

Begins Early

Infant Brain Development

Scientists discovered more about the workings of the human brain—especially before and immediately after birth—in the past ten years than in all of human history. Many discoveries about the physical structure and function of the brain confirm long-held beliefs about supporting children's growth:

- Babies are not helpless, but enter the world ready to learn
- Babies, in fact, teach adult caregivers how to meet their needs via non-verbals (eye contact, facial gestures, crying, etc.)
- Brain and body grow from an inner pattern and sequence, which can be enhanced or impeded
- Development involves a series of "learning windows" or prime times for growth in physical, mental, language, and other abilities.

New brain research helps us appreciate the biology behind these observations: In the first months of life, the axons, tissues which connect neurons or brain cells, grow a protective sheath. This myelin cover enables brain circuits to run faster, more effectively

As brain cells mature and connect, complex functions such as clear eyesight, coordination, eventually language become possible. The brain seems to be guided by an internal plan, with each brain area maturing according to a pre-set order. Caregiver warmth and stimulation keep this plan on track and adapt to individual differences. Neglect or abuse can result in brain atrophy or damage not unlike the effects of dangerous drugs.

Among the most effective strategies for supporting healthy brain development

- 1 Nutrition: breast-feeding or proper formula feeding for a balanced diet;
- 2 Parent/Caregiver warmth and communication via talk time, reading, and play.
- 3 Early identification of special needs to treat medical, developmental problems
- 4 Support for positive environments such as safe neighborhoods, adequate basic resources, and quality childcare.

Sources: Learning Windows
www.superkids.com/aweb/pages/features/early1/early1.shtml

This newsletter summarizes the volume of emerging knowledge on the development of the brain from the earliest stages of development.

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For additional resources, visit

Dreamcatcher

*Family
Life
website*

www.uwyo.edu/ag/ces/dream.htm

Research Update: Brain Development

Using Brain Development Research

New research confirms established beliefs:

- Read/respond to a child's cues and clues
- Language rich, healthy and safe environments
- Play and many other elements of good quality early childhood ed.&care

To increase public and parent support for early childhood programs:

- Include facts in brochures & promotional
- Educate funders, media, and policy makers
- Publishing short fact sheets for policy and decision makers

Referring early childhood brain dev. in letters to the editor and media appearances

Research should not be overused or overstated:

- *Market materials to build bigger and better brains.* Children learn through emotional connections to other adults
- *Indicate that it's all over after the early years.*
- *Increase parental anxiety.* Parenting is a process of problem solving
- *Mean that funding spent on older children should be diverted to early childhood programs.*

O'Donnell, Nina Sazer. 1999. Using Early Childhood Brain Development Research. *Child Care Information Exchange.* (i) 126m 58-62.

Research & Policy

Positive stimulation from time of birth really does make a difference in children's development.

1. Interaction of nature & nurture is fundamental.

- Environmental factors influence the intricate circuitry wiring of the human brain

- Human development depends critically environmental and genetic combinations

2. How baby's develop and regulate emotions is effected by early care.

- Warm care is vital for healthy development

- Early experiences shapes a child's capacity to control emotional state

- A strong, secure attachment to a nurturing adult can help child with stresses of daily life

3. Timing is crucial.

- Timid, intensive intervention can alter the brain or worsen problems

- The brain's ability to change is remarkable in the first decade of life

4. Negative experiences are more likely to have serious, sustained effects.

- Exposure to nicotine, alcohol, and drugs may have more harmful effects than previously suspected

- For children growing up in poverty, economic deprivation affects their nutrition, medical care, environment, family stress and day-to-day care

5. Evidence has pointed to the wisdom and efficacy of prevention and early intervention.

- Healthy cognitive, emotional, and social development programs can improve prospects

What to do:

1. Policies should be implemented to help relationships with parents and medical care.

- Practices and policies should follow principles of medical practice

- Improve the quality of early care and education

2. Prevention is best, but intervene quickly when child needs help.

- Warm care cushions children from occasional bumps inevitable in life

- Many children can overcome developmental problems when given intensive help

- Interventions must be timely, services and support must follow to have the greatest impact

3. Promote healthy development in every age, demographic, and risk category.

- Missed opportunities may make remediation more difficult

Source: Early years are learning years. Brain Development Research - What it means. 1997.

National Association for the Education of Young Children.
www.naeyc.org/naeyc

Stats and Facts: Brain Development

Prenatal & Infant Brain Development

- Brain dev. starts soon after conception
- A child has 100 billion brain cells and 50 trillion connections at birth
- Brain connections increase 20 times to more than 1,000 in first month of life
- Early sensory experiences create new connections that repetition strengthens
- As growth continues, a single neuron can connect with up to 15,000 cells
- A 3-yr-old has twice as many neural connections as an adult
- Depending on environment child grows up in, the number of connections could easily go up or down by 25%
- Connections that are not used wither away in a process called pruning
- At 10-yr-olds brain begins to prune extra connections dramatically and organizes tangled circuitry of brain
- New connections continue through life, but skills are as quickly mastered

Source: Brain Development. Facts about Brain Development and How Children Learn. www.lili.org/isl/rlbrain.htm

Infant Risks

There are 12 million children under age 3, many facing risks in development:

- 7% low birth weight (< 5.5 lb.) births face increased disability or death risk
- 12% births to smokers are low birth wt.
- One-fifth of all expectant mothers receive no first trimester prenatal care
- 4% of all expectant mothers receive no care or only late-term prenatal care
- 25% of all 2-yr-olds do not receive a full series of recommended immunizations
- 2.2 million children under 3 have no health insurance (employer or Medicaid)
- The number of child abuse and neglect increased 1.4 million from 1986 to 1993
- Between 1986 and 1993, the number of children seriously injured quadrupled
- 21,000 newborns are abandoned in hospitals each year
- Of 1 mil. teen pregnancies each year: 80% unintended; 50% end in abortion

Source: NGA Center for Best Practices. The Quiet Crisis. www.nga.org/Children/FirstThreeYears/QuietCrisis.asp

Child Care in the First Three Years

- In 1993, 4.4 million children were served by child care centers or family child care, with another 4 million cared for at home by relatives or non relatives
- Percentages: 30% in child care centers, 26% family child care, 7% non-relative in child's home, 37% by relatives

Infant care settings are often inadequate:

- 40% of rooms serving infants provided poor quality care, compromising health, safety, and development
- Only 8% received a rating of good quality care for infants and toddlers
- Over 1/3 of the programs were rated as inadequate, with quality low enough to hinder or harm development
- Only 9% of homes were rated as good quality or growth-enhancing

Poor quality rooms increase:

- Vulnerability to illness, esp. due to poor sanitary conditions in diapering, feeding
- Injuries due to safety problems
- Infant responsiveness, attachment, and calm due to weak connections to adults
- Learning deficits due to lack of materials such as books and toys

Poor quality care often results in:

- Increased unoccupied time, with infants tuned out, not interacting with others
- Cognitive and language delays in pre-reading and other age-appropriate skills
- Insecure attachment caregivers
- Increased aggression towards other children and adults

Since individual attention and stimulation is critical for safety and stimulation, professionals recommend a ratio of 1 adult to 4 infants (1:5 is WY state law), 1:5 with toddlers, and 1:6 over two-year-olds
In 1996:

- 20 states allowed child care centers 1:4 ratio for nine-month-old children
- 25 states allowed 1:5 for 18 month olds
- 32 states allowed 1:6 over age 27 mo.

Source: Key Facts About Child Care and Early Education. *NGA Center for Best Practices*. www.nga.org/Children/FirstThreeYears/EarlyEd.asp

Facts, continued

Ages & stages in infant brain growth

Birth to two months. Newborns seek nourishment, stimulation and comfort via senses, thus benefit from:

- Watching parents' faces and voices
- Recognizing familiar smells, such as mother's milk
- Imitating smiles, frowns, facial gestures
- Playing physically and verbally with both mothers and fathers
- Regular physical and emotional cycles

Two to seven months. Increased eye contact, cooing, smiling and nurture build parent-child attachment and learning:

- How to soothe and control themselves
- How to experience and express emotion

Seven to fifteen months. Toddler hood brings autonomy and 2-way communication:

- Sharing thoughts and feelings
- Questions, responses
- How to read the emotions of others
- How to remember
- Growing beyond separation anxiety

Fifteen to thirty-six months. Communication and exploration of feelings, ideas, surroundings shape personality:

- Knowing self as separate from parent
- Expanding memory capacity
- Expressing feelings via fantasy play
- Noticing patterns of events and rules

Source: Ages and Stages. *I Am Your Child*.
<http://iamyourchild.org/agestage/birth.html>

Stress Effects

Stress or trauma in early life can slow brain growth (20-30%) by elevating cortisol levels in the brain. Responses include:

Hyperarousal. Anxiety, hyperactivity, impulsivity, and sleep difficulties; most commonly seen in boys

Dissociation. Daydreaming, fantasy, "going to another place"; more commonly seen in girls

Early, intense, and ongoing intervention can limit damage and promote normal growth and emotional balance.

Source: The Facts About a Baby's Brain. WCCF. www.wccf.org/brainpaper.htm

What Parents Know

Most new parents accept their influential roles, but lack confidence, with only 8% seeing selves as outstanding. Barriers:

- *Time* - 50% of parents spend less time than desired with a young child
- *Information* - 20% of parents feel a need to know more about a child's feelings, needs, handling difficulties

Key concepts parents understand:

- 97% know that babies are learning from the moment they are born
- 94% grasp the link between parent warmth and child intelligence
- 92% know that experiences before age 3 influence school performance
- 87% correctly believe babies can communicate before they can speak

Concepts not well understood:

- Only 9% know that "stimulation" isn't always good for children
- 50% don't realize the impact of caregiver stress on child coping
- 65% realize that babies under 6 mo. can get depressed

Parents interest in information:

- Over 80% wanted to know more about how children learn
- 36% regularly look for information in magazines, esp. during infancy

When parents have questions or need advice on kids and parenting, informal resources are much more commonly used.

- Over 40% ask mother/mother-in-law
- 34% asks another relative
- 19% turns to friend or neighbor
- Only 15% uses their pediatrician
- 2% relies on child care provider

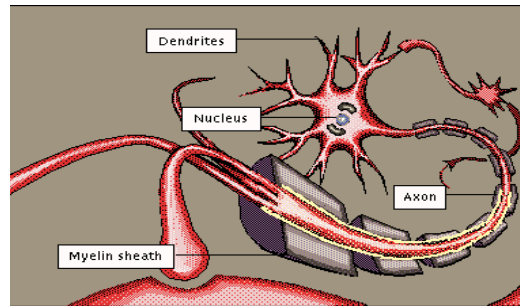
1/4 of new parents feel unprepared:

- Almost all parents claim to be "in love" with baby, happier than ever
- 56% feel stressed and worn out
- 52% are afraid of doing something wrong
- 47% fear not being a good parent

Source: March 7, 1997 What Parents Know
<http://old.nga.org/Children/FirstThreeYears/ParentsKnow.asp>

Brain Waves: How We are Wired

Prepared by Becki Sheldon



Source: SuperKids. www.superkids.com/aweb/pages/features/early1/early1.shtml

In the brain, there are millions of neurons that form electrical connections that help us think. These neurons or cells send their signals through axons. Neurons, nonetheless, are not the most important cells in the brain.

There are cells wrapped around many of the axon cells, which form myelin sheaths. Myelin sheaths are made of fat, and functions as a source of insulation for the axon. The insulation lets a signal travel about 100 times faster than in an un-sheathed axon. The more myelinated axons in a brain, the faster the “circuits” work, and activities are easier to learn.

Infants have very few myelinated axons. This explains why newborns cannot see very well and do not have motor coordination. As the child gets older, different regions of the brain become myelinated. Myelination is the key to developing ‘learning windows.’

Brain growth consists of a series of biological events that happen in a well ordered but overlapping sequence. First, the birth and migration of cells happen, then the growth of their axons. Next, dendrites form and allow connection to happen among the nerve cells. These connections are synapses that allow information flow across neurons, and then myelination occurs, which speeds up the transmission of impulses.

Axon formation is largely complete by birth in a full-term infant. Dendritic growth, synapse formation, and myelination are largely postnatal events. As soon as the Dendrite’s axons have completed movement from the cortical plate, dendrites start to form. Synapses appear at the same time as Dendrites.

In the first two years, there is a rapid growth of dendrites and synapses throughout the brain. After the age of two, synaptic and dendritic density decreases and reaches adult densities near the end of adolescence. Dendrites constantly are pruned back and synapses are shed.

Regions of brain

The Broca region of the brain is for language production and is located in the frontal lobe of the left hemisphere in the brain. When the region becomes myelinated, children develop speech and grammar. The Wernicke’s region is the center of language comprehension and is located in the left temporal lobe. This region becomes myelinated a good six months before Broca’s area even starts.

Regions of the brain (cont'd.)

In general, the left hemisphere or side of the brain is responsible for language and speech. Because of this, it has been called the "dominant" hemisphere. The right hemisphere plays a large part in interpreting visual information and spatial processing.

Many neurons are not specialized as to what exactly they have control over. The motor cortex has neurons that control movement, but are not organized early in life. The experiences of a child until age ten determines how much of the cortex will be devoted to each part of the body.

These windows are only effective if there are effective environmental stimuli that the child can interact with. For example, to stimulate more language comprehension, parents need to talk a lot with a child, especially during this 'window'. To help the child become more coordinated or active in later life, the child needs to be encouraged to run and play games, especially during the window to develop gross muscle coordination.

Parts of the brain:

Cerebral Cortex - thin layer on the brain's surface that includes lobes or sections:

Occipital lobe - processes vision; is located near base of back of head

Temporal lobe - processes hearing, speech, language development

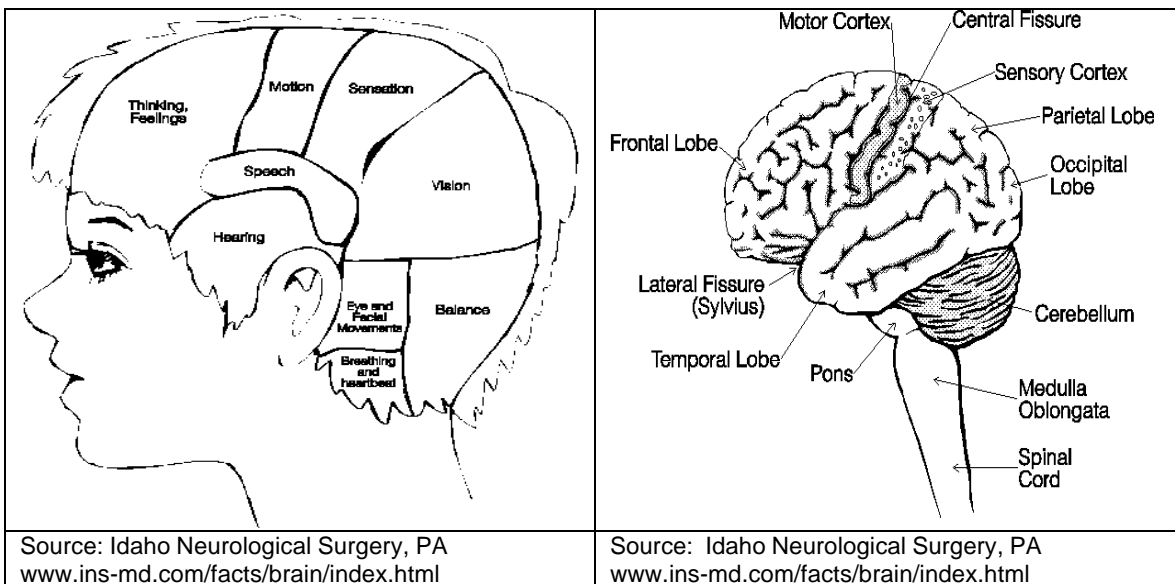
Parietal Lobe - processes sensory stimuli

Prefrontal lobe - allows us to plan and rehearse future actions; connected to the limbic area to help regulate emotions

Frontal lobe - area where critical thinking and problem solving occur

Limbic system - controls emotions and long-term memory

Cerebellum - controls automatic movements and balance



Source: Markezich, Amy. Learning Windows and the Child's Brain. *SuperKids – Educational Software Review*. www.superkids.com/aweb/pages/features/early1/early1.shtml; Gunnar, Megan R., Ronald G. Barr. (1998). Stress, Early Brain Development, and Behavior. *Inf Young Children*. 11(1):1-14; Anatomy of the Brain. *Idaho Neurological Surgery, PA*. www.ins-md.com/facts/brain/index.html; DeBord, Karen. Brain Development. www.mcc.org/Child.Dev/brain_nc.html

Activities for Healthy Thinkers (and Lovers)

Prepared by Becki Sheldon

The human brain is not fully developed at birth. A newborn's brain is approximately 25% of its adult weight. By age 3, the brain has produced billions of cells and hundreds of trillions of connections between these cells. These connections form a complex control center that enables the baby not only to see, hear, move, taste, and touch but also to think, feel and behave uniquely.

Parent's growing knowledge about their babies turns them into their babies' most powerful teachers and advocates. Parents learn the uniqueness of their babies in temperament, preferences, or what makes them smile. Most parents understand the value of loving, secure relationships and age-appropriate experiences in helping children's physical, psychological and intellectual development.

Children need lots of encouragement and learning activities in order for their brains to develop. Certain activities can be done with a baby that will help them learn and have fun at the same time. For infants from birth to 18 months, it is important to hold, snuggle, talk, and coo to build trust and help the baby recognize faces. Play simple games teaching cause and effect, such as peek-a-boo and patty-cake. These games also teach babies hand-eye coordination.

For toddlers ages 18 months to 36 months, it is important to help them follow directions and perform daily tasks by playing games such as "follow the leader" and "Simon says." Give toddlers a chance to play with toys that organizes and group by type, such as building blocks. In addition, use music and art to inspire creativity.

Research has found that it is never too early to start musical study in a child. The first of the five senses developed in the womb is one's sense of hearing. The unborn child hears sounds the mother makes such as her voice and her heartbeat. External sounds if brought close enough to the mother's body can also be heard such as the father's voice, siblings' voices or music played.

From age 0 it is recommended to use classical music because of the trochaic nature of the music (strong beat - weak beat - strong beat - weak beat). Popular music today holds a iambic nature (weak - strong - weak - strong), which is not as good for the baby.

It is also never too early to introduce books to your baby. Most babies enjoy being held and playing with the book as they listen to the sounds of the words. From the beginning, your baby will learn that looking at books is enjoyable and special. Remember that babies have a short attention span and may enjoy books for only a few minutes at a time.

For toddlers, make story time a special time during everyday. Toddlers enjoy short, simple books and often ask for a favorite one to be read over and over again. Choose books on topics that will interest your toddler; find sturdy, cardboard books for your toddler to help turn the pages; change your voice to imitate the characters during storytelling; and involve her in talking about the story.

We now know the development in the early years is quite dramatic and can establish patterns for life-long learning. The child's brain is a "work in progress" and takes years to complete. But it is still important to get your baby off to a good start within the first three years. These years feature a period of unparalleled growth in all areas of your baby's development.

Sources: Activities to make learning fun.

WTTW. www.wttw.com/wttw_web_pages/productions/10things/10_activites.html

Dodge, Diane Trister, and Cate Heroman. Building Your Baby's Brain: A Parent's Guide to the First Five Years. Teaching Strategies: Building Your Baby's Brain.

www.teachingstrategies.com/getpage...ookinfo/100084_books.html&userid=10154549; Welcome parents, this part of brain works was written for you. www.zerotothreee.org/brainwonders/parents-body.html

Tuning into the Key of Life: Music and Brain Development

The fact that a full two-thirds of the cilia in the inner ear—the thousands of tiny hairs that lie on a flat plane like piano keys—resonate only at the higher “musical” frequencies (3,000 to 20,000 hertz) suggest that at one time human beings communicated primarily with song or tone.—Don Campbell, *The Mozart Effect for Children*, p. 10

The human body seems wired for sound: not only do the inner rhythms such as brain waves, heartbeats, walking, and breathing, but also to enjoy and learn from the environment: wind and rain patterns, animal dangers and hunting cues, communication with other human beings. Some observations from research on the effects of music:

- Music calms or stimulates movement and heart rate of a baby in the womb
- Premature infants listening to classical music gain weight and health faster
- Music training enhances children’s motor skills, math and reading performance
- High school students in vocal or instrumental music have higher SAT scores
- A Mozart sonata enhanced spatial-temporal IQ in college students
- Brain structure and EEG waves of adult musicians differs from non-musicians

Fetal Experiences

First Trimester: The ear is the first sense organ to develop in utero

Second Trimester: The mother’s bloodstream and voice create natural, reassuring rhythms which probably promote healthy brain development
External noise can provoke kicking or covering ears; new music slows heartbeat; simple, regular beats calm
Calming music also reduces maternal stress, aiding fetal growth (partly by reducing toxic hormones impacting emotion centers)

Third Trimester: Music or stories heard repeatedly in the womb are more quickly recognized or learned in infancy or childhood
Other types of learning are enhanced by prenatal music training

What to do during pregnancy.

- Listen to relaxing music (e.g., Mozart’s Piano Concerto No. 21 in C Major, Rondo from Sonata in F Major, and Rondo-Allegro, Eine Kleine Nachtmusik)
- Play a variety of Mozart pieces, sing lullabies, and use toning (extended vowel sounds: humming, ahhhs, eeees, ohs, and combinations from low to high pitch)
- Sing or read children’s stories (e.g., *The Cat in the Hat*); rub the womb rhythmically
- Use classical music, rhythmic stroking, and 4/4 breathing tempo for childbirth

Infant Experiences

0-3 Months: In-born perceptions of pitch, loudness, melody, rhythm enable neonates to learn from speech, music, surroundings

4-6 Months: Cooing and babbling increases, together with movement
Brain growth cued by senses, esp. hearing (sounds and emotions)

7-9 Months: Visual and aural capacities mature and work together (ear-eye)

What to do during infancy.

- Talk (sing) and listen often, esp. face-to-face, using rhythmic, high-pitched voice
- Play a variety quiet (vs. loud, discordant) music to calm or stimulate (classical works from Bach, Beethoven, Vivaldi, or Mozart work well)
- Introduce a variety of sounds from reading aloud to percussion (beans in a can, piano), combining them with rocking, moving limbs, stroking, or routine tasks

Source: Don Campbell. (2000). *The Mozart Effect for Children*. New York: William Morrow.

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Resources and Policy: Infant Brain Development

Internet Resources

Nat'l. Childcare Information Center is a clearinghouse for practical and research on brain dev. <http://nccic.org/cctopics/brain.html>

Zero-to-Three Brainworks: Practical ideas and in-depth explanations for helping babies grow. www.zerotothree.org/brainworks/index.html

Charles A. Dana Foundation/Dana Alliance for Brain Initiatives. www.dana.org

The Brain Lab. Articles on a variety of provocative issues around brain dev. www.newhorizons.org/blab.html

Center for Early Ed.&Dev., Univ. of MN. Research reports w/ practical import on attachment & bonding.

I am your Child Parents Guide to Early Brain Dev. www.iamyourchild.org

Ass'n for Supervision and Curriculum Development. Resources primarily for teachers and school-age. April 2000 Ed. Leadership journal on brain dev. www.ascd.org

Books and Publications

J.P. Shonkoff & D.A. Phillips. (Eds, 2000). *From neurons to neighborhoods: The science of early childhood development.* Board on Children, Youth, and Families. Combines up-to-date research review with discussion of issues and options for families and decision-makers.

A. Gopnik, A.W. Meltzoff, & P.K. Kuhl. (1999). *The scientist in the crib: Minds, brains, and how children learn.* New York: William Morrow. Research related to early brain dev., with implications for educators and parents.

Carnegie Council on Young Children. (1994). *Starting points: Meeting the needs of our youngest children.* New York: Carnegie Corp. Review of research and issues related to quality child care and implications for child development. www.carnegie.org/starting_points/index.html

R. Kotukak. (1999). *Inside the brain.* Kansas City: Andrews McMeel.

C.B. Pert. (1999). *Molecules of emotion.* NY: Scribner. Describes connections between brain structure and emotions.

Understanding Early Development

1. Complex forces of nature & nurture impact each child uniquely
2. Culture influences values, aspirations, expectations, and practices (e.g. infant feeding, sleeping, response to distress, discipline, child care)
2. Self-regulation is key to physiological and behavioral mastery
3. Manageable challenges aid healthy growth; repeated stress promotes maladaptation and disorder
4. Active efforts toward mastery are inborn
5. Relationships develop personal capacities
 - Attachment and individualized give-and-take drive infant growth
6. Development reflects individual differences, talents and impairments
 - Growth patterns reflect a range of unique talents and experiences
7. Gradual, cumulative, and continuous changes cause each child's unique capacities to unfold
8. Vulnerability and resilience shape outcomes
9. Making the most of early experiences matters for long-term capacities
10. Effective interventions can positively alter early development

Source: Core Concepts of Development. *From Neurons to Neighborhoods: The Science of Early Childhood Development.* www.national-academics.org/webextra/neurons/Core.html

Paradoxes: A Parting Thought

Old Thinking and New Thinking About the Infant Brain

Old Thinking

- How a brain develops depends on the person's genes
- The experiences you have before age three have a limited impact on later development
- A secure relationship with parent allows for early development and learning
- Brain development is linear: the brain's capacity to learn and change grows steadily as an infant progresses toward adulthood
- A toddler's brain is much less active than the brain of a college student

New Thinking

- How a brain develops hinges on a multifaceted interactions between the genes and the experiences one has
- Early experiences have an important impact on the architecture of the brain, and on the nature and degree of adult capacities
- Early interactions don't just allows learning, they directly affect wiring of the brain
- Brain development is non-linear: there are prime times for acquiring different kinds of knowledge and skills
- By the time children reach age three, their brains are twice as active as those of adults

Source: Old Think vs. New Think on Brain Development, *NGA Center for Best Practices*, <http://old.nga.org/Children/FirstThreeYears/BrainDev.asp>