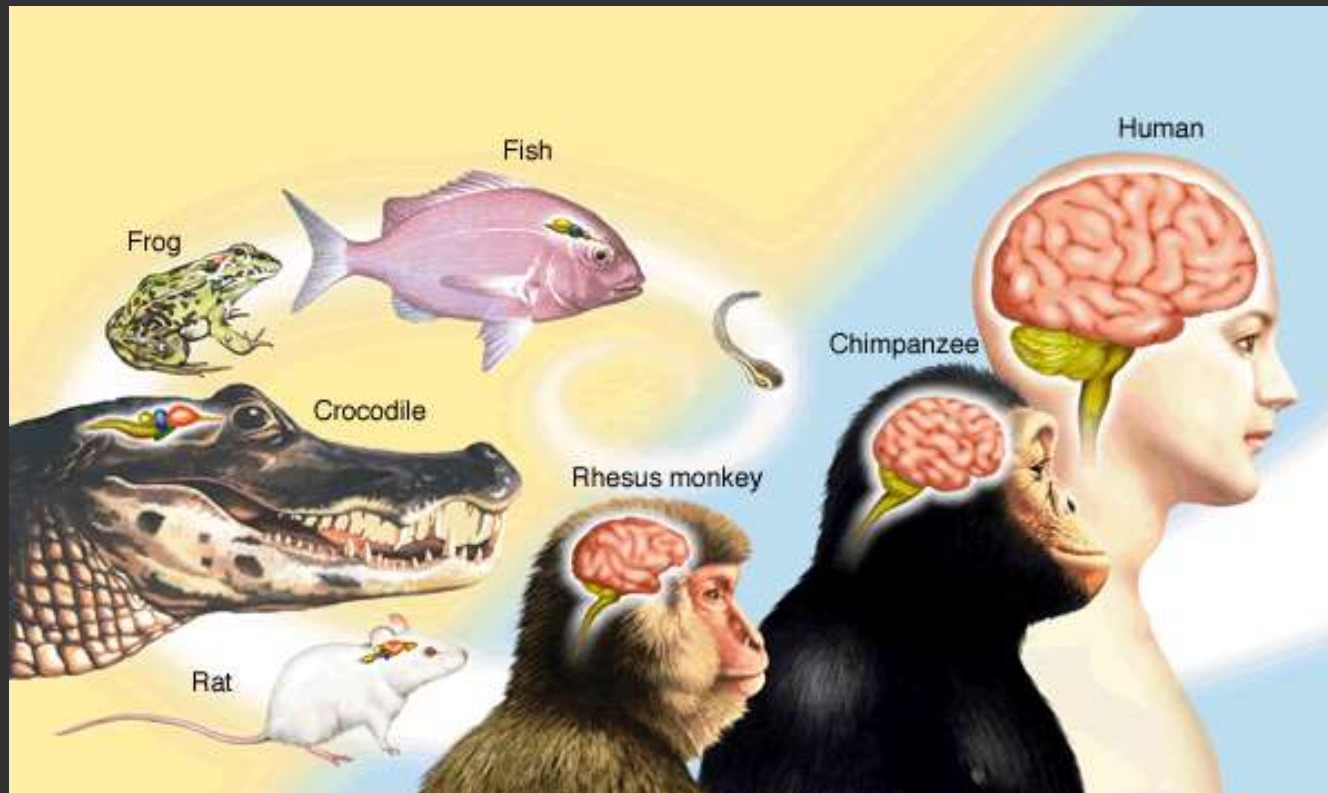
Stress Early Experience & Development
Research Center

Four top Relevant Lines of Research

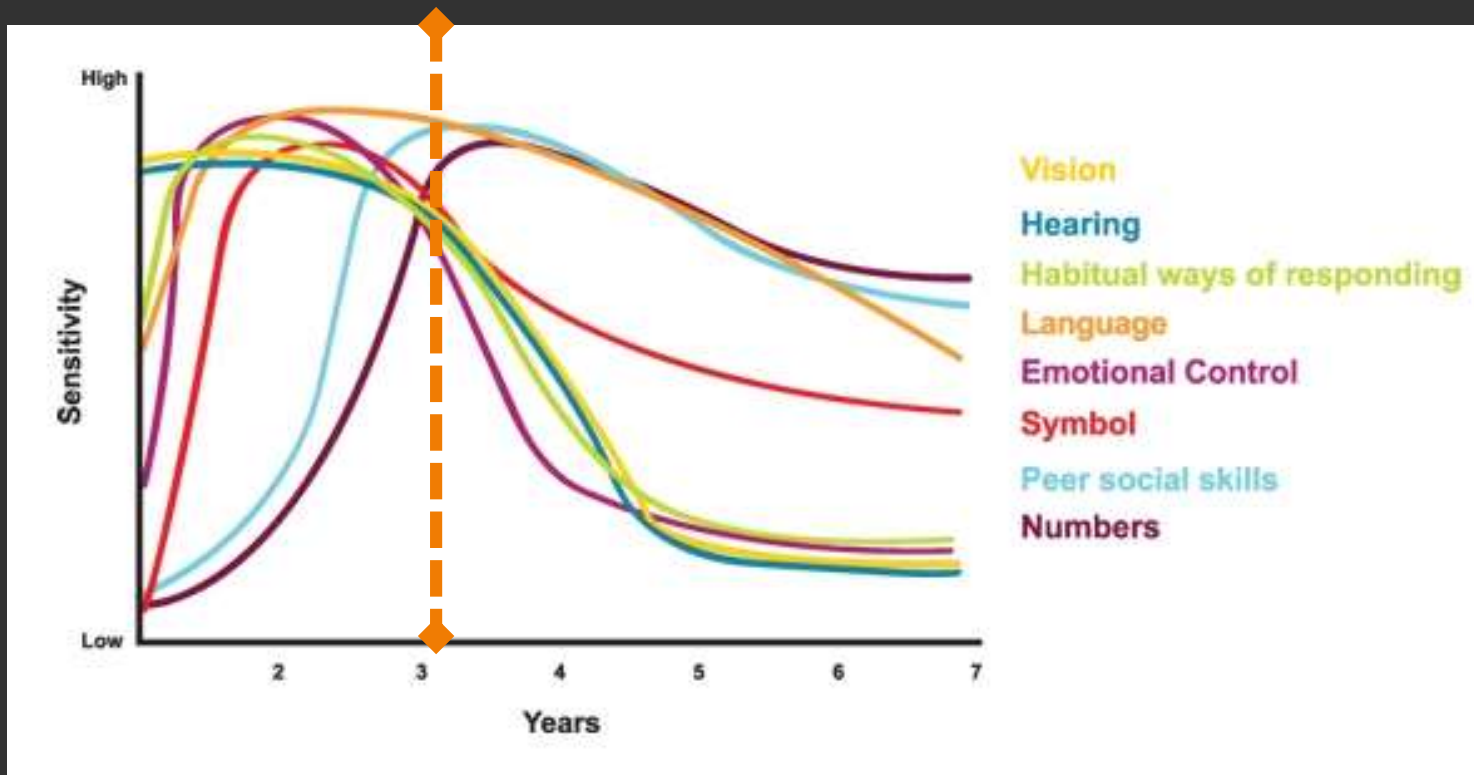
- 1) Early experiences are particularly impactful, and early family-centered prevention/intervention is particularly efficient and effective
- 2) Early life stress and toxic stress: context is everything
- 3) Two Open Windows: Infant & Parent Neurobiologic Change
- 4) Risk and opportunity can be transmitted intergenerationally; Intervention Opportunities and The Buffering Toxic Stress Consortium

Fetal (and Early Life) “Programming”

- Humans have big, under-developed (and therefore plastic) brains in early life



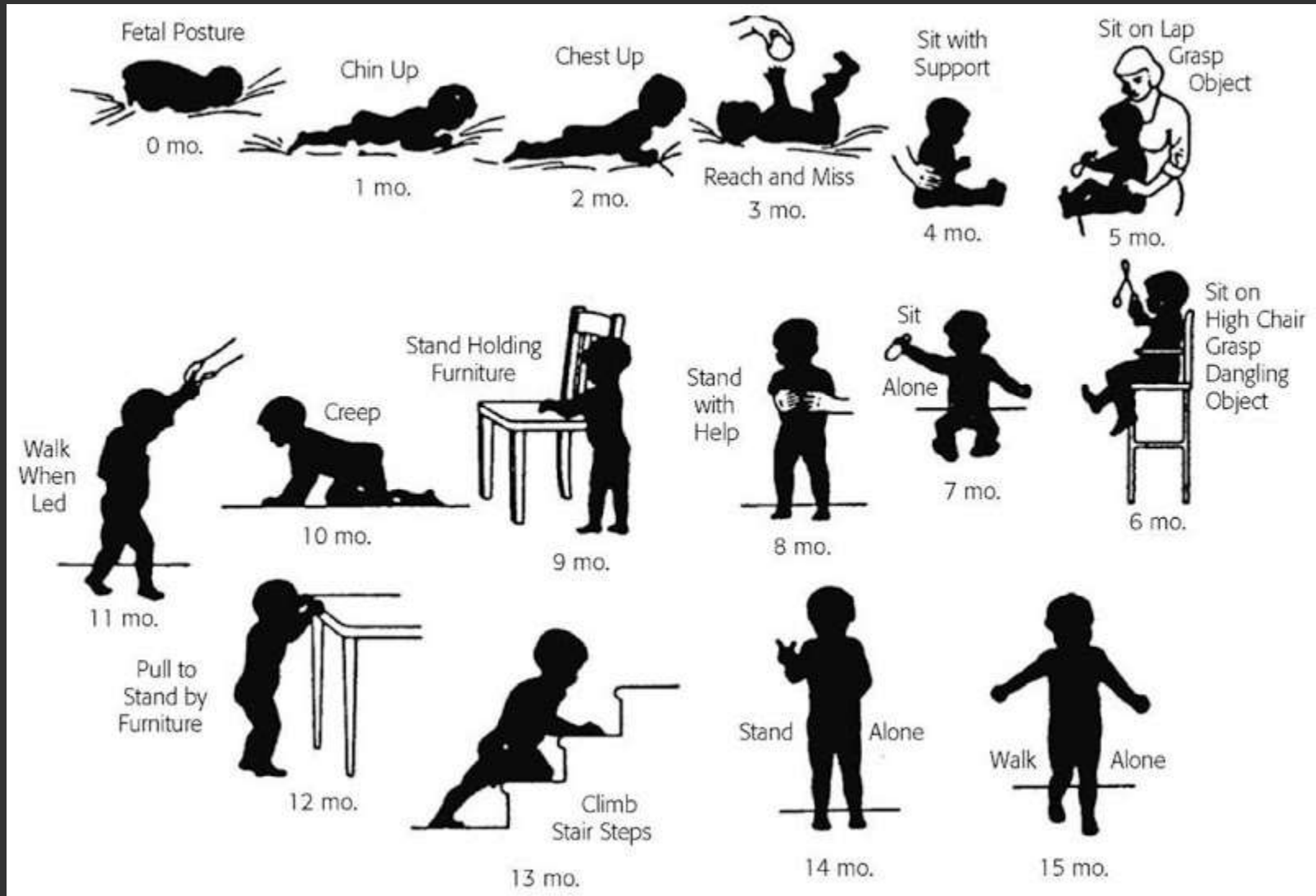
Top Evidence for Early Life as a Critical Sensitive Period



Newborn Mammals

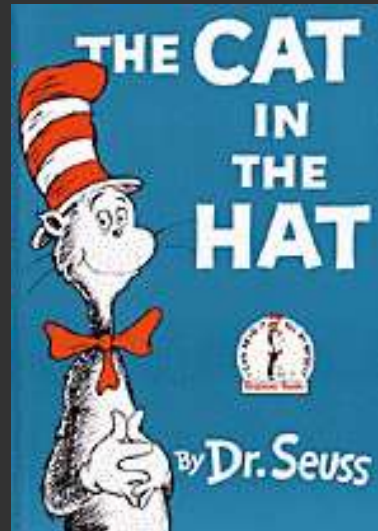


Human Motor Development

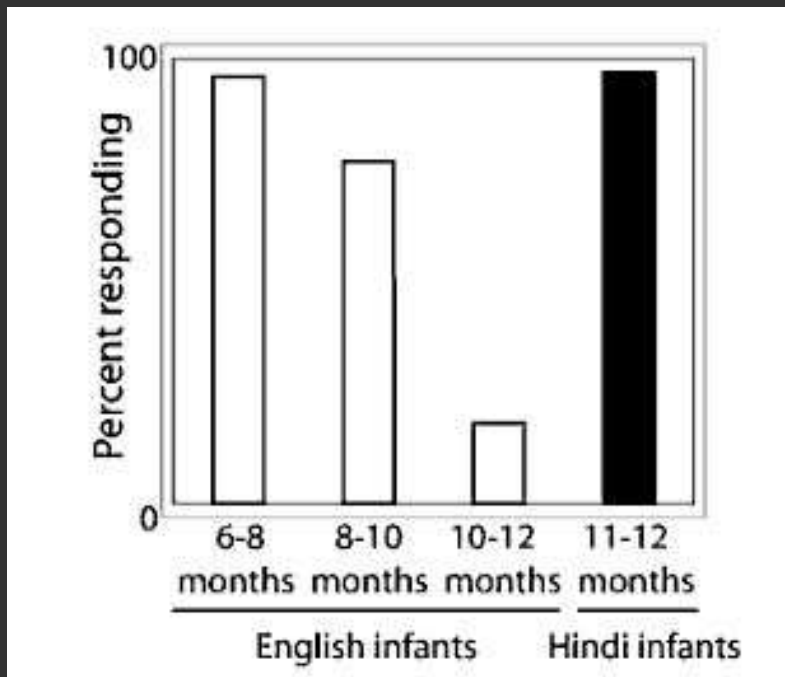


Little Scientists – Learning Begins in the Womb!

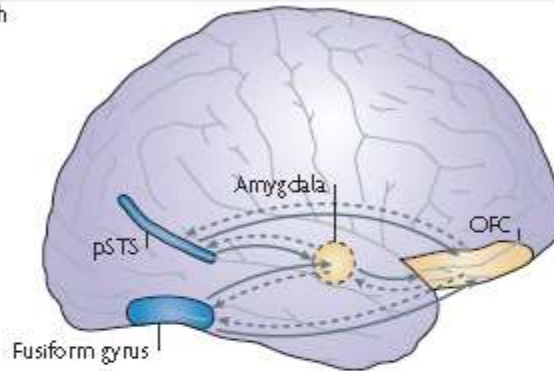
- Learning in the womb
 - Can fetuses learn sounds they hear in the womb?
 - Pregnant women (7 ½ months) read the story out loud twice a day (De Casper & Spence, 1986).



Plasticity Advantage: Infants Hear Languages Adults Don't!



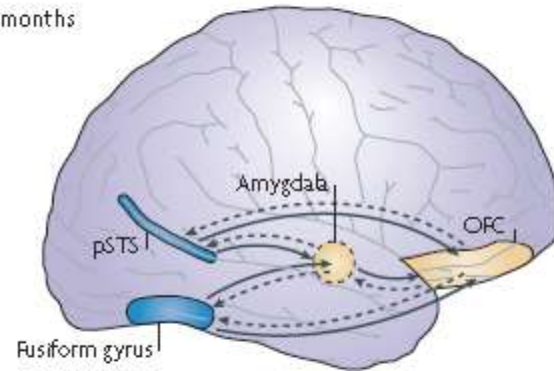
Birth



Anatomical emergence

- + Components of the emotion-processing network and anatomical connections are established
- + Infants prefer faces but do not exhibit stable discrimination of facial expressions

5-7 months

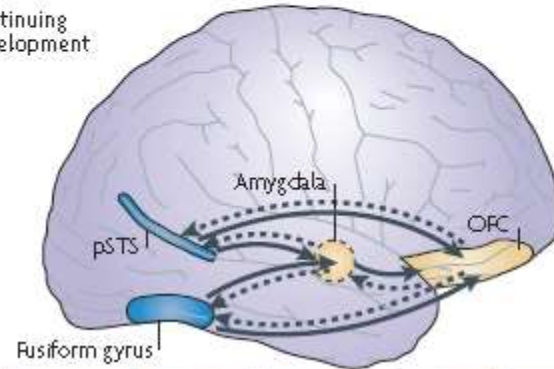


Experience-expectant functional development

- + The network becomes functional and 'expects' experience
- + Infants discriminate basic facial expressions and exhibit an attentional bias towards salient facial expressions (e.g., expressions of fear)
- + Rapid refinement of the emotion-processing network through stabilization and pruning of synaptic connections (narrowing of processing to species-typical emotional expressions)

Input needed for species typical development

Continuing development

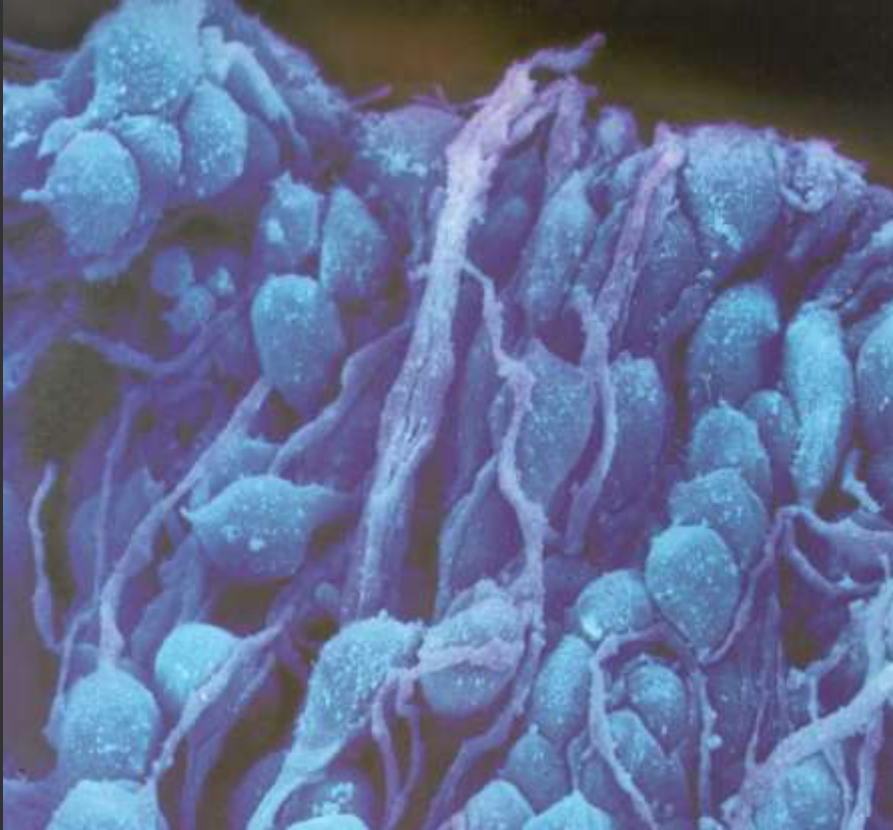


Experience-dependent functional development

- + Life-long plasticity in emotion processing in response to individual-specific experiences (e.g., fine tuning to frequent facial expressions)
- + Prefrontal-amygdala connections and the ability to integrate contextual information with facial expressions continue to develop until adolescence

Input that makes up each individual's experience

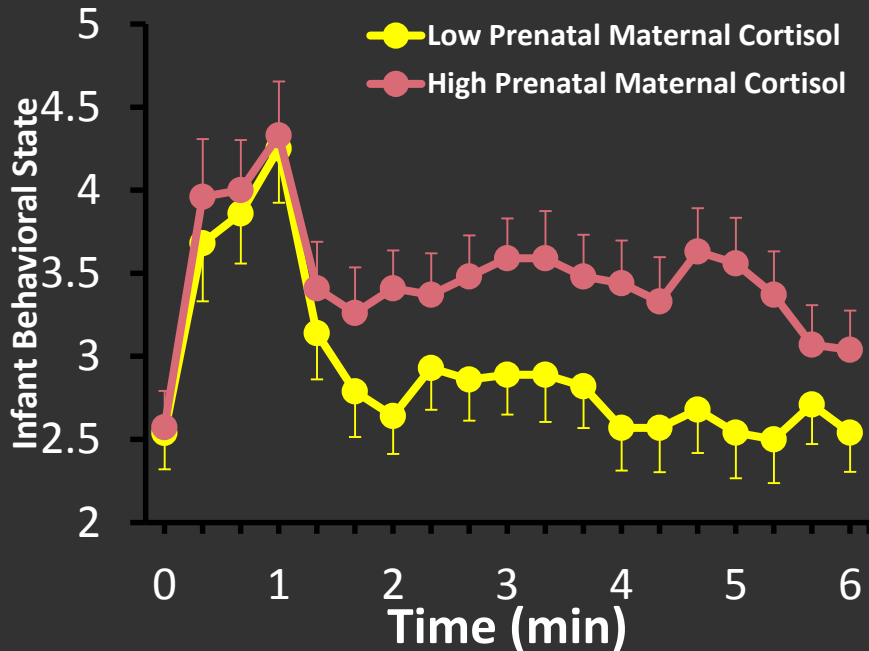
The fetal and infant brain is under active construction



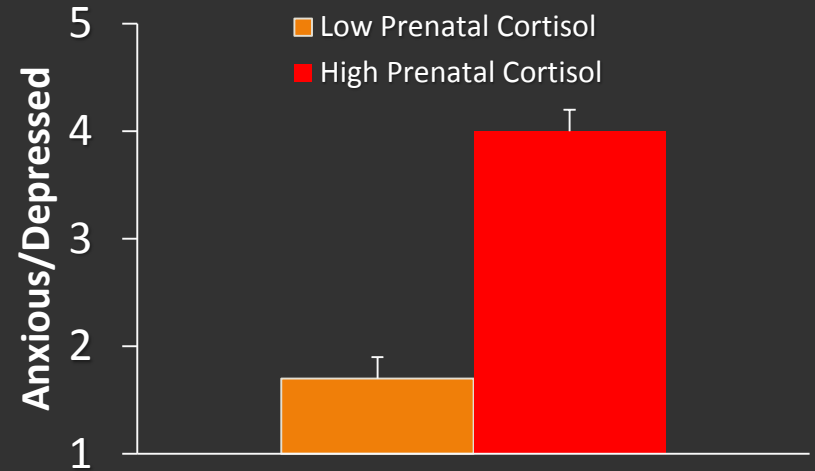
- 7 weeks - primitive nerve paths
- Over 100,000 nerve cells/minute
- At birth the baby will have 100 billion nerve cells



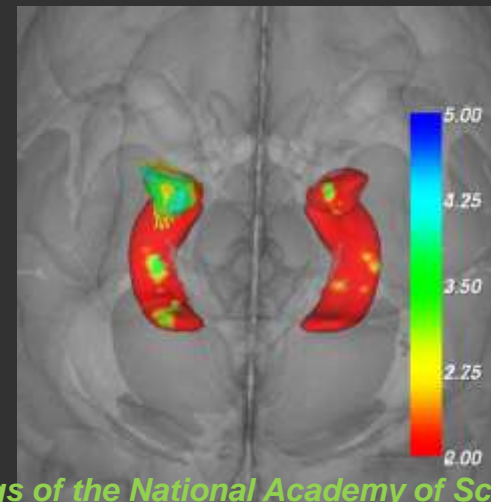
Prenatal Stress Hormone Exposure & Later Development



Davis et al., 2010a [Child Psychology and Psychiatry](#)



Davis & Sandman, 2012 [Psychoneuroendocrinology](#)

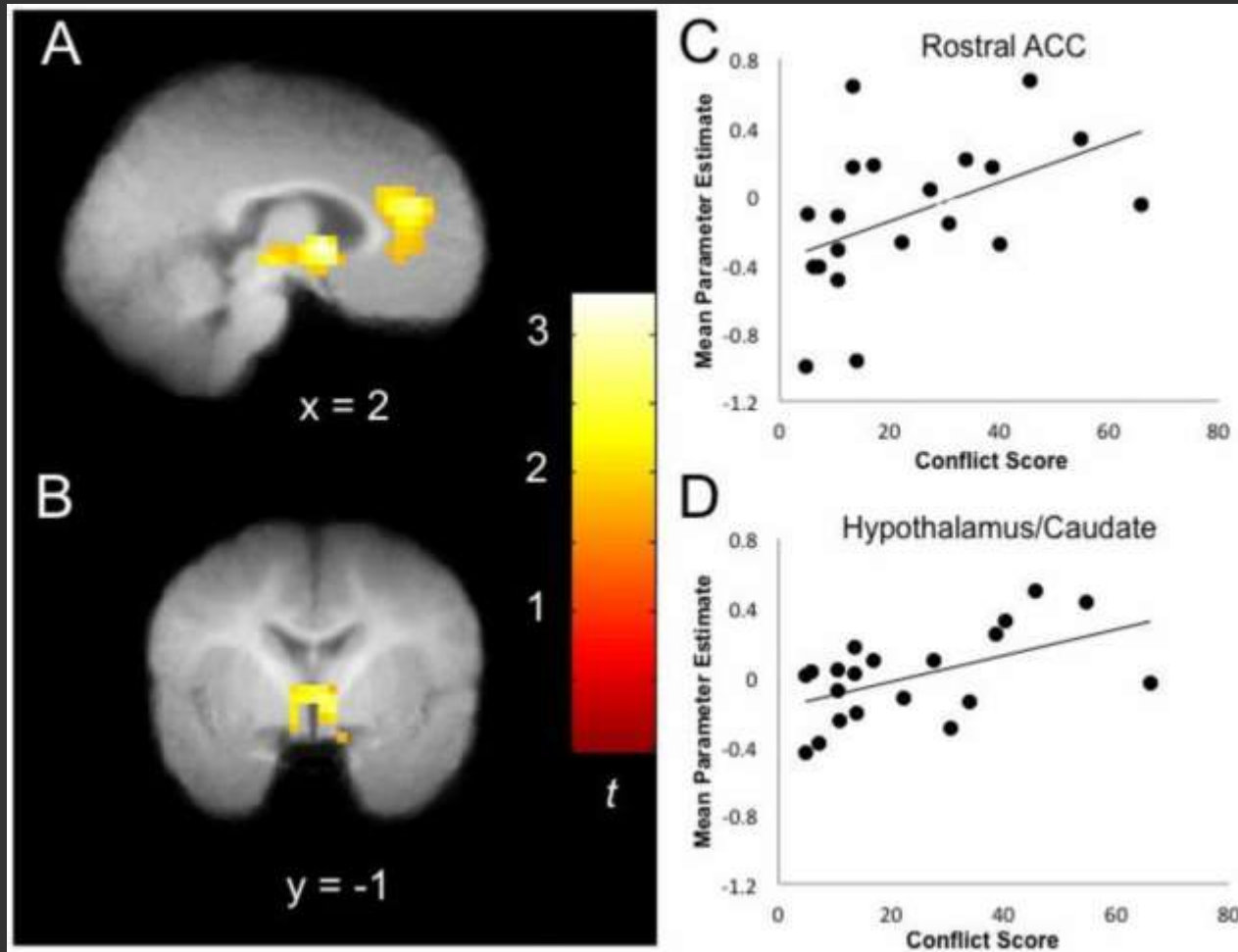


Buss et al., [Proceedings of the National Academy of Science, 2012](#)



Elysia Davis, Ph.D.

Even While Sleeping, Infants Track Family Conflict



Graham, A. M. Fisher, P. A. & Pfeifer, J. H. (2013). What Sleeping Babies Hear: An fMRI Study of Interparental Conflict and Infants' Emotion Processing. *Psychological Science*, 24(5): 782-789.

Four top Relevant Lines of Research

- 1) Early experiences are particularly impactful, and early family-centered prevention/intervention is particularly efficient and effective
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The “Toxic Stress” Framework

- A framework offered by:
 - pediatrician Jack Shonkoff
 - pediatrician and researcher Tom Boyce
 - basic science researcher Bruce McEwen (Shonkoff, Boyce & McEwen, 2009)



What is “Toxic Stress”?

- When chronic or significant stressors happen (particularly in childhood)....



AND, buffering relationships are not available



● CONDITIONS *for* TOXIC STRESS



Long-term Effects of Chronic Stress

- **influences susceptibility to or progression of a number of diseases:**
 - cardiovascular disease (Smith & Ruiz, 2002)
 - diabetes (Mooy, 2000)
 - infectious illness (Cohen & Williamson, 1991)
- **increases the risk of “risk”:**
 - obesity (Brunner et al., 2007)
 - decreases immune function (Segerstrom & Miller, 2004)
 - Increased metabolic syndrome (Chandola, Brunner, Marmot, 2006)
- **can impair cognitive functioning:**
 - memory (Lupien et al., 1998)
 - attention (Liston, McEwen, & Casey, 2009)
- **increases risk for mental health problems:**
 - depression (Siegrist, 2008)
 - anxiety (Eisenberg, 2007)
- **can accelerate aging:**
 - shorter telomere length, less telomerase activity (Epel et al., 2004)

Risk Factors' Effect on Life Expectancy

- Smoking 10 years¹
- Obesity 6-7 years^{2, 3}
- High blood pressure 5 years⁴
- Diabetes 7-8 years⁵

¹ Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ* 2004; 328: 1519–27.

² Haslam DW, James WP (2005). "Obesity". *Lancet* 366 (9492): 1197–209.

³ Nedcom, A, Barendregt, JJ, Willekens, F et al. (January 2003). "[Obesity in adulthood and its consequences for life expectancy: A life-table analysis](#)" (PDF). *Annals of Internal Medicine* 138 (1): 24–32.

⁴ Franco OH, Peeters A, Bonneux L, de Laet C. Hypertension. 2005 Aug;46(2):280-6.

⁵ Franco OH, Steyerberg EW, Hu FB, Mackenbach J, Nusselder W. Arch Intern Med. 2007 Jun 11;167(11):1145-51.

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- **Childhood Stress 20 years**

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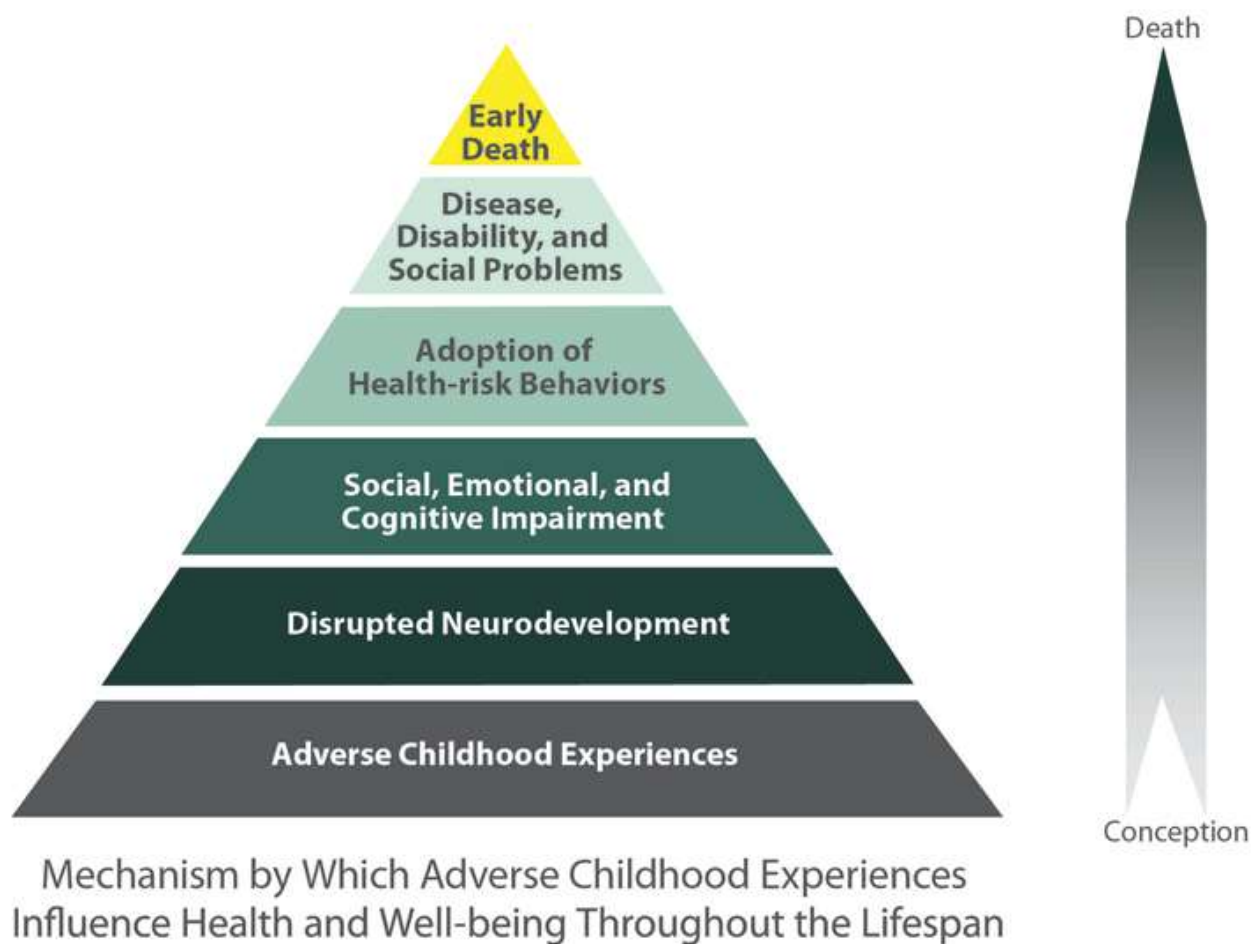
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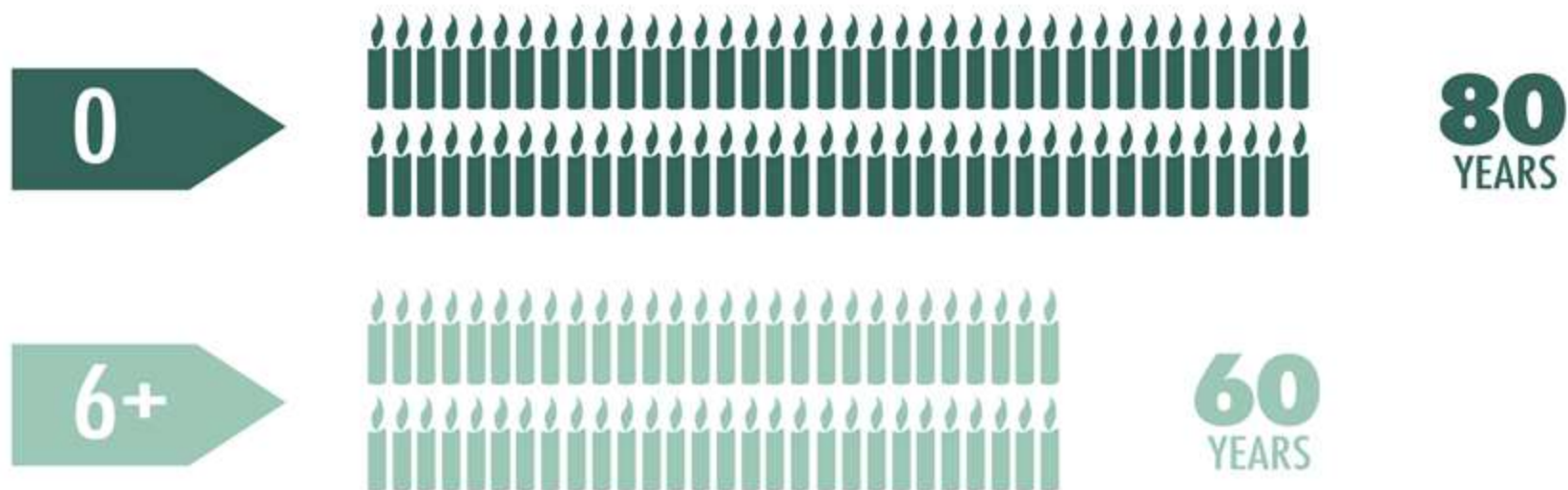
Childhood Stress Effects: Evidence from the ACE Study



For more information: <http://www.cdc.gov/ace/>

LIFE EXPECTANCY

People with six or more ACEs died nearly **20 years earlier on average** than those without ACEs.



ECONOMIC TOLL

The Centers for Disease Control and Prevention (CDC) estimates the lifetime costs associated with child maltreatment at **\$124 billion**.



Four top Relevant Lines of Research

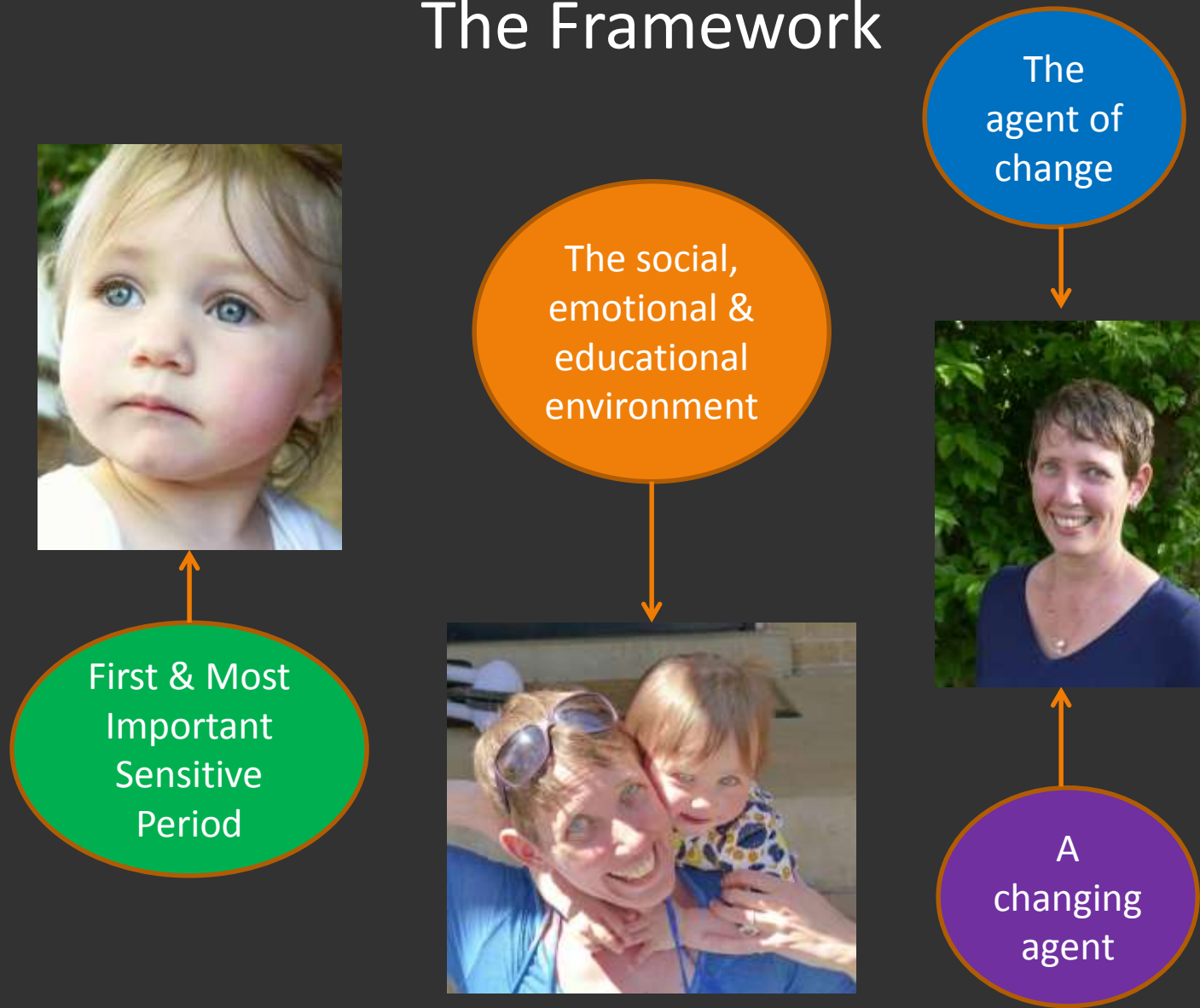
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Two Open Windows: Infant & Parent Neurobiologic Change



Supported and released by Ascend at the Aspen Institute
http://b.3cdn.net/ascend/4b320cff0e86d8fb51_gqm6btprv.pdf

The Framework



The Framework



First & Most Important Sensitive Period

The social, emotional & educational environment



The agent of change



A changing agent

Parenting Changes Your Brain!



Parenting Changes Your Brain!

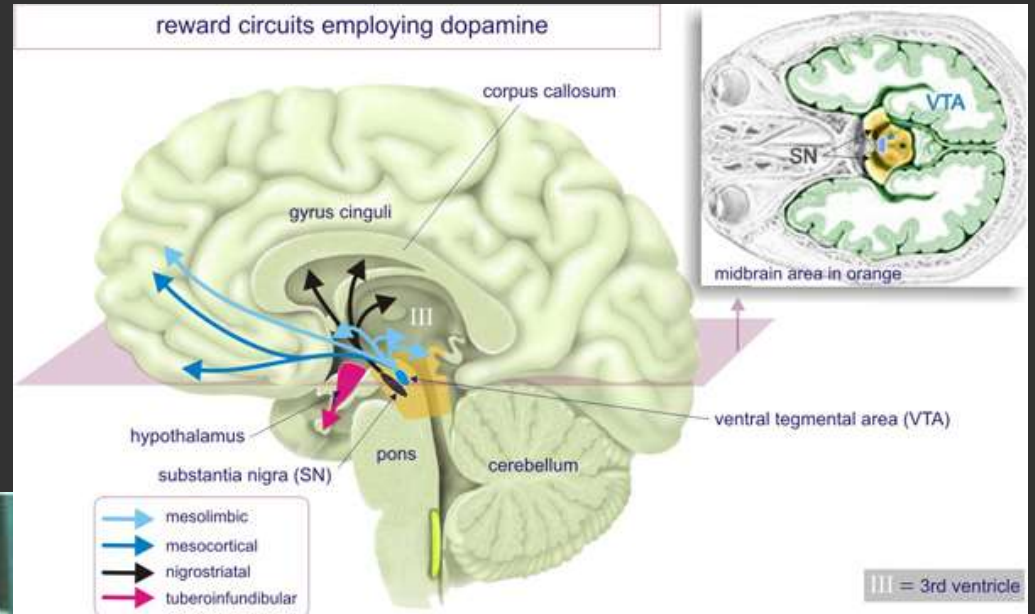


- Change the way stress is handled
- Promote positive emotions and bonding
- Increase parental motivation
- Promote caregiving behaviors



Pilyoung Kim, Ph.D.

Example: Changes in the Reward Circuit



Changes in the Reward Circuit

- New mothers and fathers during the first few months postpartum exhibit structural growth of the reward circuit



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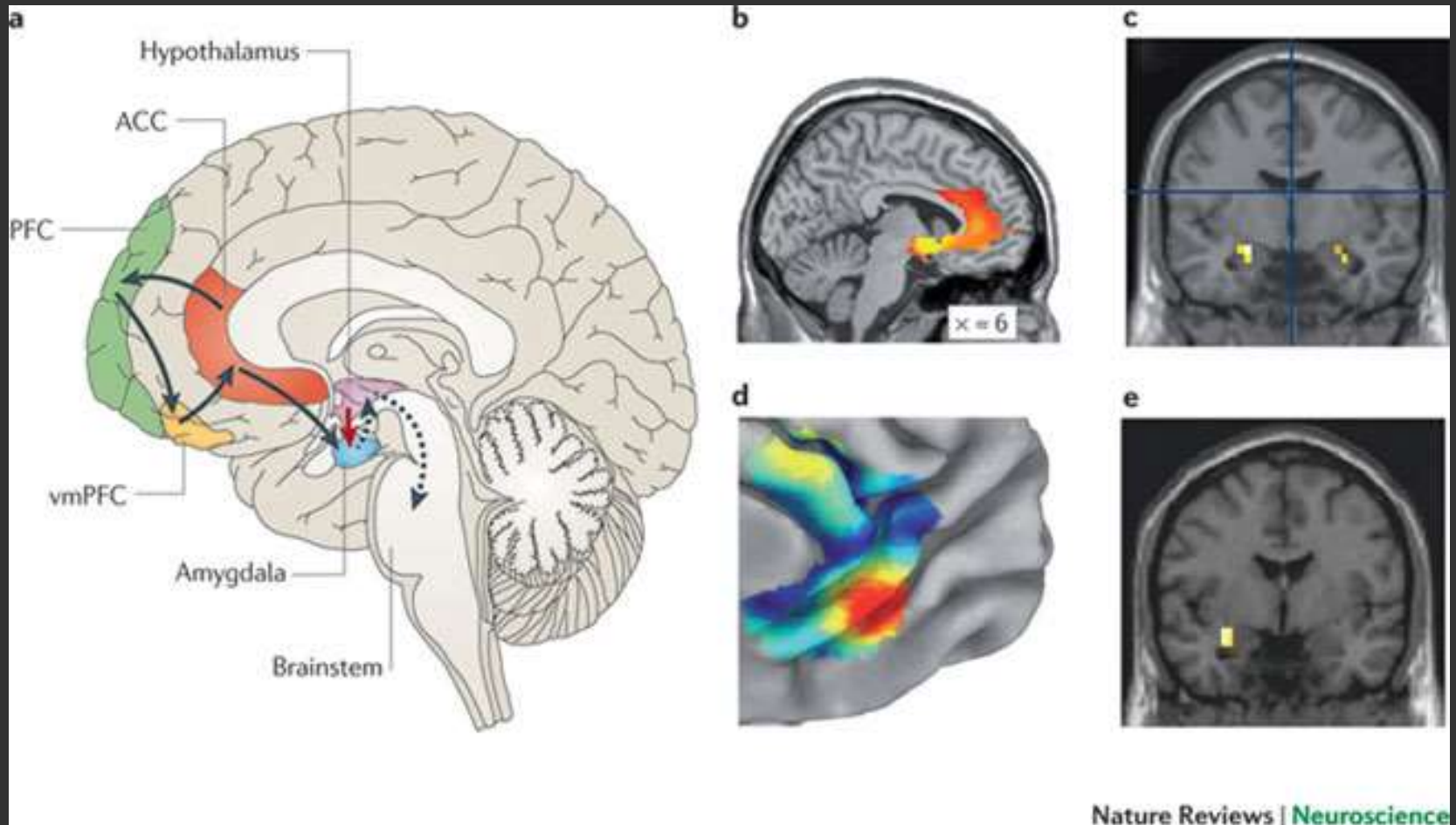


Changes in the Reward Circuit

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- More functional brain activity in this region also occurs when looking at pictures of one's own vs. other infants



The Social Information Circuit

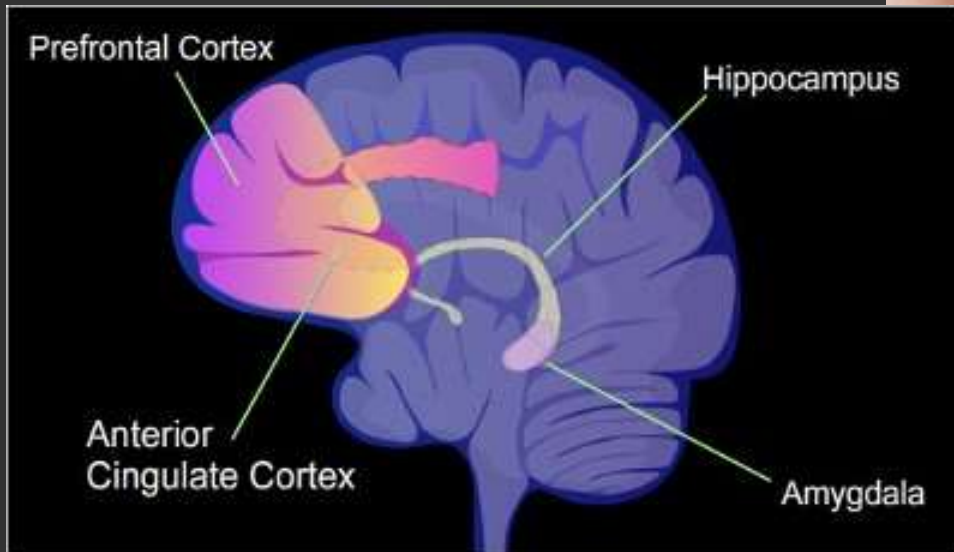


Changes in the Social Information Circuit

- New mothers and fathers exhibit neural plasticity in the circuit including structural increases [Kim, Leckman, Mayes, Feldman, et al., 2010](#); [Kim et al., 2014](#)
- New parents also exhibit heightened responses in this circuit to infant cries and images of their infant [Swain et al., in press](#)



Emotion Regulation Circuits



Changes in the Emotion Regulation Circuits

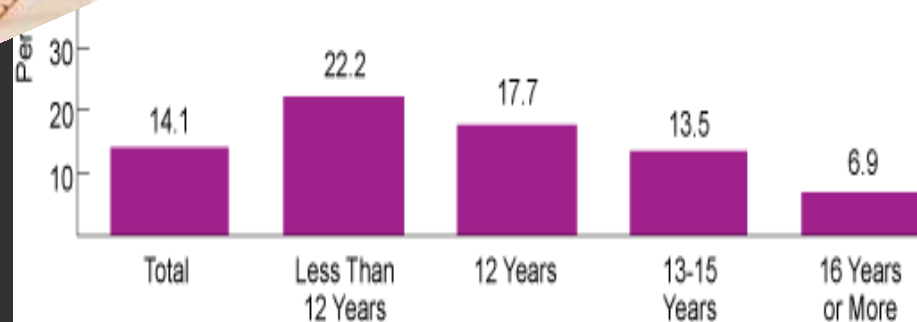


Neural Associations in Stressed Parents

- Decreased responses to infant cries and images is associated with chronic stress, depression and substance abuse among parents



Depressive Symptoms Among Women with a Recent Live Birth by Education Level, 2006–2008**



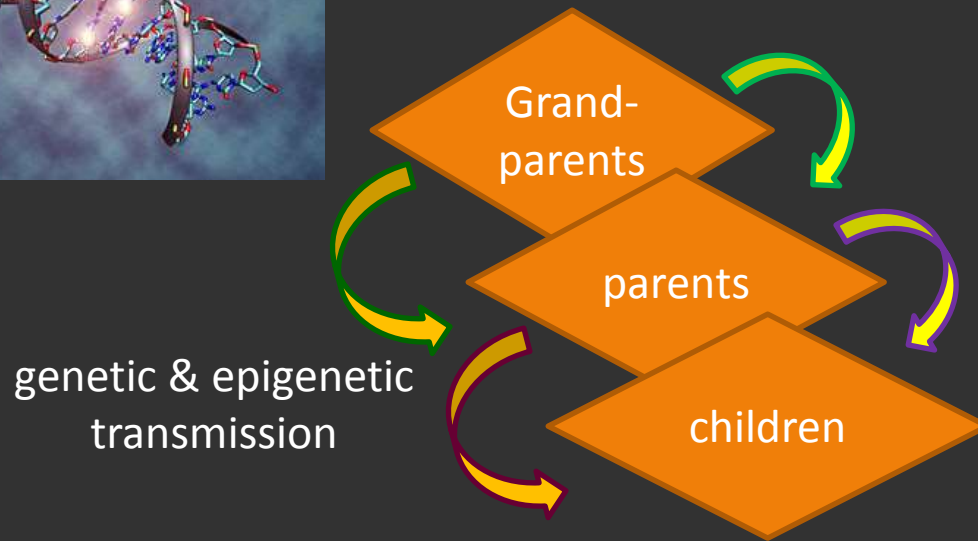
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Epigenetics



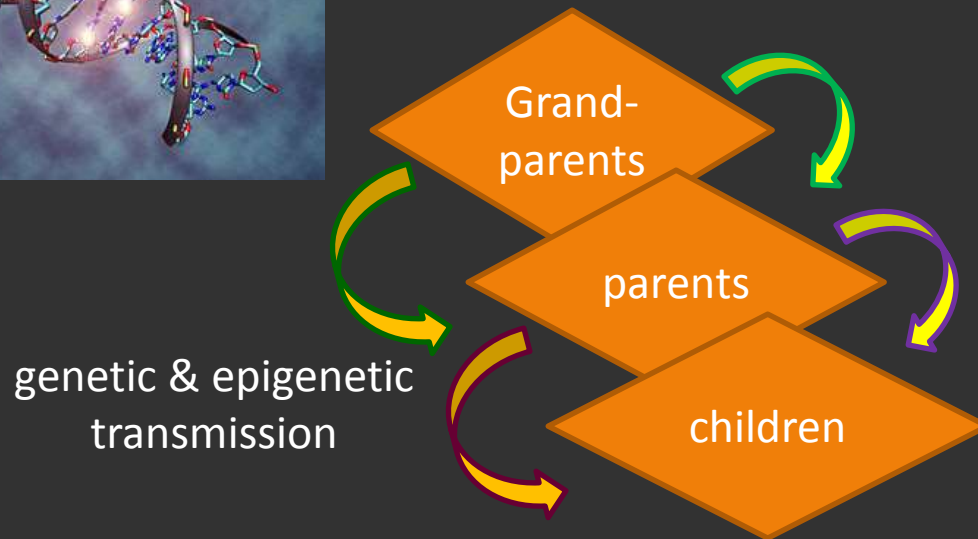
Impacts: Carry-forward, Intergenerational Transmission



Sociocultural transmission



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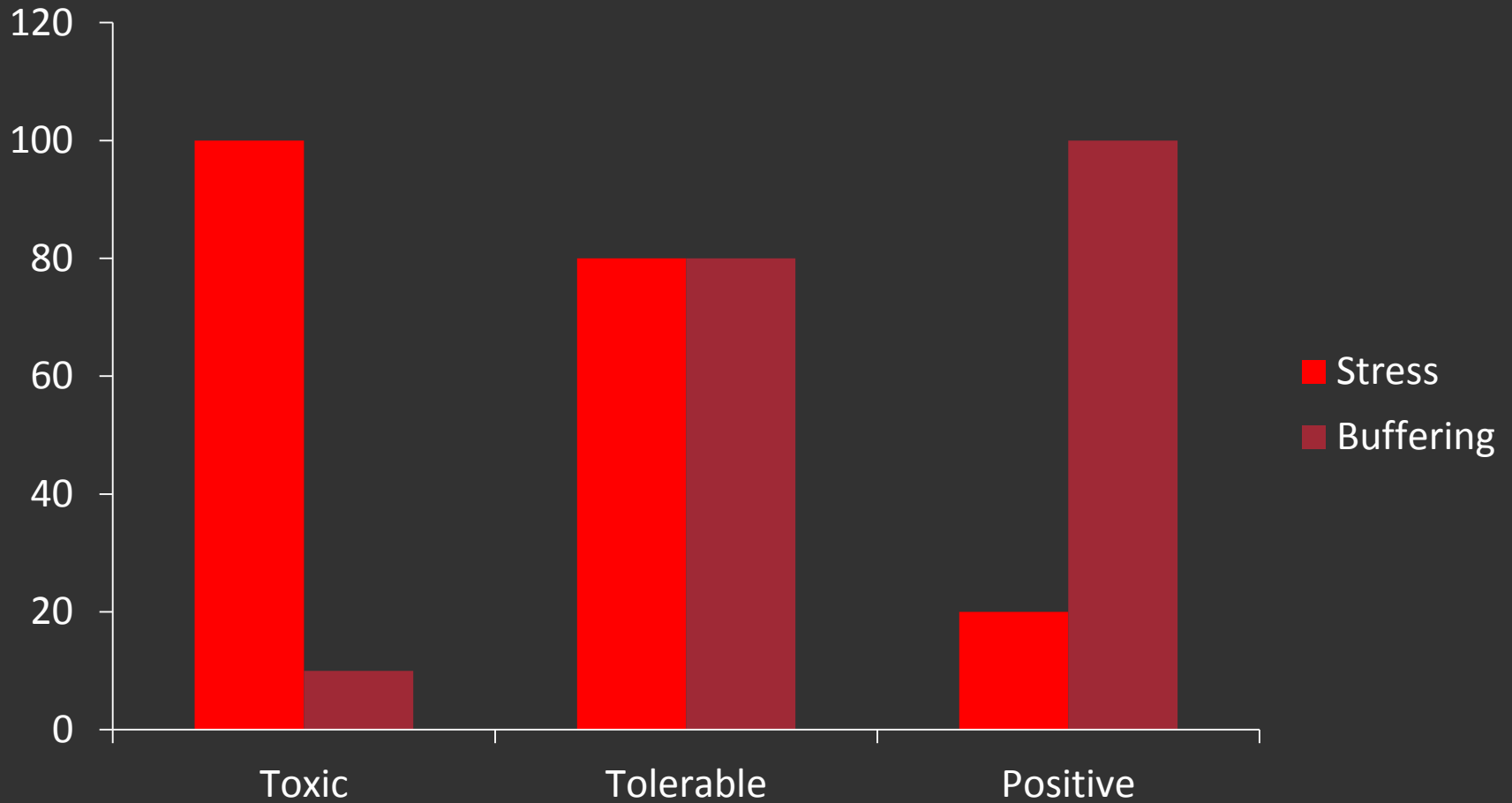


Sociocultural transmission

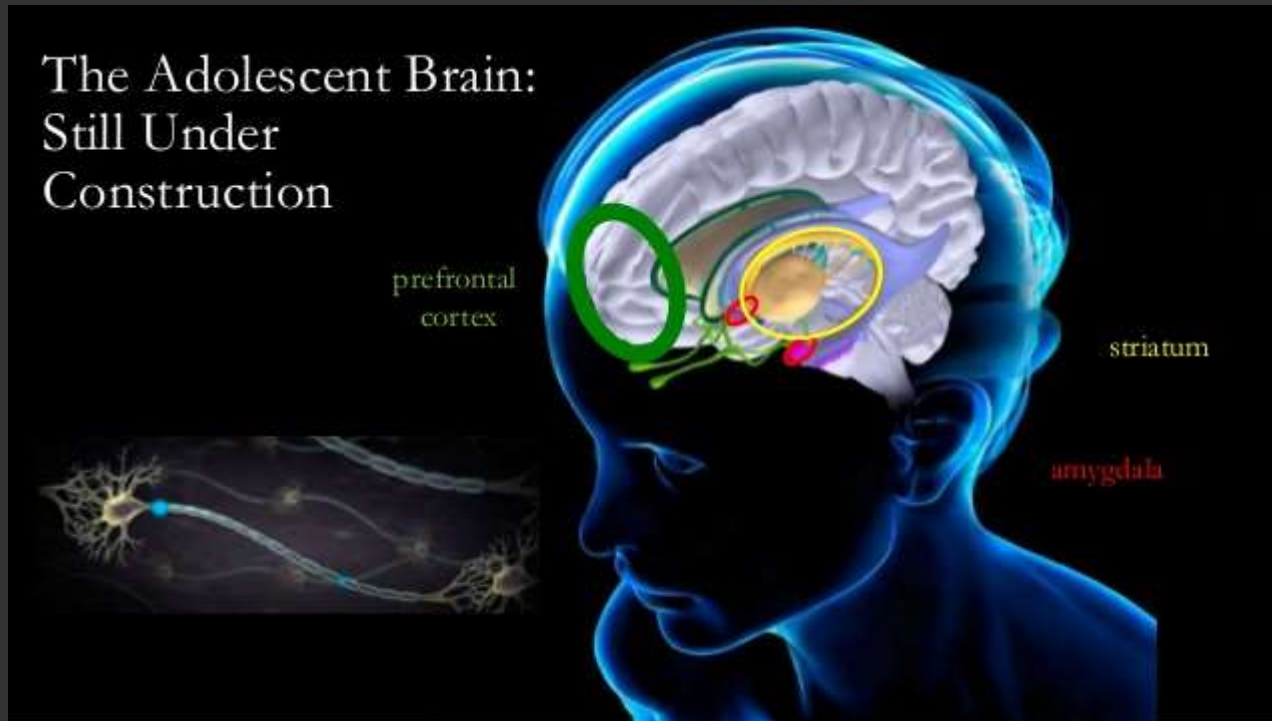


Intergeneration transmission of risk *can be transformed*
into multiplicative intergenerational intervention effects

High Stress Exposure + Low Buffering = Risk



Recognition of the Importance of Brain Development in Adolescence



Substantial structural and functional remodeling within:

- Limbic and cortical regions
- Hippocampus
- Amygdala

Focus is often on Limitations that result from protracted development.....

- Decision making
 - Risk taking
 - Emotion regulation...
-
- Adolescence is also a positive, sensitive period and a reset opportunity



Intervention Options

- Decrease stressful circumstances
 - Strengthen families
 - Community support
 - Poverty alleviation
 - Policy changes
- Increase buffering abilities
 - Strengthen families
 - Integrated health
 - Parenting support



Why is this important for state lawmakers?

- Most major taxpayer concerns and government fiscal obligations are connected to these issues

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- Early and chronic (toxic) stress likely increases:
 - Lost productivity (& therefore lost revenue)
 - Additional educational expenditures and resources by schools
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 - Low workforce preparation
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 - Health and continued economic disparities
- Prevention and EARLY Intervention for stressed families therefore could save resources and prevent problems across sectors

What questions could legislators ask during policy considerations?

- What programs do you already have?
 - Examples:
 - Home visiting, prenatal care, education, healthy marriage funds, healthy babies programs, early childhood education, rehabilitation....

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 - Can education/training help? Consider adding CE requirements?
- Can existing or proposed program effects be evaluated in this light?
 - “Does your program directly tackle the effects of stress?”
 - “How would your program work differently for children and families living in high stress situations?”
 - “How does your program consider the interconnected needs of parents and children

Two take-away Messages

- Your constituents are paying/losing a lot of money in part because of a lack of understanding and attention to these issues
- Pushing forward may require attention to holistic family and community solutions because these solutions are more efficient and likely to be more effective

Questions?



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- An archived version will be available shortly, please visit:
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- Learn more about NCSL's Early Care and Education project:
<http://www.ncsl.org/research/human-services/early-care-and-education.aspx>
- Connect with NCSL Staff:
 - Julie Poppe, program manager, Children & Families Program
julie.poppe@ncsl.org / 303-856-1497
 - Alison May, staff coordinator, Children & Families Program
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