Toxic Stress: Why Environment Matters
Objectives

• **Why does environment matter?**
  – Defining adversity or stress
  – 4 key concepts that help explain how environment-brain interaction changes the brain

• **What can you do to change this for the better?**
  – Using what we know about toxic stress to help promote healthy development
Why does environment matter?
Development is a dance between nurture and nature

Experience
Protective and Personal
(versus Insecure and Impersonal)

Brain Development
Alterations in Brain Structure and Function

Epigenetic Changes
Alterations in the Way the Genetic Program is Read

Behavior
Adaptive or Healthy Coping Skills (vs. Maladaptive or Unhealthy Coping Skills)

Source: AAP: Helping Foster And Adoptive Families Cope with Trauma. 2013.
Seeing the Environment Through an Ecobiodevelopmental (EBD) Framework

• Promotes understanding of the environment and brain development
• Shows why early support is important
• Highlights psychosocial stressors as every bit as biological as nutrition
• Emphasizes the dimension of time
How do you define adversity or stress?

• Stress is not necessarily a bad thing

• Based on the perception and reaction (objective physiologic responses):
  – Positive stress response
  – Tolerable stress response
  – Toxic stress response

Source: National Scientific Council on the Developing Child
Positive Stress Response

• Brief, infrequent, mild to moderate intensity
• Most normative childhood stress
  – 2 year-old stumbles while running
  – Beginning school or daycare
• Social emotional buffers allow a return to baseline
• Builds motivation and resiliency
• Positive Stress is not the absence of stress

Source: National Scientific Council on the Developing Child
Tolerable Stress Response

• Exposure to non-normative experiences
  – Death in family
  – Natural disaster
• Social emotional buffers can provide protection and promote a return to **baseline**
• A single major negative event does not necessarily mean long-lasting problems

Source: National Scientific Council on the Developing Child
Toxic Stress Response

- Long lasting, unremitting stress, not a “single bad stressor”
- Adverse child experiences
  - Abuse
  - Household dysfunction
- Insufficient social-emotional buffering
- Potentially permanent changes and long-term effects
- Epigenetics
- Brain architecture

Source: National Scientific Council on the Developing Child
“Social-emotional buffering is the primary factor distinguishing level of stress.”

Andy Garner, MD
AAP EBCD Leadership Work Group Chair
Eco-Bio-Developmental Model of Human Health and Disease

Ecology becomes biology, and together they drive development across the lifespan.
Key Concept 1

Childhood adversity has lifelong consequences
Adverse Childhood Experiences (ACE) Study

• One the largest studies to assess associations between childhood maltreatment and later health and well-being

• Findings suggest that certain experiences are major risk factors for illnesses and poor quality of life

Source: Centers for Disease Control and Prevention - http://www.cdc.gov/ace/
Adverse Childhood Experiences (ACE) Study

Source: Centers for Disease Control and Prevention
Epigenetics

- Which genes are turned on/off, when and where
- Ecology (environment/experiences)
- Stress-induced changes in gene expression
Parental Stress and Children’s Genes

- Parents’ stress leaves lasting marks on children’s genes
- Higher stress levels reported by mothers during their child’s first year correlated with methylation levels on 139 DNA sites in adolescents

Source: Kobor, Child Development August 2011
Hippocampus Volume by Preschool Depression Severity and Maternal Support

Hippocampus volume (mm³)

- Low Depression severity
- High Depression severity
- Low Maternal support
- High Maternal support

- t = 3.83, P < 0.001
- t = 4.20, P < 0.001
- t = 2.36, P = 0.020

Luby J L et al. PNAS 2012;109:2854-2859

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Key Concept 3

Developmental Neuroscience

• Brain architecture is experience-dependent
• Ecology influences how brain architecture is formed and remodeled
• Diminishing cellular plasticity limits remediation
Plasticity

- Plasticity refers to the brain’s unique ability to literally “rewire” itself in response to experience.
- Experience influences not only the foundational architecture, but the on-going connectivity and functionality.
- Two different types of plasticity...
Plasticity

- **Synaptic Plasticity**
  - Variation in the **STRENGTH** of individual connections
  - “a single person goes from a whisper to a shout”
  - Lifelong (how old dogs learn new tricks)

- **Cellular Plasticity**
  - Variations in the **NUMBER (or COUNT)** of connections
  - “from one person shouting to a stadium shouting”
  - Declines dramatically with age (**waning by age 5**)
Differential Maturation

- The Brake – PFC (with some hippocampal help)
  Frontal lobes:
  Abstract thought, reasoning, judgment, planning, impulse and affect regulation, consequences

  Temporal lobe (outside):
  Processing sound and language

  Limbic System (inside):
  Emotions and impulsivity
  + The Gas Pedal + Amygdala

  Brain Stem & Cranial Nerves:
  Vital functions Swallowing

  Parietal Lobe:
  Integration of sensory data and movement

  Occipital Lobe:
  Visual processing

  Cerebellum:
  Smooth movements Coordination
 Early Stress

CHILDHOOD STRESS

Hyper-responsive stress response; calm/coping

Chronic “fight or flight;” ↑ cortisol / norepinephrine

Changes in Brain Architecture
Critical Concept 4

What can you do to make it better?
Development is a dance between nature and nurture

• What you can do:
  – Apply an ecobiodevelopmental framework
  – Recognize adverse psychosocial factors
  – Collaborate with families and social service providers
Early connections form the foundation

• What you can do:
  – Encourage social-emotional skills
  – Talk about the 5 Rs
  – Help families recognize social and developmental milestones
Strategies to Improve Developmental Trajectories

What will push children in red and yellow categories towards green?

- Reading to child
- Parent Responsiveness
- Anticipatory Guidance
- Language Stimulation
- Appropriate Discipline
- High quality ECE
- Health Services
- Home visiting
- Specialized services
- Pre-school

Developmental Progress

Birth
Early Infancy
Late Infancy
Early Toddler
Late Toddler
Early Preschool
Late Preschool
3 yrs
5 yrs

Age
Brain Plasticity Declines With Age

- What you can do:
  - Work with families and child care providers to ensure that brain’s wiring is right the first time
  - Advocate for a public health approach to toxic stress
  - Help families to provide safe, stable relationships
  - Assist families in regulating stress
CONCLUSION:

It is easier to **build strong children** than to **repair broken men**.

Frederick Douglass