

Toxic Stress: Why Environment Matters

Objectives

- **What is stress?**

Defining adversity or stress

Environmental contributions to stress - ACEs

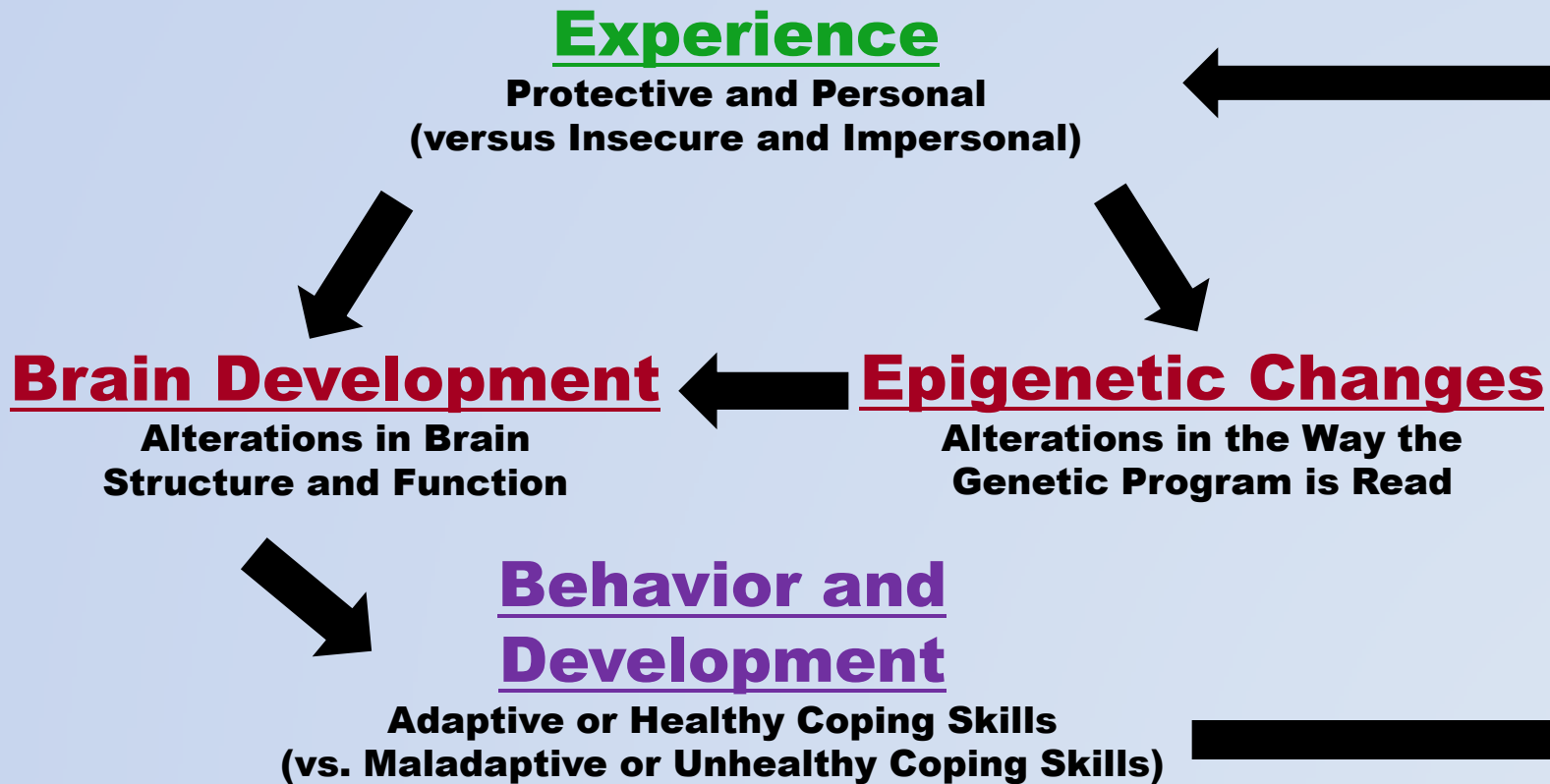
How environment-brain interaction changes the brain – epigenetics and brain architecture

- **How can we 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



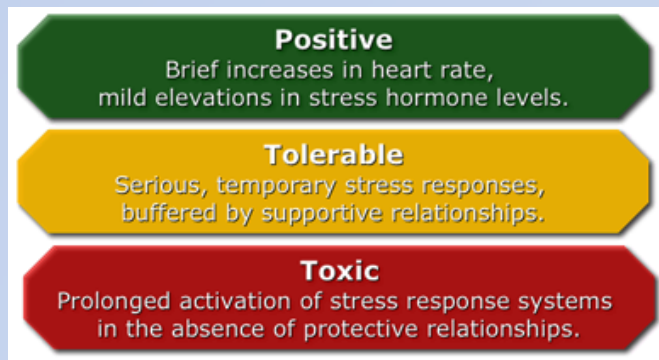
Poor Start: Behind from the Beginning (KUOW)



- <http://kuow.org/post/stressed-kids-3-year-old-who-grunted-and-pointed> (7:47)

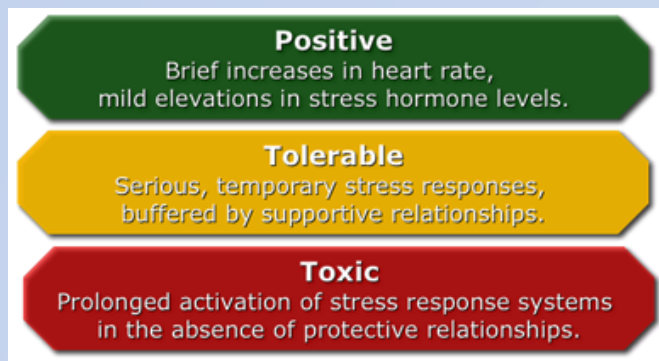
Experiences Include Stress

- There is no such thing as absence of stress
- Stress is not necessarily a bad thing
- 3 types - Based on the perception and reaction (objective physiologic responses) :
 - Positive stress response
 - Tolerable stress response
 - Toxic stress response



Positive Stress Response

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



Tolerable Stress Response

- Exposure to non-normative experiences
 - Death in family
 - Natural disasters, accidents
- Feeling out of control/helpless; stress hormones → ‘fight or flight’ ; ↑BP, HR,
- Social emotional buffers can provide protection and promote a return to baseline
 - A single major negative event does not necessarily mean long-lasting problems

Toxic Stress Response

Long-lasting, unremitting stress,
not a “single bad stressor”

Positive

Brief increases in heart rate,
mild elevations in stress hormone levels.

Tolerable

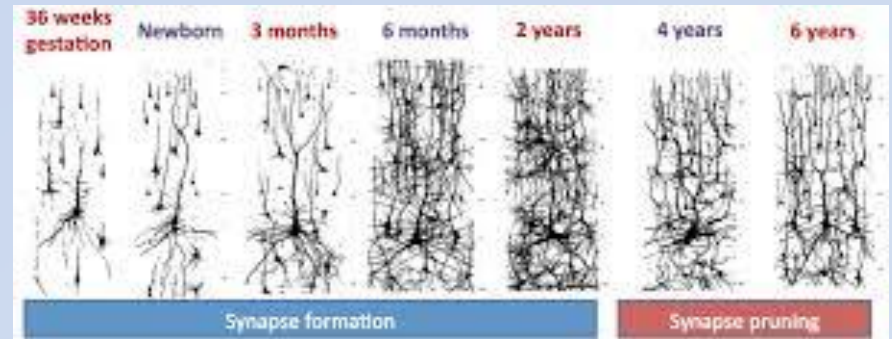
Serious, temporary stress responses,
buffered by supportive relationships.

Toxic

Prolonged activation of stress response systems
in the absence of protective relationships.

- Insufficient social-emotional buffering from innate coping skills and/or supportive relationships
- Potentially permanent changes and long-term effects
 - Epigenetics and changes in brain architecture – Neural connectivity reduced; threshold responses altered
 - Fewer connections: reasoning, planning, behavioral control
 - Overproduction of connections: fear, anxiety, impulsiveness
- Adverse childhood experiences (ACEs)

Stress responses:



- Brain stress circuits
 - Plasticity max. @ fetal/early childhood periods
- Hormones and neurochemical systems
 - Cortisol –
 - Short Term -mobilizes energy stores, enhances certain types of memory, activates immune responses
 - Longer term – suppression of immune function, learning and memory; health issues – metabolic syndrome (pre-diabetes), bone mineral loss, muscle atrophy

Cortisol Studies

- When faced with a scary situation, the child will show fright and seek proximity to his or her parent or other supportive caregiver, but there will be no rise in cortisol.
- Toddlers exposed to clowns, all showed the same frightened behavior, but
 - Children in secure attachment relationships did not register a rise in cortisol,
 - Children in insecure attachment relationships showed elevated cortisol

The difference between the two groups was the children's expectation of supportiveness from the parents in the room with them.



Megan Gunnar, PhD
University of Minnesota

Regents Professor, Distinguished McKnight University Professor of Child Development and Director of the Institute of Child Development, University of Minnesota. Dr. Gunnar's main interest area is stress and coping in infants and young children. Her work documents the importance of sensitive and responsive care by adults in the modulation and buffering of stress physiology in the developing child. She is director of the NIMH Center on Early Experience, Stress and Neurobehavioral Development and is a member of the National Scientific Council on the Developing Child and of the Canadian Institute for Advanced Research's program on Experience-based Brain and Biological Development.

Common sources of toxic stress in childhood

- Accumulated burdens of family economic hardship
- Homelessness
- Chronic neglect or abuse
- Caregiver substance abuse or mental illness
- Exposure to violence

How Stress can Manifest

- Sleep problems – difficulty falling or staying asleep, nightmares
- Eating issues – rapid eating, hoarding food, lack of satiety, loss of appetite,....
- Elimination disorders – constipation, soiling, wetting
- Skills/education – delays, attention problems, organizational problems, ...
- Behavior issues – tantrums, aggression, withdrawal, impulsiveness

What Makes Stress Tolerable?

- *Research shows, even under stressful conditions, supportive, responsive relationships with caring adults as early in life as possible can prevent or reverse the damaging effects of toxic stress response*
 - At least one parent or caregiver is consistently engaged in a caring, supportive relationship

Social-Emotional Buffering

Still Face Experiment

2:49

“Social-emotional buffering is the primary factor distinguishing level of stress.”

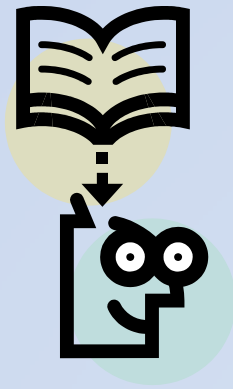


Andy Garner, MD
AAP EBCD Leadership Work Group Chair

Reduce Exposure, Provide Support

- Target: Caregivers – Parents, early childhood professionals, others who spend time with young children
- Turn off physiologic stress response by:
 - Addressing physical and safety needs
 - Promoting healthy relationships and attachment
 - Encouraging foundational coping skills as they emerge

Childhood Adversity



Lifelong Consequences

Adverse Childhood Experiences (ACE) Study

- One the largest studies to assess associations between childhood stressors and later health and well-being
- Findings suggest that certain experiences are major risk factors for illnesses and poor quality of life

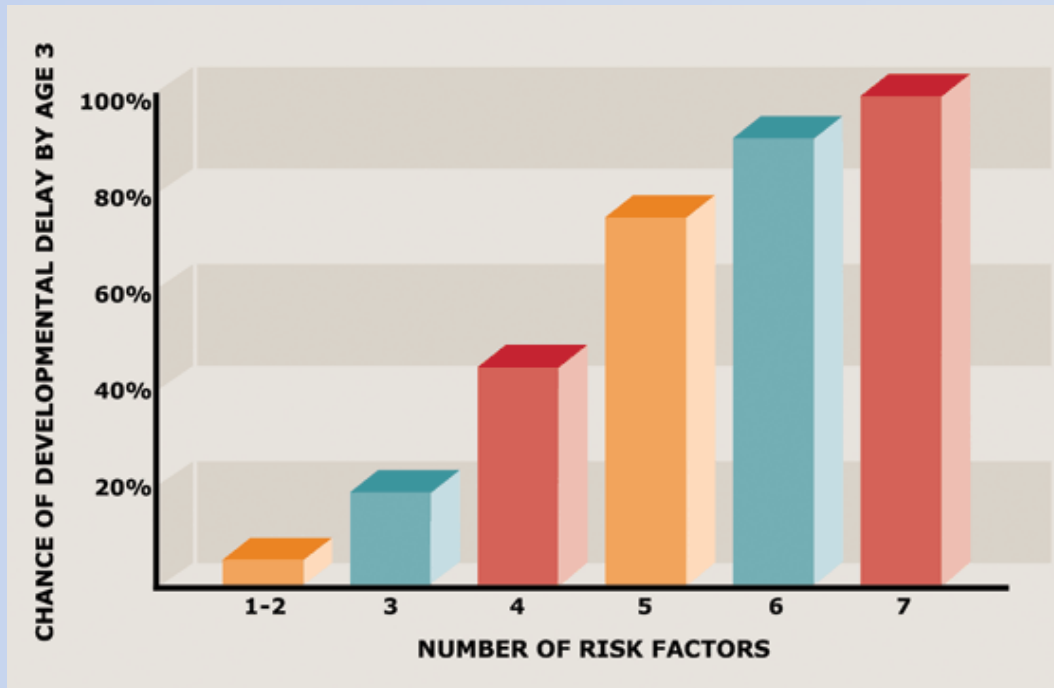
Study was on upper-middle class, college-educated
population!

Adverse Childhood Experiences (ACE) Study



Almost 2/3 reported at least one ACE; more than 20% reported 3 or more ACEs!

Adverse Childhood Experiences and Developmental Delay



- Physical, sexual or emotional abuse
- Physical or emotional neglect
- Household mental illness
- Living in a household with substance abuse
- Having a parent/caregiver divorce or separate
- Exposure to domestic violence
- Living in a household where a member was or has been incarcerated

A National Picture of the Youngest Victims of Child Abuse and Neglect

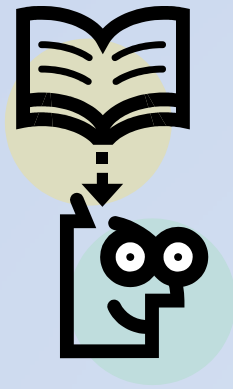
- Our youngest children are the most vulnerable to maltreatment.
 - Highest for children younger than 1 year
 - More than one-quarter (26.8%) of victims - younger than 3 years.
 - Twenty percent (19.9%) of victims - 3-5 years.
- Percentages similar for both boys (48.7%) and girls (50.9%).
- Type of Maltreatment
 - Neglect: - 78.3%
 - Physical Abuse - 18.3%
 - Sexual Abuse - 9.3%
 - Other – 10.6% (threatened abuse, parental substance abuse)

(U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau, 2013, pp. 19-20)

Intergenerational Effects

‘Early childhood adversity not only compromises children’s cognitive and emotional development, it also compromises the capacity of children as adults to care for the next generation. This long-term impact of early adversity on parenting is part of the mechanism that perpetuates a cycle of intergenerational transmission of trauma, psychopathology, addiction, and dysfunctional parenting.’

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 childrens' genes
- Higher stress levels reported by mothers during their child's first year correlated with methylation levels on 139 DNA sites in adolescents

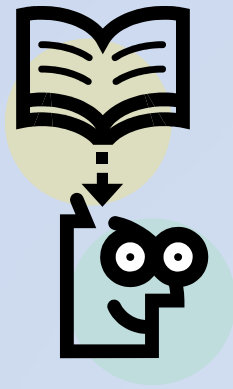
Toxic childhood stress - poor adult health

- Emerging research uncovering the pathophysiology:
 - Inflammation:
 - Inflammatory cytokines released during stress response prepare the body to meet an immediate physical threat.
 - Chronic inflammation - Over years, those proteins damage tissues, increasing the risk for disease.
 - Genetic changes –
 - Epigenetic changes –e.g. DNA methylation and histone acetylation which determine which genes are turned off or on,
 - Erosion of the DNA telomeres leading to impaired cellular replication - affects overall health and longevity

Stress and Telomeres: How Support Helps

- <http://www.youtube.com/watch?v=cvjzwTBjXMI> (5:34)

Developmental Neuroscience



- Brain architecture is experience-dependent
- Environment and experience 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*)

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

Differential Maturation

- The Brake – PFC (with some hippocampal help)

Frontal lobes:

Abstract thought, reasoning, judgment, planning, impulse and affect regulation, consequences

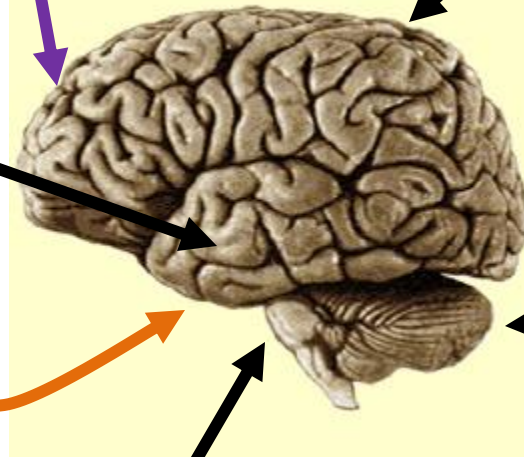
Temporal lobe (outside):

Processing sound and language

Limbic System (inside):

Emotions and impulsivity

**+ The Gas Pedal +
Amygdala**



Parietal Lobe:

Integration of sensory data and movement

Occipital Lobe:

Visual processing

Cerebellum:

Smooth movements
Coordination

Brain Stem & Cranial Nerves:

Vital functions
Swallowing

Early Stress Experiences



CHILDHOOD STRESS

**Hyper-responsive
stress response;
↓ calm/coping**

**Chronic “fight or
flight;” ↑ cortisol /
norepinephrine**

**Changes in Brain
Architecture**

Brain Architecture Alterations:

- Very good human neuroimaging evidence that chronic stress in childhood is directly related to physical changes in the developing brain:
 - Hippocampus
 - Striatum
 - Orbitofrontal cortex
 - Amygdala
 - Prefrontal cortex
 - Anterior cingulate gyrus

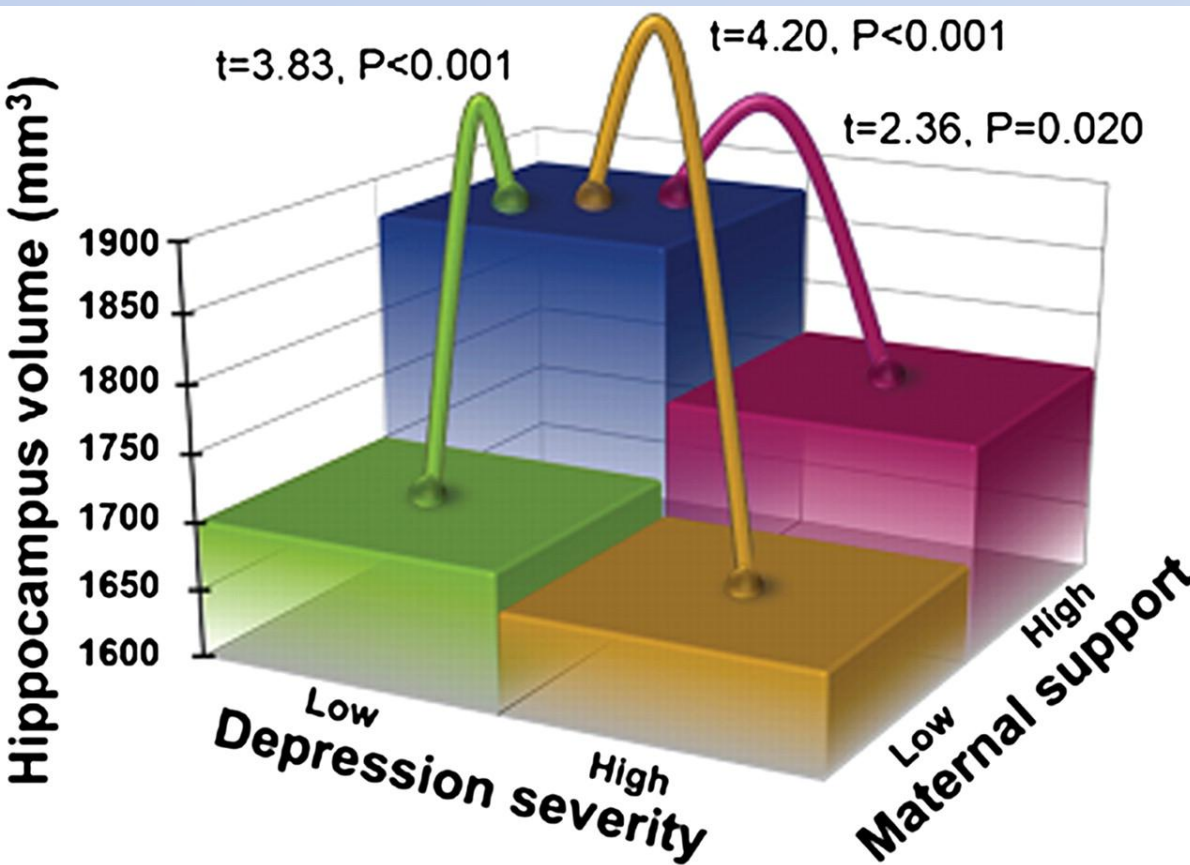
[Front. Hum. Neurosci. 2012;6:52-130](#)

Address toxic stress to shape a child's lifelong health

By: MICHLE G. SULLIVAN, Pediatric News Digital Network

January 24, 2014

Hippocampus Volume by Preschool Depression Severity and Maternal Support



Hippocampus region is key to memory and stress regulation.

- Children of nurturing mothers had hippocampal volumes 10% larger than children whose mothers were not so nurturing
- Note the effect of maternal support even in 'low severity depression'!!!

Luby J L et al. Maternal support in early childhood predicts larger hippocampal volumes at school age. *Proceedings of the National Academy of Science*. 2012;109:2854-2859

92 children in longitudinal study of preschool depression

Toxic stress can
alter size and
architecture of
prefrontal cortex

Differential Maturation

- The Brake - PFC (with some hippocampal help)

Frontal lobes:

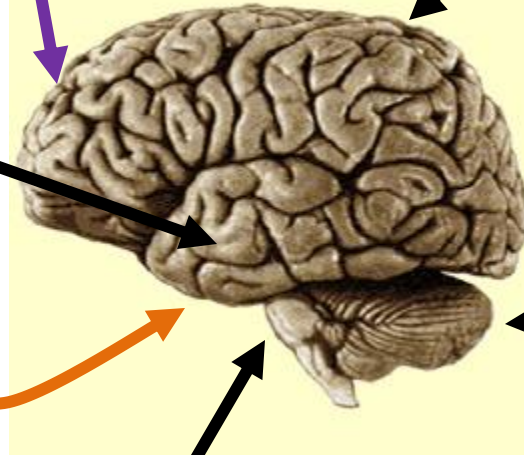
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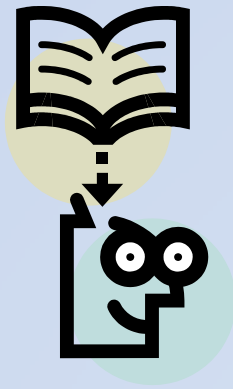
Smooth movements
Coordination

Brain Stem & Cranial Nerves:

Vital functions
Swallowing

Summary: The Impact of Early Adversity on Children's Development (Stop at 2:47)

[http://developingchild.harvard.edu/index.php
/resources/multimedia/videos/inbrief_series/
inbrief impact of adversity/](http://developingchild.harvard.edu/index.php/resources/multimedia/videos/inbrief_series/inbrief_impact_of_adversity/)

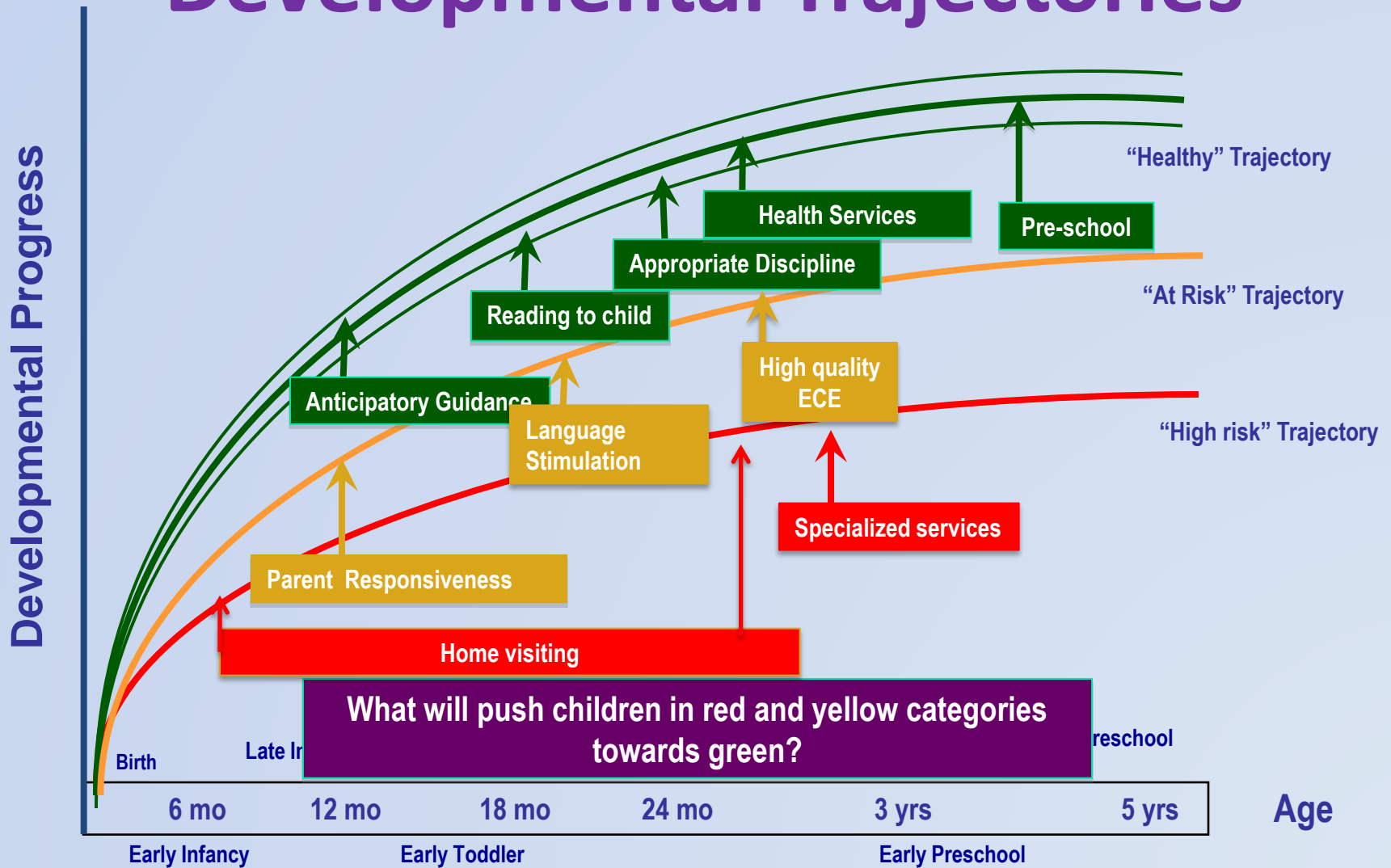


**What can you do to
make it better?**

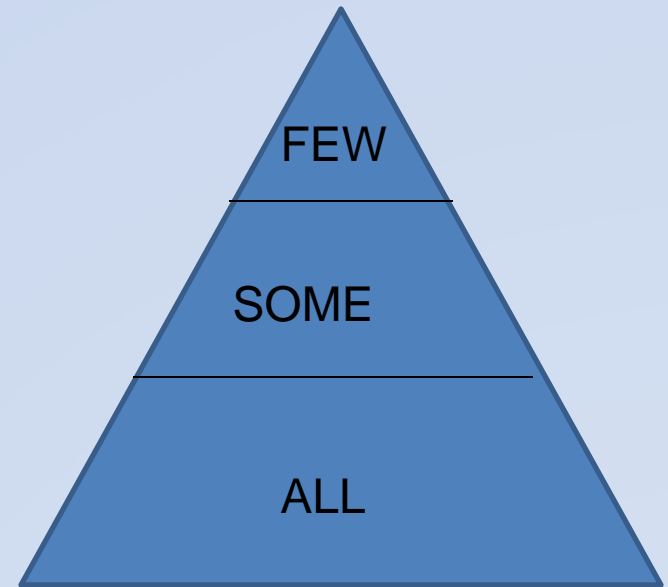
What to do about it

"It will be a tremendous challenge and require an unprecedented level of collaboration between the medical home and all systems of early child care, education, and even child protective services."

Strategies to Improve Developmental Trajectories



Preventing damage from toxic stress

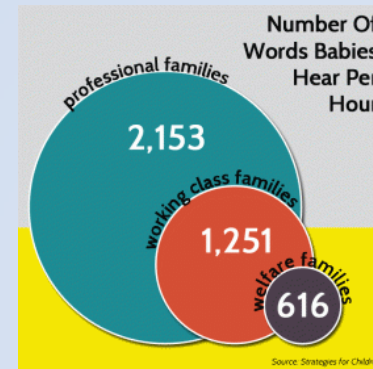


- Reduce exposure, provide knowledge – *all*
- Provide stable, buffering relationships with adult caregivers – *all*, extra support for *some*
- Provide programs/services that remediate the stressful conditions – *few (hopefully)*

Early connections for all children

- **What you can do:**
 - Talk about the 5 Rs
 - READING** together = daily
 - RHYMING**, playing and cuddling
 - ROUTINES** – help children know what to expect of us and what is expected of them
 - REWARDS** for everyday successes – Praise is a powerful reward
 - RELATIONSHIPS** – reciprocal and nurturing, the foundation of healthy child development
 - Help families recognize social and developmental milestones and encourage skills

Not just the words,
but the quality of
language used



Support social, emotional and cognitive development

– Patricia Kuhl research

- Babies learn language not just with their ears, but also with their eyes by watching facial expressions and mouth movements to figure out how to make their own mouths make those sounds.
- Overheard conversations and TV don't do the trick – only live, face-to-face interactions with baby get the right neurons firing.

<http://kuow.org/post/talk-your-baby-her-brain-depends-it>

Parents :

The Help the Helps

1. **Support:** Feeling socially and emotionally supported and hopeful
2. **Help:** Having two or more people who give concrete help when needed
3. **Community Reciprocity:** Watching out for children, intervening when they are in trouble, doing favors for one another
4. **Social Bridging:** Reaching outside one's immediate circle of friends to recruit help for someone inside that circle

Reduce Exposure:

Becoming guardians of the life-course trajectory

Helping the environment in which the child lives:

- Explore toxic exposures besides stress: e.g. FAS, smoking in pregnancy
- Environmental exposures – community violence, healthy food access, playgrounds

Prevention/Amelioration

Community programs

21ST CENTURY POPULATION BASE HEALTH:



Transportation

Agriculture

Healthy Food Sold Here!

Parks and recreation

Land use and planning

SMOKE-FREE HOUSING



Prevention – Identify the Some and Few

- Identify: e.g. Parent Stress Index
 - Child characteristics, parent characteristics and situational/demographic life stress
- I-HELLP screening
 - Medical-legal partnerships

I ncome; General food security
H ousing; H ealth Insurance (Associated utilities)
E ducation/Developmental /Early childhood programs
L egal status
L iteracy
P ersonal safety

Secondary/Targeted Preventions: Parents and Child

- Information and connections
 - Parenting classes, play groups and support programs
 - WIC and food programs
- Child Programs
 - Childcare/early childhood programs
- Home visiting – e.g. Nurse Family Partnership, Parents as Teachers

Interventions for the Few

- Provide programs/services that remediate the stressful conditions (Change the context of parent/child lives):
 - Homeless programs,
 - Job programs, other supports – Call out others???

Dr. Garner

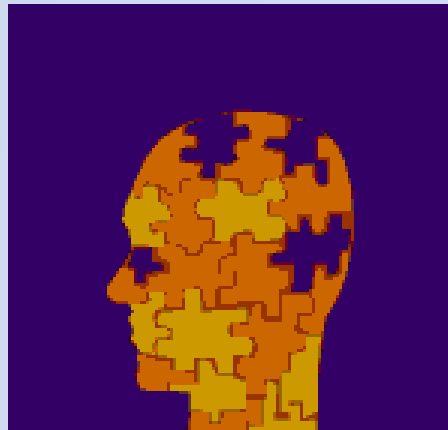
Lead author of an American Academy of Pediatrics technical paper on the enduring effects of early childhood adversity ([Pediatrics 2012;129:e232-46](#))

"If we do a good job of addressing toxic stress, we'll spend less time treating somatic illness.... And if we can prevent some of the long-term effects of toxic stress – like drinking, smoking, drugs, promiscuity – that will be a huge value to the entire health care system. The effects won't be seen tomorrow. But they will be seen. And that's where the real value is."

CONCLUSION:

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

Frederick Douglass





Early Brain and Child Development

BUILDING BRAINS, FORGING FUTURES

A Program of the American Academy of Pediatrics

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



A couple of random examples

- Walla Walla – using ACE cards to help moms think about action steps

– www.resiliencetrumpsACEs.org



- Experience Therapies (Art, Movement, Play, Drama, Creative Writing, etc)
- OTHERS?????.....

Epigenetic Changes and Brain Structure – A Video Summary

- <http://www.albertafamilywellness.org/resources/video/science-seconds-epigenetics>
 - (start at 1:18)

- "Positive stress is adversity that is brief, and shut off by social and emotional buffers," like responsive caregivers, said Dr. Garner, a pediatrician in Westlake, Ohio. "It builds motivation, resiliency, and competency."

**Address toxic stress to shape a child's
lifelong health**

By: MICHELE G. SULLIVAN, Pediatric
News Digital Network
January 24, 2014



MY NEIGHBORHOOD IS KILLING ME



FORECLOSURE For Sale



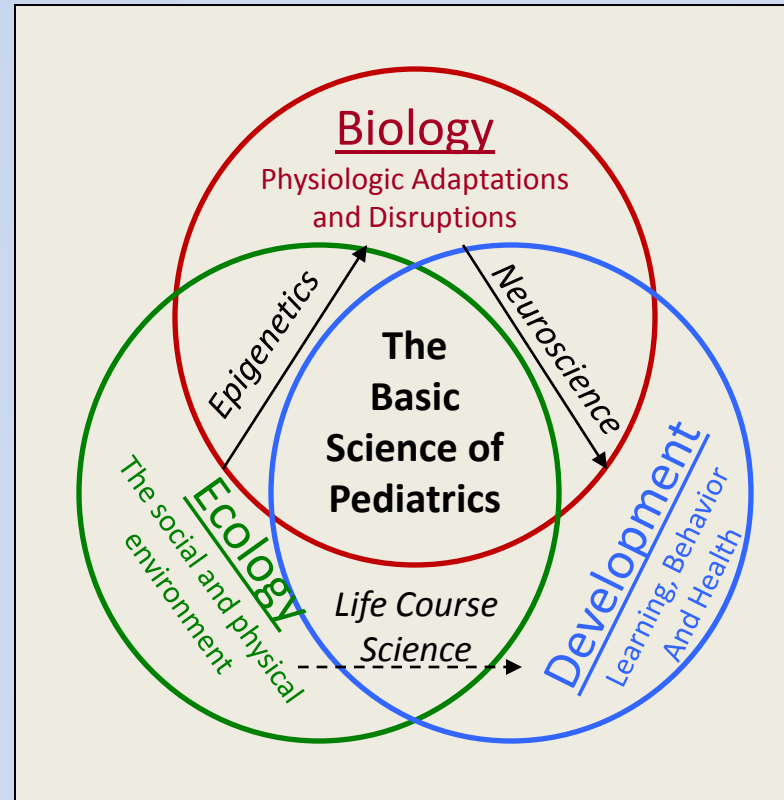
CUTTING The MENTAL HEALTH Budget MAKES NO SENSE



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

Eco-Bio-Developmental Model of Human Health and Disease



Ecology becomes **biology**,
And together they drive **development** across the lifespan

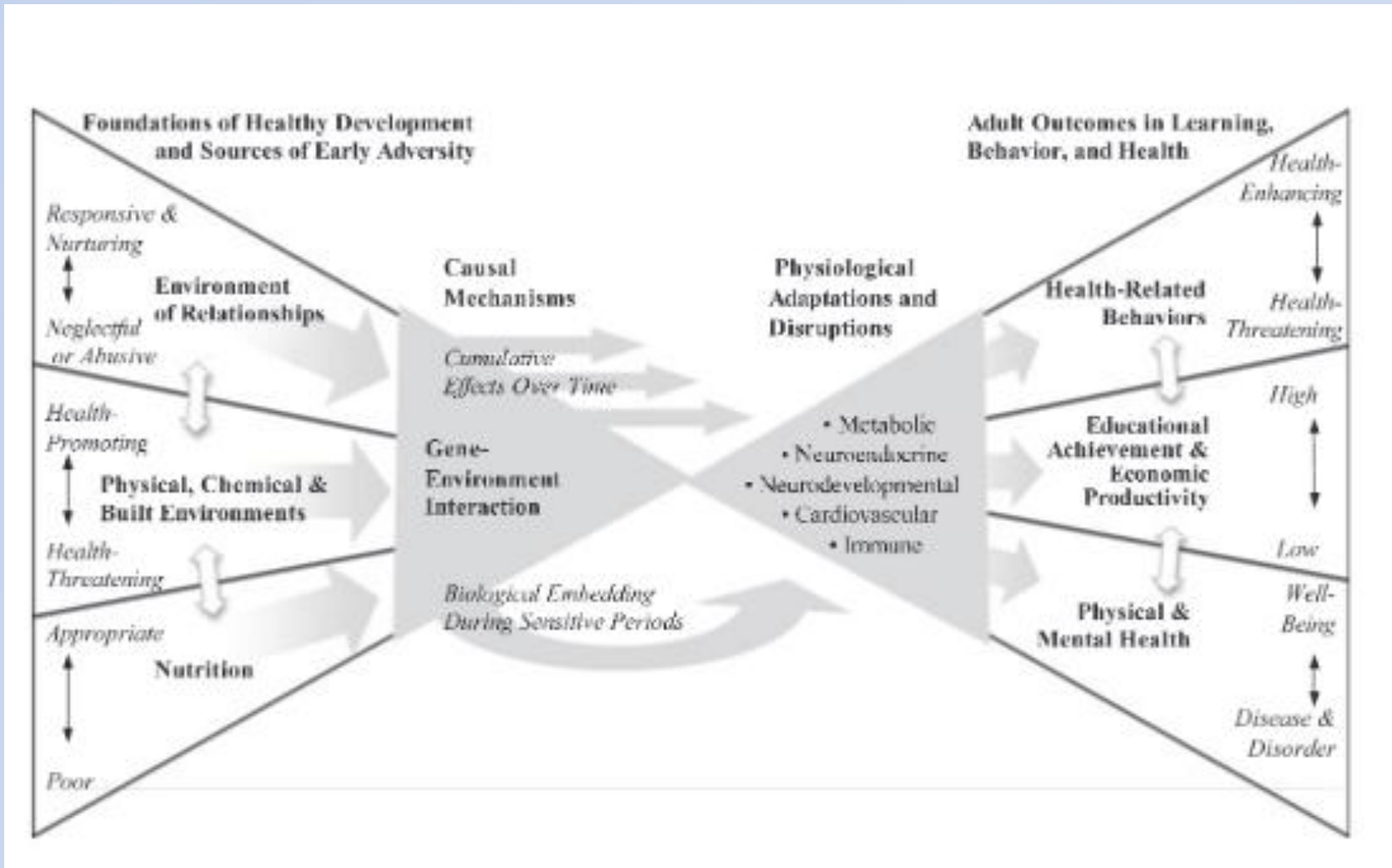
‘The weight of evidence from a wide range of research disciplines – developmental and behavioural neuroscience, epigenetics, developmental psychology, molecular biology, economics, and program evaluation – is converging on a single, fundamental conclusion: early childhood matters, enormously.’

Early Brain & Biological Development: A Science in Society Symposium.
Summary Report. Volume 3.(2012). Calgary, AB, Canada: Norlien Foundation

HOW STRESS GETS UNDER THE SKIN

Early toxic stress embeds itself in our biology in a range of systems and manifests itself in adulthood in any number of chronic conditions and disorders, from cardiovascular disease and diabetes to addiction and mental illness. early life stress can trigger an epigenetic mechanism that silences the expression of the glucocorticoid receptor gene. Glucocorticoids are secreted in response to stress and act to limit stress-induced inflammation. Individuals who experienced early life adversity show resistance to the anti-inflammatory action of glucocorticoids.

Early Brain & Biological Development: A Science in Society Symposium.
Summary Report. Volume 3.(2012). Calgary, AB, Canada: Norlien Foundation



- Toxic stress, however, can't be turned off. There's nothing to buffer its impact – no grown-up to absorb its power and reassure a child that the world hasn't really turned upside down. The situation is almost always the result of a dysfunctional environment: prolonged economic hardship or a caregiver affected by depression, substance abuse, violence, or sexual abuse – perhaps related to her own childhood experiences

Address toxic stress to shape a child's lifelong health
By: MICHELE G. SULLIVAN, Pediatric News Digital Network
January 24, 2014

Prevention

- Promoting First Relationships (in pediatric primary care)
- Text4Baby
 - Free mobile health education service for pregnant women and new moms w/infant <1yo
 - Brief health messages; English and Spanish
 - Campaign of the National Healthy Mothers, Healthy Babies Coalition
- Txt4Tots
 - Parents and caregivers of children, ages 1-5 years, English and Spanish.
 - Short, evidence-based messages focused on nutrition and physical activity
 - Development-based approach to address children's health needs in the context of family and community.

Prevention

- Provide stable, buffering relationships with adult caregivers
 - Family support – positive parenting
 - Parenting programs – Parent Trust for Washington Children; Listening mothers; Triple P; Promoting First Relationships
 - Parenting support – P2P, Father’s Network, parenting groups, diagnosis-specific support groups

Resources - examples

- Strengthening Families Program -
 - Young children 3-5
 - Young teens 13-17
- Father's Network
 - Circle of Support
 - Five Protective Factors
- Parent to Parent – matching families of children with special needs

Stressful events and resilience

- Andrew Garner – a system of care to address toxic stress - a common message, system if in
 - <http://www.youtube.com/watch?v=TzHSxUUZPIk>

Building Resilience:

- <http://www.youtube.com/watch?v=17PywpB9E8g>

- <http://www.youtube.com/watch?v=oZn0GRKjjAk>