Experience & Brain Development

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The brain is amazingly complex.


Our DNA cannot code for the wide range of individual differences.

Our brains must be able to adapt to changes in our environment, either positive or negative.

How can experience influence brain development?

Basic building blocks of the brain

Wiring the brain is a developmental process.

Errors of Commission

- Prenatal Drug Exposure
- Environmental Toxins
- Maternal Infection


Errors of Omission

Sensory & Social Deprivation
Malnutrition
Hypoxia (lack of oxygen)

The brain is not pre-wired for function. Input from the environment is essential for many aspects of typical brain development.

Development of the brain’s visual system requires light input into the eye.

Light is translated into a neuronal signal by the retina, and this neuronal firing initiates the functional development of visual regions of the brain.

Auditory cortex can become visual cortex if it receives visual input.


Some environments are unexpected.

Approximately 11% of births in the U.S. are premature (less than 37 weeks gestation)
For these infants, the extra-uterine environment is unexpected

Child maltreatment alters brain structure.

Maltreated children show decreased brain volume overall as well as specific reductions in corpus callosum volume.

Experience drives learning, which involves changes in brain connections.

Six-month-old infants can distinguish speech sounds within many world languages; however, infants become specialized by 11 months, and no longer discriminate between sounds that are not relevant in their native language.

Physically abused children require less information to recognize angry faces.

Maltreated children show preferential processing of angry faces.

Pollak et al. (2001), Psychophysiology

Orphanage rearing is typically associated with significant cognitive and social deprivation.

Early orphanage rearing is associated with smaller prefrontal cortex.

Hodel et al. (2011, abstract), Society for Research in Child Development

Mean Adjusted Volume (cubic mm)

* EA = early adopted, LA = late adopted, control = birth family

Early deprivation is associated with decreased connectivity between the frontal & temporal lobes.

Govindan et al. (2010), Cerebral Cortex

Sensory and social deprivation may impact early synaptic pruning.

Some adoptees show more diffuse fiber pathways, especially in the right prefrontal cortex, suggesting reduced pruning of connections.

Cognitive brain activity varies as a function of duration of deprivation.

Children who spent longer in orphanage care activated the prefrontal and parietal cortex more during a cognitive control task, but activated the hippocampus less.
Positive environments show positive effects on brain development.

Research by William Greenough, PhD, University of Illinois, Urbana-Champaign

Behavioral interventions can change the brain in children.

Reading intervention in children with dyslexia resulted in more typical activation of brain systems involved in reading and phonological awareness.

Temple et al (2003), PNAS