Four Top Relevant Lines of Research to Support Programs and Investments in Young Children & Families

Sarah Enos Watamura, Ph.D.
Four top Relevant Lines of Research

1) Early experiences are particularly impactful, and early 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
  – open to experience
  – allows us to create, innovate, build
  – allows us to layer complex skills (like reading) onto basic neurocognitive capacities
  – allows us to adapt to a wide range of environmental conditions
Top Evidence for Early Life as a Critical Sensitive Period

- Sensitive Period
  - A period in an organism’s life when they are particularly open to experience
    - An opportunity
    - AND a vulnerability
      - For negative inputs
      - For a lack of positive inputs
Example: Fast Mapping

<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abate</td>
<td>reduce in intensity</td>
</tr>
<tr>
<td>Abjure</td>
<td>renounce; swear to refrain from something</td>
</tr>
<tr>
<td>Blandishment</td>
<td>words used to coax or flatter</td>
</tr>
<tr>
<td>Meretricious</td>
<td>falsely attractive; tawdry</td>
</tr>
</tbody>
</table>

Number of Exposures

- Adults
- Young Children
The fetal and infant brain is under active construction

- By seven weeks nerve cells in brain have begun forming primitive nerve paths
- Over 100,000 nerve cells/minute
- At birth the baby will have 100 billion nerve cells
- Proliferation, migration, differentiation, synaptogenesis, myelination continue
Prenatal Stress Hormone Exposure & Later Development

- Higher maternal cortisol concentrations, larger right amygdala volume in girls at 6-9 years age.
- Amygdalae: part of the limbic “emotional” system, processing of fear

Davis et al., 2010a Child Psychology and Psychiatry

Buss et al., Proceedings of the National Academy of Science, 2012

Davis & Sandman, 2012 Psychoneuroendocrinology
Even While Sleeping, Infants Track Family Conflict

Economics of Early Investment

- Perry Preschool Project

Most of the savings come from reduced crime.... Directly tied to better mental health!
Economics of Early Investment

- Heckman ROI
  - Investing as early as possible (0-3) reduced social costs, and strengthens the economy
  - Provide resources to children AND their families

The Heckman Equation

+ Invest
+ Develop
+ Sustain
= Gain
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The “Toxic Stress” Framework

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

• Categorizes stress:
  – By the effects it has on the brain and body (vs. on the stressor)
  – Points to the critical role of relationships
  – What makes the tolerable toxic = the absence of a buffering adult
  – Also highlights the importance of positive stress
  – Focuses on biological mechanisms
Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities
Building a New Framework for Health Promotion and Disease Prevention

Jack F.Shonkoff, MD
W. Thomas Boyd, MD
Bruce S. McEwen, PhD

A scientific consensus is emerging that the origins of adult disease are often found among developmental and biological disruptions occurring during the early years of life. These early experiences can affect adult health in 2 ways—either by cumulative damage over time or by the biological embedding of adverse effects on development. In both cases, there can be a lag of many years, even decades, before early adverse experiences are manifested in the form of disease. From both research and policy perspectives, confronting the origins of disparities in physical and mental health early in life may produce greater effects than attempting to modify health-related behavior or improve access to healthcare in adulthood.


www.ajpmrn.com

A growing body of evidence suggests that attention to health promotion and disease prevention that focuses on the origins of poor health in early childhood may be a more appropriate strategy for preventing adult heart disease than the traditional clinical management of high blood pressure in adults. 

In 1998, the Institute of Medicine published a report titled "Promoting Health: Preventive Services for Children" that highlighted the importance of preventing chronic diseases in childhood. This report emphasized the need for a focused, proactive approach to childhood health promotion and disease prevention. The report recommended that children be screened for chronic diseases at an early age and that interventions be implemented to prevent the development of chronic diseases. The report also noted that children who are healthy in childhood are more likely to be healthy in adulthood, and that early interventions can have a lasting impact on health outcomes.

In recent years, there has been increasing recognition of the importance of early childhood development and the impact of early experiences on health outcomes. This is particularly true in the case of chronic diseases, which often have their roots in early childhood.

In conclusion, the importance of addressing health disparities in early childhood cannot be overstated. By focusing on the origins of chronic diseases and implementing interventions to promote healthy development, we can improve health outcomes for children and adults.

At the NIEHS Center for Research, Training, and Developmental Disabilities (Center) at the University of Michigan, and the National Institute on Aging (NIA), National Institutes of Health (NIH), we have a shared commitment to addressing the needs of children and adults with disabilities. By partnering with other organizations and agencies, we can work together to address the complex challenges facing children and adults with disabilities and improve their health outcomes.

For more information on the Center's work, please visit the NIEHS website at www.niehs.nih.gov.
Toxic Stress

• Strong, frequent, and/or prolonged activation of the body’s stress-response systems in the absence of the buffering protection of adult support.

  – Precipitants/Major risk factors: extreme poverty, recurrent physical and/or emotional abuse, chronic neglect, severe maternal depression, parental substance abuse, and family violence
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}

\textsuperscript{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.
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

- Collaboration between the CDC and Kaiser
- 17,000 Participants
- Compute an ACE score to calculate early life adversity
- 6 or more associated with a 20-year reduction in life span
- 4 or more with a number of disease states

For more information: http://www.cdc.gov/ace/
Maturational Timelines

- Conception
- Term birth
- Early puberty
- Later puberty
- Extended Adulthood Health
- Early death
- Later Death
- 100 years
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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_gqm6btpvrv.pdf
The Framework

First & Most Important Sensitive Period

The social, emotional & educational environment

The agent of change

A changing agent
The Framework

First & Most Important Sensitive Period

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Neural Changes in Support of Parenting

- Work from animal models and human mothers and fathers reveals **major structural changes** and **important functional changes** to the brain during the transition to parenting that:
  - Change the way stress is handled
  - Promote positive emotions and bonding
  - Increase parental motivation
  - Promote caregiving behaviors

- Changes have been documented in the **reward circuit**, the **emotion regulation circuit** and the **social information processing circuit**
Example: Changes in the Reward Circuit

- The reward circuit is activated by dopamine release and is involved in processing a range of rewarding stimuli including food, drugs and sex
  - During the postpartum period, increased hormones like oxytocin together with dopamine sensitize the circuit to infant-related information
Changes in the Reward Circuit

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

- The **amount** of the growth is associated with positive feelings mothers reported about their baby (e.g. beautiful, perfect).

- More **functional brain activity** in this region also occurs when looking at pictures of one’s own vs. other infants.
Neural Associations in Stressed Parents

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

- Depressed vs. non-depressed mothers exhibit reduced neural responses in the emotion regulation and social information circuits in response to their own infant’s cry sounds (Laurent & Ablow, 2011).

- Mothers who used one or more substances (e.g. tobacco, alcohol) during pregnancy also show reduced responses in the emotion regulation circuits in response to infant cry sounds (Landi et al., 2011).

[Graph showing postpartum depressive symptoms among women with a recent live birth, by maternal education level, 2006–2008]
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Epigenetics

• We inherit our genes, or our DNA from our two biological parents, arranged in a novel configuration

• But DNA does not equal behavior, disease etc.

• Genes must be copied and activated (or deactivated) in every cell of the body and across the lifespan

• A number of processes mark genes for activation or inactivation, collectively epigenetic processes (“on top of the genome”)

• These markers are controlled/sensitive to illness, stress and toxin exposure, environmental supports etc.

• These markers CAN also be inherited across at least a few generations
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
Intervention Options

• Decrease stressful circumstances
  – Strengthen families
  – Community support
  – Poverty alleviation
  – Policy changes

• Increase buffering abilities
  – Strengthen families
  – Integrated health
  – Parenting support
The Buffering Toxic Stress (BTS) Consortium: Testing Parenting Interventions in Early Head Start (EHS)

Sponsored by the Office of Planning, Research & Evaluation (OPRE) within the Administration for Children & Families (ACF)
**Intervention Required Components**

- No current evidence-based interventions that include comprehensive evidence of change in physiologic stress or regulation, brain architecture etc.
  - Though many intervention efforts may effect these changes

- Each site selected their own intervention
  - To meet sites specific needs and resources
  - Their assessment of the best approach

- All interventions target parents as the first critical support for infants and toddlers
  - and the barrier between what is tolerable and what is toxic

- Families served must be attending Early Head Start programming
  - home visitation
  - center care etc.
<table>
<thead>
<tr>
<th>Site</th>
<th>Selected Intervention(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New York University</strong></td>
<td>Play and Learning Strategies (Pals)</td>
</tr>
<tr>
<td><em>Clancy Blair, C. Cybele Raver</em></td>
<td></td>
</tr>
<tr>
<td><strong>University of Colorado</strong></td>
<td>Parent-Child Interaction Therapy (PCIT) &amp; Mindfulness-Based Emotional Availability Intervention</td>
</tr>
<tr>
<td><em>Anschutz Medical Campus</em></td>
<td></td>
</tr>
<tr>
<td><em>Michelle Sarche</em></td>
<td></td>
</tr>
<tr>
<td><strong>University of Delaware</strong></td>
<td>Promoting First Relationships (PFR)</td>
</tr>
<tr>
<td><em>Rena Hallam, Myae Han, Jason Hustedt &amp; Jennifer A. Vu</em></td>
<td></td>
</tr>
<tr>
<td><strong>University of Denver</strong></td>
<td>Filming Interactions to Nurture Development (FIND)</td>
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<tr>
<td><em>Sarah Enos Watamura</em></td>
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<tr>
<td><strong>University of Maryland</strong></td>
<td>Attachment &amp; Biobehavioral Catch-up (ABC)</td>
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<tr>
<td><em>Lisa Berlin &amp; Brenda Jones-Hardin</em></td>
<td></td>
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<tr>
<td><strong>Washington University</strong></td>
<td>Incredible Years Toddler Basic Parenting Program (IYT)</td>
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<tr>
<td><em>John N. Constantino</em></td>
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</table>
**Intervention**

- **FIND**
  - 10 week highly targeted intervention
  - 5 weeks of filming everyday interactions
  - Alternating 5 weeks, use edited videos to provided targeted, strengths-based feedback in 5 domains
  - Focus is on core relational building blocks
  - Parents serve as their own models of success
  - Also use “opportunity clips”, but no corrective/negative clips
Next Steps: Can Successful Intervention Change Brain Architecture to Support Parenting?
Why is this important for state lawmakers?

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

• Early and chronic (toxic) stress likely increases:
  – Additional educational expenditures and resources by schools
  – Crime
  – Mental and physical illness
  – ER visits
  – Low workforce preparatrion
  – Intergenerational disadvantage

• Prevention and EARLY Intervention for stressed families therefore could save resources and prevent problems across sectors
What questions should 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....

• How can Programs you already have use this information?
  – Are staff and participants in these programs aware of current understandings of stress and its costs?
  – 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?”
Two take-aways

• Your constituents are paying/losing a lot of money simply because of a lack of understanding and attention to these issues

• Pushing forward solutions may simply require attention to the specifics of family circumstances and a broader consideration of program effects