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## Optimizing Early Brain and Motor Development Through Movement

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It appears that research is now supporting what we in early childhood education have been saying for years. That is, positive early experiences forge the foundations for lifelong learning and behavior. And, to optimize the development of each child, a rich nurturing environment is required (Diamond & Hopson, 1998; Fischer & Rose, 1998). Such support has been abundant in news articles and journal publications in connection with the importance of early experience in brain development of the young child (Begley, 1997; Nash, 1997). In essence, "rich environments produce rich brains," and an essential agent in this process is movement activity!

In addition to supporting the need for early education, what science now provides is a better understanding of the critical periods or "windows of opportunity." These critical periods help us identify when positive experiences may be most beneficial in the developmental process. The intent of this article is to provide a brief overview of the underlying science and from research suggest recommendations for developmentally appropriate movement experiences to optimize general brain and motor development.

### New Perspectives on Early Brain Development

Of all the discoveries that have come out of brain research in recent years, one of the most intriguing has been a hint of how the neural circuitry develops. The "wiring" of the brain is an amazing phenomenon of precision considering that the mature brain contains in excess of 100 billion neurons that are intricately connected with one another in ways that make possible the amazing functions underlying human behavior. Each neuron links up with thousands of other neurons to form trillions of connections. The total length of "wiring" between neurons is estimated at 62,000 miles (Coveney & Highfield, 1995).

As early as 15 years ago researchers believed that the wiring diagram for each person was primarily "programmed" by one's genetic blueprints, much like the wiring of a new house before being occupied. However, the contemporary view is that while the main circuits may be prewired, such as for breathing, control of heart beat, and reflexes, other basic pathways are quite rudimentary, containing trillions of finer "unprogrammed" tentative connections. These connections are dependent upon stimulation from the environment and experience in the environment. It is this stimulation that completes the architecture of the brain.

Scientists now believe that to achieve the precision of the mature brain, stimulation in the form of movement and sensory experiences during the early developing years is necessary (Greenough & Black, 1992; Shatz, 1992). Experience appears to exert its effects by strengthening and bonding synapses, which are the connections that are made between neurons. Connections that are not made by activity, or are weak, are "pruned away," much like the pruning of dead or weak branches of a tree. If the neurons are used, they become integrated into the circuitry of the brain. Due to differences in experience, not even identical twins are wired the same (Chugani, 1998).

The primary basis for the importance of movement and sensory experiences was derived from studies which compared brain structures of animals raised in various environmentally normal, deprived, and enriched settings. The enriched settings provided the opportunity to interact with toys, treadmills, and obstacle courses. Overall, such research has led to the conclusion that stimulation is a significant factor in overall brain development (Jones & Greenough, 1996; Kempermann & Gage, 1999). Animals placed in enriched environments had brains that were larger and contained more synaptic connections.

### Implications for the Early Childhood Educator

One of the strongest implications of brain research has been the identification of critical periods in brain development in which experience may be most effective in forging connections in wiring the brain. Studies with young children using modern neuroimaging, pictures of the brain, have provided the basis for identifying the periods of exuberant neural connectivity associated with the windows of opportunity (Chugani, 1998). These critical periods have more recently been referred to as "windows of opportunity;" nature opens certain windows for experience to have the greatest effect. These windows begin opening before birth and then narrow as a child grows older. In theory, there are a series of windows for developing motor control, vision, language, feelings, etc. If a child misses an opportunity, his or her brain may not develop its circuitry to its full potential for a specific function. Does this mean that a child will be impaired? Not likely, except in abnormally deprived conditions. What we are talking about is "optimizing" individual development. As just noted, the hypothetical window narrows, it does not close shut, as some earlier studies had inferred. Considerable restructuring and learning takes place over adulthood.

### Windows for Motor Development

For basic gross-motor skills, the general window of opportunity appears to be open from the prenatal period to around age five. Once again, this is a period in which experience is vital to laying the "foundation" of brain circuits dedicated to motor control. The primary motor circuits that connect to the cerebellum, which controls posture and coordination, forge during the first two years. It is during this period that the child begins to gain considerable experience in the world as he or she "moves" about in the environment. Once again it is suggested that physical activity is a strong determinant in the early development of the brain, not just motor control. It seems reasonable that the critical period for finer muscle control and timing, which typically follow gross-motor development, would be open from shortly after birth to about age nine. This information has strong implications for developing the primary circuits needed for learning skills that require a high degree of

manual dexterity, such as playing a musical instrument or performing precise manual operations. There is also speculation that the general window of opportunity for most behavioral functions narrows considerably around age 10 (Chugani, 1998).

### **What We Can Do**

As noted earlier, the general time frames for the windows of opportunity are still quite speculative. This is especially true in regard to the types and effects of specific movement activities. Nevertheless, few researchers would deny that early movement experiences are critical to optimal brain development. To be of maximum benefit, movement experiences should be introduced early in life and during the windows of opportunity. Certainly, this is not to say that such activities should not be stressed beyond the critical period. Motor skills enhance our lives at all ages and a positive attitude about habitual physical activity sets the foundation for a lifetime of good health.

Although it seems quite reasonable that a comprehensive developmentally appropriate movement program would be effective in enhancing early brain and motor skill development, the following recommendations are offered based on the research discussed.

1. Provide children with lots of sensory-motor experiences, especially of the visual-motor variety. This would include activities that integrate visual information with fine- and gross-motor movements. Such activities include striking, kicking, and catching.
2. Include a variety of basic gross-motor activities that involve postural control, coordination of movements, and locomotion – crawling, creeping, body rolling, and jumping. In addition to stimulating the general wiring patterns of these fundamental skills, moderate and vigorous intensity gross-motor activity provide the brain with its chief energy source, glucose. In essence, these activities increase blood flow, which feeds the brain and enhances neuronal connectivity during the critical period.
3. Combine movement activities and music. Although the jury is still out regarding the relationship between musical experience and specific academic achievement, the combination of music with movement presents an excellent learning medium for young children.
4. What follows are the recently released activity guidelines for children birth to five years and a brief description of appropriate movement activities for infants, toddlers, and preschoolers (NASPE, 2002).

### **Physical Activity Guidelines for Infants, Toddlers, and Preschoolers (NASPE, 2002)**

#### **Infants (Birth–12 months)**

##### **Guideline 1:**

Infants should interact with parents and/or caregivers in daily physical activities that are dedicated to promoting the exploration of their environment.

##### **Guideline 2:**

Infants should be placed in safe settings that facilitate physical activity and do not restrict movement for prolonged periods of time.

##### **Guideline 3:**

Infants' physical activity should promote the development of movement skills.

##### **Guideline 4:**

Infants should have an environment that meets or exceeds recommended safety standards for performing large muscle activities.

##### **Guideline 5:**

Individuals responsible for the well being of infants should be aware of the importance of physical activity and facilitate the child's movement skills.

**Movement Activity Ideas for Infants-** To promote movement in infants, provide colorful and moving mobiles over their cribs that they can reach and grasp or kick with their feet. In addition, play games that encourage infants to "come and get" toys within crawling or reaching distance. Infants should also be given opportunities to play with large blocks, stacking toys, nesting cups, textured balls, and squeeze toys (NASPE, 2002). Be sure that none of the items can be swallowed and have sharp points or edges.

#### **Toddlers (12-36 months)**

##### **Guideline 1:**

Toddlers should accumulate at least 30 minutes daily of structured physical activity.

##### **Guideline 2:**

Toddlers should engage in at least 60 minutes and up to several hours per day of daily, unstructured physical activity and should not be sedentary for more than 60 minutes at a time except when sleeping.

##### **Guideline 3:**

Toddlers should develop movement skills that are building blocks for more complex movement tasks.

##### **Guideline 4:**

Toddlers should have indoor and outdoor areas that meet or exceed recommended safety standards for performing large muscle activities.

##### **Guideline 5:**

Individuals responsible for the well-being of toddlers should be aware of the importance of physical activity and facilitate the child's movement skills.

**Movement Activity Ideas for Toddlers**—As toddlers begin to explore and master the movements of their own bodies, it is important to provide them with a variety of movement activities that introduce basic gross

motor skills such as striking, kicking, catching, and bouncing balls of different sizes and shapes. Toddlers should also be given a variety of manipulatives, such as building blocks, rings, and large puzzles. It is also important to give them opportunities to develop their fine-motor skills by encouraging them to scribble and draw with crayons and pencils.

### **Preschoolers (3-5 years)**

#### **Guideline 1:**

Preschoolers should accumulate at least 60 minutes daily of structured physical activity.

#### **Guideline 2:**

Preschoolers should engage in at least 60 minutes and up to several hours of daily, unstructured physical activity and should not be sedentary for more than 60 minutes at a time except when sleeping.

#### **Guideline 3:**

Preschoolers should develop competence in movement skills that are building blocks for more complex movement tasks.

#### **Guideline 4:**

Preschoolers should have indoor and outdoor areas that meet or exceed recommended safety standards for performing large muscle activities.

#### **Guideline 5:**

Individuals responsible for the well-being of preschoolers should be aware of the importance of physical activity and facilitate the child's movement skills.

**Movement Activity Ideas for Preschoolers**— Preschoolers should be given a wide variety of movement experiences that require coordinating body movements with visual information, such as ball rolling, throwing and catching balls, and striking or kicking. Preschoolers can also be introduced to activities that elevate the heart rate such as dancing, biking, jump rope, swimming, and brisk walking. Experiences with outdoor play equipment stimulate movement exploration and creative play. And providing preschoolers with opportunities to draw, play musical instruments, and complete puzzles can further develop fine-motor development.

### **Conclusion**

In addition to developing the motor system and laying the foundation for a positive attitude about physical activity, early childhood programs are finding that movement is a very effective learning medium for the young child. Through the use of movement experiences, educators can stimulate problem-solving abilities, critical thinking, and reinforce a variety of academic concepts. As interpreted from the work of Robert Sylwester (1995), author of *A Celebration of Neurons*, such experiences aid learning and retention by creating a multidimensional mental model of the experience. This is a concept that is certainly not new, but unfortunately appears to have had little impact in early childhood programming.

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### **Additional Resources**

A variety of excellent resources are available that can help a teacher develop a movement-based learning program. Here are just a few:

#### **Educational Activities, Inc.**

800-645-3739

www.edact.com

Features CDs and audiocassettes from Hap Palmer, Ella Jenkins, Greg & Steve, and many other children's recording artists.

**Kimbo Educational**

800-631-2187

[www.kimboed.com](http://www.kimboed.com)

Features movements CDs and audiocassettes such as *Dance Party Fun!*, *A World of Parachute Play*, *Good Morning Exercises for Kids*, and much more.

**Delmar Publishers**

800-477-3692

[www.earlychilded.delmar.com](http://www.earlychilded.delmar.com)

*Moving & Learning series* by Rae Pica

**Gryphon House**

800-638-0928

[www.ghbooks.com](http://www.ghbooks.com)

*Wiggle, Giggle and Shake* by Rae Pica

**Stenhouse Publishers**

888-363-0566

[www.stenhouse.com](http://www.stenhouse.com)

*Shake, Rattle, and Learn* by Janet Miller Grant



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