We Can't Wait Conference

Neurobiology of the Developing Child

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September 10, 2020

Starting points

- I have no disclosures
- Human Beings are
  - Complex
  - Our understanding is evolving
  - Social and Inter-connected
  - Cannot be reduced to parts
  - Models are useful, but are limited

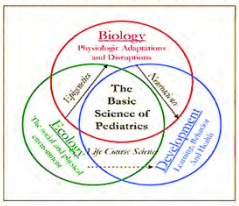
Neurons to Neighborhood 2000

- All Children Are Born Wired For Feelings and Ready to Learn
- Early Environments and Nurturing Relationships Are Essential
- Society Is Changing and the Needs of Young Children Are Not Being Addressed
- Interactions Among Early Childhood Science, Policy, and Practice Demand Dramatic Rethinking

Children live in the context of relationships

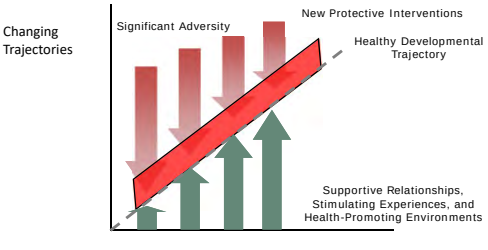
AAP Technical Report

Eco-Bio-Developmental
Model of Human Health and Disease



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

Our Goal



Source: Harvard Center on Developing Child, 2012

6

Section 1

- Child Needs and Development
- Temperament
- Polyvagal Theory and Social Engagement System
- Attachment
- Self-regulation and Co-regulation

What do babies and young children need?






Nurture - to care for and to encourage the growth and development of ….

Ideally
Parents and Caregivers Are Available, Attuned, and Interested

Nurturing Relationships are Love in Action

Nurturing Relationships Builds

- Better brains
- Healthy attachment
- SE intelligence
- Self regulation
- Resilience

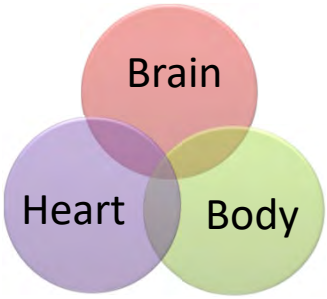
Relationships + Regulation = Resilience

Nurturing Relationships are Inborn

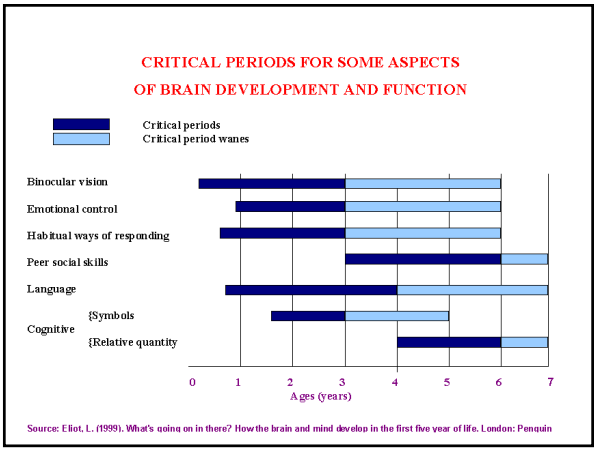
What is the mind?

- The mind can be defined, in part, as an **embodied and relational process** that **regulates the flow of energy and information**
- 2 aspects of the regulation process are **monitoring and modifying**
- Attuning to ourselves is our primary skill

Our Body's 3 Inputs to our Mind



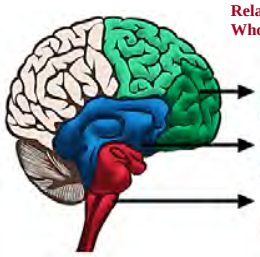
Physical State
- Tired
- Sleepy
- Hungry
- Thirsty



5 Developmental Areas in the Brain

Inter-relational/Prosocial – Feeling the needs of others
Who can help and how can I make the world better?

Relational/Social – Connection to others
Who are my family and friends?



Executive State
Prefrontal Lobes
What can I learn from this?

Emotional State
Limbic System
Am I loved?

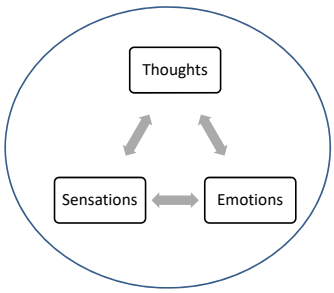
Survival State
Brain Stem
Am I safe?

Thoughts

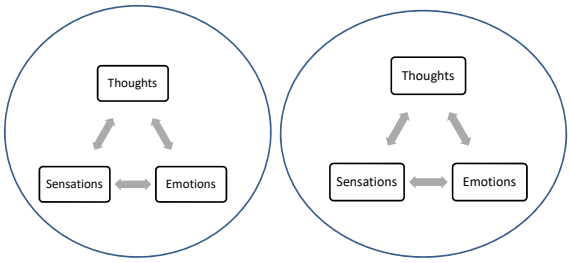
Emotions

Sensations

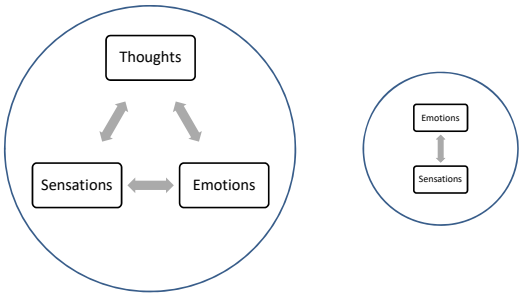
Our Inner World



Inner Worlds of Two



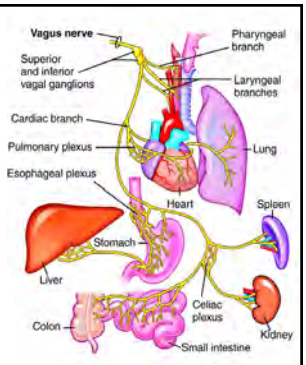
Inner Worlds of Parent and Baby



Temperament - Biological Response to our Environments

Activity Level	Persistence	Distractibility
Initial Reaction	Adaptability	Mood Intensity
Sensitivity	Regularity	Sensory Threshold

Polyvagal Theory and Neuroception



Stephen Porges, PhD

	ANS Component	Behavioral Function	Lower motor neurons
III	Myelinated vagus *(ventral vagal complex)*	Social communication, self-soothing and calming, inhibit "arousal"	Nucleus ambiguus
II	Sympathetic-adrenal system	Mobilization (active avoidance)	Spinal cord
I	Unmyelinated vagus *(dorsal vagal complex)*	Immobilization (death feigning, passive avoidance)	Dorsal motor nucleus of the vagus

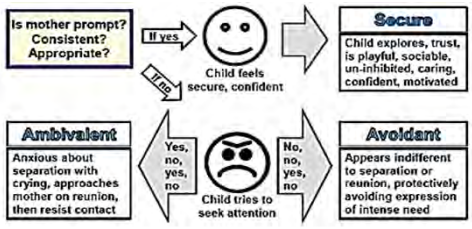
Social Engagement System

- A developing neuro-physiological system
  - to regulate contact with the external world
  - to modulate physiological and behavioral state
- In infants, vagal regulation in infants is associated with social behavior, ingestion, and state regulation
- Fussy infants may not experience the soothing effects of feeding

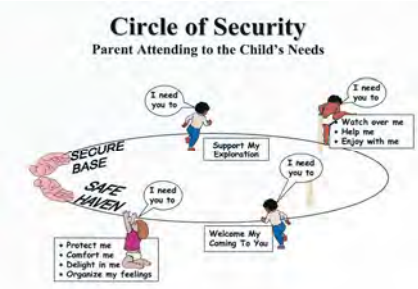
Social Engagement System

- Voice prosody
- Auditory sensitivities
- Gaze
- Facial expression
- Posture during social engagement
- Mood and affect
- State regulation

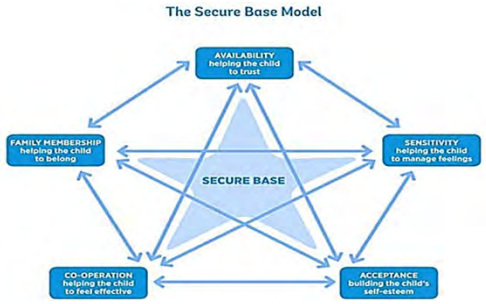
Attachment Styles



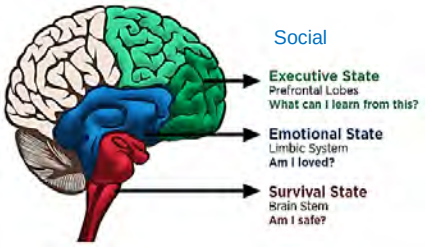
Children Learn by Exploring



Repeated Positive Experiences



Trust = Physically and Emotionally Safe, Consistent, and Comforting

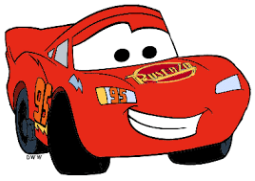


Self-Regulation Skills

- Allows kids to manage their emotions, behavior and body movement when they're faced with a situation that's tough to handle
- Allows them to do that while still staying focused and paying attention

Self-Regulation Metaphor

- Think about:



How parts work together
Engine
Accelerator
Brakes
Gas Tank
Speedometer
Gauges
Tires

Needs to consider
Roads
Weather
Traffic

Self-Regulation

- Depends on our level of stress and arousal
- Take in information from our environment that is useful or tune out what is not useful
- Critical to self-control and our ability to form relationships with others

Self Regulation Research

- Dr. Allan Schore (2001) sees this transfer of regulation from external (relying on others) to internal (developing the capacities to self-regulate) as the key task of early development
- Some see it as lifelong

The Arousal Continuum

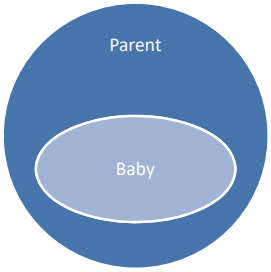
Calm, Alert, and Present

Flooded
Hyper-alert

Hypo-alert
Drowsy
Asleep

We learn best when we are Calm, Alert and Present

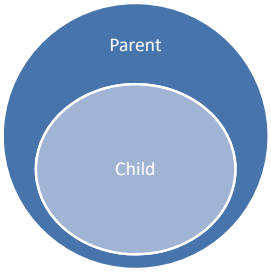
Babies Need Co-Regulation



Babies Need External Regulation

- Babies cannot self-regulate
- Massive brain growth occurs in areas critical to self-regulation in the early years of life
- Primary caregiver serves as an "external brain" *regulating and stimulating* the baby
- By being regulated, the baby develops the ability to self-regulate

Children Learn to Self-Regulate



When distressed, we all need someone to respond to us





Positive Relationships Down Regulates Stress

Safety
Pleasure

Hormonal Cascade

Creates Calm

Section 2

- Definition of Trauma
- Stress Basics
- Developmental Impact of Stress

Definition of Trauma

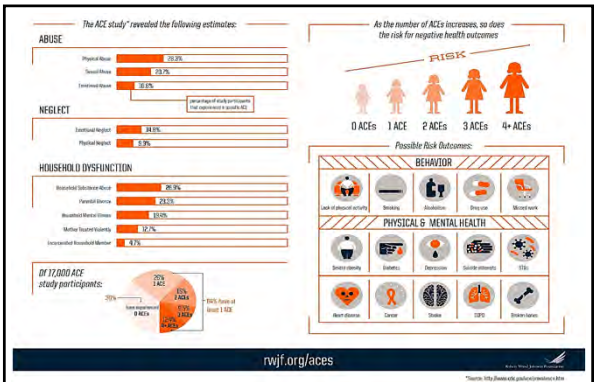
- Trauma is often the result of an overwhelming amount of stress that exceeds one's ability to cope, or integrate the emotions involved with that experience
- Trauma differs between individuals, according to their subjective experiences

Childhood Trauma

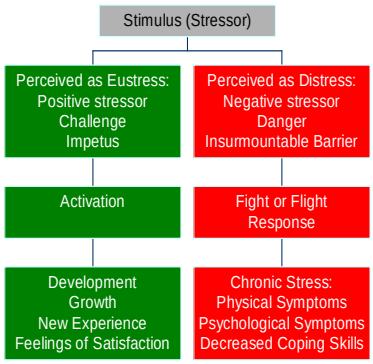
- The physical and emotional responses to events that threaten the **life or integrity of the child** or **of someone critically important to the child**
- Traumatic events overwhelm a child's capacity to cope and elicit feelings of terror, powerlessness, and out-of-control physiological arousal
- Failure to provide sensitively responsive and mutually confirming interaction during developmentally important periods of life

Vulnerability of the Developing Child

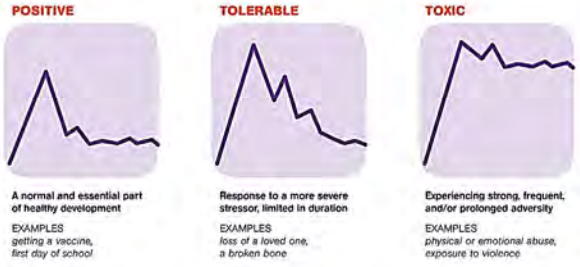
- Immature alert/alarm systems
- Dependent on caregiver for support and context
  - Lack of physical ability to shield self
  - Lack of emotional resources
  - Lack the ability to discriminate novelty from threat
  - Need for child to stay with caregiver even if caregiver is the source of arousal/trauma



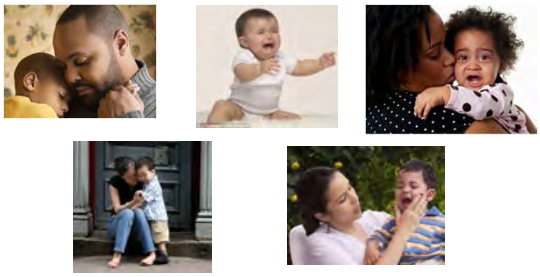
ACEs are strongly related to the development and prevalence of a wide range of health problems throughout a person's lifespan, but they are not destiny – relationships can mitigate trauma



Types of stress responses

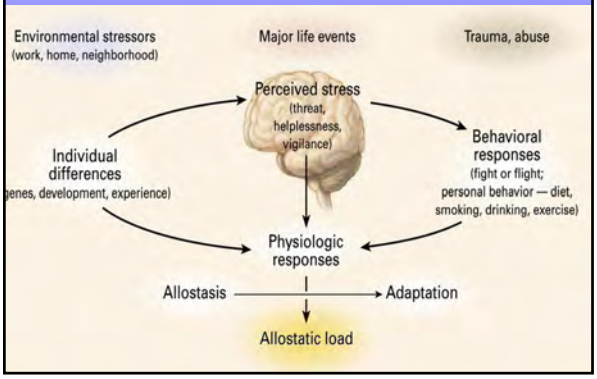


When distressed, we all need someone to respond to us

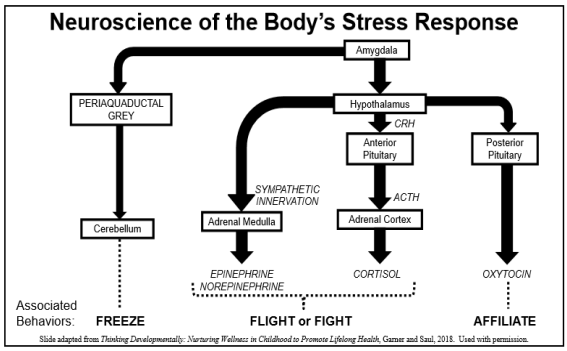


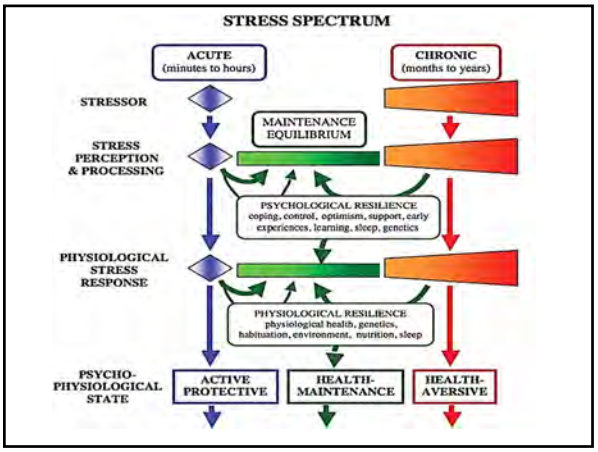
Sometimes the person is the stessor

Threat Response



Stress Response





Vulnerability and Resilience

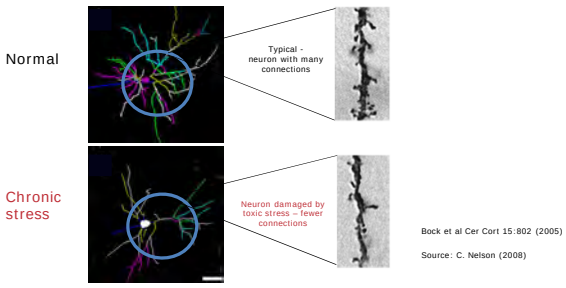
Relationships are needed

Relationships + Regulation = Resilience

Developmental Impacts of Stress

- Biologic Effects
  - Brain abnormalities
  - Hormone dysregulation
  - Immune dysfunction
- Behavioral

Changes to Neurons



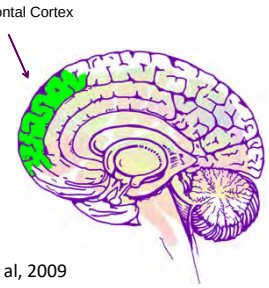
Prefrontal Cortex and Hippocampus

Long term Changes in the Brain

- Mood and attachment (changes in serotonin and GABA receptors) altered
- Memory and learning difficult (hippocampus)
- Increased high-risk and pleasure-seeking behavior (changes in the nucleus accumbens -reward center of the brain)

Physical Punishment and the Developing Brain

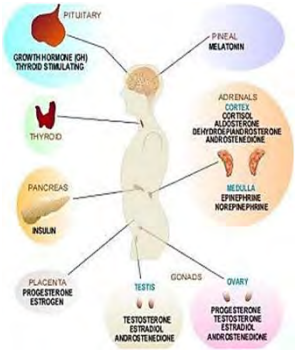
- In case-control study with non-clinical sample of young adults, harsh corporal punishment associated with reduced gray matter volume in prefrontal cortex

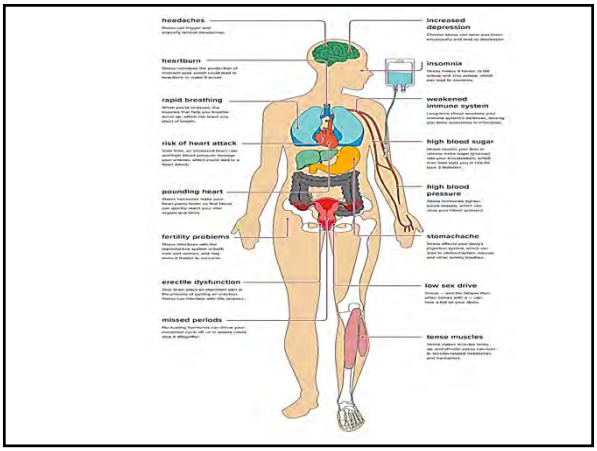


Tomoda et al, 2009

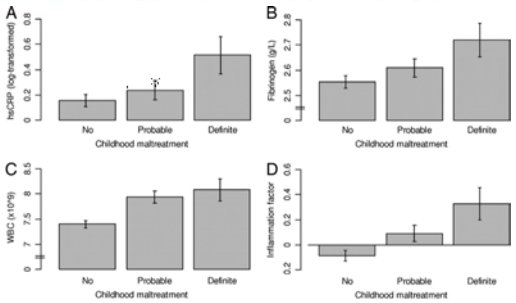
Changes in the Hormonal System

- Fight or flight or flee response dysregulated
- ↑ responses to subsequent stressors (hyper-arousal, irritability) loss of feedback inhibition





The association of childhood maltreatment with biomarkers of inflammation



Andrea Danese et al. PNAS 2007;104:4:1319-1324 ©2007 by National Academy of Sciences

ACEs and SE Development Concerns

- Head Start Children (N=50)
  - 60% had violence exposures < 4 yrs.
  - Mean ACE >3
  - Mean ACE of their Parents is >5
  - 2/3rs of children with Positive ACE screen had one report of social-emotional development concerns (by teacher and parent DECA)

Source: C. Blodgett, 2012

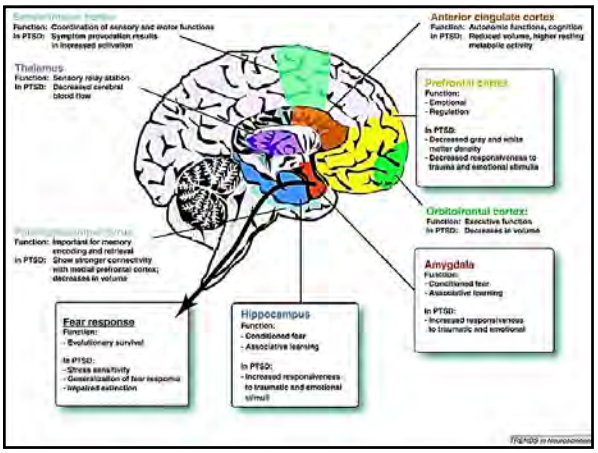
59

Research – Chronic Stress and Behavior

- Threat perturb the hypothalamic-pituitary-adrenal axis and promote inflammatory contributes to CVD and a propensity toward depression and aggression (Kemeny, 2009)
- Kindergarteners' chronic exposure to parental conflict ↓ cortisol reactivity - predicted developing eternalizing behavior two years later (Davies et al., 2007)
- Parental verbal abuse, even absent other forms of abuse, affected brain white matter tract integrity -affected areas of the brain - verbal IQ, depression, and anxiety. (Choi, Jeong, Rohan, Polcari, and Teicher, 2009)

Effects of Childhood Trauma

- Attachment: The world and other people are unsafe, uncertain and unpredictable. (Withdrawal and difficulty forming relationships)
- Physical: Problems with movement and sensations
- Emotion Regulation: Difficulty regulating their emotional states.
- Behavioral control: Poor impulse control, risky behaviors, and aggression towards others.
- Development/Cognition: Inattention, learning difficulties, regression of previously attained milestones, and either global or domain specific developmental delays (e.g. speech/language, motor skills, self-care abilities, etc.)



Understanding of Mental Health Problems in the Past

- Genetic or heritable vulnerability
- Congenital
  - Physical malformation
  - Exposure to chemicals or infection
  - Birth Trauma
- Learned Maladaptive Behavior
- Psychological Conflict
- Social relations problems
- Caregiver/child relationship
  - Attachment and Loss
  - Temperamental mismatch
- Medical problems
  - In child
  - In caregiver
- Physical trauma
  - Head injury
  - Broken bones, burned skin
  - Dog bites

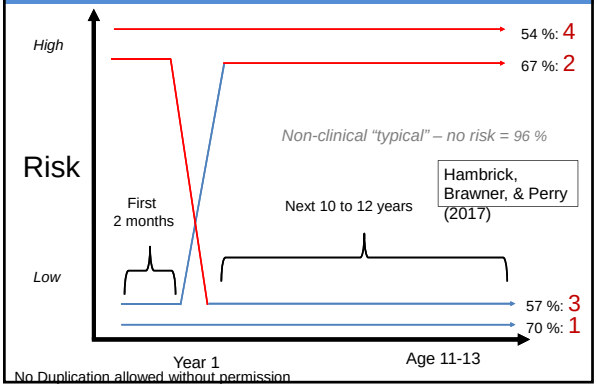
Now we must add 2 more

1. Psychological Trauma
   - Physical abuse
   - Sexual abuse
   - Emotional abuse
   - Neglect
2. Interruptions of development

Interruptions of Development

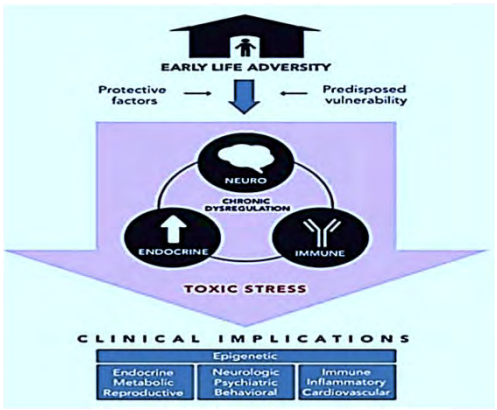
1. Inexperienced caregiver
   - Lack of support for caregiver
   - Lack of capacity of caregiver
2. Loss of Continuity of Affectionate care
   - Removal from home; change of placement
   - Loss of parent, nanny, sibling
3. Problems of Sensitive Responsiveness and Mutually Confirming interactions
   - Inability to attune to child's states
4. Challenges that are not overcome early
   - Sleeping
   - Eating
   - Speech and language Fine and gross motor development
   - Social development
   - Behavioral problems (aggression, emotional dyscontrol, anxiety, depression, attention)

Timing of Developmental Risk & Functional Outcomes in a Clinical Population



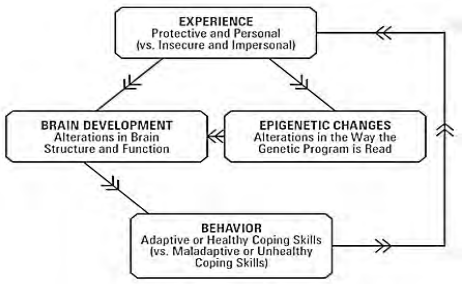
Section 3

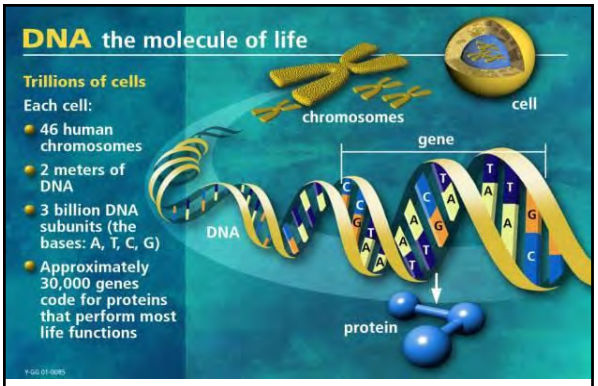
- Genetics
- Epigenetics



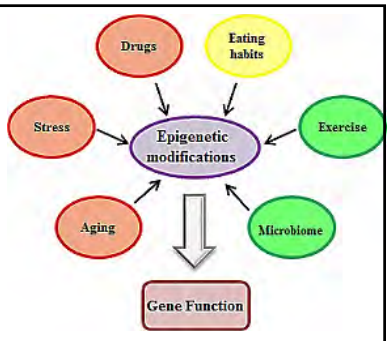
Bucci e al., 2016

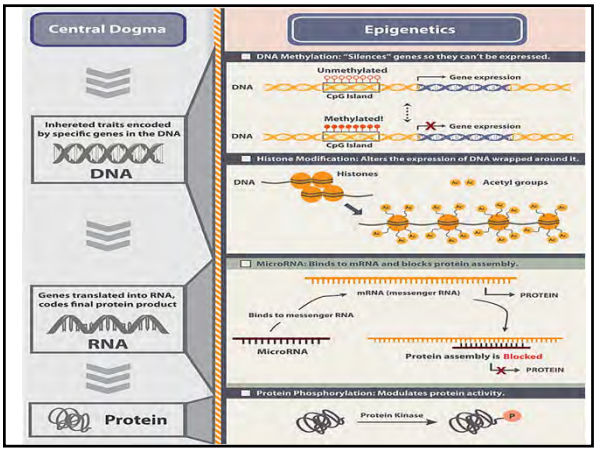
Experiences/Relationships Change Genetic Expression and Behavior



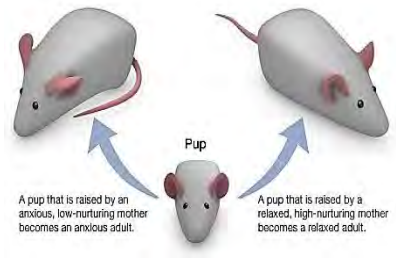


Environment Effects Gene Expression



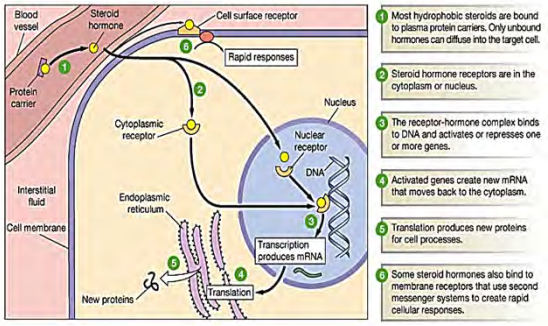


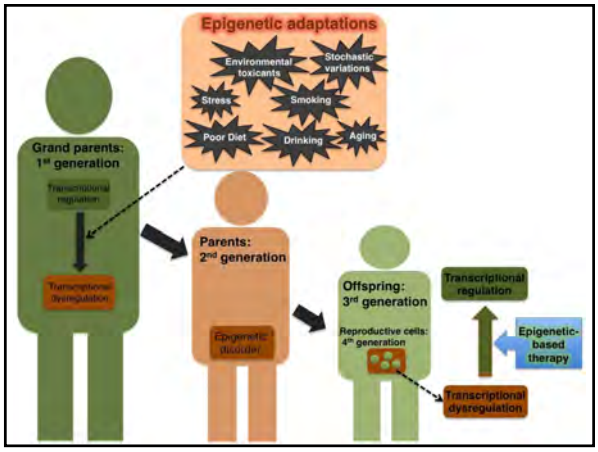
Mouse model



- High Licking Moms Deactivates Methyl in Pups
- Activate GR Gene
- GR Protein in the Cytoplasm increased
- Binds Cortisol
- Pups are Less Stressed and Recover faster
- Changes in Hippocampus

Steroid Hormone





Section 4

- What can we do
- What works

An Early Brain and Child Development Agenda

- Promote healthy relationships
- Promote the healthy early childhood foundations for life course health
- Promote kindergarten readiness and life long success
- Decrease toxic stress effects on health and developmental trajectories
- Strengthening the systems and community supports to address the social determinants of health

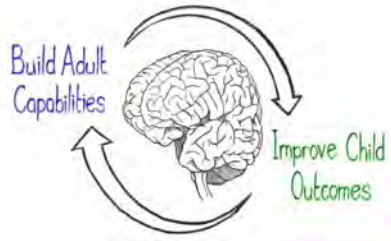
77

Good News

- Brain architecture is experience dependent
- Social-emotional buffering makes a big difference
  - Positive parenting
  - Trusted mentor
  - Healthy attachment
  - Social-emotional skills
  - Co-regulation and Self-regulation

Focus on the Adults who Care for Children

If we really want to achieve breakthrough outcomes for children experiencing toxic stress, then we have to transform the lives of the adults who care for them.



Working with Parents and Caregivers

- Emphasizing the Importance of Relationships
- Explaining Self-Regulation and Co-Regulation
- Restoring Nurture
- Building Resilience

Our 3 R's

Relationships create resiliency by developing the capacity to regulate and reflect

Self-Regulation Skills

- Allows adults and children to manage their emotions, behavior and body movement when they are faced with a situation that is tough to handle
- Allows them to do that while still staying focused and paying attention

Affect regulation

- Affect regulation, or emotion regulation, is the ability of an individual to modulate their emotional state in order to adaptively meet the demands of their environment.
- Individuals with **a broad range of affect regulation strategies** will be able to flexibly adapt to a range of stressful situations.

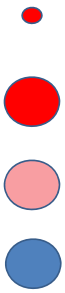
What Are Our Families' Unspoken Questions?

- Are you safe? (physically, emotionally, mentally, and our relationship)
- Can you "see" me? Do you understand me?
- Can you help me? Are you useful?
- Will you be around? For the long run? When things get tough?
- "Yeah, I've heard that before." (emotional hurt – betrayal, abandonment, etc.)

Restoring Nurture

- Nurture can only be restored in the context of respectful, reliable, responsive, regulating relationship
- Through reflection, an individual can examine her or his representation of the world and change her or his reality
- Reflection can only happen when we feel safe and have internal space
- With inner strength and change is possible

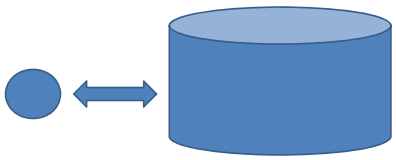
Start with Establishing Safety and Trust



- We might be the first person that our client feels safe with
- Convey caring and a sense of worthiness
- Add stability, support and time
- As trust develops, our client's inner world shifts

Building Trust

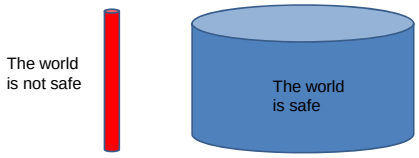
- Benevolence - the degree to which the other party takes your best interests to heart and acts to protect them
- Reliability
- Competence
- Honesty
- Openness



When a parent begins to trust herself, her world moves from 2D to 3D

Safety and Inner Space

By focusing on the parent's strengths and helping them build skills, their inner space grows



With ***safety*** and ***inner space***, a parent can reflect
With ***reflection***, a parent can change their view of the world - ***representation***
With ***safety***, ***inner space***, and ***inner strength***, a parent can make meaningful change

Resiliency plus Hope

- Resiliency is the ability to recover
- Resiliency is developed in context of reliable, responsive, regulating relationships
- Resiliency is reaching in and out to your resources
- Resiliency gets you back to where you were and Hope gets you beyond where you were

"Hope is the mindset that drives resilient behavior."
-Dr. Chan Hellman, Director of Hope Research Center, University of Oklahoma

Hope

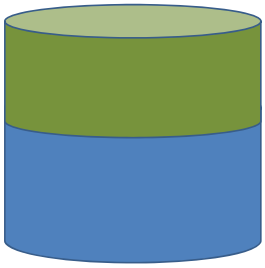
- For our families
  - My future can be better than right now
  - A sense of agency (will power) and pathway thinking (way power) are required
- For our staff
  - Asking - "Where did you see hope today?" with families and at the beginning of our team meetings
  - Hope helps decrease burnout and turnover
- Trauma looks backward, hope looks forward

Practicing Hope - Linking to Values and Dreams

- Meeting at common values
  - I want the best for you (and your child).
  - What do you value for you (and your child)?
  - What can we commit to together to meet that value?
- Exploring dreams for themselves and children
  - Help parents imagine a better future for themselves and their children
- Setting and meeting goals creates hope
- Cultivating a future mindset →

Create more dreams than memories

Hope – Showing Parents a Way Forward



We help parents focus on optimism, hope, and extending joyful interactions

With hope, parents can be more reflective and have a greater chance to change the way they see the world

Positive Childhood Experiences Help

- The positive experiences with the greatest protective impact for those with 4+ ACEs included:
  - feeling that your family stood by you in hard times
  - having someone to talk with about difficult feelings

Sege, R., Bethell, C., Linkenbach, J., Jones, J., Klika, B. & Pecora, P.J. (2017). Balancing adverse childhood experiences with HOPE: New insights into the role of positive experience on child and family development. Boston: The Medical Foundation

We Use Our ACEs to Treat ACEs

- **A**pproach
  - Relationship based, parent centered, builds on families' strengths and develops skills, focuses on parent-child interaction, promotes nurture
- **C**oordination
  - Systems and
  - Family care coordination and case management (continuum based on need)
- **E**xcellence in Service Delivery
- **S**upports for Our Providers and Families