NIEER

Connecting Neurons, Concepts, and People

Brain Development and its Implications

by Ross A. Thompson, Ph.D.

The past decade has seen an upsurge in public understanding of early brain development. News reports, statements by policymakers, and commercial marketing of products for infants and young children have all contributed to a widespread understanding of the explosive growth of the brain in the early years and that stimulation acts as a catalyst to brain growth. Beyond this, however, most people are unsure what to make of this new knowledge about brain development.

What We Know:

- The most significant advances in brain architecture occur prenatally.
- Brain development is life-long, hierarchical, cumulative, and integrated.
- The brain incorporates experience into its architecture.
- Critical periods are exceptional, not typical, in brain development.
- The developing brain's flexibility declines over time, but some plasticity endures.
- The young mind is astonishingly active, capable, and self-organizing.
- Developmental neuroscience provides much greater insight into the hazards to avoid in brain development than opportunities for enrichment.

Policy Recommendations:

- Government and business should support prenatal and well-child health care, good nutrition, efforts to eliminate children's exposures to harmful pollutants and toxins, and high-quality preschool programs in striving to support healthy early brain development.
- Early prevention is better and less expensive than later remediation. Health care services, early intervention programs, and preschools should ensure that they provide early hearing, vision, language, cognitive, and behavioral screenings, and link children to necessary services.
- Sensitive interactions with adults do more to promote brain development than any toy, CD, or DVD. Preschools should deliver services that enable adults to have rich interactions with children.
- Preschools should embrace educational approaches that encourage child-oriented discovery over adult-directed instruction.
- Since social-emotional and cognitive development are intertwined, preschool programs should recognize and focus on both.
- Exposure to chronic early stress is harmful. Mental health experts can help preschool staff work with children with behavioral problems and learn to identify and refer children and families to other services as needed.

Preschool Policy Facts

Policy Facts series edited by
Ellen C. Frede, Ph.D., and
W. Steven Barnett, Ph.D.

National Institute for
Early Education Research

www.nieer.org

Rutgers
Graduate School of Education

The Science of Early Brain Development

Brain development is the product of an ongoing complex interplay between the child's active mind and the environment, in the context of strong genetic guidance. These are the main principles of early brain development:

1. The most significant advances in brain architecture occur prenatally. While in the womb, the child's brain grows more significantly in size and function than at any subsequent stage of development. Neurons are produced at an astonishing rate, migrate to their destinations within the brain, and begin to form neural connections. Damage to brain growth can occur if the child is exposed to viral infection, drugs, alcohol, or environmental hazards. A mother's malnutrition or chronic stress can also result in negative effects.

2. Neural connections develop over an extended period that varies for different brain regions. Neural connections develop most rapidly in the early years but also throughout life, occurring earliest for basic sensory and motor areas, later in brain regions for language and speech, and latest for areas associated with higher cognitive functions like reasoning and planning.

3. The brain incorporates experience into its developing architecture. Through experience, the brain's efficiency improves as neural connections relevant to everyday life are strengthened. Responsiveness to experience also means that during times of rapid brain growth such as early childhood, negative experiences (such as chronic stress) can become incorporated into brain architecture.

4. Critical periods are exceptional, not typical, in brain development. While there are some critical periods in brain development (such as early exposure to light required for sight to develop), the complexity of human brain and behavioral development suggests that "sensitive" periods are more common, involving a wider and more flexible window of opportunity

5. Brain development is life-long. The brain has tremendous adaptive flexibility, and neuroscientists have also discovered that new neurons continue to be produced in certain areas of the *adult* brain, and new synapses are forged throughout life as a product of experience.

6. The developing brain's flexibility declines over time, but some plasticity endures. As neural connections become refined and consolidated through experience and as sensitive periods channel brain growth in specific directions, the brain's plasticity declines. An important implication of declining brain plasticity is that it is biologically more efficient to prevent difficulties from arising in brain functioning than it is to try to remediate already developed problems.

7. Brain development is integrated. The interconnections among specialized brain areas contribute to the brain's efficiency. Scientists are learning that as children grow older, certain areas within their brains become better integrated with one another and changes in children's behavior result. For example, as their brains develop, children become more proficient at using their memory, attention, behavior, and emotions in strategic ways.

8. The young mind is active, capable, and self-organizing. The developing brain is not an empty vessel, passively waiting to be filled with knowledge, but rather an active organ that grows through its own activity. The experiences that promote growth are those that provoke the brain's activity, often through the child's interest and engagement, especially through socially responsive interaction. Because of differences in brain development, a high-quality learning environment for a 4-year-old looks much different than a quality learning environment for a fourth-grader.

9. Developmental neuroscience provides much greater insight into the hazards to avoid in brain development than opportunities for enrichment. Beyond recommending attention to health and responsive care, developmental neuroscience has few strategies for improving or accelerating typical brain development. It has greater implications for interventions to prevent harms associated with poverty, deprivation, and abuse, and for children with cognitive delays and difficulties in learning.

Interpreting Developmental Neuroscience

Any brain development findings should be interpreted against the rich backdrop of scientific understanding that already exists concerning children's development. What we learn from studies of the developing brain should be consistent with what we already know about the growth of cognitive, social, emotional, and other behavioral capacities in children. If we forget to connect brain science with the science of behavior and development, we run the risk of moving too quickly to embrace services or programs for children that do not make sense.

This fact sheet is based on the policy brief "Connecting Neurons, Concepts, and People: Brain Development and its Implications" by Ross A. Thompson, Ph.D. The brief includes full references and is available at www.nieer.org. It was made possible by the generous support of The Pew Charitable Trusts. The opinions expressed are those of the authors and do not necessarily reflect the views of The Pew Charitable Trusts.

RUTGERS Graduate School of Education

THE PEW CHARITABLE TRUSTS