Pruning

- Brain wired genetically to work in any human environment
- First 9 months-3 years tell brain what that environment is through experience
- Synapses are strengthened by experience (firing)
- Those not used are pruned--lost
- Those used frequently are strengthened--wired
- Normal & necessary
Neuron density and synaptic connections in development

3 months  6 years  adult

From H.T. Chugani
Wayne State University
Basic Terminology

• Myelin: the fatty sheath that surrounds axons & dendrites
• Insulates the wiring
• Makes signaling faster & more efficient
• Biggest periods of development: gestation/infancy & adolescence
• Diet & environment influence
Myelination

What major debilitating disease involves deterioration of the myelin sheath?
What Influences Myelination?
Brain Development

- *From the bottom up*
- *Neural plasticity*
Hierarchy of the Brain

• Begins a few days after conception
• From the bottom up, from the inside out
• Simple, autonomic functions 1st, followed by motor & sensory functions
• Higher-order thinking last (PFC)
• Each structure relies on integrity of lower structures for healthy development
From the Bottom Up

Timeline of brain development

Prenatal
- Week: 0, 6, 12, 18, 24, 30, 36
- Cell birth
- Migration
- Axonal/dendritic outgrowth
- Programmed cell death
- Synaptic production
- Myelination

Postnatal
- Month: 0, 6, 12, 18, 24, 30, 36
- Year: 4, 8, 12, 16, 20, 24
- Majority of neurons
- Fewer neurons, primarily in cortex
- Synaptic elimination/pruning
What triggers the brain to develop this way?
Genetically Wired, but

• Only occurs in response to environment
• Environment triggers genes to produce proteins that guide brain development
Genetically Wired: 2 Periods of Development

Critical periods (experience-expectant development)

- All species members experience the necessary stimuli
- Narrow time window
- Vision
- Hearing
- Capacity for language
- Capacity for relationships
Genetically Wired: 2 Periods of Development

• Sensitive periods (experience-dependent development)
  – Specific to culture & context
    • Music
    • Specific language
  – More flexible & longer time window
    • Learning a second language
  – A bit more “fixable”
  – Epigenetic process
Example: Poverty Affects Brain Development

• Children in poverty have smaller brains
• Hippocampus is especially affected:
  Area of the brain associated with learning & memory
Poverty Is Stress
Mom’s stress is developing baby’s stress.
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
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)
- Less effective immune system