


Early Childhood Brain Development




Todd Twogood, MD, FAAP
Pediatrician

1



NUTRITION



How it effects Brain Growth & Development

3



Doctors believe

It is their responsibility to be involved in promoting quality child care in their practice community

Healthy Childcare American Newsletter 1999

5

Early Brain Development

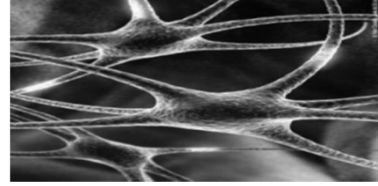
- All behavioral development has to do with the brain
- Brain development is dependent upon both experience and genetics

6

The Brain's Composition

- Growth of the brain occurs from the inside out and the bottom up
- You are born with 100 billion brain cells
- There are 15,000 synaptic connections for each cell

7



8

Early Experiences are Crucial



- By age 3, 80% of synaptic connections are already made
- By the second decade of life growth levels off and pruning begins
- Increased experiences define the wiring of an infant's brain

9



Plasticity

The brain's ability to change as a result of experience.

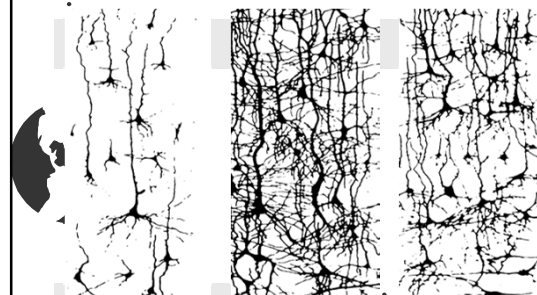


11

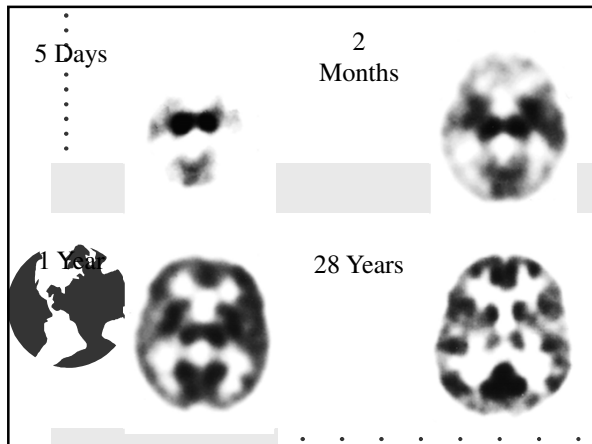
Human
Brain
at Birth

6 Years
Old

14 Years
Old



12



Biology & Environment
Work together to shape the brain.

14

The slide features a title bar with the text 'Biology & Environment' and a subtitle 'Work together to shape the brain.' Below the text is a black and white photograph of a newborn baby sleeping peacefully in a hospital bed. The baby's face is the central focus, showing its eyes, nose, and mouth. The number '14' is located in the bottom right corner of the slide.

Nature vs. Nurture

- During the first 10 years of life the brain is twice as active as that of an adult's
- 60% of nutrition is used by the brain during the first year of life. This decreases to 30% by age 3
- Genetic and environmental factors have a more dynamic, qualitative interplay that can not be reduced to a simple equation

15

The slide has a title bar with the text 'Nature vs. Nurture'. Below the title bar is a bulleted list of three points. The first point states that the brain is twice as active as an adult's during the first 10 years. The second point states that 60% of nutrition is used by the brain in the first year, decreasing to 30% by age 3. The third point states that genetic and environmental factors have a dynamic interplay that cannot be reduced to a simple equation. The number '15' is in the bottom right corner.

Growing a Healthy Brain

- Nurturing experiences.
- Good nutrition.
- Intervening early.
- Protection.
- Taking care of the caregiver.

16

The slide has a title bar with the text 'Growing a Healthy Brain'. Below the title bar is a bulleted list of five points. The points are: Nurturing experiences, Good nutrition, Intervening early, Protection, and Taking care of the caregiver. The number '16' is in the bottom right corner.



Early Care Experiences

- Babies thrive when they receive warm, responsive early care
- Early care has a decisive, long lasting impact on how people develop, their ability to learn, and their capacity to regulate their own emotions

18

The slide has a title bar with the text 'Early Care Experiences'. Below the title bar is a bulleted list of two points. The first point states that babies thrive with warm, responsive early care. The second point states that early care has a long-lasting impact on development, learning, and emotion regulation. To the right of the text is a black and white photograph of a woman kissing a baby on the cheek. The number '18' is in the bottom right corner.

⋮

Parenting

The parent/child relationship is the most powerful influence on children's early brain development, particularly in the first two years.

19

⋮

Problem-based play

Regular, consistent play provides **rich stimulation** that is absorbed into core brain development.

20



⋮

Making a Difference

Parents need support from others to do the best job they can.

They always have.

22

⋮

Percent of Mothers Working Outside the Home

- 76% of mothers with children ages 0-6
- 85% of mothers with children ages 6-12
- 61% of mother of infants and toddlers
- 82,000 children potentially need child care
- 30% of infants and toddlers are in child care full time

23

⋮

Quality Care for Children

- The way that parents and caregivers relate to young children and the way they mediate children's contact with the environment directly effects the formation of neural pathways
- The child care environment provides an incredible opportunity to positively effect child development

24



The Challenge of Health and Safety

- Staff knowledge and skill the number one indicator of quality
- The turnover rate of providers is 30%
- The average hourly wage for a child care center worker is \$7.20
- Infants and toddlers in center care are cared for by an average of seven caregivers a year

26

National Cost, Quality and Child Outcomes Study

- 8% of infant-toddler programs rated high enough to support children's development
- 52% of infant-toddler programs rated mediocre (healthy and safe, some nurturing, few learning experiences)
- 40% of infant-toddler programs judged of poor quality with basic health and safety, no warmth or nurturing, no learning is encouraged

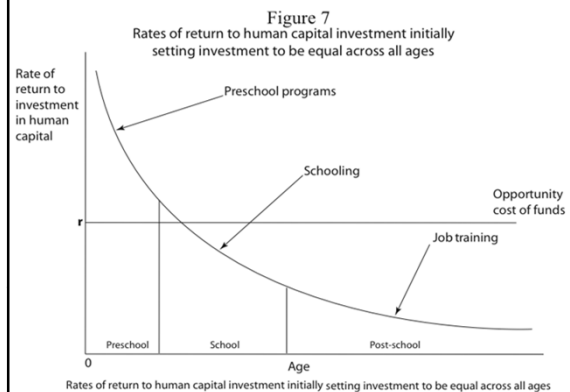
27

Child Care Quality in ND

(90 centers participating impacting 800 infants and toddlers)

- Only 6% of infant-toddler programs rated high enough to support children's development (national 8%)
- 76% of infant-toddler programs rated mediocre
- 18% of infant-toddler programs judged of poor quality with basic health and safety needs not met and care damaging to children's development

28





•
•
•

Critical Periods in Development

Critical periods are sensitive periods when certain important psychological processes are developing most rapidly.

Disturbances during these periods might alter the development of these processes in critical ways.

32

•
•
•

Examples of Critical Periods

- German Measles during the 1st trimester of pregnancy = death, or deaf, blind, deaf and blind, and heart problems.
- Chimpanzees reared in darkness the first year of life will have permanently impaired vision because of certain cells of the retina fail to develop. The first year of life is critical for most normal visual development.

33

•
•
•

Examples of Critical Periods

- Extremely poor nutrition can affect the central nervous system and brain growth.
- Children born with a cataract will become permanently blind in that eye of the cataract if it is not promptly removed.

34

•
•
•

Effects of Neglect on a Child's Development

Growth delay with certain postural and behavioral signs. Infants may also exhibit mental and motor delays.

- A. Less adaptive social interaction behavior
- B. Less positive affective behavior
- C. Avoidant and resistant attachment to primary caretaker

Deficits on measures of intelligence
Deficits in language ability (auditory comprehension and verbal ability)
Academic underachievement
See special Issue: (1993). Child Neglect. Criminal Justice and Behavior, 20, 49-64.

35

•
•
•

Brain Research and Neglect

- Infants of depressed mothers exhibit atypical frontal electrical brain activity
- Chronic and severe neglect can reduce the size of the cerebral cortex thus the neglected child's brain can be smaller
- Stress early in life can promote long-term changes in multiple neural transmitter systems and brain structures (demonstrate through animal studies)

36

Impact of Neglect on Infant Mental Health

During Infancy....

- Attachment disorders
- Delayed development
- Infant depression
- Inconsolable crying

During Toddler Years....

- Aggressive behavior
- Impulsive behavior
- Difficulty being motivated to learn
- Difficulty tuning into teaching

Greater Likelihood for....

- Placement in special education
- Grade retention
- School Dropout

37

The Developing Brain

Brain development is much more vulnerable to environmental influence than we ever suspected. Poor nutrition before and after birth can seriously interfere with brain development.

Brain scan studies of animals show changes in brain structure and function as a result of early experience.

Studies of children reared in poor environments show cognitive deficits by 18 months of age.

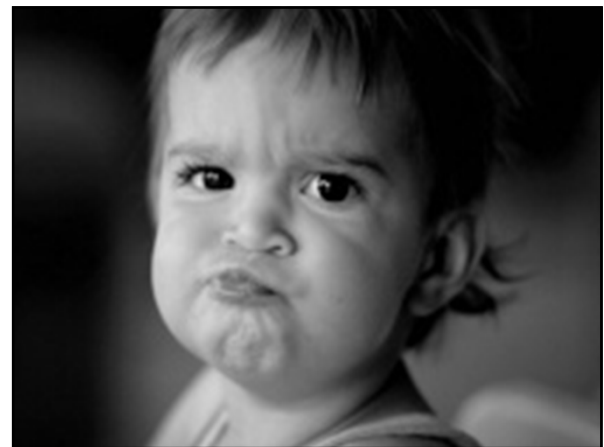
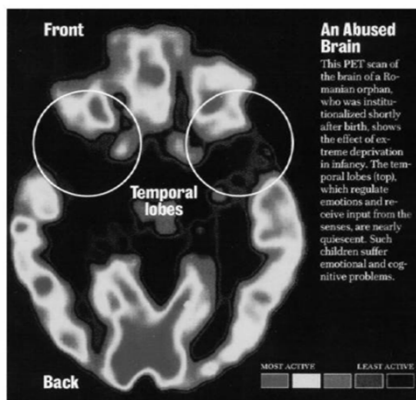
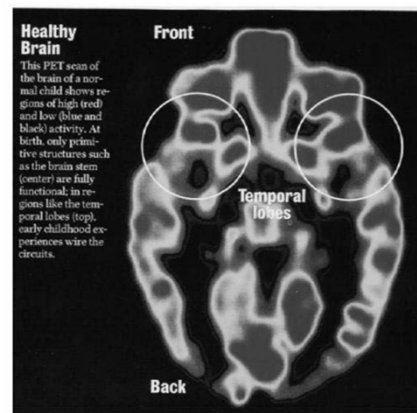
38

The Developing Brain

The influence of early environment on brain development is long lasting

Moderately to severely neglected children are at risk of having smaller head sizes resulting in smaller brains and lower IQs. PET scans of institutionalized children show the effect of extreme deprivation.

39





How the brain develops

- Development of the brain and nervous system of the embryo begins shortly after conception
- Ectoderm → neural tube → spinal cord & brain (2-4 weeks)
- Umbilical cord and placenta not formed until week 2 of the embryonic life

44

How the brain develops

- Period of the fetus (3rd month)
- Nervous system (brain & spinal cord) connect with organs and muscles
- Weeks 13-24, brain neurons are mostly complete (2nd trimester)

45

Human Brain Development – Synapse Formation

C. Neelson, in *From Neurons to Neighborhoods*, 2000

Sensitive Periods for Early Development

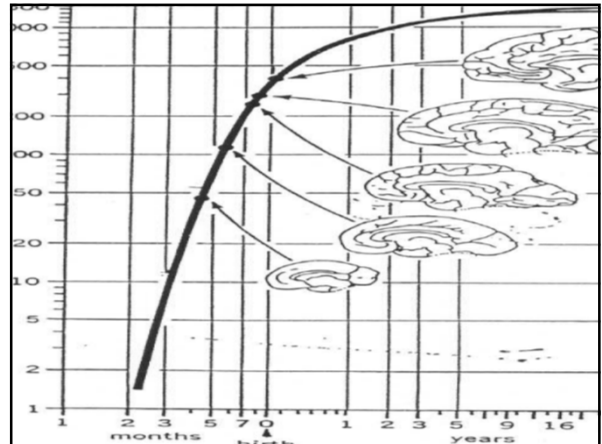
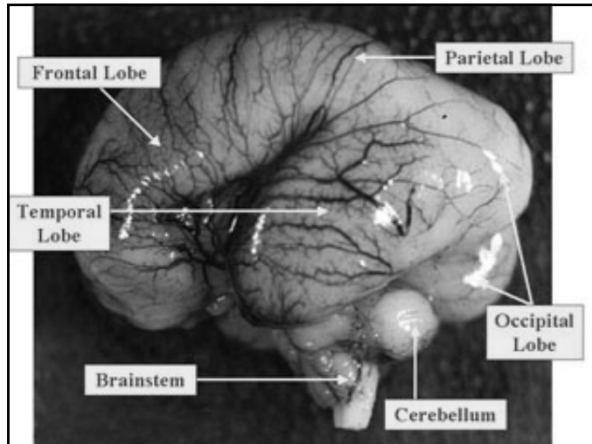
Skill	Critical Period (Solid Bar)	Critical Period Wanes (Dashed Bar)
Binocular vision	0 - 3	0 - 7
Central Auditory System	0 - 3	0 - 7
Emotional control	0 - 3	0 - 7
Habitual ways of responding	0 - 3	0 - 7
Peer social skills	3 - 7	0 - 7
Language	0 - 7	0 - 7
Cognitive skills: symbols	1 - 5	0 - 7
Cognitive skills: relative quantity	4 - 7	0 - 7

age (yrs)

The Developing Brain

- The brain development that takes place before age one is more rapid and extensive than we previously realized.
- Position Emission Tomography (PET) studies show that biochemical patterns of a one-year-old's brain resembles a normal young adult.

48



Disproportionate exposure of Children

- Pound for pound, children take in more air, food, and water than adults
- Gastrointestinal tract is more permeable to nutrients and contaminants, e.g. calcium, Lead
- Children’s activities and environment differ from adults

57

Disproportionate susceptibility of Children

- Developing tissues generally more vulnerable to environmental factors
- Environmental factors can “program” genetic expression, tissue and organ development in unique and lifelong ways
- Brain, respiratory, gastrointestinal, reproductive, immune system, metabolic systems are not fully developed for days, weeks, months, or years

58



The Developing Brain
Poverty and Nutrition

Monckeberg studied 500 preschool children in Chile who were divided into three groups:

- Group A-well nourished, middle-class children
- Group B-disadvantaged who received supplements of milk and free medical assistance
- Group C-disadvantaged, no assistance.

60

Results:

Groups A & B had little or no malnutrition, only 3% of children had below average IQs.

Group C had high incidence of malnutrition and 40% had IQs below 80, they also had smaller head sizes.

61



Nutrition

Optimal early child development begins with **adequate nutrition** from conception onwards.

63

Nutrition & Brain Development

- Prenatal nutrition
- Rapid development early in life
- Importance of nutrition in the main stages of development

64



Nutrition during pregnancy

- Conception to 2nd week
 - Umbilical cord not formed
 - Mother's food intake does not have an effect on the embryo

66

Nutrition during pregnancy

- Week 2 to birth
 - Nutrients to unborn child via mother
 - Most critical time for development of central nervous system
 - Folic acid
 - Early in pregnancy
 - Also late in pregnancy

67

Nutrition during pregnancy

- Folic acid deficiency
(Biotech Week, 2004)
 - Anencephaly = irregular brain formation
 - Stem cell division
 - Lifelong brain impairment



68

Nutrition during pregnancy

- Proper nutrition
- Recommended amount of nutrients
- Alcohol & smoking
- Normal cognitive development

69



Nutrition for Infants



- Breast Milk vs. Formula
- Convenience vs. health
- 3rd world vs. developed countries

71

Nutrition for Infants



- (Better Nutrition, 2000)
 - Premature infants
 - Long-chain polyunsaturated fatty acids
 - Faster brainstem maturation

72

Nutrition for Infants

- When the bottle may be better
 - (Lawson, 2003)
 - Vegan mother's
 - Vitamin B12 deficiency
 - Developmental delays
 - Attention span, motivation

73

Nutrition in young children

- (Core, 2003)
 - Poor nutrition = hampered mental development
 - Information processing
 - Language
 - Below average for age
 - Marasmus

74



Nutrition for Continued Growth

- Healthy mind
 - Balanced diet
 - Essential nutrients
 - variety



76

Summary

- Most critical stages of cognitive development
- Effects of poor nutrition
- Healthy eating
- Healthy mind

77

