Translating Developmental Science into Healthy Lives:

Realizing the Potential

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My 3 Objectives For Today

• Provide a generalist’s overview of advances in developmental science

• Present an organizing, integrated, ecobiodevelopmental framework

• Discuss ways early childhood professionals (ECPs) might collaborate to translate science into healthier lives
Critical Concept #1

Childhood Adversity has Lifelong Consequences.

Significant adversity in childhood is strongly associated with unhealthy lifestyles and poor health decades later.
# Prevalence of Adverse Childhood Experiences (ACE)

<table>
<thead>
<tr>
<th>Experience</th>
<th>Girls</th>
<th>Boys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abuse</strong></td>
<td>(n=9,367)</td>
<td>(n=7,970)</td>
<td>(17,337)</td>
</tr>
<tr>
<td>- Emotional</td>
<td>13.1%</td>
<td>7.6%</td>
<td>10.6%</td>
</tr>
<tr>
<td>- Physical</td>
<td>27.0%</td>
<td>29.9%</td>
<td>28.3%</td>
</tr>
<tr>
<td>- Sexual</td>
<td>24.7%</td>
<td>16.0%</td>
<td>20.7%</td>
</tr>
<tr>
<td><strong>Household Dysfunction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mother Treated Violently</td>
<td>13.7%</td>
<td>11.5%</td>
<td>12.7%</td>
</tr>
<tr>
<td>- Household Substance Abuse</td>
<td>29.5%</td>
<td>23.8%</td>
<td>26.9%</td>
</tr>
<tr>
<td>- Household Mental Illness</td>
<td>23.3%</td>
<td>14.8%</td>
<td>19.4%</td>
</tr>
<tr>
<td>- Parental Separation or Divorce</td>
<td>24.5%</td>
<td>21.8%</td>
<td>23.3%</td>
</tr>
<tr>
<td>- Incarcerated Household Member</td>
<td>5.2%</td>
<td>4.1%</td>
<td>4.7%</td>
</tr>
<tr>
<td><strong>Neglect</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Emotional</td>
<td>16.7%</td>
<td>12.4%</td>
<td>14.8%</td>
</tr>
<tr>
<td>- Physical</td>
<td>9.2%</td>
<td>10.7%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

*Wave 2 data only (n=8,667)

**Source:** Kaiser ACE Study, 1995-1997. **Data from:** [www.cdc.gov/nccdphp/ace/demographics](http://www.cdc.gov/nccdphp/ace/demographics)
ACEs Impact Multiple Outcomes

Risk Factors for Common Diseases:
- Smoking
- Alcoholism
- Promiscuity
- High Perceived Risk of HIV
- Obesity
- Illicit Drugs
- IV Drugs
- Multiple Somatic Symptoms

Prevalent Diseases:
- Cancer
- Liver Disease
- Chronic Lung Disease
- Skeletal Fractures
- Ischemic Heart Disease
- Sexually Transmitted Diseases

General Health and Social Functioning:
- Difficulty in job performance
- Married to an Alcoholic
- High perceived stress

Mental Health:
- Depression
- Sleep Disturbances
- Anxiety
- Memory Disturbances
- Panic Reactions
- Poor Anger Control

Sexual Health:
- Teen Paternity
- Fetal Death
- Teen Pregnancy
- Unintended Pregnancy
- Sexual Dissatisfaction

Dependent Variables:
- Poor Self-Rated Health
- Hallucinations

ACEs
Mechanisms By Which Adverse Childhood Experiences Influence Adult Health Status

The True Nature of Preventive Medicine

Adverse Childhood Experiences
- Social, Emotional, and Cognitive Impairment
- Adoption of Health-Risk Behaviors
- Disease & Disability
- Early Death

Death

Birth

Slide modified from V. J. Felitti
Developing a Model of Human Health and Disease

Early childhood ecology strongly associates with lifelong developmental outcomes.

What are the mechanisms underlying these well-established associations?

How do you begin to define or measure the ecology?
Defining Adversity or Stress

How do you define/measure adversity?

Huge individual variability

Perception

Reaction

National Scientific Council on the Developing Child (Dr. Jack Shonkoff and colleagues)

Positive 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
(there are life long / intergenerational changes in how the genetic program is turned ON or OFF)

Epigenetics

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 epigenetic switches (and gene expression)

“Genes may load the gun, but the environment pulls the trigger”
Through epigenetic mechanisms, the early childhood ecology becomes biologically embedded, influencing how the genome is utilized.
Critical Concept #3

Developmental Neuroscience:

- **Brain Architecture is experience dependent** (both individual connections or “synapses” and complex circuits of connections are 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
  - **Parietal Lobe:** Integration of sensory data and movement
  - **Temporal lobe (outside):** Processing sound and language
  - **Occipital Lobe:** Visual processing
  - **Cerebellum:** Smooth movements Coordination
  - **Limbic System (inside):** Emotions and impulsivity
    - **Amygdala**
  - **Brain Stem & Cranial Nerves:** Vital functions Swallowing

_+ The Gas Pedal +_

_American Academy of Pediatrics_
Out of Balance?

**Prefrontal Cortex**
- Cold Cognition
- Judgmental
- Reflective
- Calculating
- Think about it

**Amygdala**
- Hot Cognition
- Emotional
- Reactive
- Impulsive
- Just do it

Biological maturity by 24

Biological maturity by 18

Adapted from Ken Winters, Ph.D.
Impact of Early Stress

CHILDHOOD STRESS

Hyper-responsive stress response; calm/coping

Changes in Brain Architecture

Chronic “fight or flight;” cortisol / norepinephrine
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

Epigenetics

Physiology of Stress

Neuroscience

Education

Health

Economics

The Science of Early Brain and Child Development

One Science – Many Implications

The critical challenge now is to translate game-changing advances in developmental science into effective policies and practices for families with 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.

• 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.

**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)
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
  – **HOW** to change the early childhood ecology?

• 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

<table>
<thead>
<tr>
<th>Needs</th>
<th>Maslow’s Hierarchy of Needs (Theoretical - 1943)</th>
<th>America’s Promise Alliance (Evidence-based)</th>
<th>ASCD’s Whole Child Education (Implementation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-Actualization</strong></td>
<td>Need to know, explore and understand</td>
<td>An effective education</td>
<td>Each student is actively engaged in learning</td>
</tr>
<tr>
<td><strong>Esteem</strong></td>
<td>Need to achieve and be recognized</td>
<td>Opportunities to contribute opportunities</td>
<td>Each student has numerous opportunities to demonstrate achievement</td>
</tr>
<tr>
<td><strong>Love/Belonging</strong></td>
<td>Need for friends</td>
<td>Caring adults and family</td>
<td>Each student has access to qualified, caring adults</td>
</tr>
<tr>
<td><strong>Safety/Security</strong></td>
<td>Need to feel secure and safe from danger</td>
<td>Safe places</td>
<td>Each student learns in a physically and emotionally safe environment</td>
</tr>
<tr>
<td><strong>Physiological</strong></td>
<td>Need to satisfy hunger, thirst, sleep</td>
<td>A healthy start</td>
<td>Each student enters school healthy</td>
</tr>
</tbody>
</table>

Unmet needs are potential sources of **STRESS**!!
Linking Childhood Experiences and Adult Outcomes

Childhood Adversity → Toxic Stress → Poor Adult Outcomes

- Epigenetic Modifications
- Disruptions in Brain Architecture
- Behavioral Allostasis
The BIG Questions are...

If toxic stress exposure is the missing link between ACE exposure and poor adult outcomes, it raises the following BIG questions:

Are there ways to:
- treat,
- mitigate,
- immunize against
  the effects of toxic stress?

If so, is there a mismatch between:
- what we KNOW... and...
- what we actually DO? (may not have time!)
Addressing Toxic Stress

Treatment of the consequences and are evidence-based

TF-CBT and PCIT – some “damage” already done!

Very COSTLY

Efficacy linked to age and chronicity

Declining brain plasticity?

Insufficient number of / access to providers

Limited reimbursements; carve-outs

Mental Health Parity?

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; minimize “damage”

Requires screening (no screen is perfect)

Still issues with stigma, numbers of access to providers
Addressing **Toxic Stress**

**Primary / Universal Prevention**
Proactive, universal interventions to make stress positive, instead of tolerable or 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/Caregiver** skills for younger children

**SEL** skills for older children (www.casel.org)
Social-Emotional Skills Can Be Taught / Learned

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 93-0406. 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
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!)
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”?
  - Is there a “ceiling effect” on returns?
- 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 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 for a public health approach to address 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

**Social-Emotional Safety Nets**
A Public Health Approach to “**Toxic Stress**”
Universal Primary Preventions
Bright Futures
Connected Kids / NCH
Circle of Security / ZTT
Relationships as a “vital” sign

Decrease Stress/Build Skills

Targeted Interventions
Screening for risks
(assess the ecology)
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

WHAT are we DOING?!
**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?

McGinnis, Williams-Russo and Knickman, 2002
**Proximal Causes of Death:**

**Chronic Disease**

**EXHIBIT 2**

<table>
<thead>
<tr>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of heart</td>
</tr>
<tr>
<td>Malignant neoplasms (cancer)</td>
</tr>
<tr>
<td>Cerebrovascular diseases (stroke)</td>
</tr>
<tr>
<td>Chronic lower respiratory diseases</td>
</tr>
<tr>
<td>Accidents (unintentional injuries)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
</tr>
<tr>
<td>Alzheimer’s disease</td>
</tr>
<tr>
<td>Nephritis, nephrotic syndrome, nephrosis</td>
</tr>
<tr>
<td>Septicemia</td>
</tr>
<tr>
<td>Intentional self-harm (suicide)</td>
</tr>
<tr>
<td>Chronic liver disease and cirrhosis</td>
</tr>
<tr>
<td>Essential hypertension/hypertensive renal disease</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
</tr>
<tr>
<td>Assault (homicide)</td>
</tr>
</tbody>
</table>

0 100 200 300 400 500 600 700  
Number of deaths (thousands)  


**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

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

*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**

Most NCDs are due to **unhealthy behaviors** (overeating, smoking, alcohol, promiscuity, and illicit drugs)
Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes

Theresa M. Marteau, Gareth J. Hollands, Paul C. Fletcher

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**

- **Childhood Adversity** → **Poor 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)
Childhood Adversity Poor Adult Outcomes

Toxic Stress

Epigenetic Modifications
Disruptions in Brain Architecture

Behavioral Allostasis
Maladaptive behaviors
Non-communicable Diseases

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 collaborative, public health approach to address toxic stress)
  
  – **Help** children figure out **how to turn off** their stress response (parent/child skills)
  
  – **Intervene early** to **turn off** for those children who appear **unable** to turn off their stress response (secondary and tertiary prevention)
It is easier to **build strong children** than to **repair broken men**.

**CONCLUSION:**

Frederick Douglass