

Translating Developmental Science into Healthier Lives:



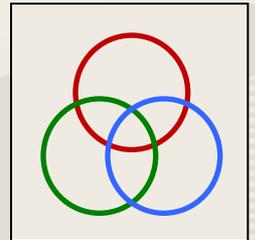
REALIZING the Potential

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Case Western Reserve School of Medicine, and
Chair, AAP Leadership Workgroup on
Early Brain and Child Development**

My 3 Objectives For Today

- Provide a **very general overview** of advances in developmental science
- Present an organizing, integrated, **ecobiodevelopmental** framework
- Discuss a **public health approach** towards the prevention of **toxic stress** and its **lifelong** consequences

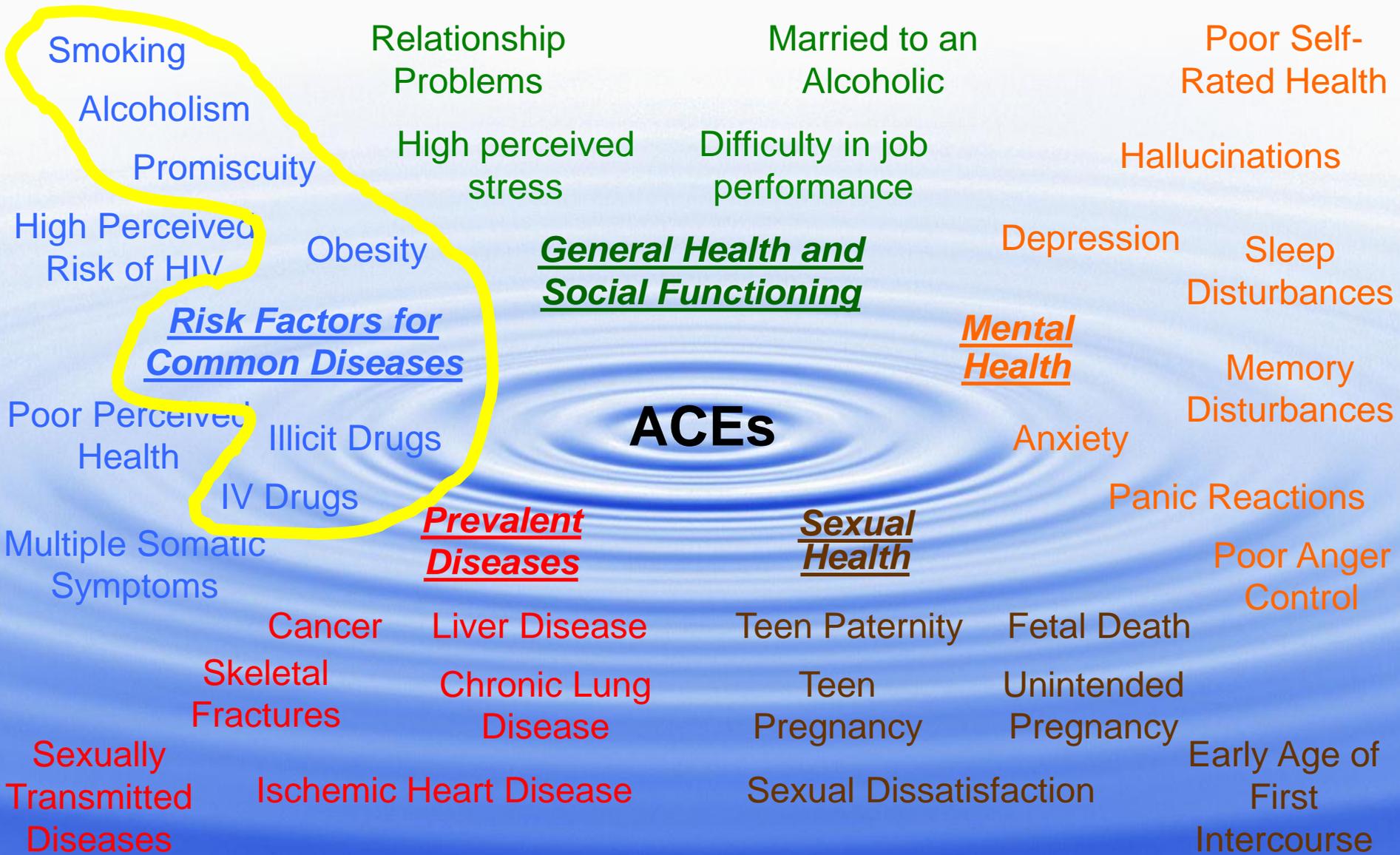


Critical Concept #1

Childhood Adversity has Lifelong Consequences.

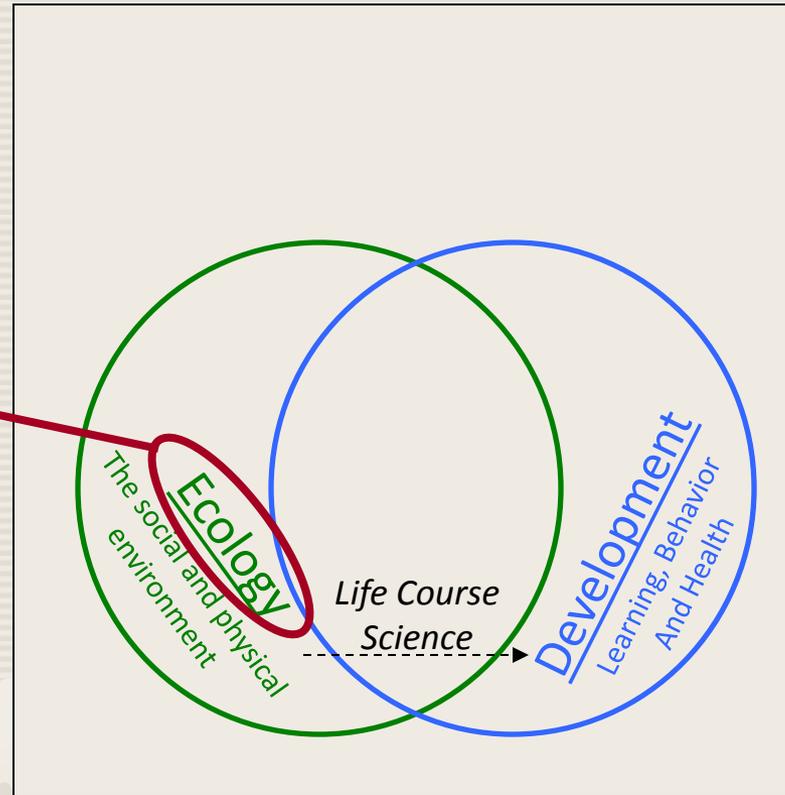
Significant adversity in childhood is **strongly** associated with **unhealthy** lifestyles and poor health **decades** later.

ACEs Impact Multiple Outcomes



Developing a Model of Human Health and Disease

How do you begin to define or **measure** the ecology?



What are the **mechanisms** underlying these well-established associations?

Early childhood **ecology** strongly **associates** with lifelong **developmental** outcomes



Defining **Adversity** or **Stress**

- How do you define/**measure** adversity?
- Huge **individual variability**
 - **Perception** of adversity or stress (subjective)
 - **Reaction** to adversity or stress (objective)
- **National Scientific Council on the Developing Child (Dr. Jack Shonkoff and colleagues)**
 - **Positive** Stress
 - **Tolerable** Stress
 - **Toxic** Stress

Based on the **REACTION**
(objective physiologic responses)

Defining **Adversity** or **Stress**



- **Positive Stress**

- Brief, infrequent, mild to moderate intensity
- Most normative childhood stress
 - Inability of the 15 month old to express their desires
 - The 2 year old who stumbles while running
 - Beginning school or daycare
 - The big project in middle school
- **Social-emotional buffers** allow a return to **baseline**
(responding to non-verbal clues, consolation, reassurance, assistance in planning)
- **Builds motivation and resiliency**
- Positive Stress is **NOT** the **ABSENCE** of stress

Defining **Adversity** or **Stress**



- **Toxic Stress**

- Long lasting, frequent, or strong intensity
- More extreme precipitants of childhood stress (**ACEs**)
 - Physical, sexual, emotional abuse
 - Physical, emotional neglect
 - Household dysfunction
- **Insufficient social-emotional buffering**
(Deficient levels of emotion coaching, re-processing, reassurance and support)
- Potentially permanent changes and long-term effects
 - **Epigenetics** (there are life long / intergenerational changes in how the genetic program is turned **ON** or **OFF**)
 - **Brain architecture** (the mediators of stress impact upon the mechanisms of brain development / **connectivity**)

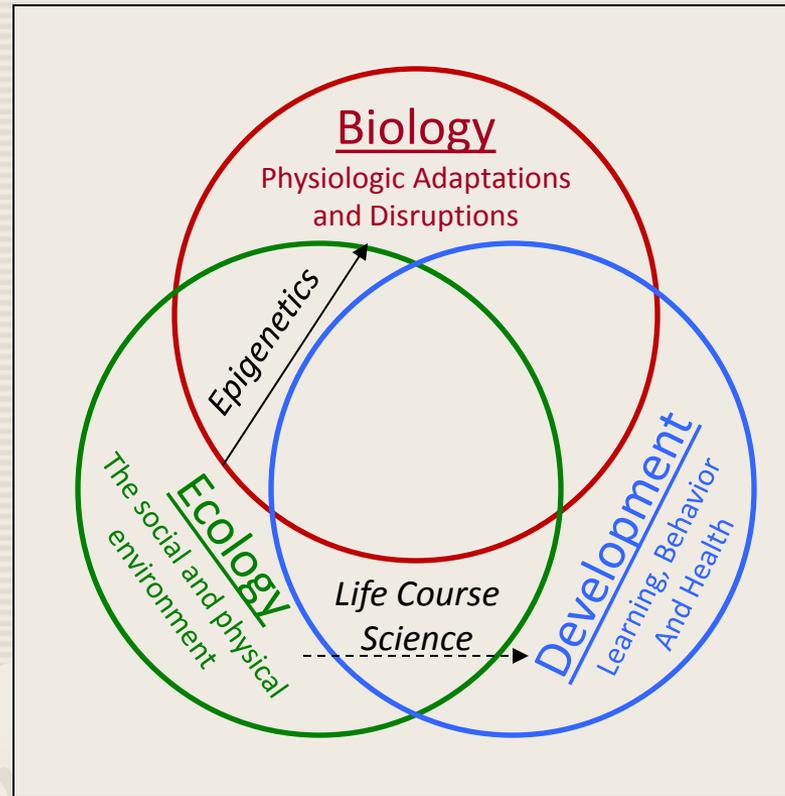
Critical Concept #2

Epigenetics:

- **Which** genes are turned on/off, **when**, and **where**
 - **Ecology** (environment/experience) influences how the genetic blueprint is read and utilized
 - Ecological effects at the **molecular level**
 - **Stress-induced changes in gene expression**
- “**Genes** may load the gun, but the **environment** pulls the trigger”

“Epigenetics: NOT your parents’ genome!”

Developing a Model of Human Health and Disease



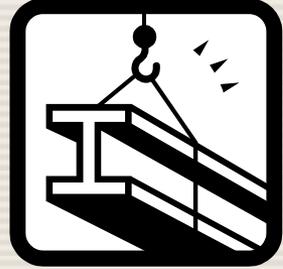
Through epigenetic mechanisms,
the early childhood **ecology** becomes
biologically embedded, influencing how/which genes are used

Critical Concept #3

Developmental Neuroscience:

- **Brain Architecture** is experience dependent (individual connections or “synapses” and complex circuits of connections or “pathways” are both dependent upon activity)
- **Ecology** (environment/experience) influences how brain architecture is formed and remodeled (plasticity)
- **Diminishing cellular plasticity** limits remediation
- Early childhood adversity -> **vicious cycle of stress**
- **Potentially permanent** alterations in brain architecture and functioning

Two Types of Plasticity



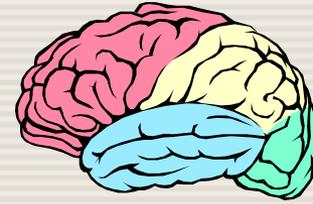
- Synaptic Plasticity -

- Variation in the STRENGTH of individual connections
- “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 Brain 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:

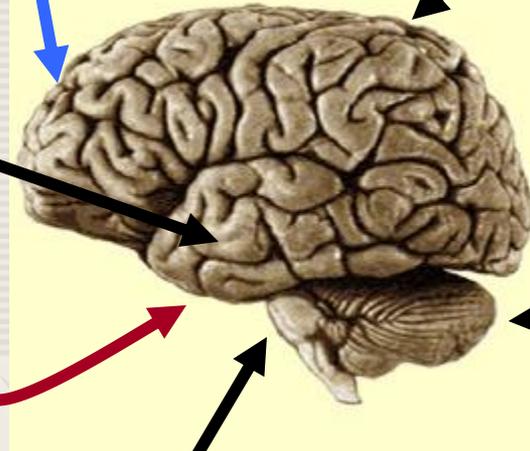
Visual processing

Cerebellum:

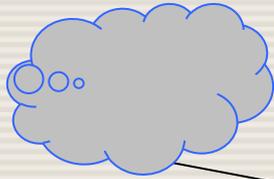
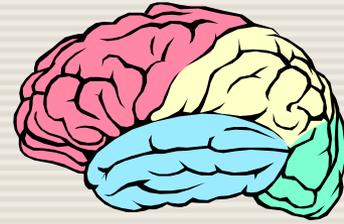
Smooth movements
Coordination

Brain Stem & Cranial Nerves:

Vital functions
Swallowing



Out of Balance?



Prefrontal Cortex

Cold Cognition

Judgmental

Reflective

Calculating

Think about it

Biological maturity by **24**

Amygdala

Hot Cognition

Emotional

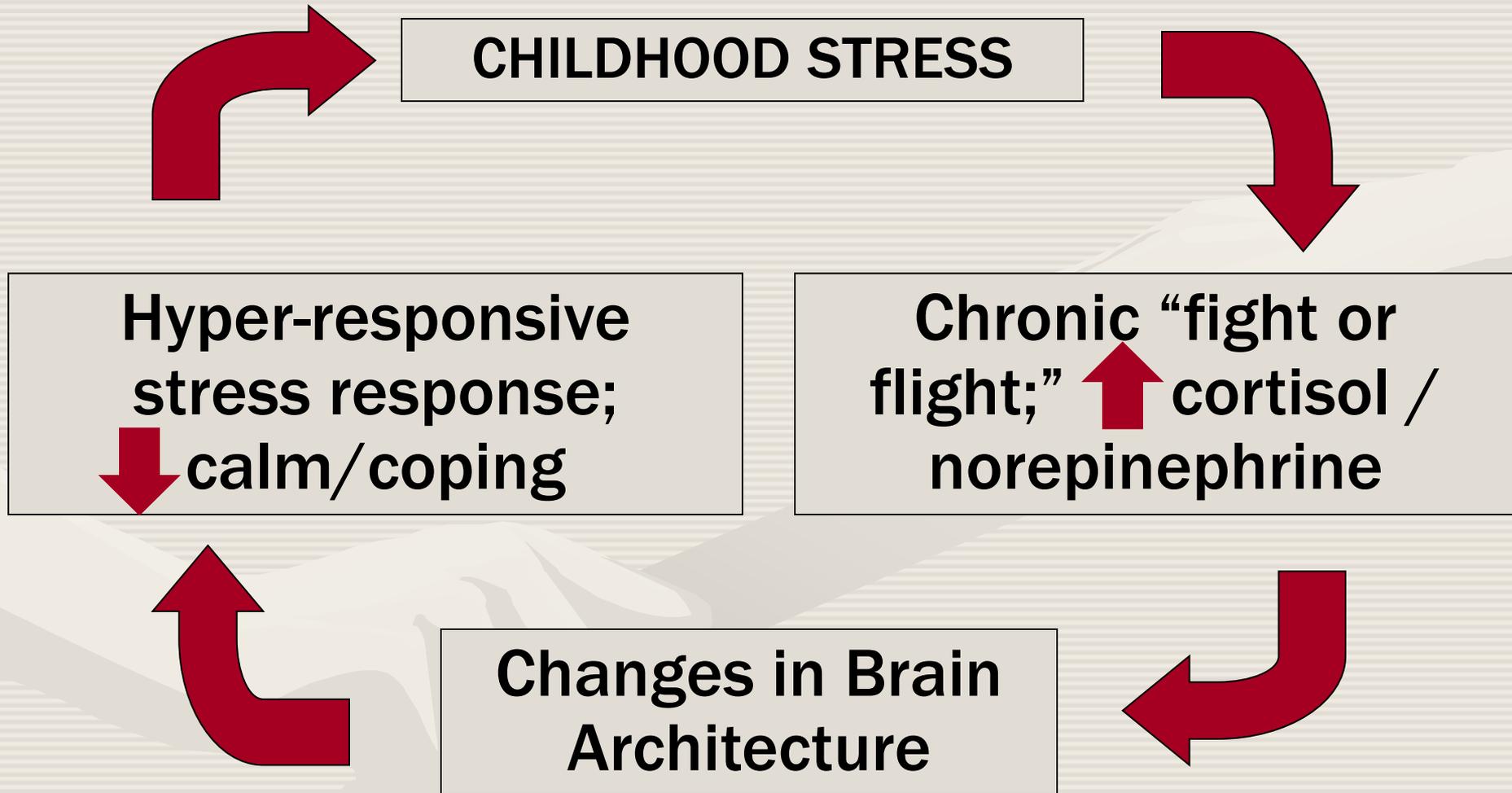
Reactive

Impulsive

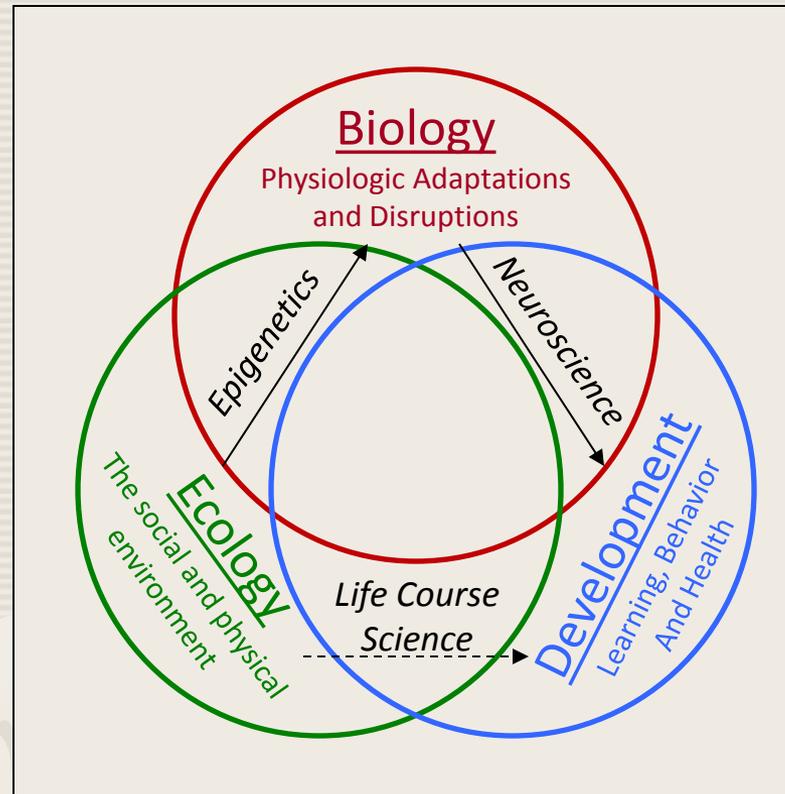
Just do it

Biological maturity by **18**

Impact of Early Stress



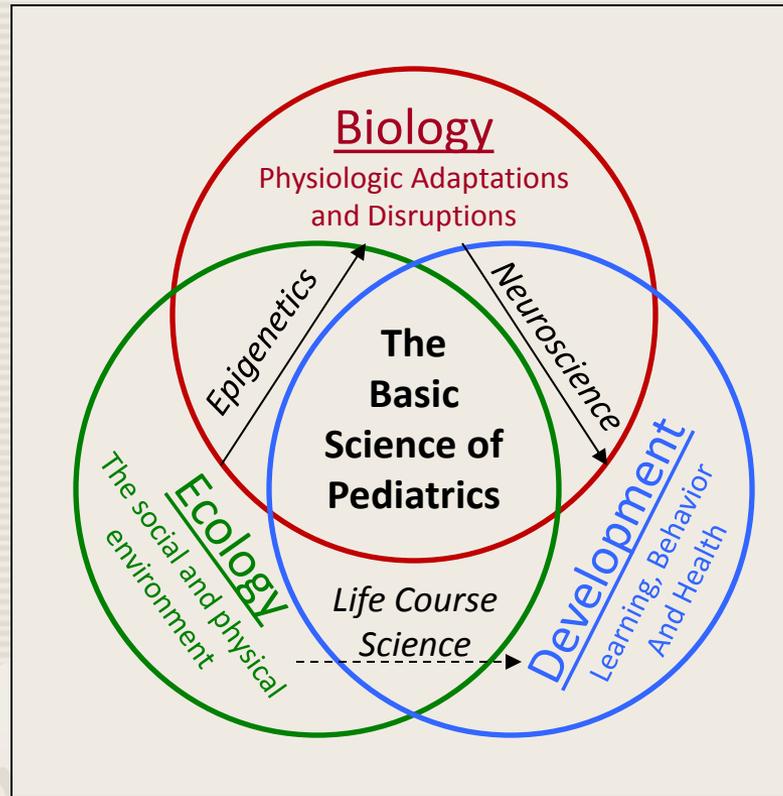
Developing a Model of Human Health and Disease



Declining plasticity in the developing brain results in potentially permanent alterations in brain functioning and **development**

Eco-Bio-Developmental

Model of Human Health and Disease

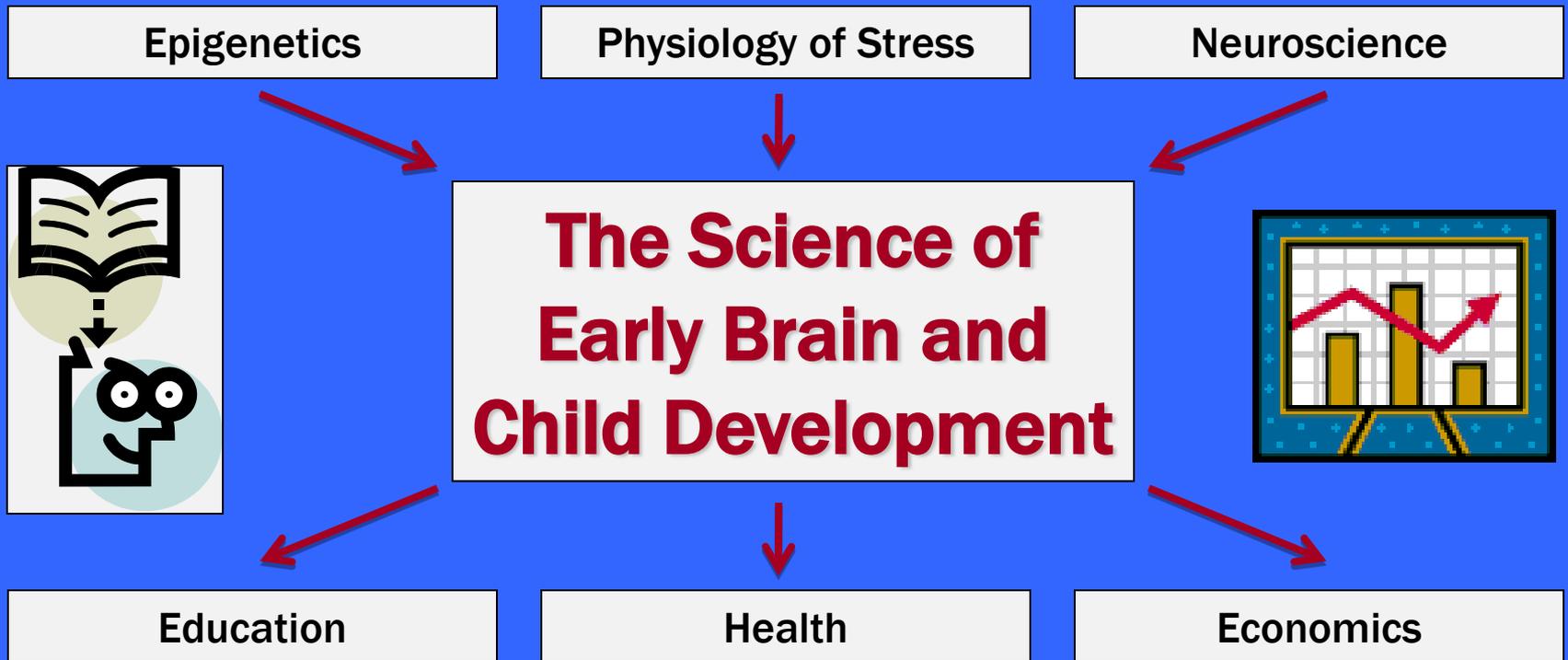


Ecology

Becomes **biology**,

And together they drive **development** across the lifespan

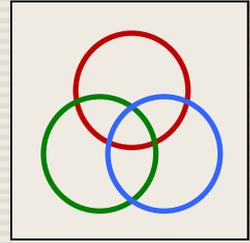
Critical Concept #4



One Science – Many Implications

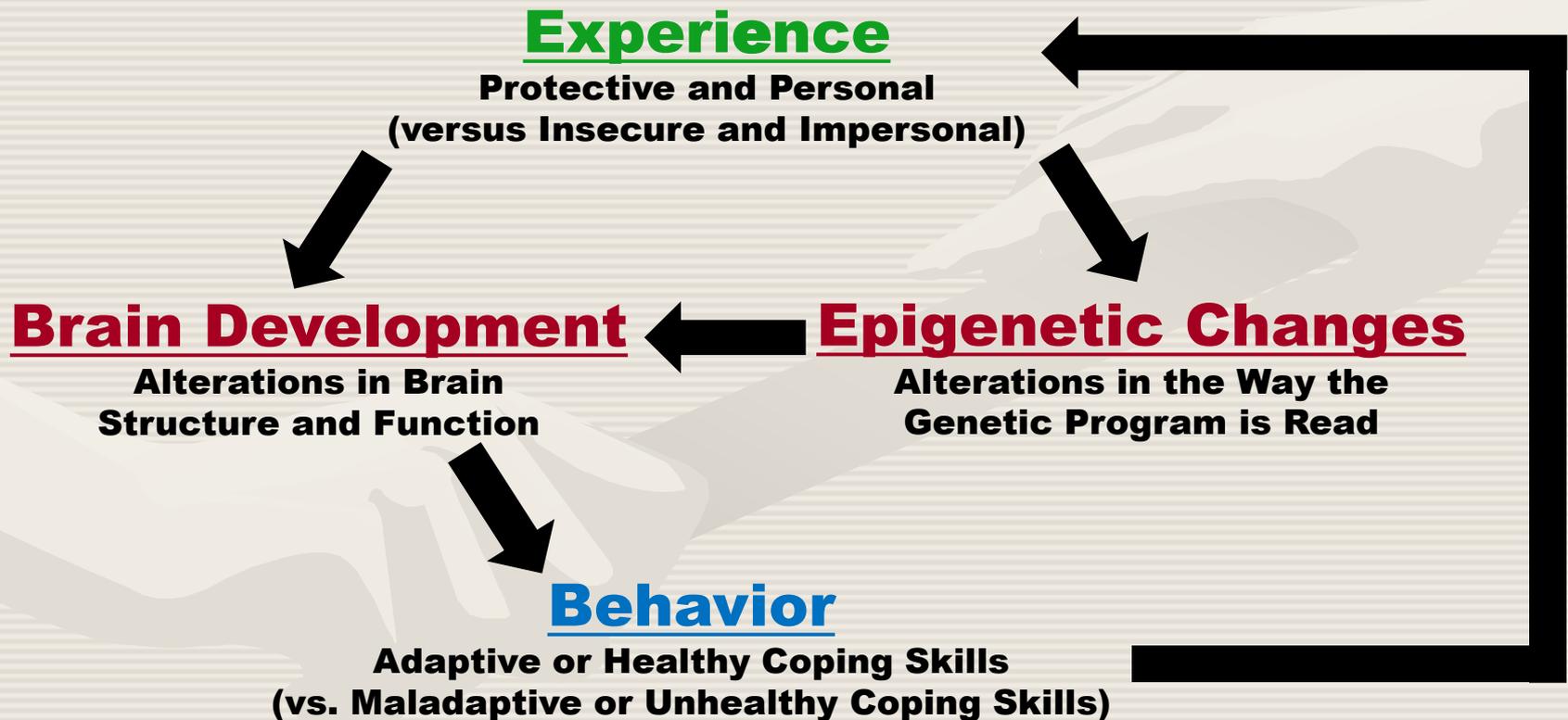
The critical challenge now is to **translate** game-changing advances in **developmental science** into effective **policies** and **practices** for families w/ children to improve **education, health** and **lifelong productivity**

Advantages of an **EBD** Framework

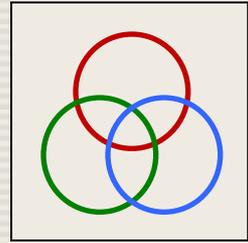


- Though grounded in **developmental science**, the **simplicity** of the EBD framework may promote understanding as well as **support for translation** (early investments are the right thing to do **biologically**)
- Psychosocial stressors and other salient features of the **ecology** are every bit as **biological** as nutrition or lead (no distinction between mental and physical health, just healthy vs. unhealthy **development**)
- Emphasizes the dimension of **time** – to reflect the **on-going, cumulative** nature of benefits and threats to health and wellness

Development results from an on-going, re-iterative, and cumulative dance between **nurture** and **nature**



Advantages of an **EBD** Framework



- Underscores the need to improve the early childhood **ecology** in order to:
 - Mitigate the **biological** underpinnings for educational, health and economic **disparities**
 - Improve **developmental**/life-course trajectories
 - **Changing the early childhood ecology will require a PUBLIC HEALTH approach ... and collaboration!!**
- Highlights the pivotal role of **toxic stress**
 - Not just “**step on the gas**” or enrichment
 - But “**take off the brake**” by treating, mitigating or immunizing against toxic stress

Reinventing the Wheel - All over again?



Models

Maslow's Hierarchy of Needs (Theoretical - 1943)

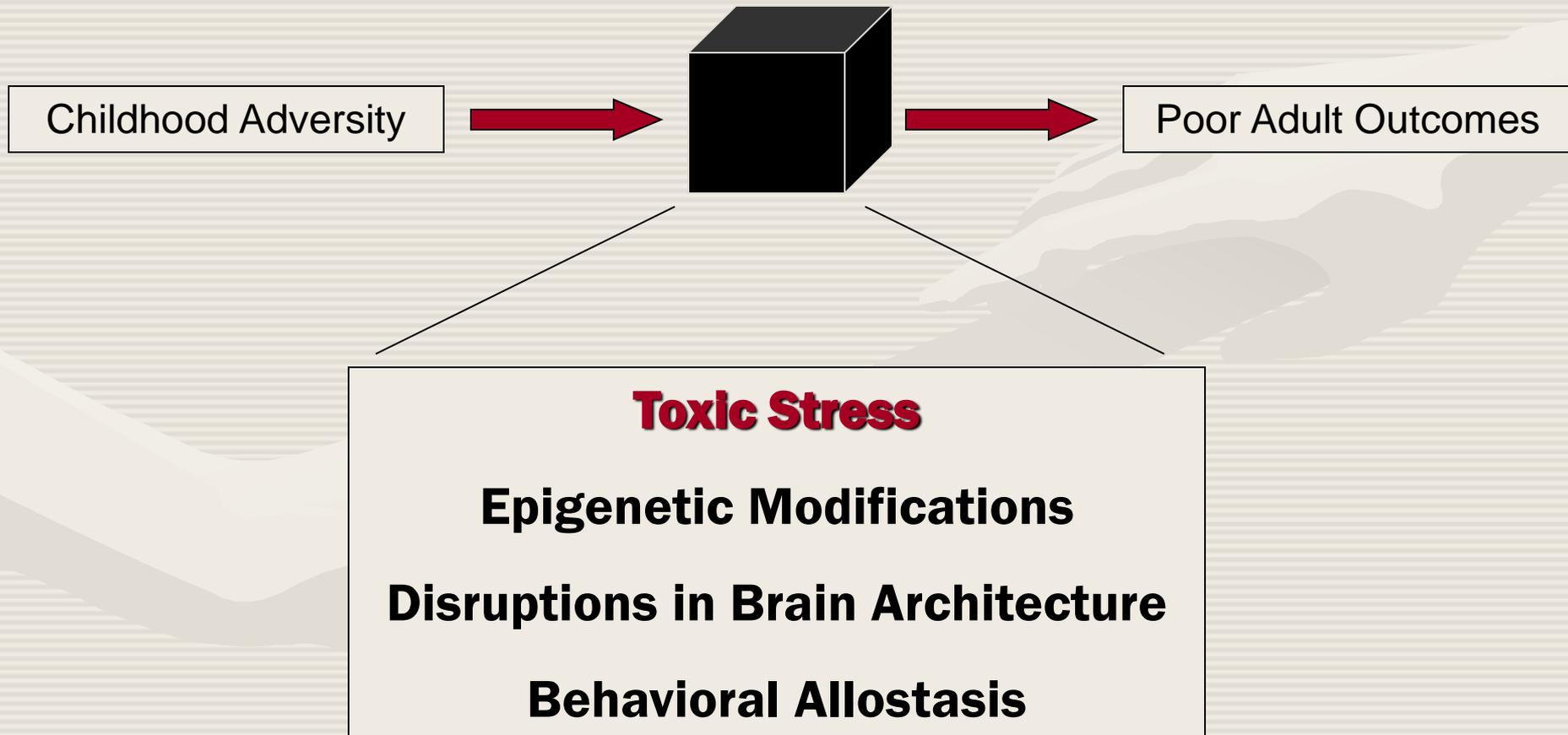
Needs

Self-Actualization

Need to know, explore
and understand

Unmet needs are potential sources of **STRESS!!**

Linking **Childhood Experiences** and **Adult Outcomes**



The **BIG** Questions are...



If **TOXIC STRESS** is the missing link between **ACE exposure** and **poor adult outcomes**, it raises the following BIG questions:

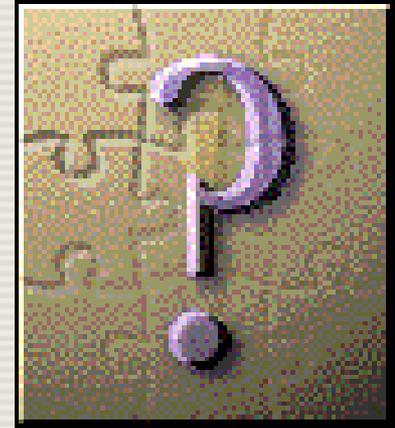
- Are there ways to:
 - **treat**,
 - **mitigate**, and/or
 - **immunize against** the effects of toxic stress?
- If so, is there a mismatch between:
 - what we **KNOW** ... and ...
 - what we actually **DO**? (If there is time!)

Addressing **Toxic** Stress



- **Treatment** of the consequences
 - **TF-CBT** and **PCIT** are evidence-based
 - **Reactive** – some “damage” already done!
 - Efficacy linked to age and chronicity
 - Declining **brain plasticity**?
 - Can be **costly**
 - Insufficient **number** of / **access** to providers
 - Limited reimbursements; carve-outs
 - Persistent **STIGMA**
 - “**Character Flaws**” vs “**Biological Mal-adaptations**”

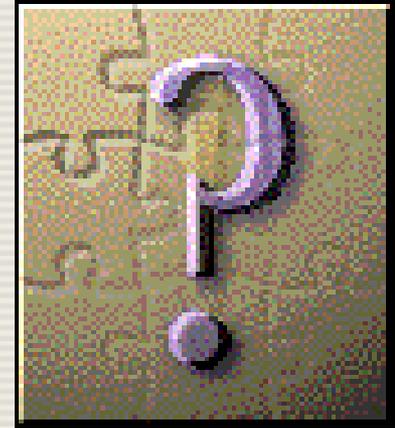
Addressing **Toxic** Stress



- **Secondary / Targeted Preventions**

- Focused, targeted interventions for those deemed to be **“at high risk”**
- Visiting Nurse Programs (Nurse Family Partner.)
- Parenting Programs (Triple-P, Nurturing Parent.)
- More likely to be effective; to minimize **“damage;”** less costly/higher ROI
- Requires **screening**
- Still issues with **stigma**, **numbers** of/**access** to providers

Addressing **Toxic** Stress



- **Primary / Universal Prevention**
 - Proactive, universal interventions to make stress **positive**, or tolerable instead of toxic
 - Acknowledges that preventing all childhood adversity is **impossible** and even **undesirable**
 - **Actively building resiliency** (“immunizing” through positive parenting, 7C’s, promoting optimism, formalized social-emotional learning)
 - **SE Buffers** allow the physiologic stress response to return to baseline
 - **Parenting/Caregiving** skills for younger children
 - **SEL** skills for older children (**www.casel.org**)

Social-Emotional Skills Can Be Taught / Learned



Illinois Learning Standards for Social/Emotional Learning(SEL) - Windows Internet Explorer provided by University Hospitals

http://www.isbe.state.il.us/ils/social_emotional/standards.htm

File Edit View Favorites Tools Help

★ Favorites Illinois Learning Standards for Social/Emotional Learning...

 **Illinois State Board of Education**
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ISBE Home Site Map Funding Opps IWAS ECS FRIS Inquiry Programs

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Teacher Info

Navigation

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Illinois Learning Standards

Social/Emotional Learning (SEL)

The standards describe the content and skills for students in grades K - 12 for social and emotional learning. Each standard includes five benchmark levels that describe what students should know and be able to do in early elementary (grades K - 3), late elementary (grades 4 - 5), middle/junior high (grades 6-8), early high school (grades 9-10), and late high school (grades 11-12). These standards build on the Illinois Social/Emotional Development Standards of the Illinois Early Learning Standards.



These standards have been developed in accordance with Section 15(a) of Public Act 93-0495. This Act calls upon the Illinois State Board of Education to "develop and implement a plan to incorporate social and emotional development standards as part of the Illinois Learning Standards."

Introduction 

Goals

- Goal 1 - Develop self-awareness and self-management skills to achieve school and life success.  
- Goal 2 - Use social-awareness and interpersonal skills to establish and maintain positive relationships.  

Internet 100%

Critical Concept #5

SOCIAL-EMOTIONAL SKILLS...

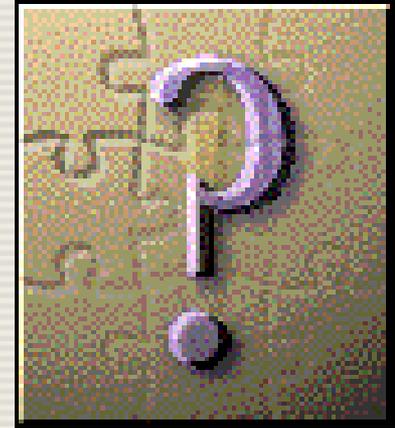
(a.k.a – Affect Regulation, Non-Cognitive Skills, Mindfulness)

...Are **learned** (they can be **modeled, nurtured, taught, practiced, and reinforced**)

...Effectively **buffer** against **toxic stress**
(by helping to turn **off** the physiologic stress response)

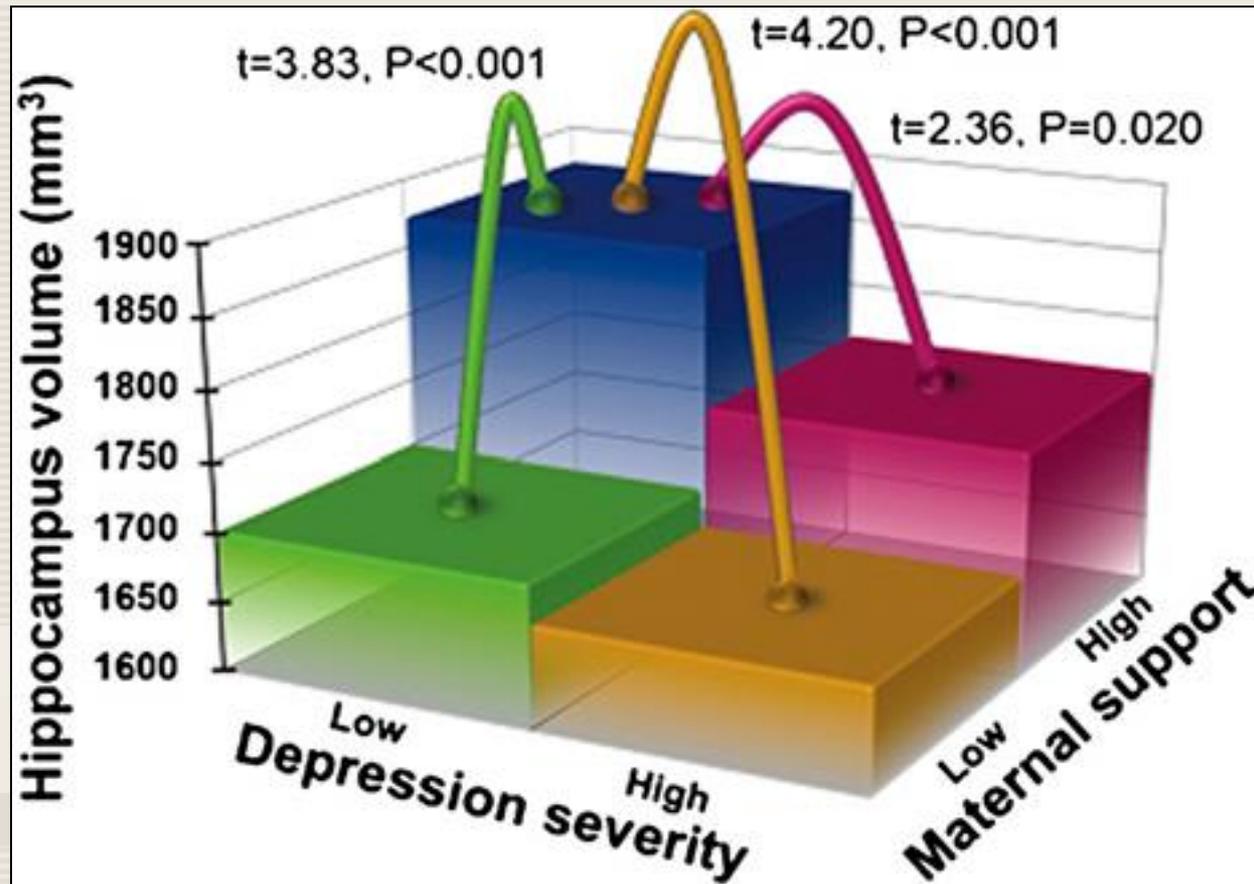
...Increase **test scores**
(an average of **11 points** by meta-analysis!)

Parenting as **Primary** Prevention



- Promoting **Parenting Skills** in the first 1000 days
 - Parenting is personal – makes pediatricians **NERVOUS!**
 - “Positive/Nurturing/Supportive” Parenting
 - A Poor investment?
 - Are parenting skills “**teachable?**” **YES!!**
 - Is there a “**ceiling effect**” on returns? **What is “OK?”**
 - Or the “**Gold Standard?**”
 - Shouldn’t this be THE reference point (NOT routine, general, or control populations)
- Recent article from Luby *et al.*, PNAS
 - **Maternal support** and **Child depression severity** at ages 3-5
 - “Waiting Test” assessed the dyad (Bright Gift + Parental Surveys)
 - **Hippocampal volumes** at school age (7-13)

- Early maternal support exerts **a positive influence on hippocampal development**
- The positive effect of maternal support on hippocampal volumes was **greater in nondepressed children**



Critical Concept #6

For young children, **parent/caregiver support is critical:**

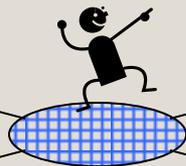
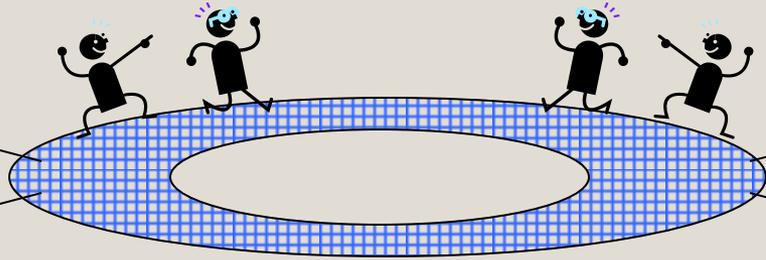
- Turns off physiologic stress response by **addressing physiologic and safety needs** (**PROTECT** = Maslow levels 1+2)
- Turns off the physiologic stress response by **promoting healthy relationships and attachment** (**RELATE** = Maslow level 3)
- Notes and encourages **foundational coping skills** as they emerge (**NURTURE** = Maslow levels 4+5)

Early Childhood Professionals are ideally placed to:

- Promote this sort of “Purposeful” Parenting
- Advocate / participate **public health approach** to address TS

Social-Emotional Safety Nets

A Public Health Approach to “**Toxic Stress**”



Universal Primary Preventions

Anticipatory guidance
Consistent messaging (CTC)

No identification

No stigma

**Ceiling effects =
Limited evidence base**

Targeted Interventions

(for those “at risk”)

Nursing home visits (NFP)

Parenting programs (PPP)

Early Intervention

Less ceiling=More evidence

Requires screening

Issues with stigma

Evidence-Based Treatments

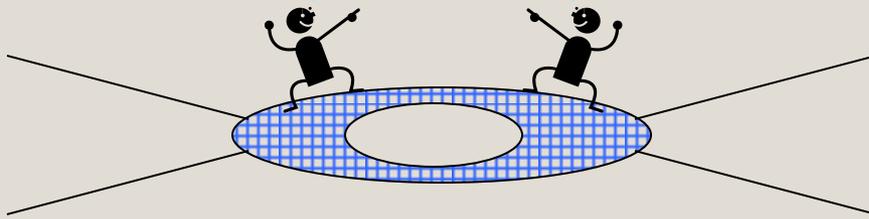
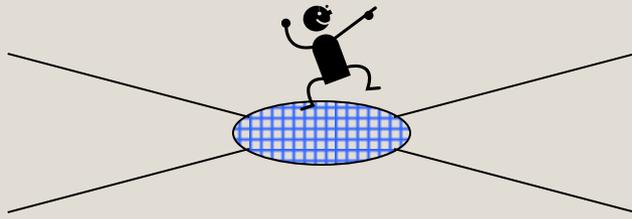
(for the symptomatic)

PCIT; TB-CBT; Pharmacotx

Treatment works!

Screening / stigma / access

WHAT are we DOING?!



Universal Primary Preventions

Bright Futures

Connected Kids / HS - NCH

Circle of Security / VIP

Relationships as a “vital” sign

Decrease Stress/Build Skills

Targeted Interventions

Screening for risks

Assess the ecology (SEEK/cACE)

Refer to/advocate for EBI

Collaborating/Developing EBI

ID Risks/Provide EBI

Evidence-Based Treatments

Screening for diagnoses

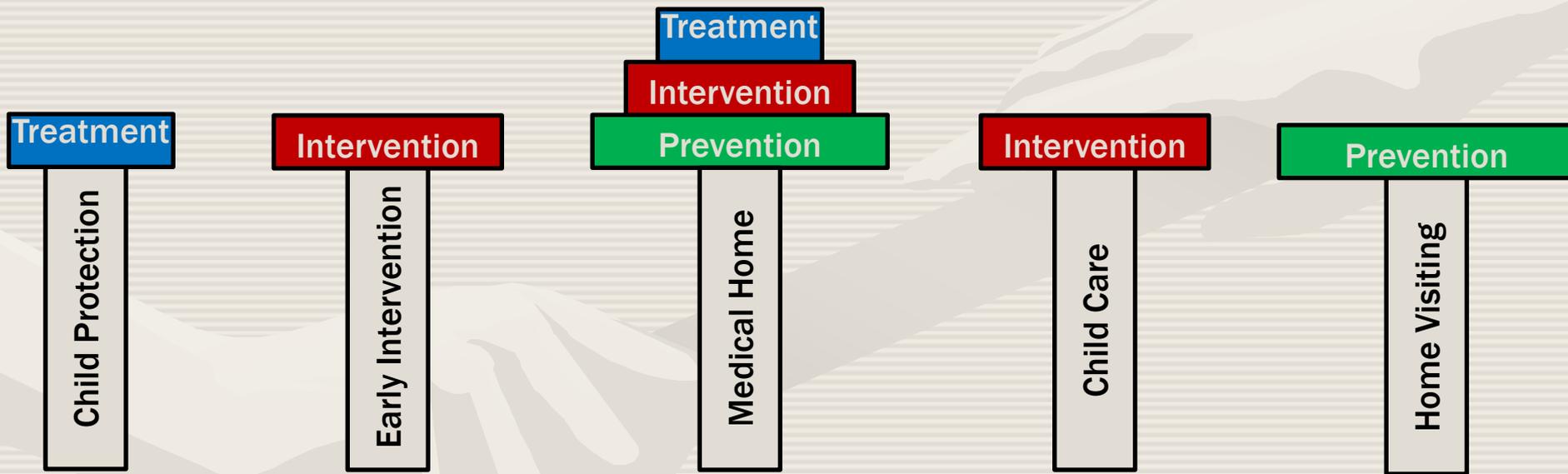
Common factors approach

Refer for/advocate for EBT

Collaborating/Developing EBT

ID Symptoms/Provide EBT

From Individual Pillars ...



... to a Network of Pillings!

Treatment

Intervention

Prevention

Child Protection

Juvenile Justice

Early Intervention

Education system

Medical Home

Faith Community

Child Care

Rec. Leagues

Home Visiting

Developing a Shared “VISION”



Public Health Implications

- ACE data provide a working model for understanding and addressing the **childhood antecedents** of **adult disease**.
- Is there a gap between what **we do** and what **we know?**
- What we **DO**:
 - 95% of the trillions of dollars that we spend on health is on **treatment** and **NOT prevention**

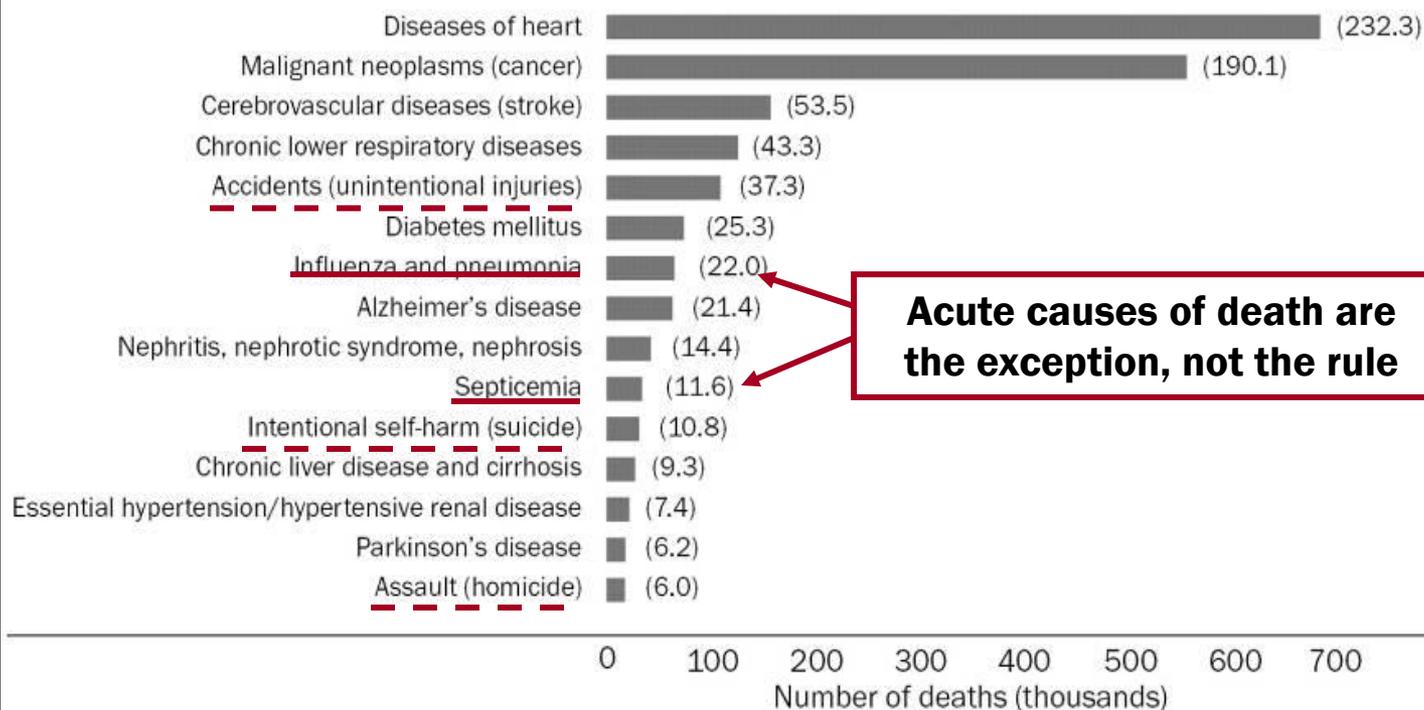
Public Health Implications

- What we **KNOW**:
 - That **70% of early deaths are preventable**, with...
 - The **majority (40% overall)** due to **behavioral patterns** that lead to **chronic disease**.
 - **Behavioral Allostasis** due to toxic stress?

Proximal Causes of Death: Chronic Disease

EXHIBIT 2

Total Deaths And Age-Adjusted Death Rates (Per 100,000 Population) For The Fifteen Leading Causes Of Death In The Total U.S. Population, 2003



SOURCE: D.L. Hoyert et al., "Deaths: Final Data for 2003," *National Vital Statistics Report* 54, no. 13 (2006): 1-120.

NOTE: Numbers in parentheses are age-adjusted death rates per 100,000 population.

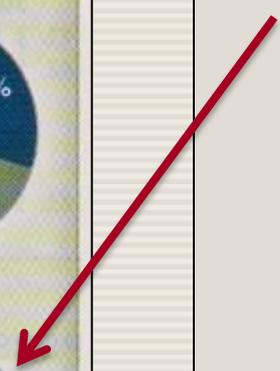
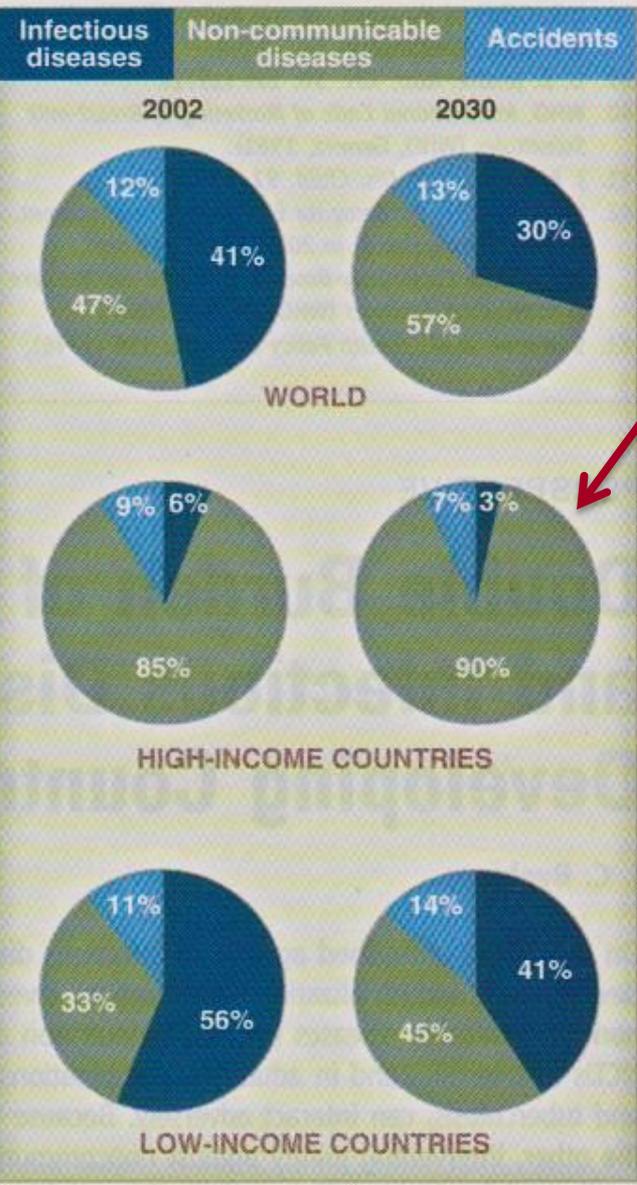
Distal Causes of Death: Unhealthy Lifestyles

Table 2. Actual Causes of Death in the United States in 1990 and 2000

Actual Cause	No. (%) in 1990*	No. (%) in 2000
<u>Tobacco</u>	400 000 (19)	435 000 (18.1)
<u>Poor diet and physical inactivity</u>	300 000 (14)	400 000 (16.6)
<u>Alcohol consumption</u>	100 000 (5)	85 000 (3.5)
Microbial agents	90 000 (4)	75 000 (3.1)
Toxic agents	60 000 (3)	55 000 (2.3)
Motor vehicle	25 000 (1)	43 000 (1.8)
Firearms	35 000 (2)	29 000 (1.2)
<u>Sexual behavior</u>	30 000 (1)	20 000 (0.8)
<u>Illicit drug use</u>	20 000 (<1)	17 000 (0.7)
Total	1 060 000 (50)	1 159 000 (48.2)

*Data are from McGinnis and Foege.¹ The percentages are for all deaths.

If these unhealthy lifestyles are manifestations of behavioral allostasis, a **FUNDAMENTAL** cause of death is **TOXIC STRESS!**



- By 2030, **90%** of the morbidity in high income countries will be due to **Non-Communicable Diseases**
- NCDs are related to **unhealthy behaviors** (overeating, smoking, alcohol, promiscuity, and illicit drugs)

Fig. 1. The proportional distribution of disability-adjusted life years, contributable to infectious diseases and NCDs for (top) the world, (middle) high-income countries, and (bottom) low-income countries for 2002 and 2030 (3).

PERSPECTIVE

Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes

Theresa M. Marteau,^{1*} Gareth J. Hollands,¹ Paul C. Fletcher²

Much of the global burden of disease is associated with behaviors—overeating, smoking, excessive alcohol consumption, and physical inactivity—that people recognize as health-harming and yet continue to engage in, even when undesired consequences emerge. To date, interventions aimed at changing such behaviors have largely encouraged people to reflect on their behaviors. These approaches are often ineffectual, which is in keeping with the observation that much human behavior is automatic, cued by environmental stimuli, resulting in actions that are largely unaccompanied by conscious reflection. We propose that interventions targeting these automatic bases of behaviors may be more effective. We discuss specific interventions and suggest ways to determine whether and how interventions that target automatic processes can enhance global efforts to prevent disease.

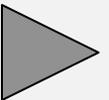
How do those automatic processes form in the first place!?

A **Public Health** Dilemma:

Do we continue to treat **disease**,

the **unhealthy lifestyles** that lead to
disease,

or the **TOXIC STRESS** that leads to the
adoption of unhealthy lifestyles??



A Public Health Parable:

- Man by the river hears someone **drowning**
- Being a good swimmer, he **rescues** the person
- Before catching his breath, he hears **another** in need, and **another** and **another**...
- The man, exhausted, begins to **walk away**
- Asked where he's going, he responds...



A Public Health Parable:

“I’m going **upstream**
to prevent others
from falling in!!”



SUMMARY



- **What is Toxic Stress?**
 - **A physiologic stress response that is excessive or prolonged** (reflects an inability to “turn it off”)
 - **Results in potentially permanent changes in:**
 - **Gene expression** (epigenetics)
 - **Brain development** (neuroscience)
 - **Behavior** (allostasis)

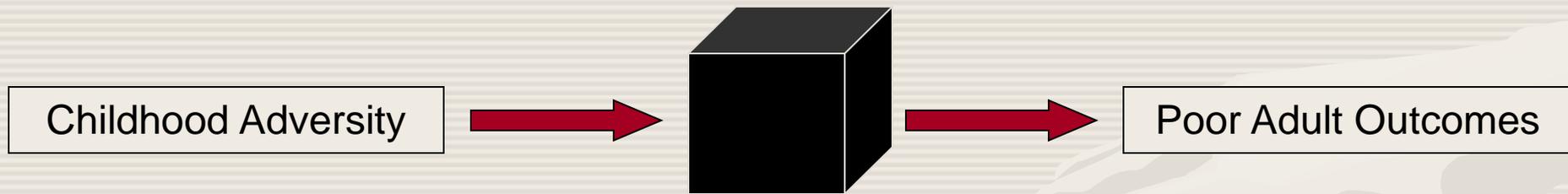
SUMMARY



- **Why should I care?**
 - **Toxic stress** is a **MEDIATOR** between early childhood **adversity** and less than optimal outcomes in **learning, behavior** and **health**
 - Understanding the **BIOLOGY** underlying these well established associations opens up new opportunities for **primary prevention** and **early intervention**



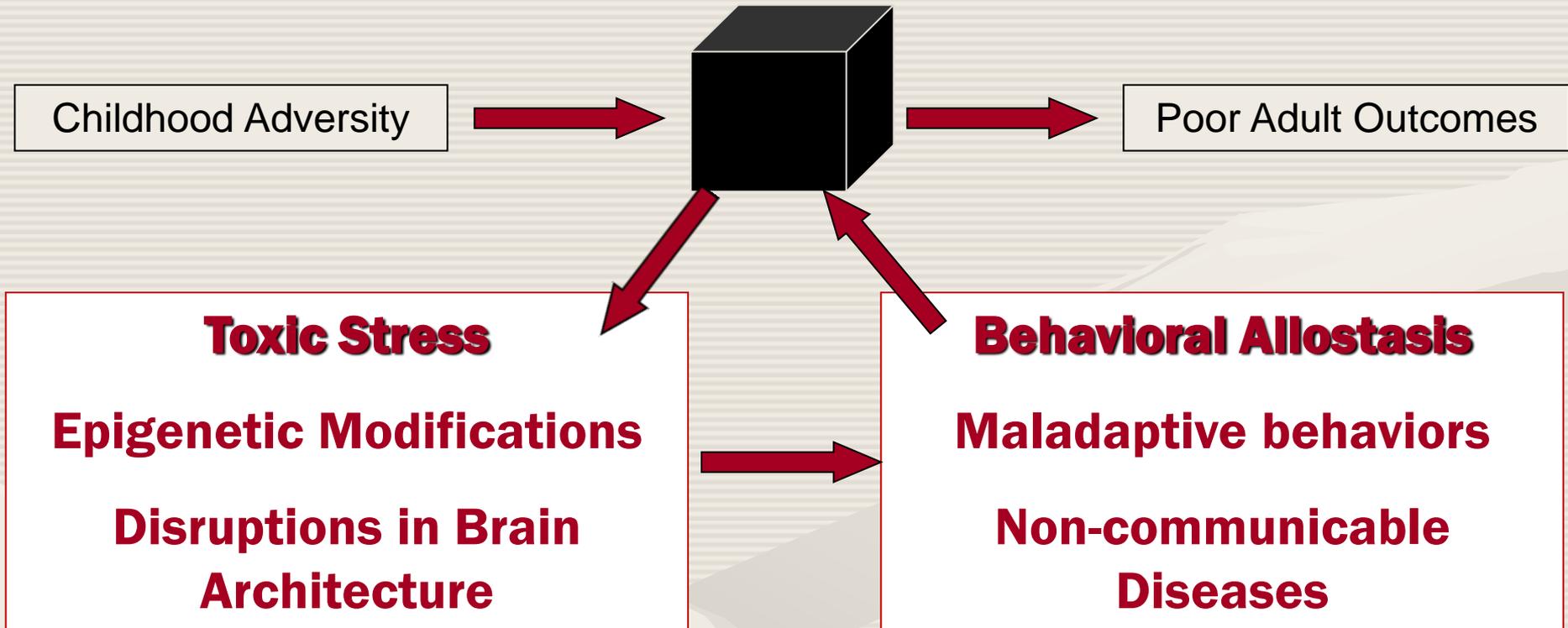
Linking **Childhood Experiences** and **Adult Outcomes**



Advocacy to minimize childhood adversity (e.g. - efforts to address poverty, food scarcity, domestic violence, parental substance abuse)

Health and social services to deal with adverse outcomes (e.g. - efforts to address the behavioral, social, health and economic consequences)

Linking **Childhood Experiences** and **Adult Outcomes**



Improve caregiver/community capacity to prevent or minimize toxic stress (e.g. – efforts to promote the safe, stable and nurturing relationships that turn off the physiologic stress response)

Improve caregiver/community capacity to promote healthy, adaptive coping skills (e.g. - efforts to encourage rudimentary but foundational SE, language, and cognitive skills)

SUMMARY



- What can I do?
 - **Understand** the **ecobiodevelopmental framework** (advocate for a public health approach to address toxic stress)
 - **Help** children figure out **how to turn off** their stress response (in a healthy way!)
 - **Intervene early** for those children who are at high risk or appear **unable to turn off** their stress response

CONCLUSION:

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

Frederick Douglass

