

Early Brain Development Research:  
Implications for Early Childhood Education

Jennifer Matthews

June 23, 2005

## Early Brain Development Research: Implications for Early Childhood Education

### Abstract

With the latest in technology, early brain development has become an important issue in early childhood education. This research supports changing policies in the field of early childhood education. The purpose of this paper is to provide parents, caregivers, and early childhood educators with valuable information and resources on early brain development and how to support young children's development in the areas of social/emotional, cognitive, physical, and language development. In the literature review, the following questions were addressed:

1. What have we learned from the scientific research on early brain development?
2. How do we use these findings from early brain development research to enhance early childhood programs?
3. What are the cautions in using early brain development research?
4. As early childhood educators and advocates how do we continue to use this valuable research?

Over the past decade, due to advanced technology and research, there has been great emphasis placed on early brain development. As an early childhood educator and a parent, the topic of early brain development is very important in the way we as a society raise and provide care for our young children, especially infants and toddlers. The purpose of this literature review is to answer the following questions:

1. What have we learned from the scientific research on early brain development?
2. How do we use these findings from early brain development research to enhance early childhood programs?
3. What are the cautions in using early brain development research?
4. As early childhood educators and advocates how do we continue to use this valuable research?

Through technology we are able to obtain images of the brain in young children and from these pictures we are able to define the brain which is "part of the central nervous system, and plays a decisive role in controlling many bodily functions including

both voluntary activities (such as walking or speaking) and involuntary ones (such as breathing or blinking)". The brain has two hemispheres (right and left) and each hemisphere has four lobes:

1. Occipital – located in the back of the brain and is primarily responsible for vision.
2. Frontal- is responsible for movement, complex judgment, emotional regulation, problem solving, decision, planning, and creativity.
3. Parietal- located in the upper left and right sides of the brain, is responsible for higher sensory-motor coordination and language functions.
4. Temporal- located above and behind the ears on the right and left side of the brain, is responsible for memory, hearing, language, and emotions.

"Each of these lobes has numerous folds. These folds do not all mature at the same time. The chemicals that foster brain development are released in waves as a result different areas of the brain evolve in a predictable sequence. The timing of these developmental changes explains, in part, why there are "prime times" (windows of opportunity and critical periods) for certain kinds of learning and development". (Shore, 1997)

Table 1. Understanding Early Brain Development Research and Strategies to Support Early Brain Development

Title	Developer	Comments
Brain Research, Infant Learning, and Child Care Curriculum	Lally (1998)	<p>Based on the last ten years of brain development research, the research findings are valuable in applying to how infants learn and why early experiences are critical to a young child’s development.</p> <p>When looking at new curricula or educational materials it is important to view products from both a brain research and child development research point of view that indicate how infants learn best.</p> <p>10 factors of infant development to be aware of:</p> <ul style="list-style-type: none"> <li>• Relationships are primary to development.</li> <li>• Infants learn holistically.</li> <li>• Infants are active, self-motivated learners.</li> <li>• Language skills and habits develop early.</li> <li>• Environments are powerful.</li> <li>• Infants are individuals with differing temperaments.</li> <li>• Infancy has three stages.</li> <li>• Infants are developing their first sense of self through contact with others.</li> <li>• The learning context is as important as the learning content.</li> <li>• Adults exhibit strong emotions when charged with the care of infants.</li> </ul>
Using Early Childhood Brain Development Research	O’Donnell (1999)	<p>Variety of ways to use the findings from early brain development research to promote and support early childhood education by:</p> <ul style="list-style-type: none"> <li>• Improving the quality of early childhood programs through trainings and educational activist on early brain development.</li> <li>• Support parents and families by sharing information about early brain development and child development.</li> <li>• Increase public and private support for early childhood programs by increasing awareness about early brain development.</li> </ul> <p>Cautions in interpreting the research</p> <ul style="list-style-type: none"> <li>• Should not be used to market toys and materials to develop smarter babies.</li> <li>• It is never too late for a child to learn.</li> <li>• Should not be used to increase parental anxiety.</li> <li>• The research does not mean funding spent on older children should be diverted to early childhood programs.</li> </ul>

Title	Developer	Comments
Turning Knowledge Into Practice	Schiller (1999)	<p>There is now scientific support for what early childhood educators know to be best practices for teaching young children.</p> <p>Based on early brain development research the author has taken many of the research findings and offers suggestions of ways to translate those findings into classroom application.</p>
Brain Research and Its Implications for Early Childhood Program-Applying Research to Our Work	Schiller (2001)	<p>Early brain development research:</p> <p>Finding 1: brain development is contingent on complex inter-play between genes and environment.</p> <ul style="list-style-type: none"> <li>• environmental implications for early childhood</li> </ul> <p>Finding 2: Early experiences contribute to brain structure and capacities.</p> <ul style="list-style-type: none"> <li>• curriculum implications for early childhood</li> </ul> <p>Finding 3: Early interactions affect brain wiring.</p> <ul style="list-style-type: none"> <li>• staffing implications for early childhood education</li> </ul> <p>Finding 4: Brain development is non-linear (windows of opportunity).</p> <ul style="list-style-type: none"> <li>• training implications for early childhood.</li> </ul> <p>Finding 5: A child’s brain is two and half times as active as an adult’s.</p> <ul style="list-style-type: none"> <li>• communication implications for early childhood professionals.</li> </ul>
Important Concepts that Help Every Parent Help Their Child	Stamm (2001)	<p>Developed curriculum to help parents and caregivers remember simple concepts about early development:</p> <p>ABC’s of early learning</p> <ul style="list-style-type: none"> <li>A- Attention</li> <li>B- Bonding</li> <li>C- Communication</li> </ul> <p>This curriculum focuses on critical information about various topics influencing brain development. The information is summarized using “S.T.E.P.S” approach:</p> <ul style="list-style-type: none"> <li>S- Security</li> <li>T – Touch</li> <li>E – Eyes</li> <li>P – Play</li> <li>S- Sound</li> </ul> <p>ABC’s of learning and the S.T.E.P.S. approach to early brain development are intertwined that promote healthy development and school readiness.</p> <p>Author lists top 10 facts about early brain development.</p>

Title	Developer	Comments
Primed for Learning The Young Child's Mind	Stephens (1999)	<p>Describes the brain at birth</p> <p>Describes the brain after birth</p> <p>Provides insight to how to nurture brain development while promoting learning by understanding:</p> <ul style="list-style-type: none"> <li>• strong, secure attachments (1<sup>st</sup> year critical for forming attachment)</li> <li>• brain is resilient</li> <li>• “windows of opportunity” that occur in brain development (important to know to make for successful learning)</li> <li>• young children learn through imitation</li> <li>• young children need activity based, hands-on, sensory experiences to make connections in the brain</li> <li>• neural pathways become permanent and are strengthen through repetition</li> <li>• the brain is programmed to learn a language</li> <li>• the brain is an organ seeking patterns</li> <li>• each child's brain and learning experience is unique</li> </ul>
What Do We Know from Brain Research?	Wolfe & Brandt (1998)	<p>Early brain development research has the potential to increase our understanding of teaching and learning.</p> <p>Early childhood educators are responsible for carefully interpreting what early brain development research findings mean for classroom practices.</p> <p>Four important findings in brain research:</p> <ol style="list-style-type: none"> <li>1. Experiences physiologically change the brain by creating more connections.</li> <li>2. Intelligence is not fixed at birth. Early experiences impacts learning and brain development.</li> <li>3. There are critical, sensitive periods or windows of opportunity in regards to brain development.</li> <li>4. Emotions effect learning.</li> </ol> <p>Based on the findings an enriching environment influences brain development and learning. The author list what to look for in an enrich environment.</p>

## **What have we learned from the scientific research on early brain development?**

Stephens (1999) explains that infants are born with 100 billion neurons (brain cells). The neurons are connected to each other by an axon. An axon has fibers which are referred to as dendrites. The dendrites receive and transfer information from one neuron to the next. A synapse occurs when a connection is made between the two brain cells. The term “wiring the brain” is referring to the many connections being made.

Another important term is neural pathway, which is a series of synapses that forms a network in the brain. Particular experiences can activate these pathways. Stamm (2001) states that there are 10 important facts about early brain development that everyone should know:

1. At birth the brain is the least developed organ.
2. By age one the brain is 75% wired.
3. IQ is not fixed at birth. Vital wiring of the brain occurs after birth.
4. An infant's brain doubles in size by the age of three.
5. A child is always capable of learning since the brain is “plastic”. Connections can be made later in life, but requires far more effort.
6. There are windows of opportunity for brain development in the areas of vision, hearing, social attachment, language, motor skills, math/logic, music, and foreign languages.
7. Stressful experiences such as neglect or abuse can have a serious impact on brain development.

8. It is the primary caregiver's duty to provide the child with stimulating and appropriate experiences that increase brain connections.
9. The most important factor for ensuring a healthy, normal brain is a strong attachment between 1 to 3 consistent caregivers.
10. Quality parenting/care giving is important for brain development.

Stamm (2001) clearly explains early brain development research to parents and caregivers in a systematic approach. This approach first focuses on the ABC's of early learning (Attention, Bonding, and Communication). Parents/caregivers are encouraged to remember these three key concepts in their interaction with their child to enhance brain development. In addition, Stamm (2001) takes all the important concepts of early brain development and breaks them down into S.T.E.P.S. Each letter refers to critical information about early brain development (S- security, T- touch, E- eyes, P- play, S- sound). It is important for the parent/caregiver to remember that each portion of S.T.E.P.S. is intertwined.

Many of the ideas mentioned above were voiced in another influential article, Wolfe and Brandt (1998), which states four important findings in brain research:

1. Experiences physiologically change the brain by creating more connections.
2. Intelligence is not fixed at birth. Early experiences impacts learning and brain development.
3. There are critical, sensitive periods or windows of opportunity in regards to brain development.
4. Emotions effect learning.

## **How do we use these findings from early brain development research to enhance early childhood programs?**

Schiller (1999) has taken many of these findings from early brain development research and translated those findings into classroom application. Schiller (1999) states based on the finding that the brain needs water to be alert and is therefore important that young children are allowed to have water when they ask for it. In addition, water can be served with snack. It is found that aromas affect alertness and attention. Based on this information teachers can provide cooking activities that release aromas that increase alertness such as peppermint, basil, lemon, rosemary, and cinnamon. Teachers can also offer the children scented play dough and markers to use. It is found that cross lateral movements keep both sides of the brain connected. Teachers can have the children do exercises that require cross lateral movement such as sing songs that use hand motions that cross the midline and provide the young children with streamers and scarves to dance with in creative movement. It is found that emotions influence learning and affects both memory and motivation. Teachers need to be expressive and show their emotions, add surprises to instruction, and laugh. In one of last findings, novelty increases attention. Teachers can rearrange the classroom environment, rotate shelf toys, books, and equipment, and try new things.

Schiller, discusses how there is no longer a debate between nature and nurture and which of these two has the most significant impact on a child's development, (Schiller, 2001). From the findings of early brain development research it shows how

nature (genetics) installs the complex system of brain circuitry. How this circuitry is wired depends upon the young child's environment and experiences (nurture). This information is very powerful when designing early childhood programs. The environmental implications for an early childhood program based on early brain development research suggests that rest and nutrition impact brain functions, therefore, children need to be provided with nutritious meals and teach children the value of eating healthy. Children should be provided with daily naps. In the classroom environment there should be toys and equipment that are multi-sensory. In the environment there should be adequate space for motor development. Early experiences contribute to forming connections in the brain. In early childhood programs the selection of curriculum is important in enhancing the wiring of the brain. When implementing curriculum it is important to keep in mind:

- Activities and experiences are multi-sensory.
- Repetition of activities is important. Brain connections add strength through repetition.
- Include music and movement.
- Use assessments to guide.

Overall, the richer the environment the more connections are made in the brain, which supports healthy brain development.

**What are the cautions in using early brain development research?**

According to O'Donnell (1999) it is important that this information on early brain development is not misused or to overstate the research. Information on early brain development should not be used to market toys and materials that encourage baby geniuses. It is important to keep in mind when looking at the research that it does not indicate that children cannot make brain connections after turning three years old. It is never too late for children to learn due to the plasticity of the brain. However, as the child gets older it is harder to make the connections. When presenting early brain development research to parents, it is important to not present it in away that increases parental anxiety. Parenting is a process for which we make mistakes and learn from them. This research does not support funding being taken away from programs that focus on older children and diverting it to early childhood programs.

According to Lally (1998) there will be great concern placed on not missing the window of opportunity in brain development, therefore parents are going to be bombarded by all kinds of educational products that claim to enhance early brain development. In addition, early childhood teachers will be expected to implement new curriculum or educational materials emphasizing teacher-directed lessons and activities claiming to foster brain development. Therefore, it is important that early childhood educators make sure curriculum for infants and toddlers is in fact developmentally appropriate based on brain research and child development research.

## **As early childhood educators and advocates how do we continue to use this valuable research?**

O'Donnell (1999) suggests using early brain development research as a communication tool. The research provides a new way to explain what happens in early childhood and it supports what early childhood educators believed all along. Now with this information on early brain development it scientifically supports why high quality child care and early education is so important. The information can be used to improve the quality of early childhood programs, support parents and families by sharing the information on early brain development, and increase public and private support for early childhood programs.

### **Discussion**

The outcome of this review answers the following questions in detail:

1. What have we learned from the scientific research on early brain development?
2. How do we use these findings from early brain development research to enhance early childhood programs?
3. What are the cautions in using early brain development research?
4. As early childhood educators and advocates how do we continue to use this valuable research?

In addition, this review provides scientific findings from early brain development research that support and promote best practices in the field of early childhood education. Overall, the field of early childhood education benefits from the information gained from early brain development research.

## **Implications**

There is a lot to be gained from the early brain development research. We have learned from this scientific research that the first three years of life are very important for “wiring” the brain. At birth, the brain is the least developed organ and by age one the brain is 75% wired. A child is always capable of learning since the brain is “plastic”. Connections can be made later in life, but requires far more effort. We can use these findings from the early brain development research to enhance early childhood programs by providing training through organizations such as NDI to caregivers and early childhood educators on early brain development. In addition, early childhood programs can use the early brain development research to select curriculum and design classrooms environments that enhance the wiring of the brain. Parents, caregivers and early childhood educators need to be cautious when it comes to the research on early brain development. Here are three things to remember when using early brain development research:

- It is also important to keep in mind that it is never too late for children to learn due to the plasticity of the brain.
- Select curriculum for infants and toddlers that is developmentally appropriate based on brain research and child development research.

- Try not be overly bombarded by all kinds of educational products that claim to enhance early brain development. The key is for the child to at least have one person in their life that is special.

As early childhood educators and advocates, we can continue to use this valuable research by improving the quality of child care for infants and young children, by sharing information with parents and families so they can support their child's cognitive, social/emotional, physical, and language development, and by increasing public and private support for early childhood programs.

This research is powerful in regards to supporting early childhood education and early childhood policies. In addition, this research supports the fight to improve child care in our nation. It is crucial to the well being of our children that this information on early brain development be shared with others.

## References

- Lally, J. (1998). Brain Research, Infant Learning, and Child Care Curriculum. Child Care Information Exchange, 121, 46-48.
- New Directions Institute for Infant Brain Development. (2005). About Us and Programs. Retrieved on May 1, 2005 from <http://www.newdirectionsinstitute.org/about.html>
- O'Donnell, N., Phipps, P., Schiller, P., & Stephens, K. (1999). Applying Brain Research. Child Care Information Exchange, 126, 43-62.
- Schiller, P. (1999). Turing Knowledge Into Practice. Child Care Information Exchange, 126, 49-52.
- Schiller, P. (2001). Brain Research and Its Implications for Early Childhood Program-Applying Research to Our Work. Child Care Information Exchange, 140, 14-18
- Shore, R. (1997). Rethinking the Brain. New York: Families and Work Institute.
- Stamm, J. (2001). Important Concepts that Help Every Parent Help Their Child. New Directions Institute.
- Stamm, J (2002). Top 10 Facts about Early Brain Development! New Directions Institute.
- Stephens, K. (1999). Primed for Learning: The Young Child's Mind. Child Care Exchange, 126, 44-48.
- Wolfe, P., & Brandt R. (1998). What Do We Know From Brain Research? Educational Leadership, 56(3), 8-13.