Brain Development in Young Children: The Early Years ARE Learning Years

Dawn Ramsburg

Introduction

Early Years are Learning Years. . . Make Them Count! This is the theme of this year's Week of the Young Child (WOYC), an annual celebration sponsored by the National Association for the Education of Young Children (NAEYC). The purpose of the WOYC is to focus public attention on the needs of young children and their families and to plan how we (as parents, as professionals, and as citizens of states, communities, and the nation) will better meet those needs. The WOYC is scheduled this year for April 13-19, 1997.

To explore the importance of the early years and to provide ideas for how you can support young children in your community, this issue of *Parent News* contains a feature article about emerging research on brain development in young children, a community spotlight on how to build community collaborations to support young children, and a description of the "I Am Your Child" early childhood public engagement campaign.

Much attention has been focused in recent years on the importance of the early years for young children's healthy mental development. Activities have included a plenary session devoted to the need for investment in children from birth through the first three years of life at the National Governors Association (February 1997) meeting and a guest appearance by Hillary Rodham Clinton at the April 1997 meeting of the Society for Research in Child Development, where she reiterated the importance of early experience in child development and described a conference the White House will host in late April on early development and learning. A primary reason for this increased attention was the 1994 release of *Starting Points: Meeting the Needs of Young Children* by the Carnegie Corporation of New York. This report documented the burgeoning literature on young children's emotional, social, physical, intellectual, and brain development and concluded that "how children function from the preschool years all the way through adolescence, and even adulthood, hinges in large part on their experience before the age of three" (p. 6).

Why the increased attention on the early years? Since the 1970s, strong evidence has emerged that suggests that activity, experience, and stimulation can alter brain development. In recent years, technological advances have enabled researchers to make important advances and discoveries in brain research. As a result of the emerging evidence, a shift is taking place in traditional views of development in young children.

Emerging Views on Brain Development in Young Children

In the past, the two dominant views on children's development proposed that children either came into the world genetically pre-programmed ("nature") or that they were a "blank slate" on which their environment shaped their development ("nurture"). The debate over nature vs. nurture is fading quickly, however, as scientists now are investigating the complex ways in which genes and environment interact. Scientists understand that both nature and nurture shape brain development, and that each set of influences is dominant to varying degrees at various points in time.

Brain Development in the Prenatal Period

Before birth, nature is the dominant actor in brain development, although the environment also plays an important role. According to Dr. Pasco Rakic, a professor of neuroscience at Yale University, "The number of neurons and the way that they are organized is determined by heredity" (Jabs, 1996, p. 24). Scientists know that during the third week of pregnancy, a thin layer of cells in the developing embryo folds inward to create a fluid-filled cylinder called the "neural tube" (Berk, 1994, p. 99). It is in the neural tube where the production of *neurons,* the brain cells that store and transmit information, begins—at the rate of 250,000 per minute (Nash, 1997, p. 52).

By the end of the second trimester, the process of producing neurons is completed. No more neurons will *ever* be produced again in an individual's lifetime. Some neurons are programmed for specific functions such as breathing, controlling the heartbeat, regulating body temperatures, or producing reflexes. But, for the most part, neurons are not designated to perform specific tasks, and thus brain development is not complete at this point.

Although nature or genetics plays the dominant role in the prenatal period, the environment is important at this time as well. Researchers have found that environmental factors such as maternal malnutrition, substance abuse (including alcohol, smoking, illegal drugs, and use of over-the-counter medications), exposure to chemicals or radiation, and viral infections (such as measles) can lead to adverse effects on the developing brain.

Brain Development Following Birth

While newborns are born with all the neurons they will ever have, a new phase of brain development begins after birth—the wiring phase. Following birth, each of the brain's 100 billion neurons creates links to thousands of others (Nash, 1997, p. 53). This process is accomplished as neurons produce a web of wire-like fibers called *axons* (which transmit signals) and *dendrites* (which receive signals). Once axons make their first connections, the nerves begin to fire (Nash, 1997, p. 53). It is at this point that the environment begins to take over in the process of brain development. Scientists often describe this stage as the equivalent of creating telephone trunk lines between the right neighborhoods in the right cities. At this point in development, the brain has to sort out which wires belong to which house (Nash, 1997, p. 53). It is with these maps that learning will take place (Carnegie, 1994).

The most important factor in this process of developing connections is stimulation, or repeated experience. Scientists now know that in the months after birth the number of synapses increases from 50 trillion to 1,000 trillion (Carnegie, 1994). Neurons that are stimulated by input from the surrounding environment continue to establish new synapses. Those that are seldom stimulated soon die off. According to Dr. Harry Chugani, a professor of pediatric neurology at Wayne State University, "It's like a highway system. Roads with the most traffic get widened. The ones that are rarely used fall into disrepair" (Nash, 1997, p. 26).

Critical Periods in Brain Development

Because of the evidence emerging on synaptic development, scientists believe that appropriate stimulation of the child's brain is critically important during periods in which the formation of synapses is at its peak (Berk, 1994). It is during these critical periods, or windows of opportunity that exist for different brain functions, when a child's experiences can make the most difference. And, for some areas, if the connections between neurons are not developed during these critical periods, they will never develop at all.

One area of brain development that has received much attention in determining its critical period is vision. It has been found that the synapses associated with vision multiply quickly in 2- to 4-month-olds and keep increasing until around 8 months

(Jabs, 1996, p. 25). At 8 months, each neuron is connected to 15,000 other neurons (Begley, 1996, p. 56). This rate makes sense when we realize that infants have limited motor skills and spend much waking time watching the world around them. Yet researchers have found that a baby whose eyes are clouded by cataracts from birth will, despite cataract removal surgery at the age of 2, be forever blind. This finding indicates that the window of opportunity for vision does not stay open for a long period of time.

Implications of These Findings

Does this research mean that it is too late to make a difference in the brain development after age 3? Absolutely not. Researchers have found that the brain during the first years of life is malleable, citing instances in which very young children who suffer strokes or injuries that wipe out an entire brain hemisphere still mature into highly functioning adults (Nash, 1997, p. 54). Children have also been found to overcome emotional and physical abuse suffered during the first year, presumably because of "plasticity," or the ability to rewire damaged brain areas.

It is also important for parents not to push children during this period and provide too much stimulation. Parents who try to rush children through the stages of development are asking children to function with capacities that may not be ready to be used (Jabs, 1996, p. 25). In addition, if parents try to push children, they may form connections between certain activities and stress. Parents who try to force a child to complete a puzzle before he or she is developmentally ready may decrease the child's disposition to do the puzzle or engage in related activities because of the stress connection. For more information on dispositions in young children and how to encourage the disposition to be intellectually curious, see Lilian Katz's ERIC/EECE Digest "Dispositions as Educational Goals."

With few exceptions, with vision as perhaps one notable exception, the windows of opportunity in brain development do not close abruptly. What research findings do indicate is the importance of helping children develop a sound foundation in early learning, so that they have the building blocks for a lifetime of learning. This foundation comes from stimulating education and child care experiences during the early years.

Sources

Begley, S. (1996, February 19). Your child's brain. *Newsweek, 127,* 55-62.

Berk, L. (1994). *Infants and children: Prenatal through early childhood.* Boston, MA: Allyn and Bacon.

Carnegie Corporation of New York. (1994). *Starting points for young children.* New York: Carnegie Corporation of New York.

Jabs, C. (1996, November). Your baby's brainpower. *Working Mother, 19,* 24-28.

Nash, J. (1997, February 3). Fertile minds. *Time, 149,* 48-56.

Source of This Document

Ramsburg, Dawn. (1997). Brain Development in Young Children: The Early Years ARE Learning Years. *Parent News* [Online], *3*(4). Available: http://npin.org/pnews/1997/pnew497/pnew497b.html