

Brain Research in Early Childhood: A Primer for Caregivers and Administrators

Section One: What the Research Tells Us



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What Research Says About the Developing Brain

Parents and experts have long known that babies raised by caring adults in safe and stimulating environments are better learners than those raised in less nurturing settings.

Research has shown:

- **The brain develops more rapidly before age one than at any other point in a person's life.** Biochemical patterns of a one-year-old's brain strongly resemble those of a normal young adult. Connections between neurons multiply at an exceedingly fast rate during the first year of life.
- **Upon birth, the brain has already begun to link billions of cells together—up to 15,000 connections (synapses) per cell.** These synapses form the brain's physical "maps" that allow learning to take place, and, over time, largely determine the intellectual and emotional capacity of the child. The number of synapses increases 20-fold, from 50 trillion to 1,000 trillion, in the months after birth.
- **Brain development is extremely susceptible to environmental influence.** The quality and variety of the physical and emotional environment are very important. Studies of children raised in poor environments show that they have cognitive deficits of substantial magnitude by 18 months of age. Full reversal of these deficits may not be possible.
- **The influence of the early environment on brain development is long lasting.** The positive effects of early nurturing appear to accumulate over time. One study followed two groups of inner-city children. The first group was exposed from early infancy to good nutrition, toys and playmates; the second group was not. The first group demonstrated significantly more complex brain function at age 12. There continue to be gains at age 15, suggesting that over time, the benefits of early intervention are cumulative.
- **Early stress can impair brain function.** A child's social environment can activate hormones, such as serotonin and cortisol, in ways that adversely affect brain functions, including learning and memory. These effects may be permanent. Children who have experienced extreme stress in their earliest years have proven to be at greater risk for developing a variety of cognitive, behavioral, and emotional difficulties.



Adapted from: Kids Count in Colorado. (1997). Ensuring the future of our children: Brain child. Denver: Colorado Children's Campaign. Retrieved March 21, 2000, from World Wide Web: <http://www.coloradokids.org/brain.htm>.

Early Childhood Development and Learning: Key Lessons

The impact of early experience on early brain development is powerful and specific, and may last a lifetime. This is a major finding of recent brain research, and it represents a sharp departure from centuries-old ideas about how children develop and grow.

1. **Early experience affects how brains are “wired”.** At birth, children’s brains are in a surprisingly unfinished state. Newborns have all of the billions of brain cells, or neurons, they will need for a lifetime of thinking, communicating, and learning. But these neurons are not yet linked into networks needed for complex functioning. Our initial immaturity gives us a powerful evolutionary edge. Humans have found ways to adapt to almost any habitat on earth. Why? In large part, because so much of our brain development takes place through contact with our environment. This makes humans uniquely flexible and adaptable.
2. **The young brain is a work in progress.** A young child’s brain is a work in progress, and scientists are now able to watch it unfold. Scientists can use new technologies, such as magnetic resonance imaging (MRI), positron emission tomography scans (PET scans) and magnetoencephalogram, to see how the brain looks and functions at different stages of development, including in the months before birth. Crucial steps in brain development take place early in pregnancy, before many women know that they are expecting. At birth, newborns cannot yet make sense of the flood of sensation and information that comes their way. However, as new experiences occur, young children’s brains respond by forming and then reinforcing trillions of connections, or synapses, among neurons. Connections form so quickly that by the time children are three, their brains have twice as many synapses than they will need as adults. What happens to the excess connections? They are pruned as children grow, in order to streamline the neuro-network and make it more efficient. Those connections that are used often enough tend to survive; those that are not used often enough vanish.



3. **Every child is unique.** Because experience so powerfully affects early development, no two brains grow and mature in the exact same way. Children are individuals right from the start, even if they are raised in the same culture, locality, or even household. Even the brains of identical twins develop differently, based on their early surroundings and their individual interactions with the adults who care for them. The new brain research answers many questions about how children grow and develop, but it does not diminish the reality that every life is unique and complex.
4. **Children learn in the context of important relationships.** What kind of experiences do infants and toddlers need? Researchers are finding that, more than anything else, young children need secure attachments to the adults who care for them. Babies respond to touch, sounds, images, tastes, and smells. They are at ease when they receive warm, responsive care geared to their needs, moods, and temperament. When this kind of care comes consistently from the same adult or adults, young children form secure attachments. When children form such relationships, their development tends to flourish. What matters to young children is an adult’s ability to understand their needs and to read their signals most of the time, to respond with warmth and affection, to model the pleasures of conversation and turn-taking, to protect them from life’s minor bumps and bruises as often as possible, and to shield them from neglect

and abuse.

5. **Other caregivers can meet young children's needs, but don't take the place of Mom or Dad.** Research shows that children are capable of forming strong attachments to more than one adult, but not all attachments are equally strong or compelling. Babies tend to prefer their primary caregiver, usually mom. But they quickly learn that other people can meet their needs, and that different people have different ways of caring for them. In this way, they begin to get a sense of life's complexity and richness. Child care providers can be important people in young children's lives, but they do not take the place of parents. Recent studies show that high-quality child care does not disrupt young children's attachments to their parents, as long as parents spend enough time with their infants and toddlers to know them well, care for them confidently, and read their signals and cues.
6. **"Small talk" has big consequences.** Adults have special ways of talking to children that help them master language. Speakers of "parentese" often set their words to enticing melodies that act as acoustic hooks, pulling the baby's attention to them. But some caregivers do not realize the importance of talking to their children in the first year, even before their children are old enough to begin talking back. Research suggests that their children may be missing out on important learning opportunities. Linguistic experience constitutes a critical part of the setting in which young children grow up, and can have a positive or negative effect on children's development. Once caregivers know about this kind of research, most will want to make "small talk" with their infants more frequently, warmly, and responsively, and they will want to be sure that child care providers are talking with their babies as well.
7. **Children need a variety of stimulating activities.** Children need opportunities for a variety of vigorous, safe, appropriate physical activities. They need touch, sounds, and images. They need social and emotional contact. And they need thought-provoking activities. Most adults who care for children have some awareness of these needs, but despite parents' best intentions, many infants and toddlers do not get enough intellectual stimulation. On the other hand, just as too little stimulation can hinder brain development, so can over-stimulation. Children will demonstrate intolerance of over-stimulation in a variety of ways ranging from falling asleep to screaming uncontrollably. Young children have different temperaments and moods. Aside from seeing to their children's basic health and safety, the most important thing caregivers can do is to learn to read their children's moods and preferences and whenever possible, adjust activities, schedules, and even the way they touch and talk to their young children.
8. **Prevention is crucial.** The brain does not develop all at once. Different parts of this complicated organ mature at different times and at different rates. Although development continues throughout life, there are periods of great opportunity (and risk) when a particular part of the brain is the site of intensive wiring and is therefore especially flexible. These are known as "windows of opportunity," or "critical periods". The concept of critical periods helps to explain why the early years are so important, and why it can be difficult for caregivers and teachers to compensate for experiences that were missed in the first years of life. The bottom line is that in the early years of life, prevention and early intervention are crucial. When health problems are addressed, when family stress is reduced, when mothers seek treatment for depression, young children tend to fare better. The earlier the intervention, the better. The more follow-up, the better. These are simple lessons. As they are applied more widely, results for young children are bound to improve.
9. **Know your baby.** Unconditional love goes to the heart of what it means to be a caregiver. But love is not enough. From a child's viewpoint, good care is responsive care. It requires getting to know a particular

child very well. This is not simply a matter of instinct or affection, it usually takes time and practice and help from more experienced caregivers. No caregiver gets it right every time. In fact, the ups and downs are among the experiences that help the brain to mature. What's more, when children have a secure attachment to the adults who care for them, they are forgiving. When a caregiver disappoints them, they usually offer another chance. However, some mistakes cannot be tolerated. There is never an excuse for abuse or neglect, or for household dangers that imperil children's lives.

Adapted from: U.S. Department of Education. (1999, September). How are the children? Report on early childhood development and learning. Retrieved March 21, 2000, from the World Wide Web: http://www.ed.gov/pubs/How_Children/IIEarlychildhood.html#1



What is Essential for Optimum Brain Development

All children need and benefit from:

- Emotionally responsive, dependable, educated, healthy, economically stable, and trusting parents;
- Intensive nurturing;
- A rich and responsive language environment in which children are exposed to a wide vocabulary and are read to every day;
- Full-day, five-day-a-week, year-round care and education (whether provided by parents or other significant caregivers) that keep children safe and provide consistent, enriched learning environments with toys, playmates; and developmentally appropriate challenges.

Children need and benefit from the additional support of:

- Prenatal care that emphasizes nutrition and healthy behavior;
- Parent education in child-rearing skills and development;
- Home visits by health professionals for premature babies;
- Preventative health care with follow up services that alerts parents to hearing, vision, and learning difficulties before easily treated ailments, such as ear infections, result in permanent damage; and
- Home visits by child development professionals supplemented with comprehensive, early, center-based care and education.

Results of Appropriate Early Years

With a nurturing environment early in life, all children:

- Adjust more easily to school, have better cognitive and language development, are less likely to repeat a grade, and are assigned to special education programs less frequently, and
- Are more likely to be emotionally competent, well adjusted, responsible, and able to control violent impulses.

All children can benefit from brain development research. Targeted programs have been shown to:

- Double the growth rate and increase IQ scores of premature babies;
- Improve IQ scores an average of 20 points for children of impoverished parents;
- Achieve normal functioning in children with mild retardation;
- Improve rates of graduation, secondary education or training, employment; and annual earnings among disadvantaged children.

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