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

THURSDAY, APRIL 27, 2017
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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.
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

- Fetal Posture: 0 mo.
- Chin Up: 1 mo.
- Chest Up: 2 mo.
- Reach and Miss: 3 mo.
- Sit with Support: 4 mo.
- Sit on Lap: 5 mo.
- Grasp Object: 6 mo.
- Creep: 7 mo.
- Stand Holding Furniture: 8 mo.
- Sit Alone: 9 mo.
- Stand with Help: 10 mo.
- Walk When Led: 11 mo.
- Pull to Stand by Furniture: 12 mo.
- Climb Stair Steps: 13 mo.
- Stand Alone: 14 mo.
- Walk Alone: 15 mo.
**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!
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

**Graphs and Data:**
- **Left Graph:**
  - Title: Infant Behavioral State over Time (min)
  - Y-axis: Infant Behavioral State
  - X-axis: Time (min)
  - Data points for Low Prenatal Maternal Cortisol (yellow) and High Prenatal Maternal Cortisol (red)
  - Source: Davis et al., 2010a, *Child Psychology and Psychiatry*

- **Right Graph:**
  - Title: Anxious/Depressed
  - Y-axis: Anxious/Depressed
  - Data for Low Prenatal Cortisol (orange) and High Prenatal Cortisol (red)
  - Source: Davis & Sandman, 2012, *Psychoneuroendocrinology*
Even While Sleeping, Infants Track Family Conflict

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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
What is "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 years\textsuperscript{1}
– Obesity 6-7 years\textsuperscript{2, 3}
– High blood pressure 5 years\textsuperscript{4}
– Diabetes 7-8 years\textsuperscript{5}

Risk Factors’ Effect on Life Expectancy

- Smoking 10 years$^1$
- Obesity 6-7 years$^2$, $^3$
- High blood pressure 5 years$^4$
- Diabetes 7-8 years$^5$
- Childhood Stress 20 years


Childhood Stress Effects: Evidence from the ACE Study

Mechanism by Which Adverse Childhood Experiences Influence Health and Well-being Throughout the Lifespan

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.
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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 social, emotional & educational environment

First & Most Important Sensitive Period

The agent of change

A changing agent
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
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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- 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

[Image of brain diagram with labels for Prefrontal Cortex, Hippocampus, Anterior Cingulate Cortex, and Amygdala]

[Image of a mother holding a crying baby]
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.
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Epigenetics
Impacts: Carry-forward, Intergenerational Transmission

- Grandparents
- Parents
- Children

Sociocultural transmission

Genetic & epigenetic transmission
Impacts: Carry-forward, Intergenerational 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
  - Crime
  - Mental and physical illness
  - ER visits
  - Low workforce preparation
  - Intergenerational disadvantage
  - Health and continued economic disparities
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• 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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  – Are staff and participants in these programs aware of current understandings of stress and its costs?
  – Can education/training help? Consider adding CE requirements?
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• 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?
STAY CONNECTED

• An archived version will be available shortly, please visit: http://www.ncsl.org/research/human-services/brain-science-interventions-and-policy-implications.aspx

• Learn more about NCSL’s Early Care and Education project: http://www.ncsl.org/research/human-services/early-care-and-education.aspx

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