Brain Development Research Can Influence Early Childhood Curriculum
By Judith Colbert

The scientific community is one of the most valuable sources of information about the learners in your care. Recently much has been written about the latest findings of researchers into brain development in young children. Why is this research important to you as an early childhood professional? How can the findings of these studies be implemented into your classroom? How will this recent brain research affect your role as a curriculum developer?

Brain Development Research_ Both the popular press (*Newsweek* [Special Ed.], 1997) and professional press (Carnegie, 1994; Newberger, 1997) have sparked public debate on the critical importance of the first months and years of a child's life. Scientists have conducted studies showing the dramatic influence of very early experience on the actual wiring of the human brain. Early stimulation, they have said, prepares the way for later growth and development. Lack of stimulation or negative stimulation can make such growth and development impossible or extremely difficult. Other researchers have studied how the brain influences specific functions. For example, some have used information processing theory to understand memory, while others have searched for ways to define intelligence as a system and to explain how intelligence differs from individual to individual.

Howard Gardner's Theory of Multiple Intelligences_ - Among the best known and discussed of these researchers is Howard Gardner (Gardner, 1993, 1991; Hine, 1996; Sternberg, 1990). In 1983, he identified at least seven intelligences:

- linguistic
- logical-mathematical
- spatial
- musical
- bodily-kinesthetic
- interpersonal intelligence
- intrapersonal intelligence

In Gardner's view, these "ways of knowing the world," although distinctive, combine within each individual to create a "profile of intelligences" that differs from person to person (1991). Since 1983, Gardner has continued to refine his theory and consider its application in the sphere of education. His work provides a direct link between research about intelligence, how the brain works, and early childhood practice.

Project Spectrum

In 1984, Gardner and some colleagues established Project Spectrum, a form of early childhood education spanning the period from pre-school through the early grades. Their principal goal was to determine whether preschoolers exhibit distinctive profiles of intelligence. Their studies concluded that "even students as young as four years old present quite distinctive sets and configurations of intelligences" (Gardner 1991, p. 205-210). This finding is supported by more recent research into early brain development. For example, physicist Gordon Shaw of the University of California, Irvine, commented on the positive effect of piano training on three- and four-year-olds and concluded that "music training produces long-term modifications in neural

circuitry" (cited in Begley, 1997, p. 31). In the course of their research, Gardner's group found themselves developing a general approach to early education. As early childhood professionals, you may find his approach familiar. Early childhood teachers are accustomed to project-based learning and learning centers that have the potential to help children explore a number of ways of knowing. Your curriculum plans regularly include a variety of activities involving small and large motor skills, language and cognitive, and social and emotional development. Similarly, a Spectrum classroom includes:

- Rich and engaging materials that draw upon combinations of intelligences. For example, a building area gives children opportunities to develop spatial, bodily, and personal intelligences.
- Learning centers which develop and strengthen a child's specific skills and intelligences.
- Specific games and activities combined with other curricular materials to create theme-related kits that draw on the range of intelligences (1991).

Gardner's Multiple Intelligences

Intelligence is a way of knowing the world. We all learn, remember, perform, and understand in different ways through a distinctive combination that Howard Gardner has termed our "intelligence profile." In his view, that profile is a blend of at least seven ways of knowing the world.

Language (linguistic intelligence) - Includes the skills involved in reading and writing, listening and talking. Logical-mathematical analysis (logical-mathematical intelligence)-Involves computing numbers, solving logical puzzles, and thinking scientifically. It combines with linguistic intelligence in the solution of mathematical word problems.

Spatial representation (spatial intelligence) - Includes the skills necessary for driving a car, piloting a plane, and figuring out how to get from one location to another. It is important in the visual arts and in playing games like chess where it is important to imagine what the board will look like after certain moves have been made.

Musical thinking (musical intelligence) - Involves singing, playing an instrument, conducting an orchestra, composing, and to some extent appreciating music.

Bodily movement (bodily-kinesthetic intelligence) - Involves the ability to use the whole body or portions of it in the solution to problems or in the construction of objects. It is used by dancers, athletes, actors, surgeons and others who use physical movement to achieve their goals.

Understanding other individuals (interpersonal intelligence) - Includes both understanding others and acting upon that understanding. It involves noting distinctions among others, becoming aware of what they are thinking or feeling, and realizing what their needs might be. It can be expressed both verbally and nonverbally through gesture and facial expression. It is especially helpful for those engaged in politics, sales, psychotherapy, and teaching.

Understanding ourselves (intrapersonal intelligence) - Involves the ability to know how we feel; to be aware of the range of our emotions; and to have insights into why we act as we do and behave in ways that are appropriate to our needs, goals, and abilities.

Brain Development Research and Your Classroom_ You will find that other, more recent

scientific studies into the importance of early stimulation largely confirm what you regularly observe in child care settings. Such studies are valuable because they help you fully understand the processes behind what you see as you interact with young children. On a practical level, they help you develop strategies that will make your work more effective.

Planning for Developmental Stages_ - When you develop curriculum within your own program, research findings remind you of the importance of thinking about the daily activities you are planning, especially the activities for the youngest infants in your care. These findings validate the concept of "developmental appropriateness" for all ages by reinforcing the need to respect the developing brain and what it can accommodate at particular stages.__

Planning for Groups_ - When you make curriculum plans for groups of children, research results also remind you that each child within the group is a distinctive individual. You can build on what Gardner and others have written about multiple intelligences and the many ways that each of us comprehends the world around us by considering the variety of individuals in your group and ensuring that each kind of intelligence is represented in the plans that you make. Such ideas are not new to the early childhood community. In its most recent position statement on developmentally appropriate practice, the National Association for the Education of Young Children (NAEYC) states "that children demonstrate different modes of knowing and learning and different ways of representing what they know" (Bredekamp & Copple, 1997). NAEYC cites Gardner's work in its discussion of this position and echoes his theories in its teacher guidelines. For example, in fulfilling their role as educators, teachers are advised to "make plans to enable children to attain key curriculum goals across various disciplines such as language arts, mathematics, social studies, art, music, physical education, and health" (Bredekamp & Copple, 1997).

Assisting Individual Children - _ Research also shows how curriculum planning and ongoing observation can be used to assist individual children. Each child's "intelligence profile" is different. In some cases, you will be called upon to develop curriculum and teacher behavior to support a particular child's dominant intelligence. In others, it will be necessary to strengthen an area of weakness.__

Identifying and Supporting Individual Strengths_ - Teachers are in a position of providing activities that support particular strengths and increase a child's likelihood of success. Such support is especially important when a child's dominant intelligence is not typical of the group or valued in the culture. Most would agree with Gardner that North American culture, and educational practice in particular, places the highest value on linguistic intelligence and to a lesser extent on logical-mathematical intelligence (1991). Individuals with strengths in areas other than linguistics often find it difficult to succeed.

Gardner himself shows how early childhood curriculum planners and teachers can use their knowledge of multiple intelligences to support children in the classroom in a paper he co-authored with Jessica Davis of Harvard's Project Zero (1993). "The Arts and Early Childhood Education: A Cognitive Developmental Portrait of the Young Child as Artist" presents two approaches to a child's drawing of her family.

The first approach is likely the more typical. The teacher compliments the child named Lucy on

a lovely drawing, then asks her to "tell me about it." As Lucy talks, the teacher prints on the top of each figure, "My mother. My father. Me. My brother." In the space above, the teacher writes "Lucy's Family" and whispers in her ear, "Nice work." The teacher is supportive, positive, and responsive to the child's effort. Yet, as the authors point out, the teacher's response focuses on language and implies that "the drawing 'says' nothing on its own." The teacher's response suggests, however indirectly, that words convey meaning more effectively than the drawing itself. It says that linguistic intelligence is superior to artistic (spatial) intelligence, and that the symbolic domain of language is more effective than the symbolic domain of art.

However, each domain is distinctive and fully capable of expressing meaning. Davis and Gardner (1993) point out that the teacher would have left a very different impression by commenting on "the action in this line"; by telling the child, "This is a nicely balanced drawing"; or by saying, "This drawing is very strong." By focusing on the aesthetic elements of the drawing, the teacher would have introduced Lucy to a vocabulary that could strengthen her spatial intelligence and provide a foundation for its further development.

Identifying and Strengthening Skills_ - As an early childhood professional, you are also in a position to observe a child and to encourage activities which will broaden his or her skills. As you watch curriculum unfold within your classroom, it is important to observe how each child responds to the task at hand. Is there a variation that would be more appropriate for that child? Are there other ways in which all of the children could approach a particular task/activity? Are you ensuring that they are tapping the potential of as many of their intelligences as possible?

Once again, research into how the brain works can help you develop ways of assisting the children in your care. Many researchers use information processing theory to model human thinking after the workings of a computer. For example, Kelvin Seifert's summary of research into cognitive development reveals differences in the ways that young children process information in relation to older children and in relation to each other (Seifert, 1993). These differences, he believes, have implications for developmentally appropriate practice. Teachers are advised to observe how children prefer to organize new knowledge and, as a result of their observations, think of new ways to introduce unfamiliar topics to them. Instead of organizing animals according to biological classes, for example, teachers might present them by "petability." (Presumably, a kitten is more "petable" than a frog.) When considered in relation to Gardner's classifications, such advice means appealing to the children's bodily intelligence more strongly than their logical intelligence.

While Seifert's summary of research shows the importance of broadening children's knowledge bases, he stresses that such an extension can take place only with adult help. Teachers must assume a directive and supportive role to enable the children in their care to reach their fullest potential. Therefore, the child who always chooses crafts could be encouraged to try another activity and be supported until that activity is mastered. Similarly, the child who always paints and never reads could be encouraged to make paintings about books; a child who always reads and never paints can read a book about painting (Seifert, 1993).

Although this research focuses on the cognitive development of children, it also addresses issues raised by Gardner. In these examples, teachers are being encouraged to appeal to another "intelligence" in their efforts to broaden the experience of the children in their care.

When Einstein thought through a problem, he always found it necessary to formulate his subject in as many different ways as possible and to present it so that it would be comprehensible to people accustomed to different modes of thought and with different educational preparations. He liked to formulate his ideas for mathematicians, for experimental physicists, for philosophers, and even for people without much scientific thinking, if they were at all inclined to think independently.

Frank, P. (1953). Einstein: His life and times. In Howard Gardner, *The unschooled mind: How children think and how schools should teach*. New York: Basic Books.

Logical-Mathematical Intelligence_ - Other researchers have focused on ways in which early childhood teachers can strengthen particular intelligences. For example, Arthur J. Baroody (1993) urges teachers of young children, including preschool teachers, to ensure that their curricula include informal introductions to mathematics. He further recommends that they identify and try to remedy any weaknesses they observe in the informal knowledge of the children in their care. Baroody's research suggests that although lower-class children had many counting and number skills, they did significantly poorer than middle-class children in solving simple addition and subtraction word problems. Baroody recommends that teachers plan curricula around the development of mathematical intelligence by including counting experiences at every possible opportunity. Teachers can plan curriculum units on cooking, shopping, and other activities in which numbers have a role on a daily basis. Without actually stating that their goal is to strengthen the children's logical-mathematical intelligence, they are doing just that. The same is likely true of most of the other intelligences.

Can Experience Make a Difference? Can Intelligence Be Altered?_ - Stanley Greenspan, a pediatric psychiatrist at George Washington University, believes, "Nature affects nurture affects nature and back and forth. Each step influences the next" (cited in Peyser & Underwood, 1997). In other words, experience can alter the structure of the brain. More specifically, the brain can be "rewired" to alter intelligence and ultimately, behavior. As Newsweek reported on February 19, 1996, "Early-childhood experiences exert a dramatic and precise impact, physically determining how the intricate neural circuits of the brain are wired" (cited in Begley, 1997). In a paper entitled "The Emotional Basis of Learning," Serena Wider and Greenspan (1993) describe how sensory changes influence learning through an educational model based on the process of learning through relationships and emotional understanding. They consider individual differences in three areas: self-regulation, sensory reactivity, and behavioral organization. They identify six stages of development, beginning at birth and extending through age four. During this period the central nervous system is maturing as the child interacts with different experiences. Their goal is to assist teachers who wish to encourage emotional learning and, in effect, strengthen what Gardner has called the interpersonal and intrapersonal intelligences. Ultimately, like Gardner, they point to the importance of integrating all ways of knowing and developing each as fully as possible.

For example, teachers who plan curriculum in early childhood settings often encounter children who have either short, fleeting attention spans or long, focused attention spans.

Wider and Greenspan suggest that when a child has difficulty paying attention, the solution may not be to provide increasingly structured activities. Rather, it may be more helpful to give the

child an opportunity to learn how to learn by providing "shared attention." They believe that when an adult shows an interest in what a child is doing, regardless of the type of activity, the child becomes aware of that interest; the adult's interest gives the activity meaning for the child. Therefore, the child understands that the activity is important, and gains experience in choosing an activity and regulating how long that activity will last. In other words, the child learns how to learn. In the process, the child can "feel" the adult's tone and gestures and experience the adult's empathy. The child is calmed and acquires emotional understanding and control. Wider and Greenspan also suggest that teachers encourage symbolic play and representational thinking. They recommend addressing "negative" themes such as jealousy and fear and supporting the children as they come to understand what these themes mean. To promote what they term a more "process-oriented" approach to learning, they suggest that teachers:

- Ensure that children have access to a rich environment that encourages exploration and choices. Children need to learn to choose and to focus and move on to make another choice.
- Provide children with enough time to get fully involved in an activity and benefit from it. Children who wander before making a choice may have little time to experience their selection.
- Consider play an opportunity to integrate all learning processes and skills.
- Realize play is complex and requires the integration of all of the child's abilities on a "common pathway."
- Make learning interactive and fun. This combination provides a motivation and a basis for further learning.
- Identify and make goals for the specific learning tasks of each stage of emotional development. Such tasks address the processes children need to learn on their own.

These suggestions may help you as you carry out your daily tasks in the classroom or as a curriculum developer. Many, if not most, will be familiar to you. What may not be familiar, however, is the underlying scientific basis that brings a whole new world of research activity to bear upon child development.

Conclusion_ - Although the research cited has been carried out by different individuals at different times, certain elements appear to be consistent. For example, what happens in the earliest months and years is of greatest importance and has long-term consequences for later life. There are a number of ways of knowing, and Gardner's theory of multiple intelligences seems to provide a framework for discussing the findings of other researchers. All children, including very young children, should be exposed to the broadest possible range of positive experiences and encouraged to learn in all ways. There are direct links between brain development research findings and early childhood curriculum decisions and practice.

Judith A. Colbert, Ph.D., is a childcare consultant and training specialist. She has a particular interest in regulatory, administrative, and curriculum issues. She is the author of the training program, Better Care for Children: Regulations and Standards.

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