chapter one

# Healthy Children:
## Lessons from Research on Child Development

*"And remember the seed in the little paper cup:*
*First the roots go down and then the plant grows up."*

—From the song *"Kindergarten Wall,"* by John McCutcheon

When it comes to human childhood, nature is in no hurry at all. At birth, human infants are far more dependent on others' care than are the young of any other species. Even our formidable brains are relatively immature at birth, compared to other primates. And the span of childhood is far longer for our species than for any other animal, including other primates.[1]

In fact, recent brain-imaging studies suggest that even adolescents' brains are relatively immature. The biological changes that allow emotions to be harmoniously integrated with abstract thinking and sound judgment do not generally occur until the early twenties.[2] Human beings also do not reach physical maturity, in terms of muscular strength and motor coordination, until their twenties.[3]

The uniquely unhurried pace of human development is a fact of vast significance to educators because it seems so closely related to the broad range of capacities — including an unparalleled potential for lifelong intellectual, social, emotional, and moral growth — that is also uniquely human. Indeed, the length of childhood allows the human brain and nervous system to achieve their full size and remarkable complexity. This long period of complex growth, anthropologists Raymond Scupin and Christopher DeCorse suggest, is "the source of our extraordinary capacity to learn, our imaginative social interactions, and our facility — unique among all life forms — to use and produce symbols, language, and culture."[4]

### The Beginnings of Life

Human life begins in the warm, safe, living sphere of the womb. It is the perfect environment for the child-to-be. Here she is bathed in the gentle flow of amniotic waters, calmed by the rhythmic beat of mother's heart, nourished, and protected. Her world is small, but there is enough space to grow, and even, as the months pass, to stretch and kick, and so to begin a lifetime of motion. As the fetus matures, the womb responds, adjusting and expanding again and again to meet her changing needs. The womb thus offers a constantly recalibrated balance of nurture, security, and freedom that is crucial to healthy prenatal development. It's nature's version of "just-in-time" care.

As the young child learns to stand and then walk, he orients himself to a much larger and yet still spherical environment. The earthly world is beneath his feet, the starry world above his head. Life unfolds around the child on every side. Gradually, the child's senses open and help him to engage the world around him.[5]

The womb is a living metaphor for the nurturing, developmentally-responsive environment — at home, at school, and in the community — that best serves the full range of children's needs. Mechanistic models of education, in contrast, are guided by the dead metaphor of computer engineering. They see the child's mind as a machine that can and should be both powered up and programmed into adult levels of operation as quickly as possible. The fallacy of this premature focus on cognitive skills, as if they could and should be singled out for expedited development, is now evident.

Popular attempts to hurry children intellectually — such as the trend toward academic kindergartens — are at odds with the natural pace of cognitive development. They also ignore evidence that the natural patterns of cognitive development are intricately coordinated with other well-established patterns of development, in the emotional, social, sensory, and physiological realms of human experience.[6]

Research in many disciplines supports what attentive parents and teachers have long known from personal experience: healthy development is promoted by a balance of freedom, secure limits, and generous nurturing of the whole child — heart, body, and soul, as well as head.[7] The child grows as an organic whole. Her emotional, physical, and cognitive development are inseparable and interdependent. Brain-imaging studies are instructive on this point. They indicate that experiences of every kind — emotional, social, sensory, physical, and cognitive — all shape the brain, and are shaped by the brain and by each other. Healthy human growth, in other words, is profoundly integrated.[8]

As Bennett L. Laventhal, an expert on child development and psychiatry at the University of Chicago, has explained: "There is no longer a boundary between biology, psychology, culture, and education."[9]

## Emotions and the Intellect

Complex intellectual tasks and social behaviors proceed from a successful integration of a wide range of human skills, not just a narrow set of computational and logical operations. A prime example is the adult capacity for reasoning itself. Studies of brain-damaged patients have demonstrated that feelings are an essential factor in making rational decisions. Our feelings guide us in assigning value to different possibilities, and thus provide some basis for deciding between them. Otherwise, no option that life poses could either attract or repel us, and we would be stymied by the neutrality of each. In other words, sheer logic, divorced from human emotion, is insufficient for assessing the value — and, therefore, the meaning — of a choice.[10]

That does not mean, however, that every human capacity develops at the same pace, in a lockstep fashion. Far from it. In fact, childhood patterns of development, including the physical maturation of the brain and nervous system, seem to reflect the evolutionary history of humanity. The brain's lower centers, controlling movement, evolved first, followed by the basic brain structures governing emotion, and finally by the neural regions that enable the most

abstract thinking. A rich network of connections between regions of the brain that primarily govern emotion and higher-order thinking allow human feelings to collaborate in even the most intellectual of tasks.[11]

Young children make the most dramatic strides, in terms of nearing their full adult potential, in their sensory and motor skills, and the neural regions most related to them. During the grade school years and beyond, children continue to progress incrementally in motor and perceptual skills. But now the most dramatic gains are in their social and emotional skills. The brain regions most involved in emotion near maturation as children refine their social skills and their capacity to regulate their own moods and behavior. Finally, after puberty, the developmental focus within the brain shifts to the regions of the brain that enable the most advanced thinking, relying upon abstractions and critical judgment. Also, a rich network of neural connections develops between these areas and brain regions most directly involved in emotion and movement.

Becoming an adult in our culture corresponds to the timing of this neural integration of thinking, feeling, and acting. The most precise movements of which humans are capable, such as the hand-eye coordination of a pediatric heart surgeon, the most nuanced feelings about feelings, based on mature self-awareness, and the most creative artistic and scientific achievements all tend to follow this maturation and integration of body, heart, and mind.

The biological patterns of brain development appear to correspond to children's patterns of learning. In early childhood, the child most naturally learns primarily through energetic use of her whole body in a truly "hands-on" approach to exploring the world. The child makes the most dramatic sensorimotor gains of her life, from the relative physical helplessness of the newborn, to the toddler's running, jumping, grasping relationship with the world around her.

## The Essential Human Touch

The elementary-age child fine-tunes these motor skills, as his senses, organs, muscles, and bones continue to mature. His thinking skills, of course, are also advancing. But his whole being is naturally tuned to learn through the window of feelings, as he makes correspondingly dramatic gains in emotional and social development. This is a time for storytelling, music, creative movement, song, drama, making things with the hands, practical and fine arts of every kind — in short, every educational technology that touches children's hearts. They capture children's imagination, waken their interest in learning, and serve their ever-expanding sense of the world around them. Only around puberty does the child's dominant mode for learning finally shift toward the conscious intellect, as abstract considerations of logic and cause-and-effect reasoning gradually begin to hold sway in his mind.[12]

At every stage, however, studies indicate that strong emotional rapport with responsible adults — the human touch — provides support that is critical in helping children master the appropriate developmental challenges. Studies indicate that children's earliest emotional experiences actually lay the foundation for later academic achievement,[13] and that children whose emotional needs were not met in early childhood benefit greatly from early school experiences aimed at helping them to develop the emotional skills that are critical to school success.[14] Studies have also shown that teen-

agers who report strong connections with parents and teachers are less likely to drop out of school, become pregnant, use illegal drugs, or commit other crimes.[15]

What matters most, research shows, is giving the child rich human interactions, at home, at school, and in the community, in which he receives consistent, loving care from adults who understand and honor the general milestones of childhood as well as the unique constellation of gifts — special talents as well as unusual challenges — and the unique variations in developmental pace that each child brings to the world. That happens when adults calibrate their parenting and teaching to the child's developmental needs of the moment, while encouraging the child to grow across the full spectrum of human capacities.[16]

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**This point is so critical that it bears repeating: love for each child, respect for the general developmental patterns of childhood, and a sensitive honoring of the unique gifts and developmental variations of each child provide the strongest scaffolding for healthy cognitive, emotional, and sensorimotor growth in childhood. Children need adults who care about them and care for them, personally, in ways that are developmentally appropriate.**

**The educational implications of this truth are profound. At the very heart of any attempt to improve our schools and educate our children should be a recognition of children's prime needs for close, loving relationships with caring, responsible adults, and for developmentally-appropriate care.**

## The Dangers of Premature "Brain" Work

Unfortunately, attention to these basics is lacking in many current educational policies and practices. Increasingly, schools are pushing young children prematurely into sedentary, abstract academic work — narrowly conceived "brain" work — wired to the most advanced information technologies that the schools can afford. This approach neglects the actual cognitive needs of children, as well as their emotional and sensorimotor needs.

Indeed, it is hard to imagine a less promising educational strategy for young children than emphasizing abstract thinking, fueled by powerful computers. Why? Because research findings across many scientific disciplines strongly suggests that later intellectual development is rooted in rich childhood experiences that combine healthy emotional relationships, physical engagement with the real world, and the exercise of imagination in self-generated play and in the arts. Intense use of computers can distract children and adults from these essential experiences.[17]

Literacy, for example, is inspired and reinforced by a genuine emotional rapport between the growing child and loving caregivers — first at home, later in school. The nonverbal exchanges between infants or young children and adult caretakers are beneficial in laying the emotional foundations for later literacy skills, as are rich verbal exchanges. And the critical milestones that child-development experts cite as evidence of school readiness all stem from healthy emotional and social attachments in early childhood. These include

the abilities to focus one's attention, to form close relationships with other human beings, and to communicate with others successfully, both in terms of expressing one's self and in understanding others.[18] In kindergarten, therefore, an emphasis on play and social skills — not premature pressure to master reading and arithmetic — seems most likely to prepare children for later academic success.

Researchers have documented how much young children learn intuitively through their bodies, and how this lays a critical foundation for later conscious comprehension of the world. The child's first experience of geometric relationships and physics, for example, is literally a visceral one. As she moves herself through space, she actually begins to "learn" unconsciously in her body about relationships, shape, size, weight, distance, and movement — the basis for later abstract, conscious comprehension.[19]

Hand-eye coordination seems to be especially important to later academic achievement. Evolutionary biologists and anthropologists posit that the neural pathways of the brain associated with complex language skills co-evolved with the hand. Early hand-eye coordination, they suggest, may actually blaze the neural pathways that the brain later converts to "grasp" individual words and "shape" them into meaningful communication. So the body, too, is profoundly involved in setting the stage for later abstract thinking, just as the heart is.[20]

Parents and teachers need no experts to tell them about the active energy of children. In the natural rhythms of human learning, that energy is not wasted. Young children are prodigious learners, as their brains rapidly grow. But the most impressive feats of learning, including walking and mastering language, are achieved almost entirely through moving, exploring, touching, sensing, and, above all, imitating others — not as a result of direct instruction delivered by adults. Later, children become less imitative. But they still learn about the world through actively engaging with it, in imaginative play, games, climbing trees, and artistic and other hands-on exploration.

Unfortunately, school policies often ignore the educational impact of suppressing this natural, kinesthetic mode of learning in young children. Instead, they impose the adult mode of seated, intellectually oriented approaches, such as Internet research. Some schools are even eliminating recess to provide more time to drill young students for standardized tests.[21]

The imaginative element of children's play generally first appears about the age of two. It is inseparable from the sheer physicality of play and from its emotional and cognitive rewards. Research points to creative play as the "work" that exercises and expands the imagination. The power to generate playfully one's own images and to transform them in the mind's eye, scientists now theorize, later becomes the capacity to play with challenging mathematical, scientific, and cultural concepts in ways that create new insights. The term "intuitive leap" neatly captures the childlike play that real artistic and scientific achievement reflects.[22]

## Learning About the Real World

What the child encounters in the classroom, as in the broader world, is not just some narrow band of "information" about reality. It is the full spectrum of reality itself. The very richness of this world — its beauty, its pain, its chaos, its order, its rhythms of change and motion, and its seemingly infinite possibilities — captivates and challenges the child to bring his whole heart, body, mind, and soul to bear to know it,

and to serve it. The real world, in other words, motivates the child to learn and to care in ways no software could replicate. Teachers and parents who experience a wonder and a reverence for the world and who model their love for what they seek to teach can indeed inspire children to learn. The ultimate subject, of course, is our real world, especially what's most special about our own planet — life itself.

This encounter between child, teacher, and world is the very stuff of education. The Latin root of the word "educate" is *educare*, which means "to lead out," as to lead out of darkness into light. This meeting between child and world, facilitated by loving parents, teachers, and other mentors, literally calls forth from the child her incredible capacities for lifetime growth.

In this encounter, each child mirrors the history of human evolution, which is increasingly understood as having been profoundly integrated. Physical anthropologists increasingly emphasize that our most human sensorimotor, emotional, and cognitive capacities were fine-tuned in an integrated way, "called forth" as it were, by encounters with environments that posed specific evolutionary challenges.[23]

The growing dexterity of the human hand, for example, is thought to be closely related to the development of language. So too is each child's development integrated. Neural pathways that primarily relate to physical and emotional experiences connect to the pathways that enable abstract thought, which are the last to fully mature. In this way, different regions of the brain cooperate, enriching experience and learning. Children's sensory development, their skill in movement, their capacity to pay attention and to communicate all directly influence and are influenced by their cognitive development. And all of these ways of being human in the world together help to shape the physical development of the child's brain in ways that cannot be neatly dissected from each other.

Children thus need to experience the fullness of the world around them. Computer simulations or "content delivery" are poor substitutes for hands-on lessons — outdoors, if possible — in botany, zoology, chemistry, and physics. What young children learn first in their bodies and later in heartfelt sympathy with nature does, with time and instruction, later mature into conscious understanding. Educational shortcuts that attempt to bypass the physical and emotional stages of learning defy science.

The idea that schools should focus primarily on speeding up the natural trajectory of children's cognitive development is at odds with research findings on human development. When children's emotional or physical development is stunted, their intellects also fail to thrive.[24] Treating young children like small scholars and overwhelming them with electronic stimuli that outstrip their sensory, emotional, and intellectual maturity may actually be a form of deprivation. It is reminiscent of failed experiments of the 1960s in which preschoolers were pushed to learn to read and write. By the middle of grade school, they had fallen behind less rushed children in both academic and social skills.[25]

Attempts to engineer faster learning in childhood grew out of military research in the 1950s and 1960s that had nothing to do with children. The military sought to program computers to perform complex logical operations, in part by analyzing how humans process information. It also sought to apply the lessons learned about how to "train" machines in this narrow realm of abstract operations to the

similarly narrow task of training young adult males to operate and maintain computers and weapons systems.

A new discipline, now called cognitive science, sprung from those studies. But its research agenda continued for years to be driven primarily by the military's limited range of interests, in terms of advancing information technology for weapons systems and developing efficient methods for training young adults with as few instructors as possible. In time, its educational focus shifted to cognitive engineering — attempting to improve the efficiency and productivity of human learners. Its emphasis was frequently on developing generic "problem-solving skills,"often divorced from any context of social needs or the personal goals of the learners.

Over time, many educational researchers embraced this information-processing model of human thinking. They were excited by its potential to generate powerful concepts about the mind's architecture. Eventually this model, with its guiding metaphor of the brain as a programmable computer, became broadly applied to the basic issues of educating even very young children. Researchers tried to identify how children's minds process information, and then devise methods to increase the speed and efficiency of those processes. Schools used these mechanistic models to try to devise standard methods to help children construct their own mental scaffolding for academic subjects. But they also either applied a narrow, information-processing approach to every other aspect of child development — social, emotional, physical, and moral — or neglected those aspects of development all together.[26]

A comprehensive look at human development, informed by many scientific disciplines, clearly demonstrates how foolish it is to pressure teachers to focus exclusively on cognitive skills in the classroom. Human development, it turns out, really can't be reduced to information processing.

Even in processing information, children do not behave like machines. That's because children, influenced by the culture of their families, schools, and larger communities, actively bring to their encounters with life a far wider set of capacities than any machine embodies. Each child has a growing body and a rich, unpredictable inner life, a unique imagination, and a growing sense of self-awareness.

Again and again I have come to realize that even preschool children are constantly trying to comprehend how they should think about this gift of life given them, what they should do with it. . .

—Robert Coles

Children don't just process data about the world. They actually experience the world. They are constantly creating new meaning for themselves based on those experiences. They are meaning-makers, and the meanings are created by the complex encounters with the world of their whole selves — bodies, minds, hearts, and souls.[27]

Robert Coles of Harvard Medical School has expressed it this way:

> Again and again I have come to realize that even preschool children are constantly trying to comprehend how they should think about this gift of life given them, what they should do with it. People like me, trained in medicine, often emphasize the psychological aspects of such a phenomenon and, not rarely, throw around reductionist labels.... In fact, moral exploration, not to mention wonder about this life's various

> mysteries, its ironies and ambiguities, its complexities and paradoxes — such activity of the mind and heart make for the experience of what a human being is: the creature of awareness who, through language, our distinctive capability, probes for patterns and themes, for the significance of things.[28]

[1] Carol R. Ember and Melvin Ember, *Anthropology: A Brief Introduction*, 3d ed., Upper Saddle River, NJ: Prentice Hall, 1998, pp. 29, 33, 53, 151.

[2] Shannon Brownlee, "Behavior Can Be Baffling When Young Minds Are Taking Shape," *U.S. News and World Report,* Aug. 9, 1999, pp. 44-54.

[3] Fergus P. Hughes and Lloyd D. Noppe, *Human Development: Across the Life Span,* St. Paul, MN: West Publishing Co., 1985), p. 88.

[4] Raymond Scupin and Christopher R. DeCorse, *Anthropology: A Global Perspective*, 3d. ed., Upper Saddle River, NJ: Prentice Hall, 1998, p. 87.

Also, see Ashley Montagu, *Growing Young*, 2d ed., New York: McGraw-Hill Book Co., 1983.

[5] Michaela Glockler and Wolfgang Goebel, *A Guide to Child Health,* Edinburgh: Floris Books, 1990, pp. 170-174.

[6] Dorothy G. Singer and Tracey A. Revenson, *A Piaget Primer: How a Child Thinks*, Rev. Ed., Madison, CT: International Universities Press, 1997. The seminal work in this area is Jean Piaget's theory of the progressive cognitive stages that children grow through, and how they entail different kinds of thinking — not just a question of quantities of information learned. Piaget also stressed how closely tied a young child's first intuitive learning about the world was to the physical development of his or her senses and motor skills. Cross-cultural studies support the idea of basic thinking processes developing in phases. Especially see pp. 108-110 for a description of Piaget's warning against adults trying to arbitrarily speed up children's progress through the natural phases of cognitive development. These patterns reflect a corresponding process of biological maturation, Piaget pointed out, and so their timing is neither arbitrary nor subject to cultural whim.

Also, see Daniel Goleman, *Emotional Intelligence: Why It Can Matter More than I.Q.*, New York: Bantam Books, 1995, throughout and especially p. 274.

Also, see Stanley I. Greenspan with Beryl Lieff Benderly, *The Growth of the Mind: And the Endangered Origins of Intelligence*, Reading, MS: Addison-Wesley Publishing Co., Inc., 1997, throughout, especially pp. 211-230.

Also, see Jane M. Healy, *Your Child's Growing Mind: A Practical Guide to Brain Development and Learning from Birth to Adolescence*, New York: Doubleday, 1994, especially pp. 227-256.

[7] "The healthiest children, psychologists tend to agree, have parents who are warm and accepting rather than cold and rejecting; who set up firm rules and consequences rather than remaining always lenient; and who support a child's individuality and autonomy rather than exerting heavy control." From Marian Diamond and Janet Hopson, *Magic Trees of the Mind: How to Nurture Your Child's Intelligence, Creativity, and Healthy Emotions from Birth Through Adolescence,* New York: Plume, 1999, p. 209. Diamond is a leading brain researcher whose work strongly supports current theories that the brain's physical organization is responsive, throughout life, to environmental influences and that the brain is particularly responsive — and therefore, particularly vulnerable — to experiences in childhood.

[8] Neurologist Frank R. Wilson, medical director of the Peter F. Ostwald Health Program for Performing Artists at the University of California School of Medicine at San Francisco, has summarized the research and theories on the integration of physical experience and brain development in evolution and child development, drawing upon a wide range of scientific disciplines. See Frank R. Wilson, *The Hand: How Its Use Shapes the Brain, Language, and Human Culture,* NewYork: Pantheon Books, 1998. Wilson notes: "No credible theory of human brain evolution can ignore, or isolate from environmental context, the co-evolution of locomotor, manipulative, communicative, and social behaviors of human ancestors." (p. 321).

Wilson also notes the current anthropological theory that early tool use, combined with the evolution of the hemispheric specialization associated with hand use "provide both the behavioral and neurologic context" to account for the evolution of human language itself (p. 354).

He also presents a wide range of research and case studies to argue that the development of physical skills can help foster an intense emotional commitment to learning — again, in an overall context of the dynamic synergy released by the "fusion" of movement, thought, and feeling. Citing the passion with which musicians, sculptors, jugglers, and surgeons practice their skills, he emphasizes the "hidden physical roots of the unique human capacity for passionate and creative work" (p.6).

Also, again in the context of how the holistic nature of human development generates unique capacities, Wilson states: "If it is true that the hand does not merely wave from the end of the wrist, it is equally true that the brain is not a solitary command center, floating free in its cozy cranial cabin. Bodily movement and brain activity are functionally so interdependent, and their synergy is so powerfully formulated that no single science or discipline can independently explain human skill or behavior. . . The hand is so widely represented in the brain, the hand's neurologic and biomechanical elements are so prone to spontaneous interaction and reorganization, and the motivations and efforts which give rise to individual use of the hand are so deeply and widely rooted, that we must admit we are trying to explain a basic imperative of human life" (p.10).

For a presentation of current evidence pointing to the roots of human language resting in human gestures, see the following work by three leading linguists: David F. Armstrong, William C. Stokoe, and Sherman E. Wilcox, *Gesture and the Nature of Language,* Cambridge/New York: Cambridge University Press, 1995.

For an anthropological review of the evidence that early tool use and the evolution of hemispheric specialization in the brain that is related to left- and right-handedness provide the behavioral and neurologic context for the evolution of human language itself, see Gordon W. Hewes, "A History of the Study of Language Origins and the Gestural Primacy Hypothesis," in A. Lock and C. Peters, eds., *Handbook of Human Symbolic Evolution*, Oxford: Clarendon Press, 1996.

For a summary of research and theories on the two-way, dynamic interplay between emotional experiences — especially the frequency of intimate interactions with other human beings — and brain development, see the work of Stanley Greenspan, a child psychiatrist and a leading expert on healthy emotional development across the human lifespan. For example, Greenspan with Benderly, *The Growth of the Mind and the Endangered Origins of Intelligence,* throughout, especially pp. 319-322, for a history of the science in this area.

Greenspan states: "Perhaps the most critical role for emotions is to create, organize, and orchestrate many of the mind's most important functions. In fact, intellect, academic abilities, sense of self, consciousness, and morality have common origins in our earliest and ongoing emotional experiences. Unlikely as the scenario may seem, the emotions are in fact the architects of a vast array of cognitive operations throughout the life span. Indeed, they make possible all creative thought" (p. 7).

9 Robert Lee Hotz, "Deciphering the Miracles of the Mind," *Los Angeles Times*, October 13, 1996, reprinted in *The Brain in the News*, Vol 3, No. 11, The Dana Alliance for Brain Initiatives, Washington, D.C.: November 15, 1996, p. 2.

10 Antonio Damasio, *Descartes' Error: Emotion, Reason, and the Human Brain,* New York: Grosset/Putnam: 1994. Damasio, a neuroscientist, states: "Surprising as it may sound, the mind exists in and for an integrated organism; our minds would not be the way they are if it were not for the interplay of body and brain during evolution, during individual development, and at the current moment" (p. xvi).

11 Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ,* especially pp. 9-12.

12 The editors gratefully acknowledge Story C. Landis, Ph.D., senior investigator in the Neural Development Section of the National Institute of Neurological Disorders and Stroke, for her review of the section above describing patterns of brain development. Dr. Landis is also scientific director for the Division of Intramural Research at NINDS.

Also, for a discussion of how human evolution, human cultural history, and human cognitive development all suggest the wisdom of educators recognizing and taking advantage of children's progression from relying mainly on "somatic" tools for learning in early childhood to their inclusion, much later in school, of much more abstract, "ironic" understanding as an intellectual tool, see Kieran Egan, *The Educated Mind: How Cognitive Tools Shape Our Understanding,* Chicago: University of Chicago Press, 1997.

13 *Heart Start: The Emotional Foundations of School Readiness.* (Arlington, VA: National Center for Clinical Infant Programs, 1992), especially pp. 7, 9, 13.

14 Goleman, pp. 234-260; also, W. T. Grant Consortium on the School-Based Promotion of Social Competence, "Drug and Alcohol Prevention Curricula," in J. David Hawkins, et al., *Communities That Care,* San Francisco: Jossey-Bass, 1992; also, Greenspan, pp. 252-280.

15 A recent major study of risk factors in adolescence, sponsored by the National Institutes of Health, concluded that the most critical factor associated with whether teenagers used drugs or alcohol, attempted suicide, became sexually active at an early age, or committed acts of violence was how closely connected they felt to their parents. The closer the bond, the less likely teenagers were to get into trouble. From "Add Health," *Journal of the American Medical Association*, Sept. 9, 1997.

Ann S. Masten, associate director of the Institute of Child Development at the University of Minnesota, in summarizing the research on factors that foster resiliency in disadvantaged children at high risk for academic failure, juvenile delinquency, and other negative developmental outcomes, states the following: "The most important protective factor in their lives are their connections to competent, caring adults…They have had opportunities to feel effective and valued, opportunities that were afforded by a combination of their own talents and the interests of the adults around them. They have a knack for getting into healthy contexts for development, making choices that connect them with positive people and places that foster achievement and values. In most cases, it takes more than adversity to bring down a child endowed with normal human qualities. It seems to require significant failures in the major protective systems for human development, which includes the nurturing of body and soul by adults, opportunities to learn, to play, to be safe." From "Fostering Resiliency in Kids: Overcoming Adversity," a transcript of proceedings of a Congressional breakfast seminar, Washington, DC: Consortium of Social Science Associations, March 29, 1996.

16 Greenspan with Benderly, throughout, especially pp. 211-230: "An educational system that serves the needs of our society is compelled to recognize children's developmental levels, deal with individual differences, and foster dynamic affective interactions. We do not need to justify such interactions as part of training in social skills or other desirable goals that some would argue should be left within the purview of the family. Rather, their importance is demonstrated by the fact that they are inextricably interwoven with the process of learning" (p. 230).

17 For summaries of research indicating the wisdom of a wide variety of such experiences for children, see Healy, *Your Child's Growing Mind: A Practical Guide to Brain Development and Learning from Birth to Adolescence,* 1994; and Diamond and Hopson, *Magic Trees of the Mind: How to Nurture Your Child's Intelligence, Creativity, and Healthy Emotions from Birth Through Adolescence,* 1999.

For a summary of the research connecting physically active play and pretend play to intellectual development, see Fergus P. Hughes, *Children, Play, and Development*, Allyn and Bacon, 1998.

For a discussion of the research on the positive impact of art and music education on academic performance, see Martin Gardiner, Alan Fox, Faith Knowleds, and Donna Jeffrey, "Learning Improved by Arts Training," *Nature*, May 23, 1996. The authors note that children's performance in mathematics and reading can be improved especially when arts education is based on a sequential, skill-building approach and consciously integrated into the rest of the curriculum.

For more information on the relatively recent field of research indicating that music education, for example, has an impact on neurological development and on spatial-reasoning skills important in mathematics, science, and engineering, see the MuSICA Research Database at the University of California-Irvine@http://www.musica.uci.edu

18 Greenspan, for example, in discussing how to prepare children for academic learning, states: "Now that we have a far more accurate idea of how the human mind develops, we must base our educational methods not on tradition but on the best current insights into how children learn.... We must base it, in short, on a developmental model and on its key tenet*: intellectual learning shares common origins with emotional learning* [italics sic]. Both stem from early affective interactions. Both are influenced by individual differences, and both must proceed in a step-wise fashion, from one developmental level to another.... First, a child must be able to regulate his attention. Whether he learns this easily or with difficulty

depends, of course, on the particular endowment he arrived with as well as the early nurturing he received. Second, he must be able to relate to others with warmth and trust. Those who lack adequate nurturing may not have learned to engage fully with other human beings. No teacher can then marshal this basic sense of connectedness. The child will not be motivated to please her, and ultimately himself, by doing well at schoolwork. Finally, he must be able to communicate through both gestures and symbols, to handle complex ideas, and to make connections among them. Those who have not mastered these early levels obviously cannot succeed at more advanced ones. The real ABCs come down to attention, strong relationships, and communication, all of which children must learn through interaction with adults. Learning will also be smoother if a youngster arrives at school able to reflect on his behavior, so that, for example, he can tell whether he understands a lesson or assignment and if not, know which part he finds confusing." From Greenspan with Benderly, *The Growth of the Mind* (pp. 219-220).

Also, Jane Healy, educational psychologist and former school principal, cites the work of child-development expert David Elkind in suggesting that children, to be ready for academics, need to be able to express themselves, listen, and follow directions; start and complete a task before moving to another activity; and cooperate with others. Healy adds: "All of these qualities may be eroded by the wrong kind of computer exposure." Jane M. Healy, *Failure to Connect: How Computers Affect Our Children's Minds — for Better and Worse,* New York: Simon & Schuster, 1998, p. 242; and David Elkind, conference paper: "Education for the 21st Century: Toward the Renewal of Thinking." (New York: Teachers College, Columbia University, February 10-11, 1994).

19 Hughes, *Children, Play and Development*, 1998.

Some of the most influential theorists of cognitive development, including Maria Montessori, Jean Piaget, and Rudolf Steiner, have also made the same point, based, in part, on their acute observations of young children. Piaget, for example, suggested that children up to about the age of seven — which, in the United States, corresponds to about second grade — are biologically primed to learn intuitively about the world through their senses, movement, and actually handling objects, especially through play and imitation. Then, from the ages of about seven to 11, Piaget asserted, children become more and more proficient in converting their "in-the-body" knowledge to interior, imaginative pictures and in concrete thinking about their experiences. Play is still important, but children become increasingly interested in organizing games with rules. From the ages of about 11 through 16, he suggested, children gradually grow in their capacity for abstract thought and deductive reasoning. He insisted that reading, writing, and arithmetic should not be imposed upon children until their nervous systems were biologically mature enough for such direct instruction — which he suggested was not until the primary grades. Through sensory and motor experiences in the world, he theorized, children take their "first steps in numerical and spatial intuition," which prepares them for later logical and verbal abstractions. See Singer and Revenson, *A Piaget Primer: How a Child Thinks*, 1997, esp. pp.108-109.

20 Wilson, in *The Hand*, 1998, discusses how the evolution of the human brain over millions of years has been inextricably and dynamically linked to the ways in which humans use tools. Changes in the structure of the human hand and arm, related to the need to grasp, throw, and manipulate objects like stones and sticks, led to changes in the structure of the brain and nervous system and the development of new, more complex patterns of thinking. The hand and its control mechanisms, Wilson summarizes, seem to have been "prime movers in the organization of human cognitive architecture and operations" (p. 286). This same process of co-evolution takes place in the development of individuals: children who learn to play the violin or piano, for example, develop neural networks that affect their ways of learning throughout life. And Wilson speculates that the individual infant's potential to develop incredibly refined and related hand and language skills may be a combined "elemental force in the genesis of what we refer to as the 'mind,' activated at the time of birth" (p.34).

21 Research on recess, for example, indicates that children return from recess outdoors with a new surge of energy for paying attention to their studies. From Hughes, *Children, Play, and Development*, 1998. Yet many schools have reduced or eliminated recess, or are considering doing so, in a misguided move to make more time for computer classes and deskwork.

22 Mihaly Csikszentmihalyi, a psychologist at the University of Chicago, has suggested a theory of "flow," as a special state of consciousness that arises when both energy and creative ability are synchronized. He argues that adults' creativity and achievements in the sciences and arts are linked to a sense of play, which he describes as "the spontaneous

joy of a child's natural learning experience." Like the child's play, adult creative achievements are motivated by the emotional rewards of the activity itself. Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience,* New York: Harper & Row, 1990.

Also, see Desmond Morris, *The Human Animal: A Personal View of the Human Species,* New York: Crown, 1994, pp. 206-214, for a lyrical exposition of how the human adult's retention of some childlike capacities — especially the capacity and enthusiasm for play — is both unique among species and a critical evolutionary edge. "At our best," says Morris, "we remain, all our lives, childlike adults."

23 Scupin and DeCorse, *Anthropology: A Global Perspective*, 1998, especially p. 88.

24 See Wilson, *The Hand*, 1998, p, 289, for this concise summary of the implications, for example, of research to date across the life sciences: "The clear message from biology to educators is this: The most effective techniques for cultivating intelligence aim at uniting (not divorcing) mind and body."

Also, on emotional impacts on learning, research at the University of Michigan, for example, concluded that regardless of parents' education or social class, factors that placed four-year-old children at risk of emotional problems — such as having depressed or addicted parents or suffering abuse or neglect — were related to poor cognitive development. Also, children from families with four or more emotional, social, and economic risk factors were 24 times more likely than those with just one risk factor to score below 85 on I.Q. tests and to suffer more behavioral problems. Higher test scores were also correlated with having parents who were adept at reading and positively responding to their child's particular emotional and social cues in ways that encouraged the child to explore the world, rather than ignoring their cues or responding to them in a negative or overly directive way. Follow-up studies of the same children at the age of 13 confirmed the findings. See A.J. Sameroff, R. Seifer, R. Barocas, M. Zax, and S.I. Greenspan, "IQ Scores of Four-Year-Old Children: Social-Environmental Risk Factors," *Pediatrics* 79, 1986, pp. 343-350.

Brain researcher Marian Diamond presents an accessible review of the research in this area, as well as the scientific references, in *Magic Trees of the Mind*. Diamond also cites psychologist Howard Gardner's theory of multiple intelligences — faculties for language, logic and mathematics, spatial representation, music, movement, understanding others, understanding ourselves, and understanding and appreciating nature — as confirming common-sense observations. (Recently Gardner has also suggested that there may be an "existential intelligence.") Diamond recommends that parents and schools offer children a wide variety of experiences to nurture the full spectrum of human intelligence and adds: "A school program based on many domains of intellect can also help children get practice in their weaker areas, whatever they may be, and develop and discover talents in new realms." Diamond and Hopson, *op. cit.*, 1999, (p. 197).

25 Pediatrician T. Berry Brazelton has cited this research and later evidence that "such precocious early training is costly" and warns against pushing academics on children too early. Brazelton, *Touchpoints: Your Child's Emotional and Behavioral Development,* Boston: Addison-Wesley, 1992, p. 213. He also notes: "Pressure on children to perform early seems to me to be cheating the child of opportunities for self-exploration for play and for the learning that comes from experimentation" (pp. 356-357).

Also, anthropologist Ashley Montagu has warned of "psychosclerosis," or hardening of the mind. It is, he says, a culturally and educationally induced condition that stems from pressures to rush children into adulthood and that stunts our ability to maintain the childlike qualities that allow us to continue maturing over our entire life span. Among the critical human traits he identifies that are in jeopardy in adulthood are the capacities to love, to wonder, to explore, to learn, to be imaginative and creative, to sing and dance, and to play. See Ashley Montagu, *Growing Young*, 2d ed., *op. cit.*

And child-development expert David Elkind, former president of the National Association for the Education of Young Children, has criticized the push to "collapse" the natural phases of childhood in order to "hurry" children into more adult levels of functioning. Elkind suggests that this attempt to rush children through childhood may actually stunt their development, including the healthy development of their brains. See David Elkind, "Education for the 21st Century: Toward the Renewal of Thinking," New York: Teachers College, Columbia University, February 10-11, 1994.

Also, animal studies involving the over-stimulation of more than one sense too early in life have

shown negative lifelong impacts for learning and attention. P.L. Radell and G. Gottlieb, "Developmental Intersensory Interference," *Developmental Psychology*, 28(5), 1992, pp. 794-803.

26 For the most thorough exposition of this history, see Douglas D. Noble, *The Classroom Arsenal: Military Research, Information Technology, and Public Education,* London: The Falmer Press, 1991.

Wilson, in *The Hand,* explicitly issues this "admonition" to cognitive science: "Any theory of human intelligence which ignores the interdependence of hand and brain function, the historic origins of that relationship, or the impact of that history on developmental dynamics in modern humans, is grossly misleading and sterile" (p. 7).

27 Jeffrey Kane, "On Education With Meaning," from Jeffrey Kane, ed., *Education, Information, and Transformation: Essays on Learning and Thinking*, Upper Saddle River, NJ: Merrill, 1999.

28 Robert Coles, *The Moral Intelligence of Children: How to Raise a Moral Child*, New York: Penguin Putnam, 1998, pp. 177-178.