

# **The Role of the Heart in Learning and Intelligence**

## *A Summary of Research and Applications with Children*

by **Deborah Rozman, Ph.D., Rollin McCraty, M.Sc., Jeffrey Goelitz, M.Ed.**

Strong scientific evidence now indicates that emotional stress and the environment children are exposed to have tremendous effects on their brain and nervous system development, their ability to learn and retain skills, and their long term health.

In today's fast-paced society, there is increasing pressure on children to achieve and excel in school at younger and younger ages. These same children, however, experience considerably greater stress in their lives, shouldering far greater responsibilities and emotional burdens than youngsters their age did even as few as 10 years ago.

Our educational systems focus on honing children's cognitive skills from the moment they enter the kindergarten classroom. But very little emphasis is placed on educating children in the management of the inner conflicts and unbalanced emotions they bring with them every day to school. As new research sheds light on the development of the brain and concepts such as "emotional intelligence" become more widely understood, many educators are realizing that cognitive ability is not the sole or necessarily the most critical determinant of young people's aptitude to flourish in today's society. Developing skill in emotional management, conflict resolution, decision making, communication and interpersonal skills are essential for children to develop a broader intelligence to help them successfully deal with the pressures and obstacles that will inevitably arise in their lives.

The Institute of HeartMath® (IHM) has been researching how emotional states and feelings affect the physiology of the body, brain function, hormonal balance, immune function and interpersonal relationships [1-6]. Briefly stated, when a child or adult is experiencing stressful emotions such as fear, frustration or anxiety, the autonomic nervous system, which regulates over 90% of the body's internal functions, operates with less coherence and balance. Conversely, when mental and emotional turmoil are managed, increased physiological coherence results. This becomes an optimal physiological state for learning, understanding, and improved mental and emotional clarity. A new mental and emotional management technology that incorporates a number of "tools" such as Freeze-Frame® [7] and Cut-Thru® [8] have been developed that are easy to teach and have shown in a number of scientific studies to improve anger management, teacher comfort, self control and other key indicators.

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## The Heart/Brain Connection

Although the basic brain structure and neural circuits for managing emotions are laid down well before birth, it is the experiences a baby has in the early years of life that shape the brain's circuitry. The emotional environment and emotional responses that a child is exposed to affects the development of a child's emotional circuitry. If the primary caregiver is attuned to the feelings of the child and plays back a response that is appropriate to the child's emotions, the neural circuits are positively reinforced. However, if a child's emotion is met repeatedly by a response that is indifferent or negating, the neural circuits can become confused and not strengthen. Those weakened connections may not be strong enough to withstand the neural pruning process that occurs around the age of 10 and may be lost forever. Yet, the brain's plasticity also offers hope that emotional circuitry can be re-educated by positive reinforcement and by teaching children and adults techniques for emotional self-management.

The HeartMath Research Center has been probing into the physiological mechanisms by which the heart communicates with the brain and influences information processing, perceptions, emotions and health. While over the years IHM has experimented with many different types of psychological and physiological measures, what consistently stood out as most dynamic and reflective of inner emotional states were the changes in the complex beating patterns of the heart. It became clear early on in this research that the experience of negative emotions (such as stress, anger, frustration or anxiety) led to increased disorder (incoherence) in the heart's rhythms and in the autonomic nervous system, thereby affecting the rest of the body. In contrast, positive emotions (such as love, care or appreciation) created increased harmony and coherence in the heart's rhythms and improved the balance in the nervous system [2, 5]. The heart is far more than a simple pump; it is in fact a highly complex, self-organized sensory organ with its own functional "little brain" that communicates with and influences the brain via the nervous system, hormonal system and other pathways. These influences can profoundly affect brain function and most of the body's major organs.

The recent book, *Neurocardiology*, edited by Dr. J. Andrew Armour and Dr. Jeffrey Ardell, provides a comprehensive overview of the function of the heart's intrinsic brain and nervous system [9]. Hormonal, chemical and pressure information are translated into neurological impulses and sent from the heart to the brain through several "afferent" (flowing to the brain) pathways. It is also through these nerve pathways that pain signals and potentially other feeling sensations are sent to the brain.

There are several electrophysiological methods that can be used to measure and track how the neurological information from the heart flows to the brain. One is called heartbeat evoked potentials [3, 10, 11]. This is a technique that has allowed researchers to see that the information from the heart travels all the way to the cortex and frontal lobes. Another tool is called heart rate variability analysis or HRV. In a healthy child or adult our heart rate changes with each heartbeat [2, 10-12]. The HRV is generated by the interaction of information flowing back and forth between the heart and brain. Analysis of the HRV pattern or "wave form" can be used to determine the type of activity going on in the autonomic nervous system (ANS). Not only can analysis of HRV be used to measure the balance between the two branches (sympathetic and parasympathetic) of the nervous system, it can also be used to determine the degree of coherence or "harmony" in the system.

Thus, the HRV patterns contain information about one's emotional state (as measured by coherence) that is relayed to the cardiac centers in the brain stem, which in turn feeds the information into the intralaminar nucleus, the thalamus and the amygdala. These areas are directly connected to the base of the frontal lobes, which are critical for decision making and the integration of reason and feeling. The intralaminar nuclei send signals to the rest of the cortex to help synchronize cortical activity, thus providing a pathway and mechanism which explain how the heart's rhythms can change the coherence in brain wave patterns and thereby modify brain function. The data indicates that when the heart is sending coherent patterns to the brain, cortical function and positive feelings are facilitated. This may also explain why most people associate love and other positive feelings with the heart and why many people actually "feel" or "sense" these emotions in the area of the heart.

Emotional states are contagious. Smile at a baby, and the baby smiles back. You get upset, and the baby cries. As a mother nurses her baby in a loving state, the baby's HRV patterns entrain to the mother's HRV patterns. Research has shown that 80% of mothers, whether they are right or left-handed, carry their infants in the left arm which is closer to the heart. When a parent is peaceful, loving and caring, a harmonious, coherent HRV pattern is communicated. When a parent is in a stressful, anxious or angry state, an inharmonious, incoherent HRV pattern is communicated.

New research at IHM shows that when a person is touching another or in close proximity (measurements have been made up to three feet away), the electromagnetic signal produced by one person's heart can be measured in the other person's brainwaves or electroencephalogram (EEG) [13]. This finding gives new and more precise meaning to the concept of contact comfort and places touch as the first and most fundamental means of communication and interaction between parent and child. The beneficial effect of loving contact or proximity between caretaker and child can be amplified by the adult *consciously* adopting a more sincere loving or caring emotional state, thus introducing increased coherence into the cardiac electromagnetic field.

This is especially important in the first years of life. Touching, talking to or reading to young children is not as effective for learning if the parent or caregiver is anxious, angry or stressed. If a mother or father is trying to be nice to or read to a child while anxious or emotionally upset, the electromagnetic field produced by the parent's heart is less coherent and the child's nervous system detects the real signal. Children of parents who suffer from anxiety, depression, or both anxiety and depression, are more likely to develop a broader range of mental problems. One study involving children ages 7 to 13 with parents who were under treatment for a depressive disorder, anxiety disorder, or mixed anxiety/depression disorder, found 36% of children with anxious parents had anxiety, 38% of children with depressed parents had depression, and 45% of children with mixed anxiety/depression parents were diagnosed with that same disorder. According to Deborah C. Beidel at the Medical University of South Carolina in Charleston, "These findings don't mean that anxiety and other disorders are tied to a specific gene; learning and modeling can be very powerful ways of acquiring behavior."

## The Amygdala

The amygdala is the key brain center that coordinates behavioral, immunological and neuroendocrine responses to environmental threats. It also serves as the storehouse of emotional memory within the brain. In assessing our environment, the amygdala compares incoming emotional

signals with stored emotional memories. In this way, the amygdala makes instantaneous decisions about the threat level of incoming sensory information, and due to its extensive connections to the hypothalamus and other autonomic nervous system centers, it is able to “hijack” the neural pathways activating the autonomic nervous system and emotional responses before the higher brain centers receive the sensory information [14,15].

The amygdala also receives afferent input from the heart’s nervous system [9] One of the functions of the amygdala is to organize what becomes “familiar” [16] If the rhythm patterns generated by the heart are disordered and incoherent, due to disturbed emotional states, especially as a young child, the amygdala learns to expect emotional and physiological disharmony as familiar; thus we feel “at home” with incoherence and emotional imbalance, which can affect learning, creativity and decision-making.

To summarize, the circuits in the amygdala organize what becomes emotionally “familiar” to the child, whether coherent or incoherent. If feedback patterns generated by the heart and blood pressure control systems are disordered and incoherent, the baby learns to expect disharmony as the familiar and comfortable, which will affect learning as the child grows. On the basis of what has become familiar, the frontal cortex mediates decisions as to what is appropriate or not in a given situation. However, these emotional memory patterns can be reprogrammed so that coherence becomes a more regular and comfortable state, one that provides greater access to our full range of intelligence. To transform old, inefficient patterns into new, healthier ones requires effective self-management tools and practice. A consistently supportive environment is also needed to reinforce the practice of self-management and emotional balance, but as HeartMath research is showing, dramatic changes and improvements can be gained in a relatively short time period.

## HEARTMATH IN EDUCATION

Many educational administrators and teachers have begun to integrate the HeartMath curriculum into core classroom academics. Children learn HeartMath skills for developing self-security, resilience, better communication with peers and adults, discriminating intelligent choices from emotional impulses, improving their ability to absorb and retain information, and achieving greater success. Teachers learn tools to find relief from time and energy drains, reduce overcare and burnout, find emotional balance, access their creativity and be productive, achieve classroom and curriculum objectives more efficiently, and experience greater rewards in teaching. (The Quality Classroom training program)

An example of how HeartMath tools can be incorporated into the classroom is illustrated by this teacher’s commentary:

“As an elementary school resource specialist, it was important to remind myself that HeartMath tools are something that would be the platform or ground rules of EVERYTHING that happened in the classroom. To accomplish this, I began to talk about concepts such as sensitivity towards others and diversity, and use our discussions, or reading of pertinent books as motivation to write. This way we were able to incorporate academics into HeartMath almost from the beginning. I asked children to discuss head reactions vs. heart responses in their assignments, having them look at emotional reactivity versus emotional maturity in the characters they read about. It has helped a great deal to go over some of the vocabulary of HeartMath in addition to other vocabu-

lary that is important to them in their lives — prior to teaching the tools in a formal way. This is especially true in a culturally diverse classroom or inner city environment.

Many children today have no example, role model, or marker of another way to solve problems. My students have had lots of questions for me about why I spend time teaching them a new way to solve conflicts, when the ways and strategies they used were what everyone else does. Here are some of the words and concepts I cover during HeartMath time: respect, peace, resentment/holding a grudge, prejudice, gratitude, care, love, power, focus, being unique rather than special, sincere, genuine, pride, race and culture, and appreciation.”

The following case studies represent examples of the ways the HeartMath system has been incorporated into educational programs throughout the United States. Results indicate that the techniques have not only increased children’s stress management, interpersonal skills and comfort in the classroom environment, but have also significantly enhanced learning, heightening students’ energy and motivation, sharpening their work management skills and increasing their understanding of the academic subjects studied.

Palm Springs Middle School, Dade County, Florida. Improving seventh grade students’ achievement aptitudes, interpersonal skills and mental attitudes:

Researched by Melinda G. Leaseburg, Ph.D.

**Key findings:** Training and practice in the HeartMath techniques produced significant improvements in gifted seventh graders’ mental attitudes, interpersonal skills and achievement skills as assessed one week after the training.

**Summary:** This study investigated the impact of a HeartMath training program on a group of students including 35 gifted, 10 at-risk, and 20 ESL (English as a Second Language) Hispanic seventh graders outside of a large metropolitan Southern city. The training consisted of 8 two-hour sessions conducted over a period of 6 to 8 weeks. Pre and post evaluations of students’ achievement aptitude, interpersonal skills and mental attitudes were conducted one week before and one week after the completion of the training using the 19-scale, 189-question Achievement Inventory Measurement (AIM). This test requires students to self-report on how they deal with issues at school, at home, with friends and on internal self-talk. The pre-test results reinforced the need for this school to implement the HeartMath training, indicating that this group of students was at-risk for anxiety, school drop-out, risky behavior problems and negative peer influence.

Following the 16 hour HeartMath training in the Fall of 1996, there were significant improvements in 18 of the 19 scales measured by the inventory. Highly significant changes ( $p < .0000$ ) occurred in the following 5 scales: decrease in Risky Behaviors, highly increased Teacher Comfort, decreased aggressive behavior on Anger Management, improved perception of Family Support and Satisfaction and a 100% increase in perceived Locus of Control (indicating increased self-control at school, at home and with friends and decreased negative self-talk). In addition, there were significant improvements in Motivation, Energy, Work Management, Peer Influence, Assertiveness, perceptions of Peer Support/Satisfaction, Peer Empathy/Outgoingness, Family Compliance/Participation, School Attitude, Self-Reliance and Stress Management. A large percentage of the students’ parents have now also been trained in the HeartMath techniques in order

to have a common language and set of tools.

The positive results led to a second phase of the study. Of the original seventh graders in the study, 15 began a program in which they volunteered their time once a week to provide tutoring in the HeartMath techniques to 55 at-risk second and third graders. A 6 month follow up assessment was given to the 15 middle school mentors in May, 1997. The results indicated sustained gains in all 19 scales of the AIM assessment.

A third phase began in the fall of 1997 with two, full year elective courses called Heart Smarts being offered to 62 middle school students. The curriculum offers a series of tools and strategies to help students reduce stress, sustain academic focus, improve communication skills, and enhance peer, teacher and family relationships. It includes another cross-age mentoring program in the Spring of 1998 directed at approximately 150 elementary students. Parents are required to be involved in the training process. Psychometric assessments will be conducted including a control group using the BRP 2 scale (Behavior Rating Profile) to measure behavior in areas of school and home attitude. Plans are underway to expand the program over a 4 year period to more than 1500 students, teachers, parents and local organizations.

#### Creighton Elementary School District Summer Academy, Phoenix, Arizona

Independent investigation conducted by Edie Fritz, Ph.D.:

**Key findings:** The tools not only allow children to better manage their emotions and respond to stress, but also facilitate learning. Fourteen days of instruction in the HeartMath techniques allowed a special education class of fifth and sixth graders to significantly improve their reading levels.

**Summary:** Dr. Edie Fritz, an educational psychologist at an inner city Phoenix elementary school, has been working with learning disabled students using some of the HeartMath tools. During a three week summer session in 1996, a small group of struggling fifth and sixth graders, most with behavioral and/or academic problems were placed in her class, which she called, "How to Be Cool: Learn to Manage Your Anger and Improve Reading." The class was intended to improve reading skills and allow many of the children to be promoted to the next grade. The class met for 1.25 hours each day for a total of 14 days within a 3-week period. Pre and post evaluations of students' reading skills were accomplished using the WRAT test, a Norm Referenced Wide Range Achievement Test.

In their regular classes, the students had already practiced a variety of learning methodologies for years, with very minimal improvement, and their self-esteem was extremely low. Dr. Fritz perceived that the students were under tremendous stress, and had learned to cope in one of two basic ways: acting out the frustration and rage they felt in a defiant, aggressive manner or withdrawing and retreating from these feelings of being battered. Given the short time period available and her perception of the children's true needs, Dr. Fritz decided to focus on teaching the students the HeartMath techniques and provided very little traditional reading instruction. At the end of the 3 weeks, not only were improvements in the classroom environment and the children's inner attitudes apparent, but every student's reading scores improved dramatically, ranging from a two month jump in reading aptitude for a bilingual student to over three years growth (mean

improvement = 1.5 years growth in reading skills). Dr. Fritz's conclusion: *"When techniques are presented that children are able to internalize and use to reduce stress, reduce the emotional pain of perceived failure, develop more sensitive communication and relax, they are able to access what they have already learned."*

Stanford University, Stanford, California. The Effect of Forgiveness Training on Psychosocial Factors in College Age Adults

Researched by Frederic Luskin, MFCC., Ph.D., Dissertation, Counseling Psychology, Stanford University.

**Key findings:** A six-hour program integrating the HeartMath techniques was effective in decreasing trait anger, improving psychosocial functioning and increasing the tendency to use forgiveness as a problem-solving strategy in college-aged students.

Unresolved issues between people who live or work closely together can often create feelings of hostility and tension and can become a significant ongoing energy drain. Gaining the capacity to find peace within ourselves relative to past occurrences that have caused us anger or hurt and to truly forgive others is an essential aspect of our own process of self-empowerment. The purpose of this study was to determine the effectiveness of integrating the HeartMath techniques as part of a training program designed to decrease anger, improve psychosocial well-being and encourage forgiveness in college students with unresolved interpersonal emotional conflicts.

Fifty-five Stanford University students were recruited who had an unresolved interpersonal hurt involving someone with whom they were in close relationship. The hurt could not involve an act of abuse or be the result of a crime. After randomization, 28 students received a six-hour training in forgiveness based upon an integration of HeartMath and the cognitive disputation techniques of Rational Emotive Therapy. Twenty-seven students served as a wait-listed control.

The HeartMath component (approximately 60-65% of the training) included the application of the Freeze-Frame and Heart Lock-In® techniques to help participants achieve the inner states of appreciation and "neutral." These techniques were interwoven with the disputation of the cognitive processes that create anger or hurt in the first place. Participants were assessed by self-report measures and their response to a vignette, at baseline, at the completion of the training and again 10 weeks later.

The research hypotheses for the study were that the intervention group relative to the control group would improve as a result of the training in five broad areas: Anger Management, Degree of Hurt, Forgiveness as a Major Problem-solving Strategy, Forgiveness of Interpersonal Hurt and Psychosocial Functioning.

Results of the training for the treatment group indicated significant reductions in Trait Anger, Angry Reaction, State Anger, and Specific Interpersonal Hurt in Post-test and Follow-up. The treatment group also showed a significant change in willingness to forgive and were shown to be more forgiving on the Total Response to the Interpersonal Hurt Vignette. They improved in areas of Hopefulness, Self-efficacy, Quality of Life Issues, and Principles of Living Personal Growth and Compassion. In short, the study met at least four of the five broad goals. Treatment group partici-

pants became less angry, improved psychosocial functioning, became more willing to choose forgiveness as a problem-solving strategy and felt less hurt than the control group participants. In regards to the specific hurt which brought each participant to the study, it was found that women were able to forgive more rapidly.

Of interest is the fact that at baseline, subjects had psychosocial scores in the normal or average range. That improvement was observed in this population suggests that this brief intervention could help improve psychosocial functioning even in healthy individuals. These results indicate that negative emotions and psychosocial traits induced by past events can be released in a short period of time if individuals are provided with training in the appropriate tools and techniques to achieve the desired perceptual shifts. The data suggest that the techniques provided in this program were effective in helping students gain greater clarity and wider perspectives, allowing them to transmute the source of their emotional unrest. Such a training program could serve as a valuable addition to a college curriculum, given its effectiveness in facilitating anger reduction and psychosocial improvements in a brief period of time even in student groups with normal baseline psychological scores.

DeKalb County School System, Georgia:

Independent study of educational professionals commissioned by Eugene Walker, Ph.D

**Key findings:** A group of educational professionals trained in the HeartMath techniques found them to be of significant value applied to challenges in the field of education.

**Summary:** The DeKalb County school system utilized the services of HeartMath to provide training and facilitation to 20 key administrative leaders and 90 Human Relations representatives from the school system. A formal evaluation of the training and analysis of the results was commissioned by Associate Superintendent, Dr. Eugene Walker. The following table shows the percentages of participants in the two groups who either “strongly agreed” or “agreed” that the HeartMath program had significant value and applicability. Specifically, participants rated the training as follows:

- value related to work and life	98.8% to 100%
- value of application to job challenges,	85% to 95.4%;
- value of recommending this training to other educators,	85.5% to 92.1%;
- value as a means of conflict resolution,	84.2% to 94.5%.

Dr. Walker’s conclusion: “This work had very significant value to a broad spectrum of the district’s personnel. I have no hesitation in commending their (IHM) integrity or the effectiveness of their work.”

**The Los Angeles County Office of Education, Migrant Education Division,** has trained over 1200 parents and teens using HeartMath tools. Now in its fourth year and integrated as part of a Family Wellness Program, the tools have been widely recognized as a vital component in *helping migrant families better integrate into American culture and cope with a multitude of challenges like violence, poverty, fear and isolation.* Currently, the program has expanded to 13 preschool



sites. A staff counselor has been trained along with 8 parent mentors. Programs are available in both English and Spanish languages.

**The New Horizons Elementary School in Fremont, California** has recently integrated the HeartMath curriculum into every classroom. Recognizing the critical role of the students' mental and emotional health in academic and developmental success, the administration has recommended that daily HeartMath lessons be woven into the schedule of academic classes. The overall response has been very positive with decreases in playground conflicts and a general increase in the warmth and support of the school culture. Kay Liu, the head administrator commented, "The children now have tools to deal with conflicts and a way to communicate without antagonizing their classmates."

## IHM Tools

An important contribution of IHM research is how problematic emotional and intellectual development can be corrected or at least improved. IHM has developed simple applications and tools to help parents, caregivers, and children to shift out of worry, frustration, anger, anxiety, stress and incoherence to bring their heart/brain rhythms back into greater coherence.

### Freeze-Frame

The purpose of Freeze-Frame is to intervene in the moment when stress is happening. This technique instructs people to consciously disengage from negative mental and emotional reactions by shifting their attention to the area around the heart, then self-generating a sincere positive feeling state, such as appreciation or caring. This tool can be very powerful and, with practice, can be done in less than a minute. Freeze-Frame assists children with impulse control and problem-solving as well as enhancing creativity and activating heart intelligence in the moment. Freeze-Frame assists teachers in stress relief, problem-solving, creativity, dealing with school administration, other teachers, as well as classroom and student concerns.

### Heart Lock-In

The Heart Lock-In is a tool which enables people to “lock in” to sustained positive feeling states associated with the heart in order to boost their energy, heighten peace and clarity, and effectively retrain their physiology to sustain longer periods of coherent function. This technique has been effective in helping to balance heart rhythms, emotional states, hormonal and autonomic function. In the classroom the Heart Lock-In can be used to increase classroom harmony and entrainment, facilitate learning and create a positive atmosphere for focused work assignments or test-taking.

### Cut-Thru

Cut-Thru is a tool which helps adults and children release lingering feelings of worry, anxiety, insecurity, guilt or fear, and find new insights and understanding. It helps children and adults face situations with balanced care and to let go of overcares.

### Authentic Communication

Lack of good communication between people is a major source of inner turmoil and stress. Poor communication between a child and teacher or between children may lead to an atmosphere that hinders full learning potential. Authentic communication can be achieved by learning to deeply listen from a focused heart to the true intent and meaning of what other people say as well as learning to clearly and effectively state one’s needs and desires. HeartMath tools are designed to facilitate this process.

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**References:**

1. McClelland DC and Jemmott JB. Power motivation, stress, and physical illness. *Journal of Human Stress*. 1980;6:6-15.
2. McCraty R, Atkinson M, Tiller WA, *et al*. The effects of emotions on short term heart rate variability using power spectrum analysis. *American Journal of Cardiology*. 1995;76:1089-1093.
3. McCraty R, Tiller WA, and Atkinson M. *Head-Heart Entrainment: A Preliminary survey. Integrating the Science and Art of Energy Medicine*. 1995. Boulder, Colorado: ISSSEEM.
4. McCraty R, Atkinson M, Rein G, *et al*. Music enhances the effect of positive emotional states on salivary IgA. *Stress Medicine*. 1996;12:167-175.
5. Tiller W, McCraty R, and Atkinson M. Cardiac coherence: A new non-invasive measure of autonomic system order. *Alternative Therapies*. 1996;2(1):52-65.
6. McCraty R, Barrios-Choplin B, Rozman D, *et al*. New stress management program increases DHEA and reduces cortisol levels. *Integrative Physiological and Behavioral Science*. 1998.
7. Childre DL. Freeze-Frame, Fast Action Stress Relief. Boulder Creek: Planetary Publications, 1994.
8. Childre DL. Cut-Thru. Boulder Creek: Planetary Publications, 1996.
9. Armour J and Ardell J. eds. *Neurocardiology*. 1994, Oxford University Press: New York, NY.
10. Schandry R, Sparrer B, and Weitkunat R. From the heart to the brain: a study of heartbeat contingent scalp potentials. *International Journal of Neuroscience*. 1986;30:261-275.

- 11 Schandry R and Montoya P. Event-related brain potentials and the processing of cardiac activity. *Biological Psychology*. 1996;42:75-85.
12. McCraty R and Watkins A. Autonomic Assessment Report Interpretation Guide. Boulder Creek, CA: Institute of HeartMath, 1996.
13. McCraty R, Atkinson M, Tomasino D, et al. *The Electricity of Touch: Detection and measurement of cardiac energy exchange between people*. in *The Fifth Appalachian Conference on Neurobehavioral Dynamics: Brain and Values*. 1996. Radford VA: Lawrence Erlbaum Associates, Inc. Mahwah, NJ.
14. LeDoux J. *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York: Simon and Schuster, 1996.
15. Goleman D. *Emotional Intelligence*. NY: Bantam Books, 1995.
16. Pribram KH. *Languages of the Brain*. New York: Brandon House, Inc, 1971.

### **Additional Resources:**

1. Childre DL. *A Parenting Manual*. Boulder Creek, CA: Planetary Publications, 1995.
2. Childre DL. *Teaching Children to Love: 80 Games and Activities for Raising Balanced Children in Unbalanced Times*. Boulder Creek, CA: Planetary Publications, 1996.
3. Childre DL. *Heart Zones*. Boulder Creek, CA: Planetary Publications; 1991.
4. Childre DL. *Speed of Balance - A Musical Adventure for Emotional and Mental Regeneration*. Boulder Creek, CA: Planetary Publications; 1995.
5. Gamble T and Zigler E. Effects of infant day care: Another look at the evidence. *American Journal of Orthopsychiatry*. 1986;56:26-42.
6. Garmezny N and Rutter M. Street resistant children: The search for protective factors. In: Rutter M and Hersov L, *Child and Adolescent Psychiatry: Modern Approaches*. London: Blackwell Scientific Publications, 1985.
7. Lacey JI and Lacey BC. Two-way communication between the heart and the brain: Significance of time within the cardiac cycle. *American Psychologist*. 1978(February):99-113.
8. Lacey JI and Lacey BC. On heart rate responses and behavior: A reply to Elliot. *Journal of Personality and Social Psychology*. 1974;30:1-18.
9. Luthar S and Zigler E. Vulnerability and competence: A review of research on resilience in childhood. *American Journal of Orthopsychiatry*. 1991;61(1):6-22.
10. McCraty R, Barrios-Choplin B, Atkinson M, et al. The effects of different types of music on mood, tension and mental clarity. *Alternative Therapies in Health and Medicine*. 1998;4(1):75-84.
11. Pribram K and Rozman D: Early childhood development and learning: what new research on the heart and brain tells us about our youngest children. Paper presented at the *White House Conference on Early Childhood Development and Learning*, San Francisco, 1997.
12. Resnick M, Harris L, and Blum R. The impact of caring and connectedness on adolescent health and well-being. *Journal of Pediatric Child Health*. 1993;29(Suppl 1):S3-S9.
13. Rozman D. *Meditating With Children: The Art of Concentration and Centering*. Boulder Creek, CA: Planetary Publications, 1975.
14. Runyan D. *Pediatrics*. 1998;101:12-18.
15. Russek L and Schwartz G. Interpersonal Heart-Brain Registration and the Perception of Parental Love: A 42 Year Follow-Up of the Harvard Mastery of Stress Study. *Subtle Energies*. 1994;5(3):195-208
16. Werner E and Smith R. *Vulnerable but invincible: A longitudinal study of resilient children and youth*. New York: McGraw-Hill, 1982.