

THE NEUROBIOLOGY OF RESILIENCE

Tricia Tayama, MD, MPH, FAAP
 Medical Director, Keller Center for Family Violence Intervention
 San Mateo Medical Center
 September 9, 2016

OVERVIEW

1. Resilience and childhood stress
2. Neurobiology of brain development
3. Building resilience in children, families, and communities

I. RESILIENCE AND CHILDHOOD STRESS

"If people knew how hard I worked to get my mastery,
 it wouldn't seem so wonderful at all."
 -Michelangelo

RESILIENCE

DEFINING RESILIENCE

- Latin, resiliere: to spring back, rebound
- One's ability to recover from setbacks, to bounce back after something bad happens, to stay strong in the face of adversity, to withstand a stress or challenge

CONSEQUENCES OF POOR RESILIENCE COULD INCLUDE:

- Feelings of failure, self-doubt
- Inability to stand up (for one's identity, ideals)
- Diminished drive to choose new challenges
- Poor physical and mental health outcomes

BRAINSTORM

- Describe someone you know who has shown resilience.
- What features made them seem resilient?
- How do you think they became resilient?

THESIS

Resilience in children can be developed, using the building blocks of healthy child development and nurturing relationships

CHILDHOOD STRESS

Positive stress (Potentially) Tolerable stress Toxic stress

POSITIVE STRESS

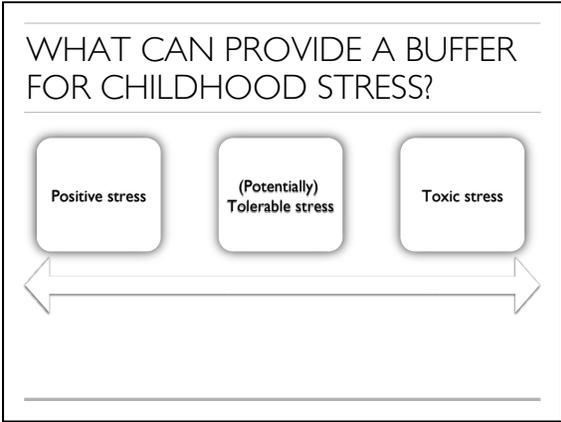
- Brief, mild to moderate level
- Normal parts of development (e.g., dealing with frustration, learning a skill, starting a new school, giving an oral report)

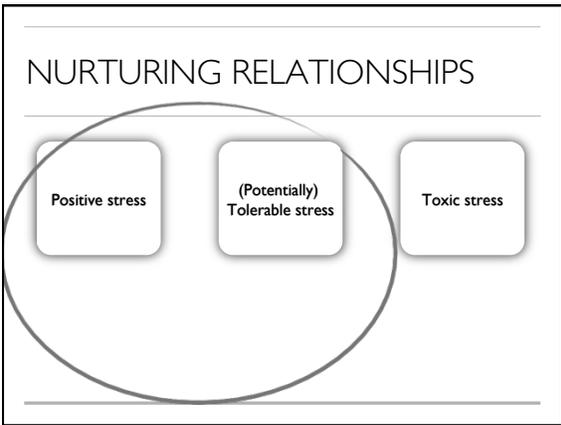
(POTENTIALLY) TOLERABLE STRESS

- Brief, moderate to severe
- Unforeseen stressor (e.g., death of a family member, contentious divorce, severe injury or illness, natural disaster)

TOXIC STRESS

- Chronic, frequent, severe
- Harmful childhood experiences (e.g., physical or sexual abuse, neglect, witness to violence, parental depression, parental substance abuse)





Q: Why do nurturing relationships exert a protective effect?

A: It's how we're wired...

2. NEUROBIOLOGY OF BRAIN DEVELOPMENT

"I am still learning."

-Michelangelo

THE AMAZING BRAIN

"Updated Brain Map Identifies Nearly 100 New Regions," *New York Times*, 7/20/16

KEY AREAS FOR RESILIENCE

	Response to a stress:
Cortex: thinking	Cognitive
Limbic system: feeling	Emotional
Brainstem: basic functioning	Physiologic

NEURONS (NERVE CELLS)

- Start developing at 3-4 weeks of fetal development
- Information in the brain is transmitted from area to area via neurons

SYNAPSE

- Where two neurons communicate, how all information is relayed
- Neurotransmitters (e.g., dopamine, serotonin, epinephrine) cross at synapses
- Early childhood is a very active time for new synapses to form

PRUNING

- Clearing away unused connections (this is normal, healthy)
- Pathways that are used frequently are reinforced; those that are neglected are lost

PLASTICITY

- Neuronal connections can change *throughout the lifespan*
- These connections are use-dependent, so "use it or lose it!"

NEURONAL CONNECTIONS DETERMINE RESPONSE TO STRESS

- Everything in the brain is processed through these neuronal connections—what we smell, see, think, remember, feel, do, react, plan, etc.
- Through repetition, particular pathways are strengthened
- Our reactions to stress are based on prior patterns (experiences)
 - Creating healthy patterns early increases resilience!
 - Rewiring unhealthy patterns is more challenging

NEURONAL CONNECTIONS FORM THE STRUCTURE OF THE BRAIN

- **Genes:** blueprint, potential plans
- **Environment:** materials, conditions
- **Experiences:** building, modifying the structure

GENES

- Same DNA code is throughout a person's body
- Numerous factors influence how that DNA is translated and expressed
- EPIGENETICS: Influences and changes (e.g., methylation, histones) can turn genes on/off, and these changes can be passed on to future generations

ENVIRONMENT

- Inputs such as nutrition, stress, and toxins all affect the developing brain
- There are some critical windows of exposure needed in the environment, such as for vision and language
- Exposures at key stages of development can have profound effects, such as Zika Virus

EXPERIENCES

- Experiences shape brain connections, and repeated experiences strengthen those connections
- Early experiences are key for establishing a solid foundation; later on, changes can be made but require much more effort
- "SERVE-AND-RETURN" describes the pattern of early experiences that influence brain development

BRAIN ARCHITECTURE

Center on the Developing Child at Harvard University
<http://developingchild.harvard.edu>

BRAIN ARCHITECTURE GAME

- Groups are tasked with creating a "brain" structure that can withstand the most stress
- Materials include pipe cleaners (connections), straws (supports), weights on hooks (stressors), life experience cards and dice (simulating reality)
- Stronger foundations support the weights more readily, are more resilient
- Consider influences of genes, environment, and experiences

<https://dev.thebrainarchitecturegame.com/>

BRAIN ARCHITECTURE DETERMINES RESPONSE TO STRESS

- Healthy environments and experiences build resilience to face challenges
- Chaotic environments and experiences lead to underdeveloped, less resilient responses
- Toxic environments and experiences build negative, less resilient responses to stress
 - Trauma-related responses to stress are based on brain architecture; Examples: Hyper-arousal and Dissociative

TRAUMA-RELATED RESPONSE:

HYPER-AROUSAL

- Fight or flight response
- Neural-hormonal systems are activated (e.g., Hypothalamic-Pituitary-Adrenal axis)
- Release of stress hormones (e.g., adrenaline, cortisol)
- Can present as ADHD, Conduct Disorder
- Case example: direct eye contact

RESPONSE WITH RESILIENCE

AROUSAL, THEN CALM

- Systems would be activated only during the actual stress
- Body would return to calm afterward
- Caregiver would be able to help child cope with the stress, develop new skills

TRAUMA-RELATED RESPONSE:

DISSOCIATIVE

- Freeze response, "preparing to be injured," inescapable trauma
- Release of opioids (endogenous pain killers)
- Can present as withdrawn, compliant
- Case example: gentle touch

RESPONSE WITH RESILIENCE

ENGAGEMENT

- Brain and body would be able to process the stress
- Caregiver would have the ability to help child cope with the stress, develop new skills

COMPLEX TRAUMA

- Complex Trauma in childhood can include numerous psychiatric symptoms, behaviors, and disorders
- A trauma-informed approach is needed to transform neural connections through environment and experiences

Q: So can resilience be developed?

A: Yes

3. BUILDING RESILIENCE IN CHILDREN,
FAMILIES, AND COMMUNITIES

"I saw the angel in the marble and carved until I set him free."

—Michelangelo

STRESS-RESILIENCE BALANCE

- Factors that influence resilience:
 - Genes/epigenetics
 - Environment
 - Experiences, Brain architecture
 - Severity, accumulation of childhood stress

PROVIDE SAFE, NURTURING
RELATIONSHIPS

- Family members, foster parents,
teachers, coaches, CASAs, neighbors,
many others
- How this builds resilience:
 - Promotes positive experiences
 - Caregivers can model healthy
reactions to stress and problem-
solving approaches
 - Caregivers can help children regulate
their physiological response to stress

STRENGTHEN CAREGIVER SKILLS

- Home-visiting programs for new moms have been shown to be beneficial
- High quality early childhood education is vital, especially in communities most affected by trauma and stress
- Parents may have their own poorly developed brain architecture and need more support
- How this builds resilience:
 - Improve the every-day experiences of children that will create their architecture
 - Improves caregivers' resilience

CREATE NEW NEURAL CONNECTIONS

- Through repetition, lay down neural networks that support healthy responses to stress
- If faced with complex trauma in an older child or adult, use even more repetition with positive experiences
- Medications can change the environment but you need experiences to lay down new neural connections
- How this builds resilience:
 - Creates new brain architecture to handle stress

ALIGN INTERVENTIONS WITH SOURCES OF STRESS

- Identify impediments to healthy child development and caregivers' efforts
 - Examples: poverty, inequality, interpersonal (domestic) violence, community violence, racism, hunger, discrimination, poor job opportunities, lack of access to resources
- Target interventions at the family, community and societal levels
- How this builds resilience:
 - Improves the environment of children's neural development
 - Decreases exposures to toxic stress

SUPPORT HEALTH AND NUTRITION

- Meet the physical and mental health needs of children, pregnant women, and caregivers
- Address health disparities, inadequate access to health care, and disease burden
- Use the built environment to support the health and nutrition of the community
- How this builds resilience:
 - Improves the direct brain environment for developing children
 - Reduces sources of childhood stress

SUPPORT CULTURE, FAITH, COMMUNITY BONDS

- Ties to culture, language, religion, faith, and community should be nurtured
- How this builds resilience:
 - Experiences within a community can provide scaffolding and modeling of a response to a challenging problem
 - Support for identity, self-esteem, sense of belonging, and appreciation of diversity all contribute to a healthy environment

RESILIENCE: TOO HARD A GOAL?

NO WAY!

REFLECTION

- Think back to your personal example of someone who has shown resilience.
- Can you now recognize any other factors that may have contributed?
- What is one thing YOU can do right away to support resilience in your work, personal life, or community?

Q: Need a boost getting started?
A: Here are some great resources...

SELECTED RESOURCES

- Center on the Developing Child at Harvard University
- American Academy of Pediatrics, Healthy Foster Care America Initiative
- American Academy of Pediatrics, The Resilience Project
- National Child Traumatic Stress Network
- California Evidence-Based Clearinghouse for Child Welfare
- Futures Without Violence
- Child Trauma Academy
- Institute on Violence, Abuse, and Trauma
- Resilience Trumps ACEs

THANK YOU

- Keller Center for Family Violence Intervention
- John Stirling, MD
- Toni DeMarco
- Carmelita Limas

QUESTIONS & DISCUSSION

Tricia Tayama, MD, MPH, FAAP
TTayama@smcgov.org
