


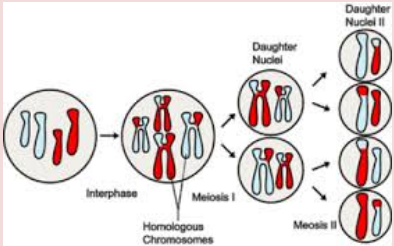
Brain Development In Early Life



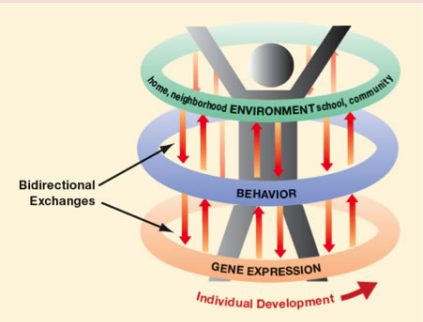
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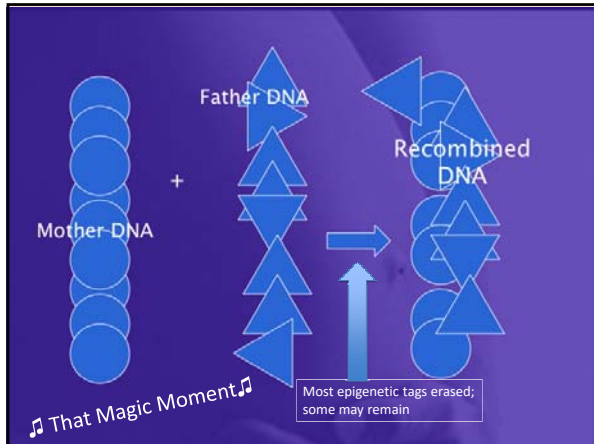


It starts at conception (actually before)

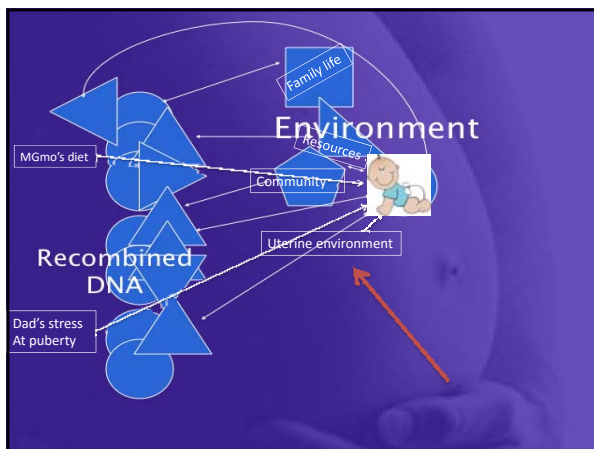


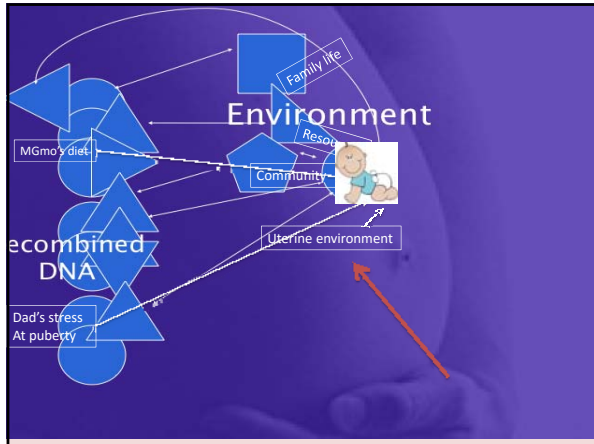
Part I: Genes are not your destiny








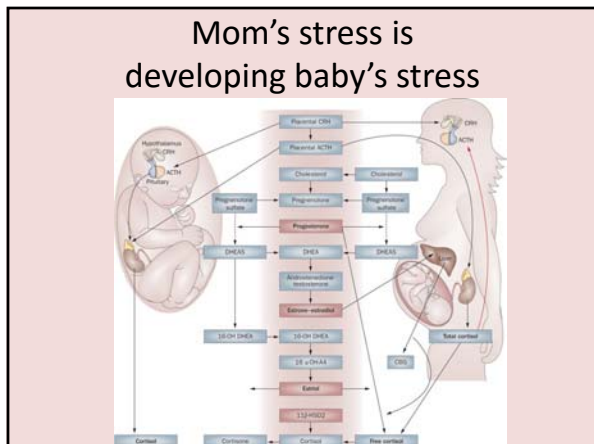


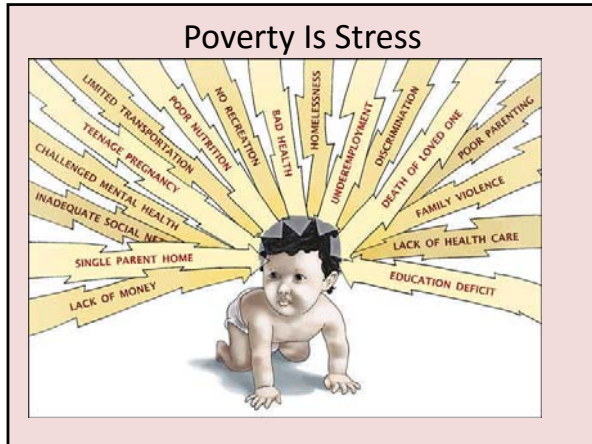


The Uterine Environment

- The Placenta
 - Shared blood supply
 - Shared nutrients
 - Shared toxins
 - Shared hormones
 - Shared stress
 - Shared serenity, peace & calm
 - ACES







11-β-hydroxysteroid dehydrogenase 2

- Enzyme
- Converts Cortisol in Placenta into Cortisone, harmless metabolite
- Persistent high levels of CRH can exhaust supply
- Higher levels of CRH trigger labor

Hypothalamus (CRH) → Pituitary (ACTH) → Adrenal Cortex (Cortisol) → Placenta (Cortisol) → Fetus (Cortisol) → Adrenal Cortex (Cortisone) → Placenta (Cortisone) → Fetus (Cortisone)

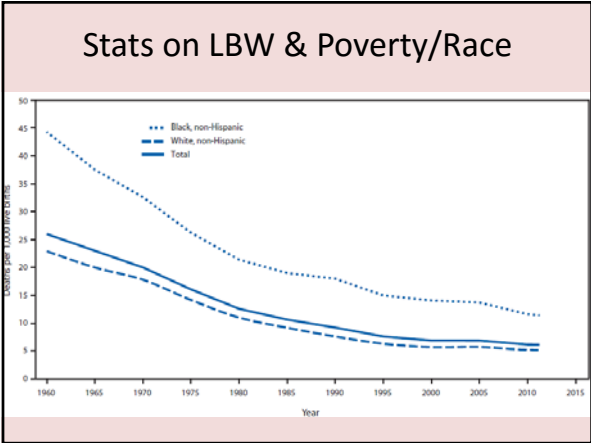
High Maternal Stress =

- Higher levels of circulating CRH
- On top of lifetime stress (Lifespan model)
- May overwhelm mom's 11βHSD2 & lead to premature labor
- Also may trigger poor growth in uterus (Intra-uterine Growth Retardation IUGR)
- Downgrades immune system

Infection

Stress & Infection

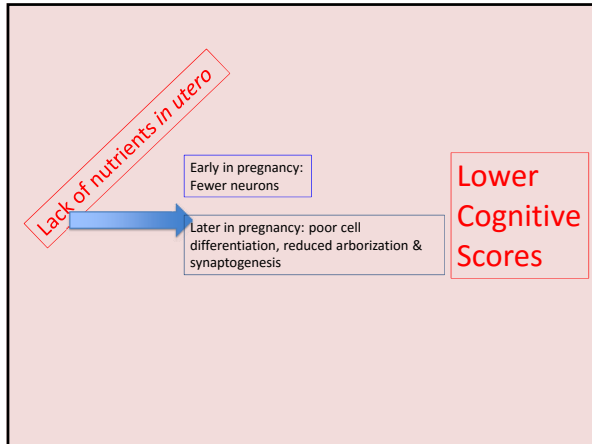
- What happens when your HPA Axis is in stress mode? (Less effective immune system)
- Under normal conditions, *Cytokines* battle infection by promoting inflammation
- Cytokines also cause prostagladins to be produced
- Prostagladins ripen the cervix to prepare for labor & contractions

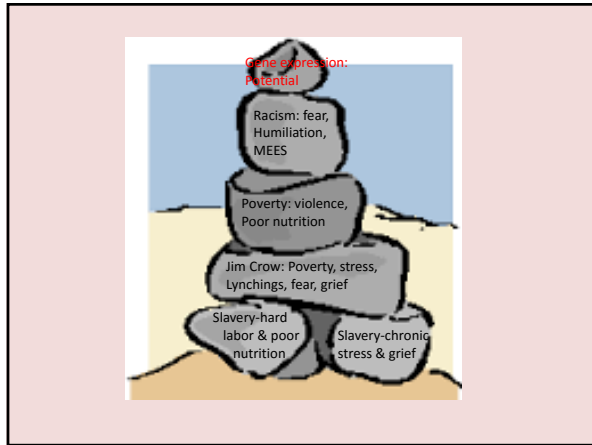


From the Bottom Up: Those last weeks are important

The diagram illustrates the timeline of brain development from prenatal to postnatal stages. Key processes include cell birth, migration, axonal growth, programmed cell death, synapse production, myelination, and synaptic elimination/pruning. A red vertical line marks the beginning of peak synaptogenesis at approximately 28 weeks gestation. A legend indicates that the majority of neurons are formed during the prenatal period, while fewer neurons are formed postnatally, primarily in the cortex.

Beginning peak synaptogenesis: 40,000 per second!





Part II: Major Themes of The First Three Years:

- Plasticity/sensitive periods
 - Experience-expectant
 - Experience-dependent development
- Synapses & experience
- Nurturing, parenting & attachment
- Influence of poverty on development



Newborns Learn Through Senses

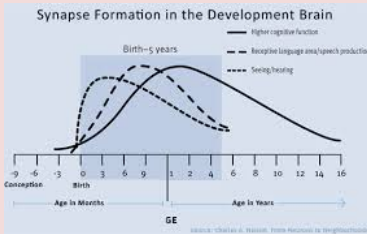
- Experience-expectant development*
- Touch
 - Gentle stroking
- Vision
 - Light & movement
- Hearing
 - Sounds



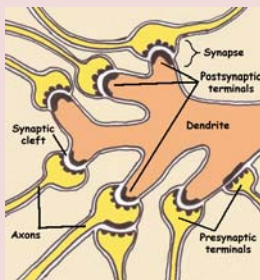
* All members of species exposed to necessary stimuli

Experiences & Learning

- “Neurons that fire together wire together.”

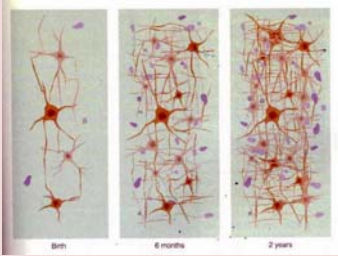


Synapses



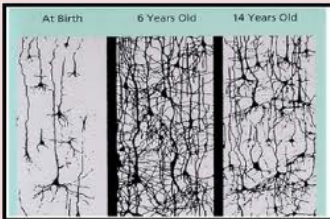
Experiences & Learning

- Neuroplasticity



Experiences & Learning

- Pruning



Experience-Expectant* Development Needs

- Sensory input
 - Constant proximity to caregiver
 - Constant interaction with caregiver
 - Nurturing
-
- * Because every member of our species is expected to experience

Attachment

- Set of behaviors that evolved to keep caregiver close, esp. in face of threat
- Why?
 - Humans born earlier than any other mammal
 - To survive, must receive complete care 24/7



Attachment: Survival of the Species

- Baby is born knowing how to summon help/care
 - Crying
 - Cuteness
 - Smiling
 - Eye contact
- Mother is primed to provide help/care
 - Hormonal forces (oxytocin)
 - Emotional bond

Synchronicity

Attachment: A Two-Way Street

- Loves faces! Mediated by **right brain**, which is most active in first 3 years
- [Can imitate facial, vocal & gestural expressions](#)
- Contributes actively in establishing a bond with caregivers



Synchronicity

4 attachment styles
Internal Working Models

- **Secure**
 - Distressed when mom leaves; avoids stranger when mom leaves but friendly when she's there; happy when mom returns; uses mom as safe base to explore
- **Ambivalent**
 - Intense distress when mom leaves; afraid of stranger; avoids mom when she returns; cries a lot, avoids exploring
- **Avoidant**
 - No distress when mom leaves; OK with stranger always; no interest when mom returns; mom & stranger comfort baby equally well
- **Disorganized**
 - No organized way of dealing with the situation; confused; variable

Attachment Styles & Outcomes

- **Securely attached children:**
 - Have fewer behavior (externalizing) problems
 - Have fewer internalizing problems
 - Have fewer mental health problems
 - Achieve more academically
 - Have better cognitive functioning
 - Get along better with peers
 - Cope with stress better

Attachment Based in the Brain

- Right side most active in first 3 years
- Right orbitofrontal cortex (ROFC) processes faces
- Vision matures at ~8 weeks
- Babies prefer faces & after can see details, especially mother's
- Attachment develops based on stimulation of ROFC through nurturing

Self-Regulation

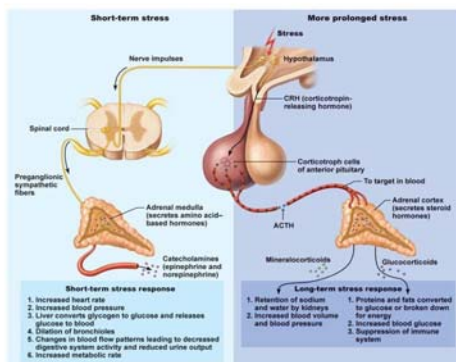
- Intra- & extra-organismic factors by which emotional arousal is redirected, controlled, modulated, & modified to enable individual to function adaptively in emotionally arousing situations ([Cicchetti et al. 1991](#), p. 15).
- Develops within attachment relationship

Part III:

Yes, babies experience stress



Function of cortisol in stress



Development & Baby's Stress

- Birth!
- Pain
- Hunger
- Cold
- Lack of attention, maternal separation
- "Crying it out"
- Immunizations
- Fear
- Parents' stress



How do babies handle stress?

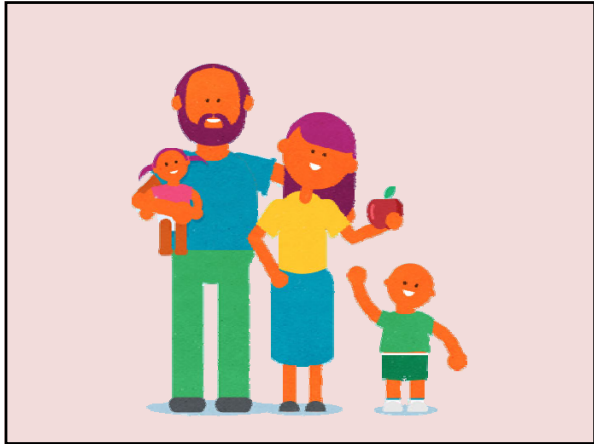
- Caregiver's soothing because:
- Touch down-regulates HPA & up-regulates **oxytocin**



How do babies handle stress?

- In first 2 years, infant's ROFC entrains to caregiver's to develop ability to self-soothe (regulation)





Parenting for Healthy Brain Development

- Sensitivity: understanding what baby needs (cries, time, accumulated knowledge)
- Responsivity: responding correctly to baby's needs (accumulated knowledge, emotional resources)




Mother-baby synchronization

- Hormonal exchange between mother & child
- Regulates vital rhythms: called *limbic regulation* (*oxytocin; stress*)
- Regulates hormone levels, cardiovascular functions, sleep rhythms & immune function




Early Nurturing

- Can you spoil a baby?
- Does your newborn understand when you tell him what you will be doing today?
- Is it OK to argue, play violent television, & curse in front of your baby?
- When will he understand your words?

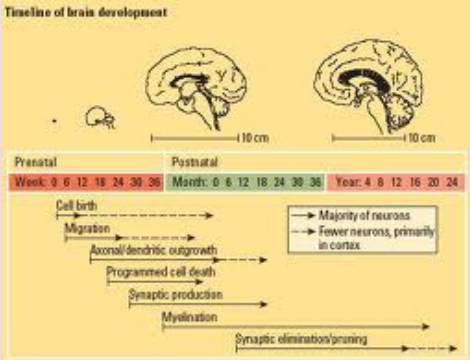


Poverty Is Stress



What's Going On Up There?

Timeline of brain development



Prenatal		Postnatal	
Week: 0 6 12 18 24 30 36	Month: 0 6 12 18 24 30 36	Year: 4 8 12 16 20 24	
Cell birth	Migration	Majority of neurons	
Axonal/dendritic outgrowth	Programmed cell death	Fewer neurons, primarily in cortex	
Synaptic production	Myelination	Synaptic elimination/pruning	

Research: How Poverty Affects What's Going On

- Neurogenesis: fewer neurons, esp. in parietal & frontal areas (attention & executive function)
- Dendritic growth: fewer connections
- Synaptogenesis: less stimulation, fewer synapses
- Myelination: reduced: inefficient signaling, attention problems

Brains of Poor Children

- SES disparities in working memory, cognitive control
 - ***Epecially*** language & memory
- Reward processing & visual cognition not significantly different
- Brains are smaller, esp. hippocampus

Stimulation

- Touching
- Kissing
- Gentle movement such as rocking
- Talking & reading
- Banging pots & pans & spoons
- *Exploring*
- Singing
- Toys
- Electronic toys?
- Educational television?
- Books & stories



Conclusion: TCCY's Vision

- All children in Tennessee are safe, healthy, educated, nurtured and supported, and engaged in activities that provide them opportunities to achieve their fullest potential