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ABSTRACT

This book is to be used with a multimedia presentation that is available on compact disc. The book and multimedia presentation are designed to help parents and childcare providers understand the concept of early exposure and exploration that is followed by increased development of synaptic connections and ultimately prepares children to handle preschool and kindergarten school work. Topics discussed in the book are: the developing brain; the enriched environment; programs specializing in early intervention; and kindergarten readiness. A checklist for parents concerning quality care and preschool, a glossary of relevant terms, and a list of recommendations for implementing ideas presented within the book are included. Appendix A provides information on Functional Magnetic Resonance Imaging and Positron Emission Tomography. Appendix B provides guidelines for utilizing the multimedia disc presentation. Appendix C provides a brief synopsis of information provided earlier in the book. (Contains 69 references.) (MKA)

# BrainWorks




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**BRAINWORKS: Birth to Kindergarten**



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# ACKNOWLEDGMENTS

Deciding to write a book about how children learn was easy; experts in child development, psychology and psychiatry do it often enough. But, for two elementary school teachers, to attempt to unravel the tremendously complex, and fast-emerging, neuroscientific information on how the brain works presented a daunting challenge. Our professor/advisor, Larry Hannah (California State University, Sacramento) provided the impetus and guidance to follow the project to completion. Larry, and superintendent Del Alberti (Lodi Unified School District, California), were the visionaries who pushed through barriers to establish the CSU-Lodi Unified Master's Degree Cohort program which led to this work. Our gratitude to both of them. To loved ones, relatives and friends who spurred us on when the going was tough, thank you!

Our respect and admiration for science writers Sandra Blakeslee (The New York Times), Ron Kotulak (The Chicago Tribune) and Robert Hotz (Los Angeles Times), among others, are immense. Their ability to put extremely complex information in words the rest of us can understand is truly a rare gift. To all of you, thank you!!

Joyce L. Goss

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# INTRODUCTION

Recent advances in the neurosciences using high resolution imaging scanning technology have demonstrated the superb ability of the brain to grasp, retain and process the information with which it is challenged. One thing is obvious: A child's mind continues to develop for a lifetime.

Too many children often lack the basic skills needed for kindergarten. To get them ready, young parents and early childhood care providers must possess basic knowledge about how the brain works. This is an attempt to provide it.

Here they will learn basic concepts about how the developing brain works, how it learns and how to make those brains thrive. Ultimately, the goal is to have children prepared and ready for school.

The multimedia presentation and its accompanying primer are designed to help parents and childcare providers understand:

- The concept of early exposure and exploration which is followed by
- increased development of synaptic connections which ultimately prepares the child to
- handle pre-school and kindergarten school work.

The primer and multimedia presentation are designed for easy use. Despite the complexity of the material being discussed, all can learn from the information presented. The multimedia disc is self-directed. The primer contains additional material and is a helpful adjunct for those who may not have access to a computer system.

The primer facilitates the expansion of specific concepts for use by wider audiences; topics are introduced sequentially and, in greater detail than it is feasible in the multimedia presentation.

Topics discussed:

The Developing Brain.

The Enriched Environment.

Quality Care/Preschool. A Parents' checklist.

Programs Specializing in Early Intervention.

Kindergarten Readiness.

The multimedia disc-primer combination gives this book a practical appeal and provides a more effective means of presenting the material; this is important because data in the neurosciences has become vast, and increasingly complex, during the past decade.

The unavoidable need to limit the scope of our discussion forced us to restrict the commentary of some very important areas of research associated with early brain development: language acquisition, the role of music (e.g., Mozart) in priming the infant's brain for learning, the potentially harmful effects of over-stimulation, on emerging medical evidence relating to dyslexia as a brain anomaly, fetal alcohol syndrome and the deleterious effects of maternal drug use on fetal brain development. We will address those areas in subsequent publications.

# GLOSSARY

Amygdala: An almond-shaped structure in the brain's temporal lobe, believed to be involved in emotion, emotional learning and memory.

Functional brain imagining: Any of the techniques used to take pictures of the brain at work. These include Positron Emission Tomography (PET), functional Magnetic Resonance Imaging (FMRI), electroencephaography (EEG) and other methods .

FMRI (Functional Magnetic Resonance Imaging): The most popular and innovative technique in brain scanning. It allows visualization of mental activity, as it occurs, over shorter intervals than PET, with sharper anatomical detail.

Limbic system: A group of interconnected structures around the brain stem involved in emotion, learning and memory. It was once thought to be our emotional center, but now scientists are finding our brain's emotional universe is much more sprawling.

Neuro-transmitter: A complex molecule that acts as a chemical messenger, conveying electrical signals between brain cells, or neurons.

Neuron or nerve cell: The brain's "computer chips" which receive, coordinate, analyze and transmit information. Each brain contain billions of these cells.

PET (Positron Emission Tomography): A type of functional imaging which uses a scanner to make a series of slice-like images of the brain; when combined later, the images provide three-dimensional images from any angle.

Prefrontal cortex: The part of the brain's cortex, behind the forehead, linked with making decisions, judgments and setting emotional tone.

Synapses: The junctions by which nerve cells link to one another: There are trillions of these structures, which form when tiny tentacles from neighboring neurons connect.

# THE LEARNING POTENTIAL

Catherine Phillips is one of the students at the Institute for the Achievement of Human Potential (IHP) just outside of Philadelphia. There, children from birth to about 13 years of age embark in a program consisting of mathematics, foreign languages (Japanese is popular), the arts, reading, writing and, of course, physical fitness. This ambitious endeavor is designed to intensify these children's ability to learn. During a visit to IHP, education reporter R. Johnson observed a presentation by Catherine Phillips, age five and quoted her opening statement:

***Today, I am going to do a demonstration of conic sections and the Cartesian plane.***

Glenn Doman founded the Institute in the 1970s with this revolutionary idea: Every child born has, at the moment of birth, a greater potential intelligence than Leonardo da Vinci ever used, and Leonardo was a genius! (Doman, 1984; Doman, Doman & Aisen, 1985; Doman, 1989) While thirty years ago such a concept may have been thought of as preposterous, recent advances in neuroscience have proven him correct: Children, from very early infancy and, perhaps, even in the prenatal stage, are endowed with an enormous capacity to learn. Those charged with the responsibility for their care must nurture and enhance the prodigious ability children have to develop their brain power (Caine & Caine, 1994; Sylvester, 1995).

# HOW THE BRAIN WORKS

Since 1993, when Dr. Jay Giedd began to use scanning technology to examine the working brains of young children and adolescents, enormous strides have been made in our understanding of the development of the normal human brain. The refining of high resolution functional imaging techniques, such as Positron Emission Tomography (PET) and Magnetic Resonance Imaging (FMRI), are among the greatest advances in brain research because, unlike structural imaging such as x rays which records anatomy, they allow scientists to watch the brain at work (Dillon, 1998; Gilman, 1998; Lyon and Rumsey, 1996; Nessa et al.1995; Carter, 1998). How does the brain work?

The brain is composed of cells called neurons. Each brain has billions of them, linked by trillions of structures, known as synapses, that form when tiny tentacles from neighboring neurons connect. In the first years of life the brain looks like Grand Central Station at warp speed, with the number of tracks multiplying at an exponential rate. To get an idea of the pace of construction inside an infant's brain, consider this: By the age of two, a healthy child will have a bounty of synapses, a number equal to that of an adult. By age three, that number has blossomed to 1,000 trillion, twice the number in mom or dad's brain. At the same time connections are being made, other tracks are disappearing. The more interaction, the more

stimulation, the greater the number of connections that survive (Diamond & Hopson, 1998). How does the brain know which tracks to delete, which to preserve? The research shows that when there is healthy mental stimulation, traffic moves along the tracks in the brain, and all the synapses along the tracks receive and stores chemical signals. Keep turning on the synapses over and over and they get stronger and stronger until they cross a threshold that wards off elimination. In other words, just like it happens with muscles, if you don't use them you lose them.

It is now well established that the basic foundations for language, thinking, vision, aptitudes, behavior or attitude and many other human characteristics are set during the first three years of life. The conduits are then closed and, for practical purposes, the basic architecture of the brain has been laid out (Barnet & Barnet, 1998). Many neurobiologists and psychiatrists feel that a type of irreversibility sets in. There is this shaping process that goes on early, and then at the end be that age two, three or four, you have essentially designed a brain that probably is not going to change very much more (Diamond & Hopson, 1998).

These findings lead to the ongoing debate over nature, your genes, versus nurture, your environment. When applied to early childhood education, the question becomes: is our traditional educational system failing to tap the capability for learning which very young children's brains possess?

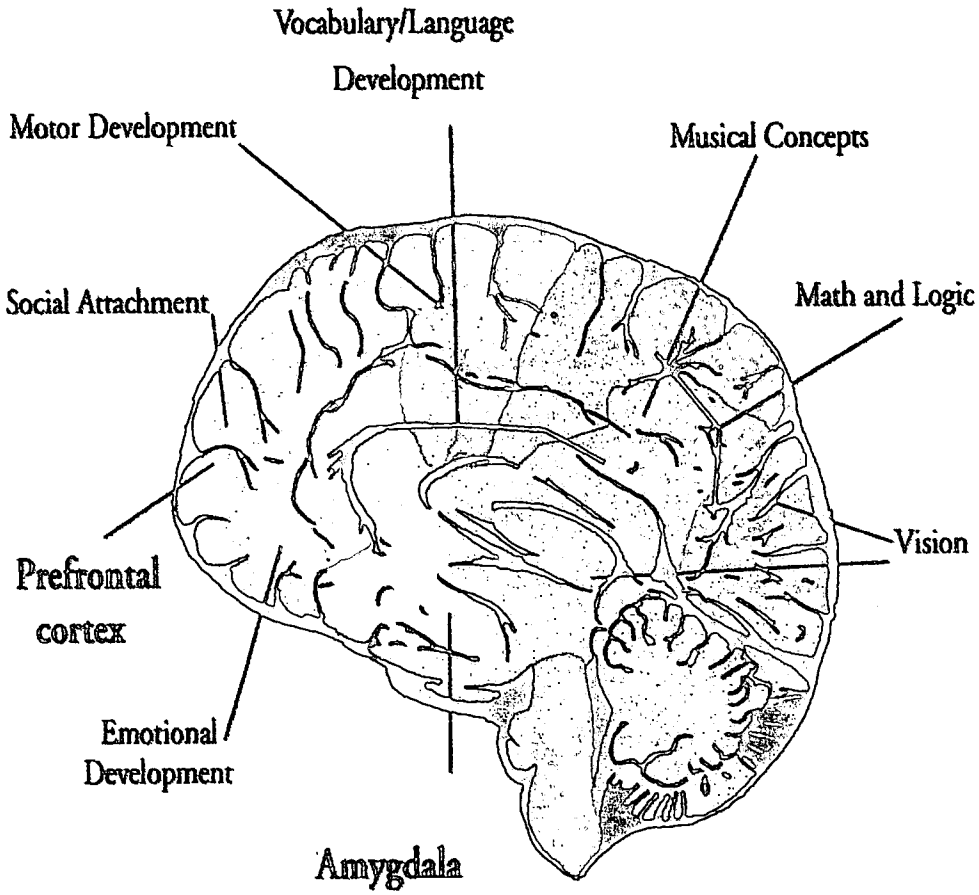
The environment affects how genes work, and genes determine how the environment is interpreted, so nature vs. nurture is no longer the issue. It is both: how genes interact with environment and how nurture reshapes nature. The "use-it-or-lose-it" concept can certainly be applied to the brain; while always ready to learn new skills, it is dependent on whether or not it is used. As an example, it is the brain's learning to read which leads it to develop the ability to form abstract thoughts (Kotulak, 1996).

An enriched, nurturing environment, such as physical activity, richness of talk, things to handle, to look at, to smell, directs the brain to develop more synapses which leads to more effective learning and remembering. This in turn produces a smarter biological brain conducive to a child:

- developing positive values and attitudes
- having a higher notion of self-worth
- having more effective coping skills
- avoiding risky behaviors
- associating with others who have similar views.

An impoverished environment leads the child's brain to sub-optimal development, resulting in early failure at school, including pre-school, and vulnerability to a wide range of behavioral problems.

# Areas of the Brain



# CHILD'S MIND

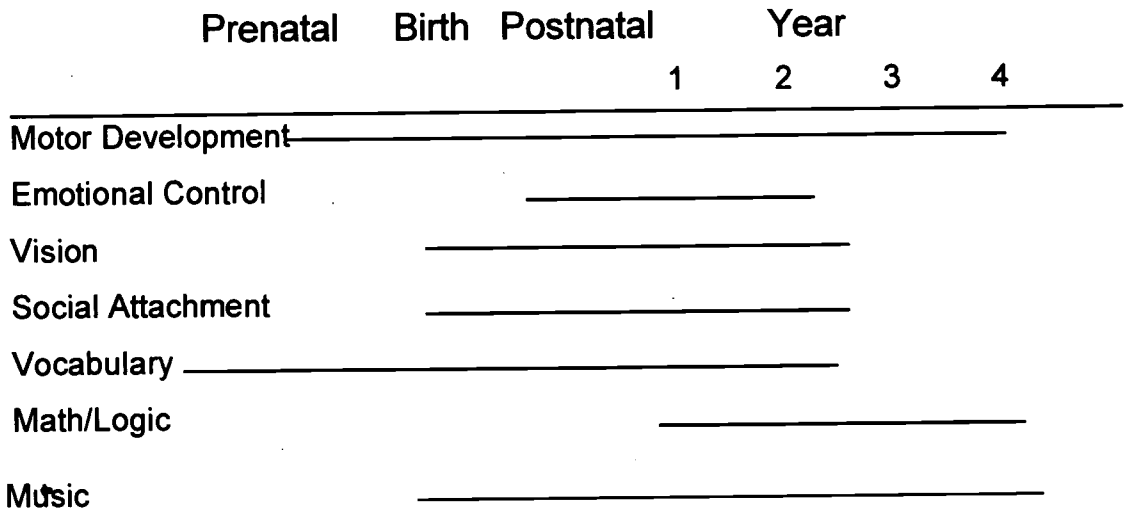
What goes on inside the mind of a child? Lets take a peek. Recent advances in the neurosciences have shown a correlation between brain development and the growing mind. It is true that brain development goes on throughout life, and at each stage of development different types of stimulation lead to enhanced mental capabilities and growth (Wade, 1998). It is in the very early years, however, that the most dramatic growth in the brain's size and in its internal architecture takes place. Prenatal and postnatal experiences stimulate the myriad connections (i.e., synapses) between neurons which, ultimately, lead the individual's brain to function at high capacity (i.e., optimally) or at low capacity (i.e., poorly). The depth and intensity of early everyday experiences, and the richness of the environment, stimulate the infant's brain at a more or less rapid pace. The infant's brain development is enhanced by responding to sights, smells, sounds, the social interaction with parents and other living beings, animated play with care givers, and the manipulation of playthings and interesting toys.

Researchers agree that, at birth, humans do not yet possess a fully operational brain. The one that eventually takes shape is the result of interaction between the individual's genetic inheritance and everything he or she experiences.

Ronald Kotulak, in his book Inside the Brain (1996), uses this metaphor to explain the gene-environment relationship.

> The brain gobbles up the external environment through its sensory system and then reassembles the digested world in the form of trillions of connections which are constantly growing or dying, becoming stronger or weaker depending on the richness of the banquet.

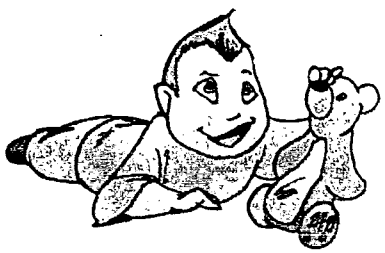
Different parts of the brain mature at different rates; this phenomenon can be summarized using this simple diagram.




Brain Development Stages

**Motor Development (Prenatal to fourth year)**

Motor skills undergo prodigious development prenatally and into the fourth year of life. According to Piaget (1969), children's cognitive growth follows a series of "discrete stops" triggered by the



development of motor skills by about the age of two; translation: Children learn by manipulating the world which surrounds them.

But until then, what were these babies? In the past they were thought to be mostly blank, passive creatures marking time while their brain cells multiplied and made the necessary connections to their muscles so their motor skills could begin to develop. Nothing can be further from the truth.

Dr. Amy Needham, professor of psychology at Duke University, has shown that: (a) by three months of age babies have developed enough cognition to be surprised when an object, such as a ball, comes to rest in midair; (b) by three months of age babies show bewilderment when objects that don't seem to be attached to one another behave as though they are.

These findings, along with those of several other research groups, indicate babies remember objects, have a general idea on how they fall (i.e., the influence of gravity), and can classify them by shape and behavior (Franklin, J. 1999: Needham, A. & Baillargeon, R. 1993).

Piaget and his followers assumed that conceptual thought is based on language, but since the babies studied by Needham, Wynn and others are pre-verbal, this assumption can be effectively challenged. Furthermore Piaget appears to have seriously underestimated babies' ability to learn; His ideas: that motor skills lead to cognitive ones, that organized patterns of thought kick in at about age seven and formal logic not until age twelve are now undergoing serious reappraisal. The problem, in all fairness to Piaget,

lies in several factors: he didn't study infant behavior; his findings were drawn from conversations with children; his idea was that young infants, being non-verbal, were essentially vegetative little creatures; and he spent most of his career working with older children and did not begin to study infants until late in his life. While devotees of Piaget may find it difficult to accept these recent research findings, nonetheless, today one thing is certain: Cognitive development surges ahead while motor skills bring up the rear.

While this concept may seem to be a radical departure from earlier ones, it appears to be the evolving one. Children have the desire to walk, for example, long before they can actually do so. They can conceptualize the idea of walking before the motor skills are developed (Franklin, 1999; Woodward, 1998).

**Emotional Control (Six months to two years)**

Emotions reflect one of the brain's most highly developed computational skills. Not surprisingly, during the past eight to ten years, the study of emotions has become a major area of investigation for neuroscientists, child development experts and psychiatrists alike. The problem lies in providing an effective, workable definition of the term because emotions are viewed as feelings accessed by

"conscious awareness;" but consciousness is difficult to define and impossible to measure (Siegfried,1996).

In babies this presents a very serious problem since, not having developed language skills, they are unable to explain their level of consciousness. A more efficient way is to approach the study of emotion on the basics of brain cell activity, nerve circuits and interacting molecules. Joseph Le Doux, neuroscientist at New York University, suggest emotion be thought of in terms of computational processes. His view is that they (emotions) are the result of sophisticated information processing by brains; sensory input is transformed into behavioral output by the nervous system's actions modulated by emotions. An analogy would be the conversion of keyboard symbols into screen displays according to the rules of a software program.

In other words, the brain's neural circuitry evolves to equip its owner with effective survival skills which require proper responses to emotion-induced situations. Presently there is little doubt emotion-induced behavior develops long before the more sophisticated "conscious awareness" of feelings.

Babies learn to fear, for example, very early and respond accordingly by calling upon the neural circuits of a structure in the brain known as the **amygdala.** A damaged amygdala diminishes the infant's emotional response and impairs the ability to learn of new dangers (LeDoux, 1996).

In fact, recent studies have shown the amygdala is involved not only in negative behavioral messages, such as fear, but in positive ones also, and its circuitry plays a very important role in controlling the intensity of emotional arousal.

The important lesson for parents and educators to extract from this research is that learning is strongly influenced by emotion. Recent works by Daniel Goleman (1995) and Le Doux show emotions play a dual role in learning. The more powerful the emotion associated with any given experience, the more powerful the memory derived from that experience. But, if the strong emotion is perceived by the learner as harmful or threatening, the ability to learn from it is decreased. Positive emotions enhance learning, negative ones blunt it!

EMOTIONS

| Positive | Negative |
|---|---|
| Happy environment | Fear and anger |
| Intellectual stimulation | Malnutrition |
| Good Nutrition | Toxins |
| Good Health | Physical abuse/drug use |

The amygdala responds accordingly (Barnet & Barnet, 1998). The question arises: Is a child's disposition and his/her emotional response to differing environmental situations a product of nature, a product of nurture, or both? No one can tell for sure, but emerging research is beginning to shed some

light on these questions. Dramatic advances in instruments and techniques are providing neuroscientists with the necessary armamentarium to track the physical origins of emotion.

**Vision (Birth to two and one-half years)**

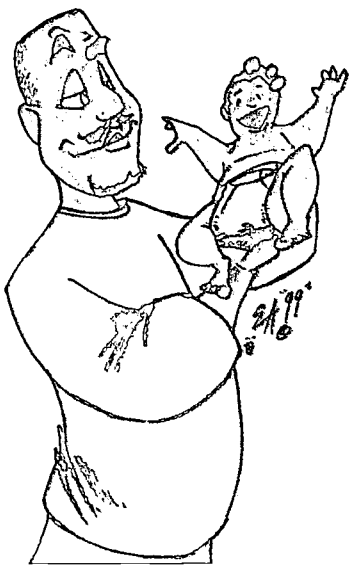

Tremendous insight into the developing brain has been gained by the use of imaging techniques pioneered by Harry Chugani and Michael Phelps at the UCLA School of Medicine. In particular, Positron Emission Tomography (PET), which looks at the living brain's utilization of energy under different conditions, has been very useful. Dr. Chugani has viewed brains at different ages and his studies conclude that a child's peak learning ability encompasses the ages birth to ten years, when maximal synaptic connectivity occurs. The brain undergoes periods of rapid development interspersed with slower ones; that is, it demonstrates great adaptability when responding to various stimuli and environmental situations (Chugani, 1996).

This is known as the brain's plasticity, its ability to be more or less responsive at different stages of development, its ability to open windows of opportunity for learning and then, at a given time, close them (Davidson, 1994; Kolb, 1995).

The development of vision illustrates this concept well. Lack of visual stimulation at birth causes those cells in the brain designed to interpret vision to degenerate, atrophy or become engaged in other tasks. Childhood cataracts and blindness are prime examples of this. The consensus is that if by age three sight is not restored, the child will be permanently blind. That is to say, the cell's window of opportunity to learn vision and vision-related tasks was not utilized (Wade, 1998).

**Social Attachment (Birth to two and one-half years)**

A very close correlation exists between a child's emotional development and his/her development as a "social being." The amygdala and other components of what is known as the limbic system (i.e., hypothalamus and thalamus), the frontal lobes and the reticular formation in the brain stem all work together to effectively develop emotions and, subsequently, emotional/social attachments.



It is known that by the second half of a baby's first year, the brain's frontal lobes have matured significantly allowing them to begin controlling their own behavior (Diamond & Hopson, 1998). In conjunction with the limbic system, which matures next, and the reticular formation, which controls

alertness but is already fairly mature at birth, the baby's brain begins to set up the stage for the formation of social attachments. Geraldine Dawson's electroencephalographic (EEG) data have shown that the activity patterns in the frontal lobe of a baby's brain respond to the mother's moods and parenting style; depressed mothers pass their affect to their young. The babies exhibit increased activity of the right frontal lobe, associated with inhibition, even when playing simple games such as peekaboo. To the contrary, this phenomenon was not observed in the brains of babies with happy, non-depressed mothers (1998).

At the University of Wisconsin, Dr. Richard Davidson and his colleagues also measured brain waves by EEG and discovered higher activity in the **RIGHT FRONTAL LOBE** when children were sad, stressed or disgusted, emotions which lead to social withdrawal. By comparison, feelings of joy, interest in situations and even anger associated with active engagement, were associated with increased activity of the **LEFT FRONTAL LOBE** (Diamond & Hopson, 1998). All of this is fine in theory; but can we, actually, pinpoint the connection between brain function, emotion and socialization in a practical manner? Yes! Examples abound.

In the early 1900s, John Watson co-founded the Behavior Movement along with B. F. Skinner and Albert Ellis. The Movement insisted that to guarantee "minimal fixations," children should be seen and not kissed, seen but not touched and, certainly, not hugged (Diamond & Hopson, 1998).

Watson applied this social engineering theory to his own three children which resulted in a devastating social-emotional deprivation. Actress Mariette Hartley, in her book "Breaking the Silence," described the traumatic effects of this unbelievable, misguided attempt to prove the theory's validity.

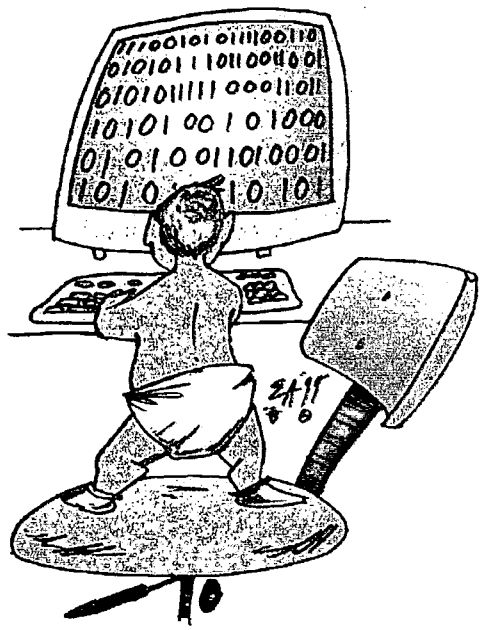
Hartley, Watson's granddaughter, told the story of her mother and uncles' suffering caused by the behavioral consequences derived from growing under his antiseptic regimen. These included dropping out of school, attempts at suicide and generalized unhappiness and dysfunctionality. The corollary here is simple: Watson's children, just like Skinner's rats and monkeys, experienced altered brain development in those structures governing emotion and, later, effective socialization (Diamond & Hopson, 1998).

A more recent and extremely tragic example involves the children raised in Rumanian orphanages who, in the absence of nurturing human contact, have altered brain development, lower IQ scores, small stature and abnormal behavior (Perry, 1994).

On the other hand, a caregiver's soothing touch, constant eye contact, nurturing voice and interactive environment allow an infant to thrive and grow. To summarize, a child, who is neglected in the first year will lower his/her potential along a wide spectrum of developmental stages.

**Math and Logic (One to four years)**

Children as young as age three can add and subtract. These skills are not related to their socioeconomic background; this concept offers tremendous implications because our targeted audience is, in fact, the very low socioeconomic level family. It has been shown that while toddlers from disadvantaged backgrounds do not possess the language skills to answer math questions verbally, they are able to work out problems when teachers use concrete objects instead of verbal cues.



Susan Levine and Janellen Huttenlocker, psychology professors at the University of Chicago, studied children at the University's lab school and concluded that as children approach the age of three, they begin to develop non-verbal calculation. In an experiment the researchers showed toddlers two black discs which were then slid under a box. With the children watching, a third disc was then placed with the others. When asked to make an identical pile of the total number of discs placed under the box, the toddlers correctly made piles of three (1998). In another experiment the children were shown

two black discs, which were then removed: When shown cards with different numbers of discs and asked to pick the correct card, they invariable chose the one with a picture of two discs. Conclusion? Children as young as three can do abstract calculations and are able to work out simple math problems (Kunzig, 1997).

**Music (Birth to four years)**

It is now a well-established fact that music helps keep the brain tuned. Studies conducted by neuroscientist Anne Blood from McGill University in Montreal, reported at the annual meeting of the Society for Neuroscience in Los Angeles, indicate music stimulates specific regions of the brain responsible for motor control, memory, timing and language (Society for Neuroscience Proceedings, 1998).

For the first time, specific areas of mental activity linked to emotional responses elicited by music have been identified. The brain responds directly to harmony, interprets musical scores and notes in a specific area of its right

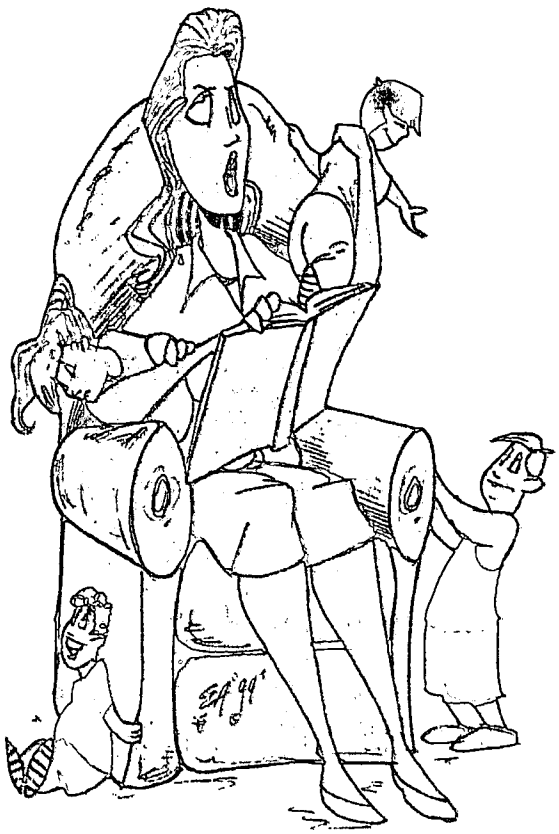
side, and grows in response to musical training, not unlike the way muscle responds to exercise. The neural mechanisms of music may have developed originally as a means to communicate emotion prior to the advent of speech, a useful way to integrate sensory information with emotion and meaning (Proceedings, 1998).

What are the implications and/or applications of these exciting findings for babies? There is a very strong belief that early exposure to specific types of music, may boost a child's IQ, and consequently, his/her ability to learn ( Rauscher, et al, 1997). So strong is this notion, in fact, that politicians in Georgia, Florida and other states are lobbying for schoolchildren to be exposed to Mozart sonatas on a regular basis.

In Colorado, starting October, 1998 a state program known as Warm Welcomes arranges for volunteers to visit the homes of mothers and their newborns within a few weeks after birth. As part of the visit, volunteers deliver a cassette called "The Mozart Effect: Music for Newborns" containing the soothing classical music of the composer. The idea is to stimulate the babies' minds, quiet them, and also calm their parents (Campbell, 1998; Kreck, 1998). Stimulating babies' brain development during their first three years of life by playing music, talking, and reading gives them a good start in the world and this interaction between caregiver and child is the best way to trigger it.

## Vocabulary/ Language Development (Prenatal to two and one-half years)

The acquisition of an effective vocabulary and language are intimately connected to the development of speech. It is no longer a matter of debate: Early language stimulation, from the moment of birth, influences brain development.



Communication is the basic cornerstone that ensures the survival and reproduction of a species. Language is defined as the transmission of emotions or ideas between any living creature by any means. All communication must begin with the ability to understand and use some form of language and, for the vast majority of humans, communication begins with learning verbal speech.

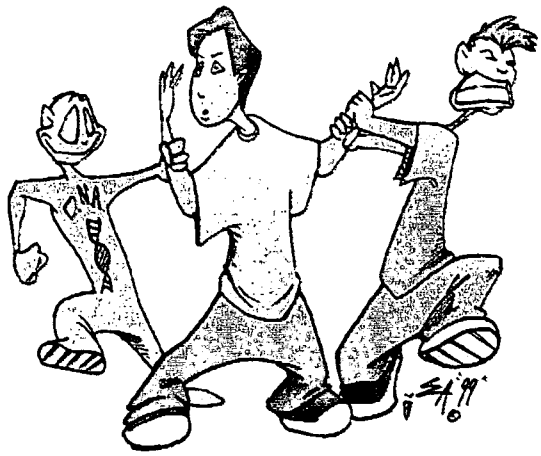
When does an infant begin to categorize and differentiate between sounds and words? How does a baby distinguish between the sound of his mother's voice and that of a total stranger? The phenomenon of language is a

concept that has baffled scientists for many decades. New technology is making it possible for scientists to see the neural activity of a fetus and, based on this, it is now thought language acquisition begins long before birth (Barnet & Barnet,1998; Kotulak, 1996). Early in the first trimester the fetus can recognize voices and emotions of the mother. How is this possible?

How a fetus responds to sound can now be measured in the womb. All fetuses hear blood pumping through the umbilical cord and the placenta. But that is not all, for they can also hear and distinguish their parents' voices, music, and the excitement or trauma in their mother's everyday world. These interactions elicit a response from the fetus (Lauderdale & Roberson, 1998; Logan, 1991). Along with movement, sounds begin neural firing and set up pathways in the brain which predispose the newborn to respond to stimuli. A study of infants who heard music in the womb indicates they exhibit higher levels of consistency in cognitive and social skills, creative abilities and physiologic alertness (Kotulak, 1996; Lauderdale, 1998).

A national child care study of 1,300 families identified verbal interaction as a key to the growth of the infant's brain. The study shows adult-child interplay ignites those tiny brain synapses and this interaction has the most powerful influence on a child. Those who were talked to, and interacted with on a regular basis, performed better on language and intelligence tests than all of the other control groups combined (Kessler, 1997).

# The Nature vs. Nurture Debate



This debate, which has been ongoing for decades, has recently intensified particularly in light of the increasing violent behavior among young children (Healy, 1999). The brain can be visualized as a super-sponge which has its greatest absortive power from birth to the age of about twelve. During crucial learning periods early in life, the brain can reorganize itself with ease because synaptic connections are being established and broken down at an enormous rate. Neurobiologists contend that, early in life, information flows easily into the brain through conduits which are open for short periods of time (Kotulak, 1996). These short periods occur in phases during the time from birth to age twelve when the brain is most actively gathering information and learning from its environment.

Scientists used to think the brain was a gray blob of neurological Play-Doh, just sitting there until nature could mold it into something useful. They thought wrong! Today the vision is profoundly altered. The train tracks of the mind are a work in progress: From a child's time in the womb, through the first

years of life, their development is streaking along at a ferocious pace, more and more track being laid down (Smith, 1998).

The construction workers are parents and grandparents, day-care workers and schoolteachers, even other children. Talking and interacting with a child strengthens the network, cementing connections that last a lifetime. **But if a child's brain is not stimulated during those early years, the negative consequences can also last a lifetime**. How does this new thinking differ from the old?

The old thinking believed that how a brain develops depended on the genes you were born with. The new thinking hinges on the genes you were born with and the experiences you have. The decades-old debate about the relative importance of nature versus nurture in brain development, the learning process, and later success in school was re-ignited with the publication of the book "The Nurture Assumption."

The author, Judith Rich Harris, attempts to shatter what she calls the "myth of birth to three" and focuses on how genetics determines behavior in children and later in life. According to Harris, behavior is greatly influenced and molded by peers and her work has two main purposes: a) to do away with the notion that children's personalities are shaped or modified by their parents b) to provide an alternative view of how a child's personality is shaped (1998).

Many child development experts, psychiatrists and psychologists scoff at Harris' suggestion that parents are mere bit players in their children's lives,

but some validity must be given to her analysis of published data. In particular, the extensive studies of twins at the University of Minnesota and the University of Colorado serve to corroborate her hypothesis. In those published studies it was found that when heredity is removed, kids shared little or no intellectual skills or personality with the people who reared them and loved them (Rich Harris, 1998).

Another study buttressing Rich Harris's arguments involved 500 middle-school boys in Pittsburgh. Those who came from high-risk families but who lived in better neighborhoods, had rates of delinquency and school failure no greater than those who lived in so-called "good families"(1998).

To us the nature vs. nurture debate has little meaning; based on the research cited, the first three years, from birth to age three, permanently shape a child's life. We believe loving, warm, responsive parents and caregivers who constantly stimulate their children's brains by talking, singing, touching, cuddling, playing and reading contribute greatly to their intelligence, physical health and emotional maturity, while abusive and neglectful treatment cripples them permanently.

Because all this happens well before school or even pre-school, our aim is to enlighten parents and caregivers on "the care and feeding of the brain," by providing information on the role of early interaction and the benefits to be derived from enriched environments.

## NEUROSCIENTIFIC EVIDENCE:

## CORRECT OR INCORRECT?

There is little question the valuable new information about the brain, its components and their functions, and how learning takes place can help caregivers and parents meet children's needs more successfully. This information, unfortunately, is viewed with skepticism by many who feel that, for the difficult questions of child-rearing, the neurosciences offer very little guidance. Regarding the work at Doman's Institute in Philadelphia, cited at the beginning of this book, child advocates say such programs simply exploit the natural desire children have to please their parents and other adults. They believe these questions should be asked:

- Are these kids well-adjusted?
- Are they stressed-out?
- Do they have friends?

Even so, recent research findings into the cognitive development of children's brains has confirmed what Dr. Doman has been saying all along:

**"Children are capable of mind-boggling feats."**

What are the important aspects of brain development from birth to kindergarten age? Our experience as elementary school teachers led to this realization: Too many children who enter school do so unprepared and lack the basic skills needed to succeed in school.

The major goal is to help those who are in constant contact with young children understand how the brain works and how a baby's prodigious capacity to learn can be nurtured. To achieve it a simple primer and multimedia presentation were made part of the book. The primer is in the physical format of a pocket guide or brochure; it is divided into sections describing:

- the developing brain
- the enriched environment
- quality care/preschool

  what to look for (checklist)
- the "Twelve Commandments for Pre-school Preparedness,"

  a list of essential skills a kindergarten student should possess in order to succeed.

The multi-media presentation is a pictorial video that describes the milestones of child development and how the brain works. The benefits to be derived by young parents, childcare and early childhood education providers, from an easy to understand guide to the brain, can not be overemphasized. From birth to age five, the brain builds synapses at an amazing rate but after age five the process slows down and comes to a halt. Despite this knowledge, there is a continued failure by many in the child development and education fields, to recognize that the early childhood years are a crucial time for learning.

The multimedia presentation disc and primer guide our audience into a path that leads to acquiring the necessary skills to make their charges develop a "love for learning" and become ready for school.

Few would disagree that toddlers whose parents constantly read to them, excite their curiosity and engage them in playful, but instructional, games start out with a huge advantage over infants who are not nurtured in this way. To effectively close this learning ability-gap training of parents,(young and undereducated ones in particular) and caregivers is imperative.

## Recommendations

Four steps useful in the future **implementation** of the ideas presented here:

- Continue to push for expansion of Head Start-type programs and increased allocation of Head Start funds to benefit infants and toddlers.
- Train staff at childcare centers and parents, to: a) teach children good eating and health habits; b) spot any developmental problems, physical disabilities, and emotional/behavioral problems among them.
- Follow Colorado and Georgia's lead in providing funding for early home visits to young mothers and their newborns within a few weeks of hospital dismissal. During these visits, social workers can provide members of the household with information about health, nutrition, the importance of keeping vaccination schedules and the need to institute early infant education procedures.
- Ultimately, continue to push for an earlier, and better, education of parents, their babies and childcare workers.

To the above recommendations some may say fine, but overambitious. To which both of us respond: **True, but can our nation afford not to do it?**

"The future of our great nation belongs to the children. Educated children."

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# APPENDICES

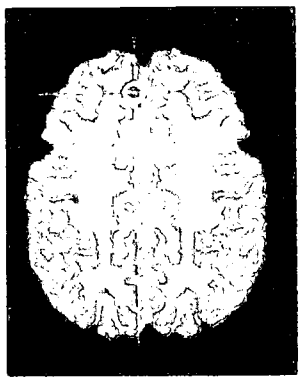
A. (FMRI) Functional Magnetic Resonance Imaging

(PET) (Positron Emission Tomography

B. Multimedia Disc Presentation
(Guidelines)

C. Primer

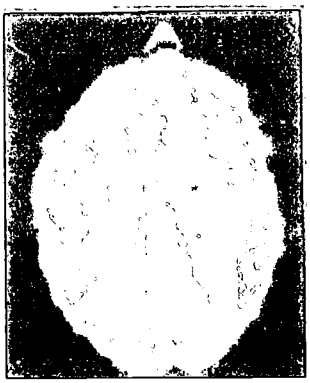
## Functional Magnetic Resonance Imaging



FMRI is an increasingly popular innovation in brain scanning. It show mental activity in shorter than in PET, with better anatomical detail, and does not require injection of radioactive tracers.

MRI makes a structural picture based on magnetic field changes through out the brain. These changes are initiated by radio pulses that affect spinning hydrogen protons. Functional MRI makes images so quickly that changes in blood flow can be detected, indicating areas of activity. Water shows up particularly well, so organs like the brain, with a high water content, show up in great detail.

## Positron Emission Tomography



PET uses radioactive tracers to track the brain's use of energy. Mental activity is revealed as the tracers decay into gamma rays, which can be detected by a scanner.

The tracers are attached to sugar or water molecules, which are introduced into the blood stream. As the tracers enter the brain, the subject performs a mental exercise or task. The PET scanner's ring of detectors picks up the radio active decay of the tracers.

As each positron decays, two gamma rays are emitted at 180 degree angles. A powerful computer counts these gamma pairs and converts them into images of the brain's energy use, showing the areas associated with the mental activity.

A PET scanner makes a series of slice like images of the brain, which can be combined later to provide three- dimensional images from any angle.

Source: "Mapping the Mind" by Rita Carter. University of California Press, Berkeley, 1998

# MULTIMEDIA DISC PRESENTATION

## (GUIDELINES)

The multimedia presentation was designed as a self-directed tutorial to give information on how the brain develops from birth to the age of kindergarten. The program includes Hyperstudio Player which, when used with the accompanying font folder, allows viewing of the program in its entirety. For further instructions or clarification a "Read me" file is also installed on the disc.

System Requirements:

| | |
|---|---|
| Power Macintosh: 256-color system | Windows 95/98 |
| *Minimum 14' monitor | CD ROM |
| *System 7.5 or higher | Pentium Processor |
| *8MB of RAM | 8 MB RAM |
| *CD ROM drive | Minimum 256 color support |

## About the Authors

**Joyce L. Goss** chose the field of education as a second career and now teaches second grade in the Lodi (California) Unified School District. Her son, Mark, is a practicing attorney in Northern California.

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# TUTORIAL

The following material presents the text of the information which is available in a CD (Mac and PC) also titled "Brainworks: Birth to Kindergarten." The tutorial consists of a short introduction, followed by four separate, sequential sections:

Section 1. Brainworks (15 frames).

Section 2. Developmental Milestones (9 frames).

Section 3. Quality Child Care (6 frames).

Section 4. Enriched Environment (4 frames).

The information contained in the tutorial will prove valuable to young parents, educators, and anyone involved in Head Start or similar early childhood education programs.

Sources: (Picture)

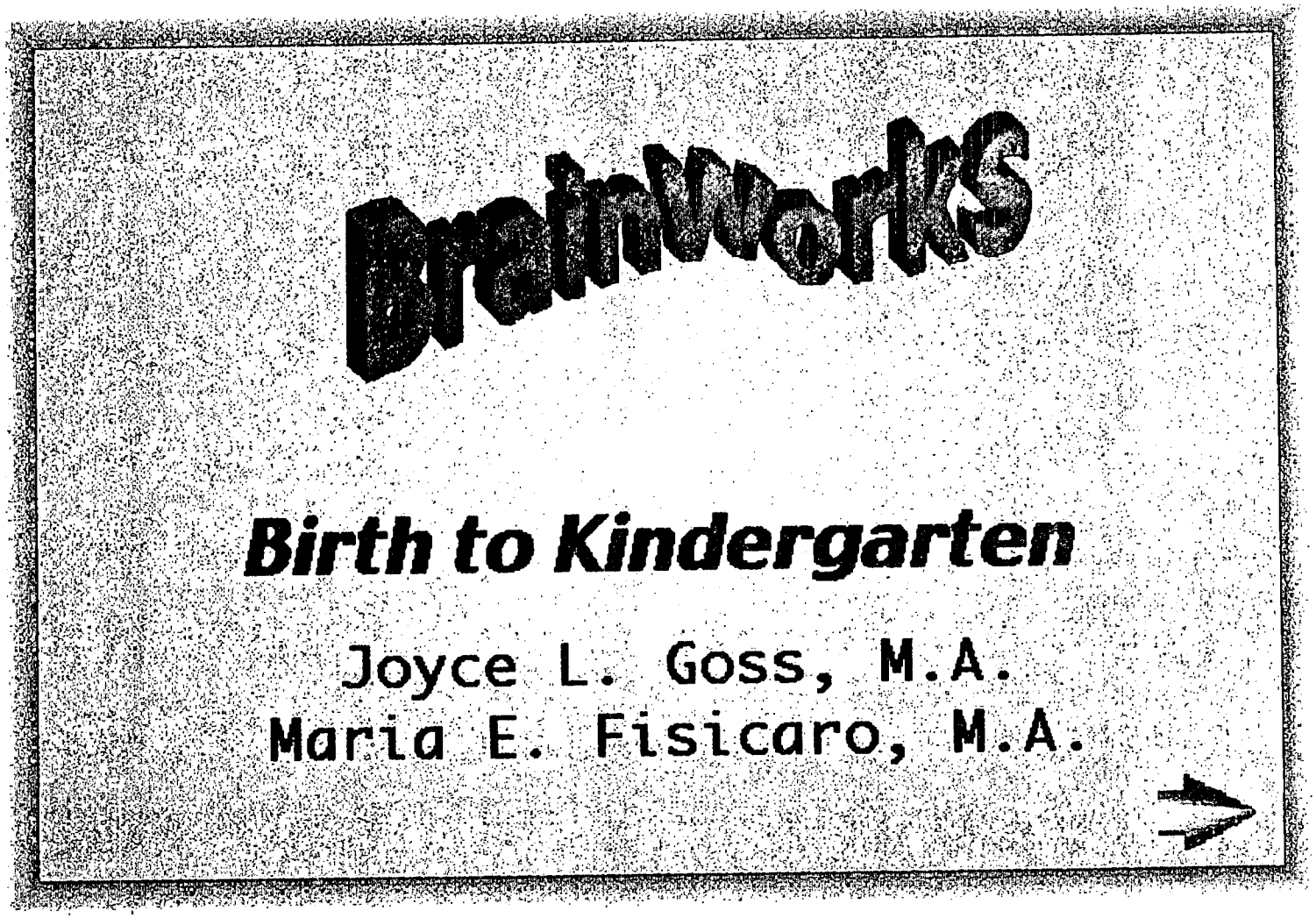
Our thanks to:

L. Nilsson (fetus at 4 ½ months)

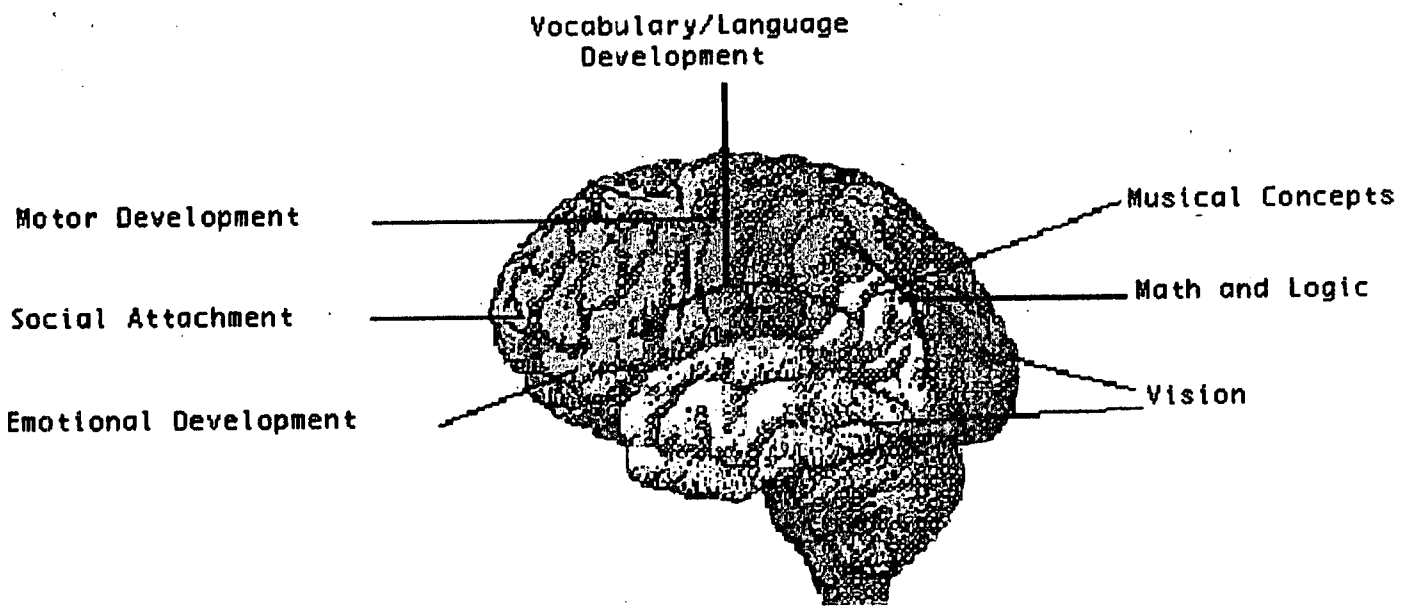
University of California Extension Services for making available to the public their child development series "Noticias Para Los Padres."

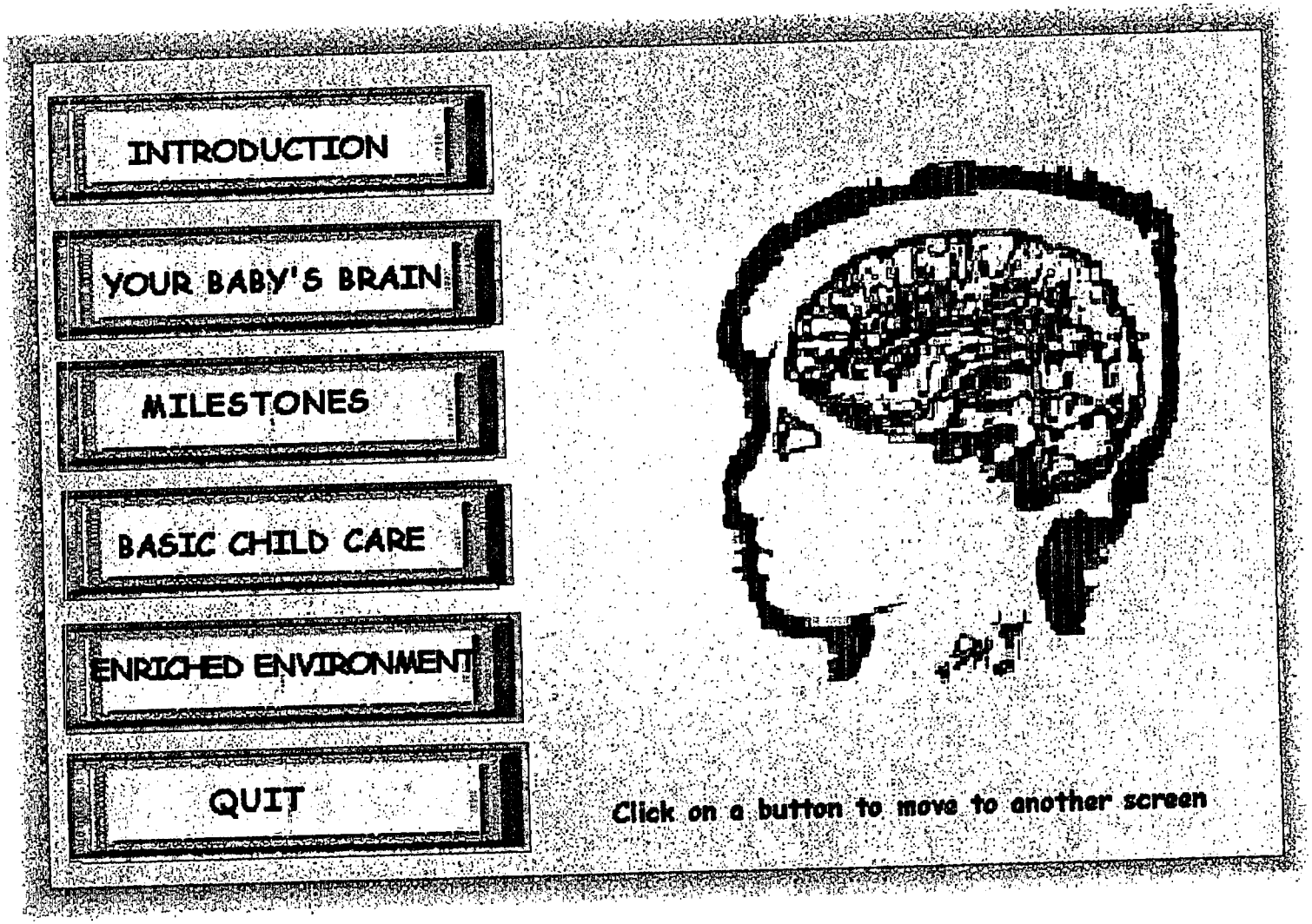
# BrainWorks

## Birth to Kindergarten



# Areas of the Brain




INTRODUCTION
YOUR BABY'S BRAIN
MILESTONES
BASIC CHILD CARE
ENRICHED ENVIRONMENT
QUIT
Click on a button to move to another screen

Recent advances in neuroscience have provided great insight into how the brain continues to grow and develop during the first years of life. Once thought to be determined primarily by genetics, it is now believed to be highly dependent upon the child's experiences.

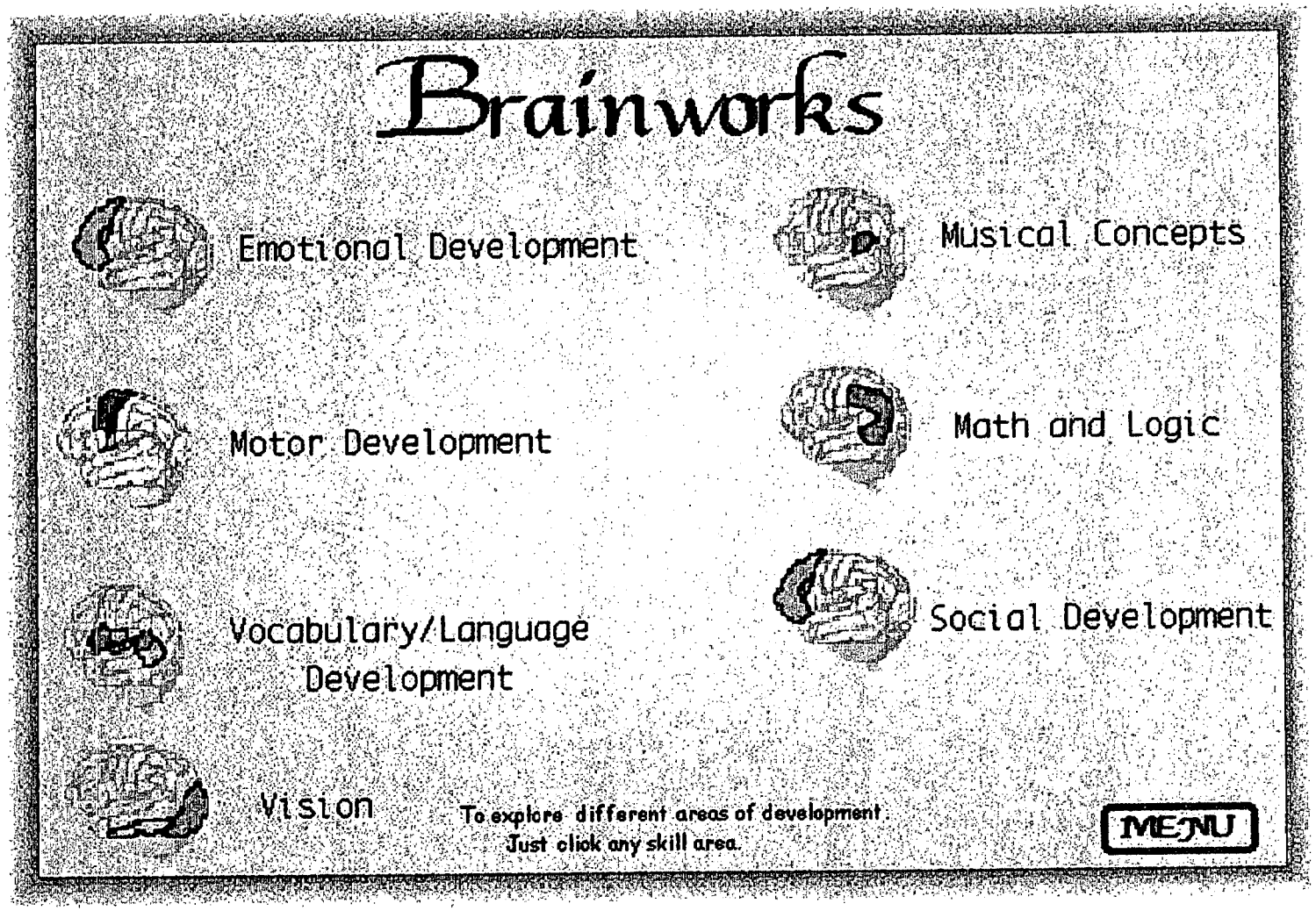
To flourish and develop to its full potential, a child's brain needs to be nourished; this requires that babies be loved, held, talked and read to, and given a chance for exploration.

From the moment a baby is born, each and every experience builds the neural connections that guide development. The newborn's brain grows astonishingly fast in the first years of life, opening windows of opportunity for learning that takes place only once in a lifetime. Experiences during this time have a definite impact on the formation of the developing brain.

Interactions with others, and with the environment, are extremely vital at this early stage of life.

From birth to age 5, a child's experiences determine much of his/her potential for later life.

MENU


Brainworks
Emotional Development
Musical Concepts
Motor Development
Math and Logic
Vocabulary/Language Development
Social Development
Vision
To explore different areas of development, Just click any skill area.
MENU

# Emotional Development

Emotions are the result of sophisticated information-processing by brains; sensory input is transformed into behavioral output by the nervous system's actions, shaped by them; learning is strongly influenced by emotions. A nurturing environment enhances the development of emotional growth; but if the environment is perceived by the learner as harmful, or threatening, the ability to learn from it is decreased.

**Positive emotions enhance learning, negative ones blunt it!**

How you can make a difference

Back

# Things you can do:

*Don't worry about spoiling your baby.

*Cuddle and respond to your baby's needs; consistent, warm and responsive care produces less stress hormones and the baby will be calmed in less time.

*Establish routines and rituals, helping your child learn what to expect from his environment.

*Positive experiences provide children with a sense of security.

Back

# Motor Development

Motor skills undergo prodigious development prenatally and continue into the fourth year of life.

Babies were once thought to be simplistic, passive creatures just waiting for the brain cell->muscle->motor skill development to occur.

**Nothing can be further from the truth!**

When something as basic as standing up is not learned during this window of time the child will have a much harder time learning the skill later.

How you can make a difference

Back

# Things you can do:

*Get down on the floor and play with you child.

*Put your infant on a mat so he can exercise his arms and legs as he rolls; have large cubes through which he can crawl and explore.

*At all times encourage safe exploration and play.

*Expose your child to physical activities; kicking and catching a ball, for example, which develop effective motor skills.

Back

# Vocabulary / Language Development

New technology has made it possible for scientists to see the neural activity in a fetus; it is now thought language acquisition begins long before birth. Every movement, sound or emotion the mother feels affects the development of the fetal brain: infants apparently learn the rhythm of their language and of their mother's voice while in the womb. To continue to thrive, the brain needs interactions with others, needs to hear others talk and learn to attach meaning to words. If a child's brain is not stimulated from birth, the neurons will not develop or may even disappear, impairing the child's ability to learn.

How you can make a difference

Back

# Things you can do:

*Talk, read and sing to your infant.

*Recite nursery rhymes, play word games, show your child that language is fun.

*Make up stories about things that are happening around him/her, the people and places they know. Talk to and describe to them what is happening during daily routines.

*Tell them stories and sing the same songs over and over; **children learn through repetition.**

Back

# Vision

At birth, because newborns' brains are not yet wired for sight, they can not see well. Lack of visual stimulation causes the cells designed to interpret vision to degenerate or become engaged in other tasks. If the brain is not exposed to visual experiences in the first years of life, the child will be permanently blind. Experiences during those first years have a decisive impact on the formation of neural connections and the opportunity to learn vision and vision-related tasks.

How you can make a difference

Back

# Things you can do:

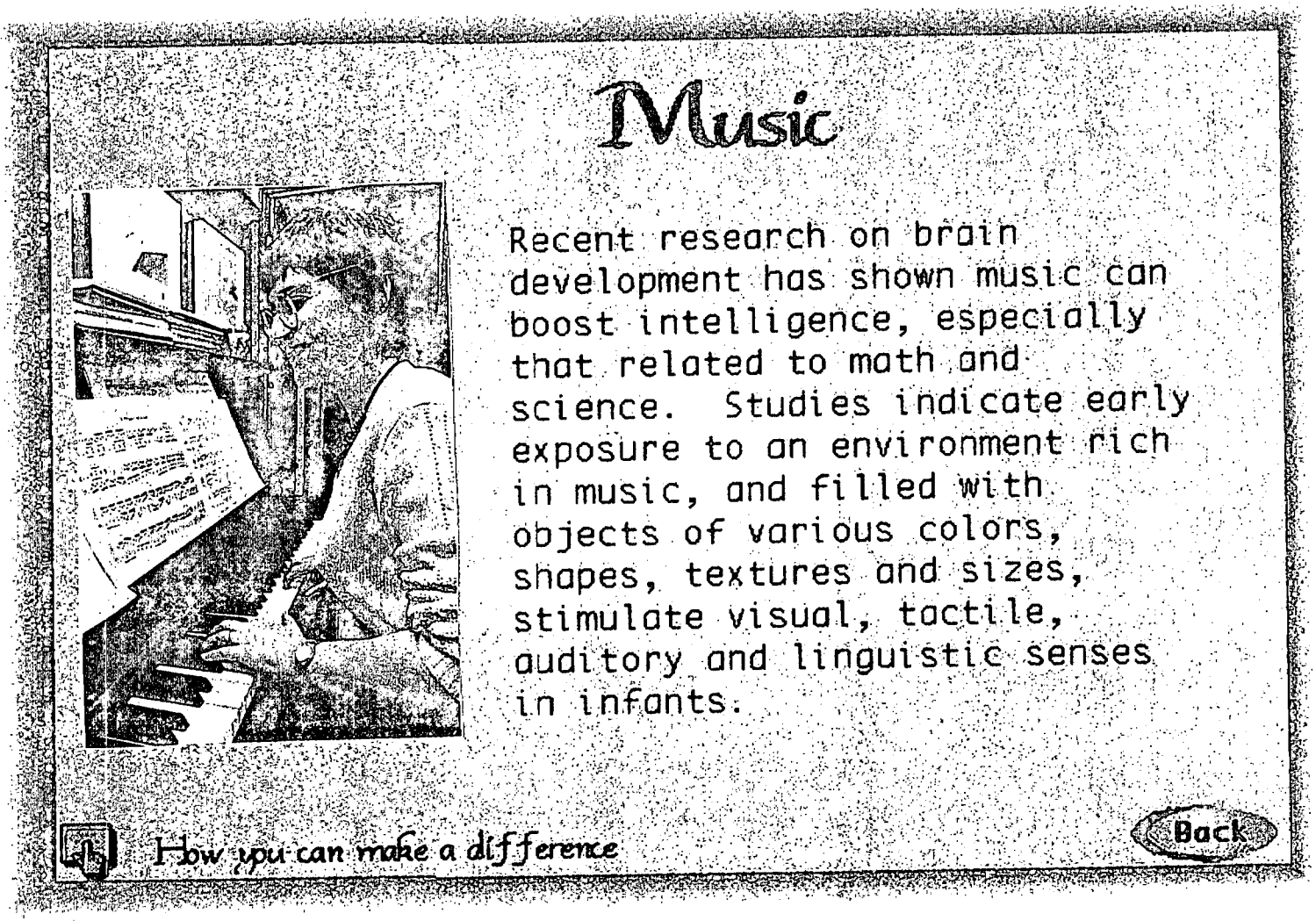
*Provide interesting and colorful things for your infant to see, when in the crib or on the floor.

*Hang a colorful mobile above the crib; this will help the baby notice differences as the mobile moves.

*Hold your baby on your shoulders so he can explore the surroundings.

*Put a colorful scarf around your neck and lean over your baby so he can see and reach for it. This helps develop hand-eye coordination.

Back



# Things you can do:

*Expose your child to a variety of music.

*Listen to Mozart and other classical composers.

*Communicate with your infant through lullabies and musical baby talk.

*An environment rich in music enhances creativity, improves self-esteem, and develops areas of the brain used for math and spatial skills.

Back

# Math and Logic

Children as young as three can add and subtract. It has been shown that exposure to simple concepts helps develop math and logic skills. Their young brains absorb concepts rather than facts. Children learn as a result of input which their brains receive from their surroundings.

**Positive environments encourage learning!**

How you can make a difference

Back

# Things you can do:

*Play counting games with your baby.

*When you are dressing your child name items and count them.

*Talk to your child about same and different, big and small.

*Play music. Research shows early exposure to music helps develop math and logic skills.

*As your child gets older, encourage him to play with puzzles and mazes.

Back

# Social Attachment

A child's "social being" begins to develop at birth. Experiences with the surrounding world provide the building blocks for healthy development. By creating a nurturing environment parents can give infants a sense of trust; this allows them to feel confident in exploring the world and forming positive relationships with others. During the early years the child learns to give and accept love, to be confident and secure, to be curious and persistent. All these abilities enable children to learn and relate well to others.

How you can make a difference

Back

# Things you can do:

*Be warm and responsive by touching, rocking, smiling and talking.

*Make them feel they are part of the family; involve them in what is going on.

*Provide an enjoyable atmosphere that promotes exploration; an environment which shows the fun and excitement of learning.

*Research has found that children who receive warm and responsive care are more curious, and develop better social relationships.

Back

# By Three Months:

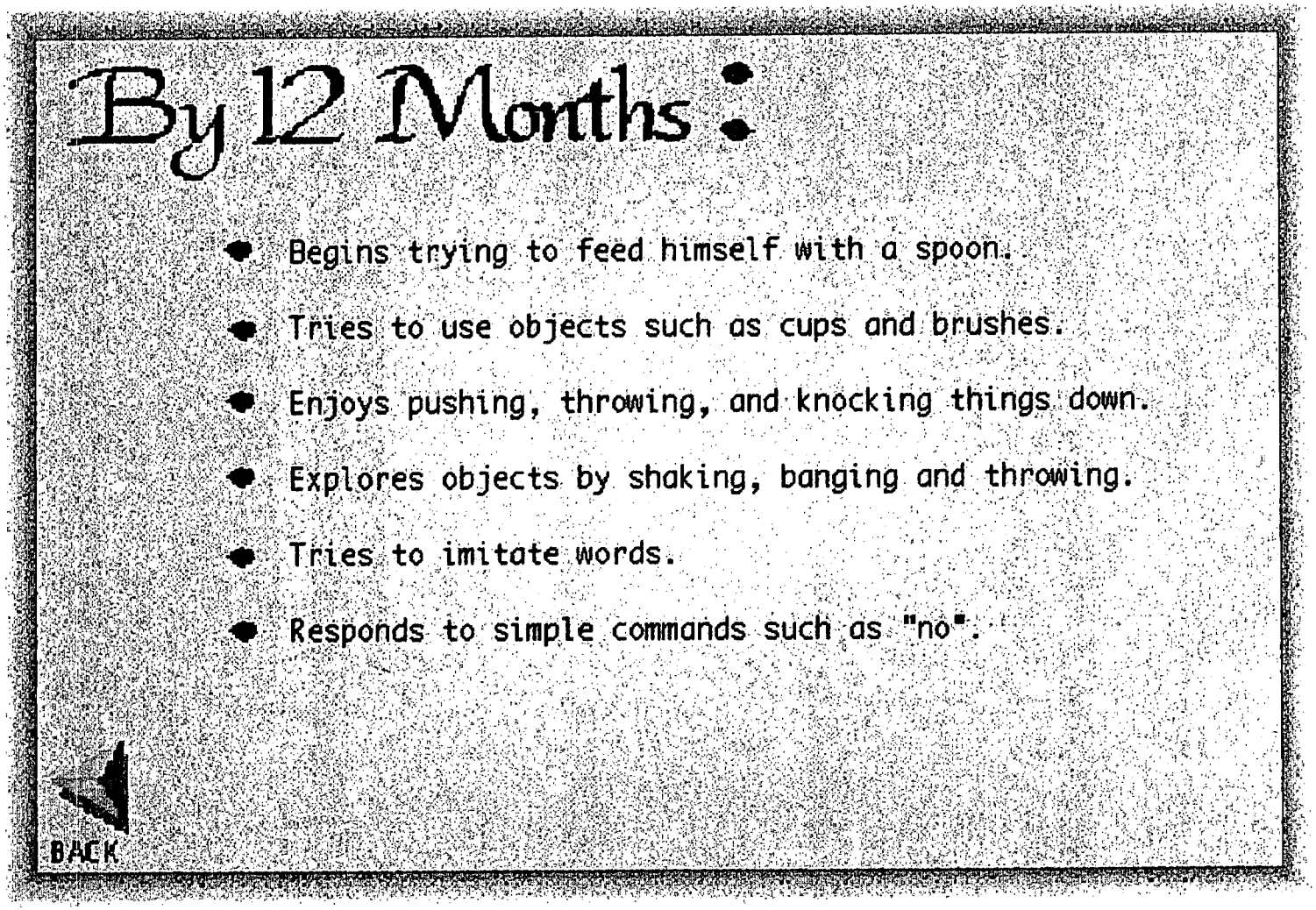
- Begins to hold head steady.
- Follows object with eyes from side to side.
- Begins to interact with others.
- Recognizes mother and father.
- Early language development begins with one syllable sounds such as "ooh" and "ah".
- Discriminates between parents' faces and those of others.
- Arm, leg, and hand coordination developing.

# By Six Months:

- Exploring with hands; beginning to grab toys and moving them from one hand to the other.
- Learning to roll over.
- Beginning to vary attention-getting skills other than crying.
- Learning to play turn-taking games.
- Language skills increase; begins to squeal, makes bubbling sounds. One-syllable sounds such as "ma," "ba," and "ga" become part of his usual conversation.

# By Nine Months:

- Responds to own name.
- Begins to put objects in and out of container.
- Almost walking, walks with some support.
- Moving around, upright, while holding onto furniture.
- Notices cause and effect,i.e., if a rattle is shaken it makes a noise.
- Voice is now used to express joy and displeasure.



# By 16 Months:

- Uses select group of words clearly, is beginning to combine two words.
- Begins to identify familiar objects within a group.
- Enjoys playing games such as peekaboo, stacking blocks, and playing body part games such as "Where's baby's nose?".
- Identifies familiar pictures in books.
- Sometimes a toddler feels overwhelmed and will have a tantrum. This is perfectly normal.

# By 20 Months:

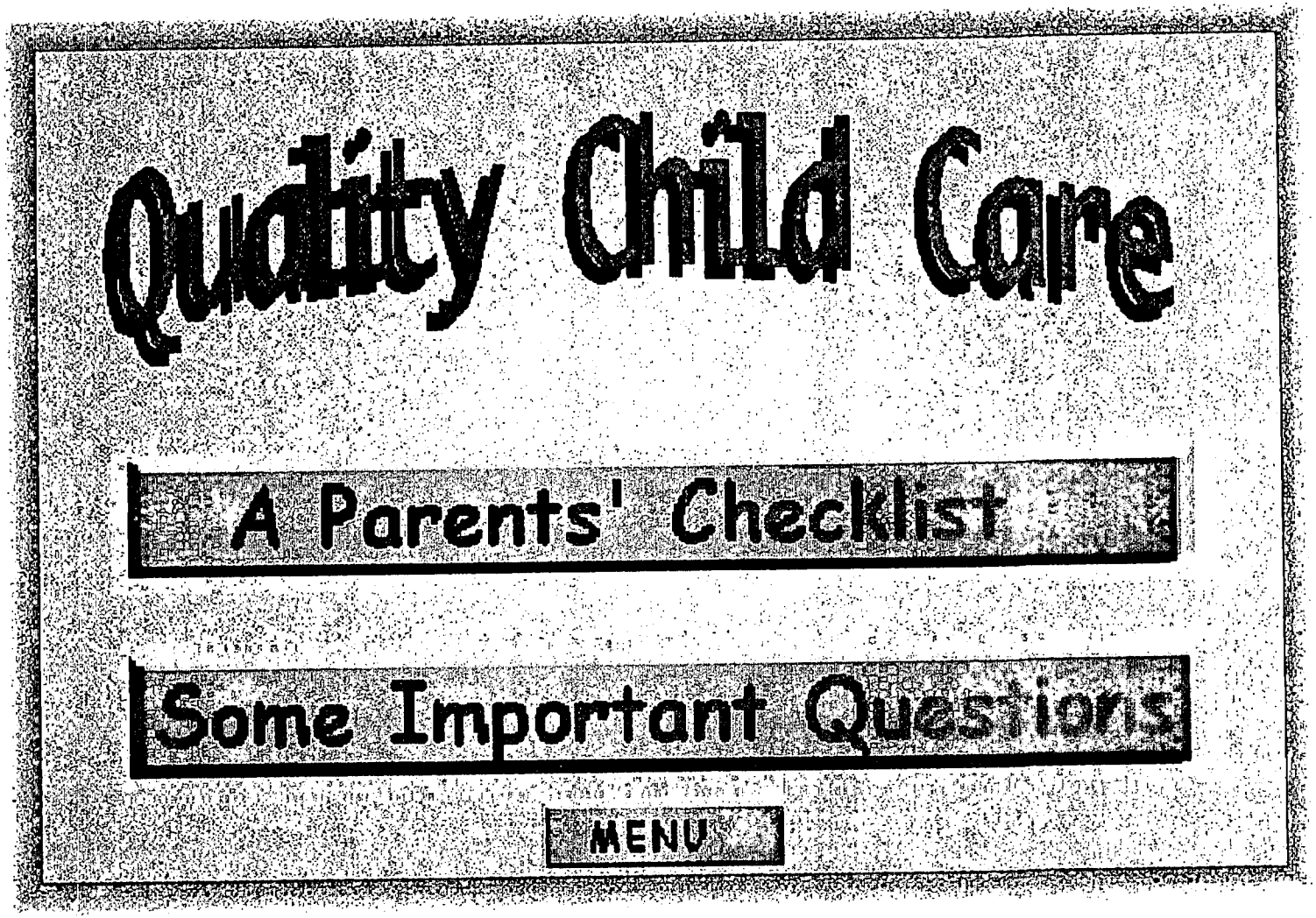
- Attempts to talk in sentences.
- Forms strong attachments to parents or other important adults. Can be unsettling for child when a parent leaves.
- Begins to run; climbs stairs on his own.
- Attempts to kick a ball.
- Labels actions such as "up" or "down".
- Realizes that everything has a name.

# By 24 Months:

- Has a vocabulary of about 50 or more words.
- Attempts to have a two or four-sentence conversation.
- Begins to understand abstract concepts: "more", "less", "sooner", "later".
- Toddler becomes very inquisitive: asks the "why" of everything.
- Begins to use pronouns: "I", "me", "you" although not always correctly.
- May be able to give first and last name.

# By 36 Months:

- Runs and jumps without reservation.
- Attempts to dress self, can probably put on T-shirt.
- Vocabulary of 300 to 1,000 words.
- Able to express feelings and desires verbally.
- Begins to master some basic rules of grammar.
- Plays more structured games with others; enjoys "tag" or "Go Fish".
- Completes simple puzzles of three or four pieces.



1. Centers must have a license. To get it, operators must pass three inspections a year that show the center or home is safe. The license and any violations are to be posted at the center.

**Check your county office for more information.**

2. Many centers and family homes are subject to an additional review if they enroll low-income children whose tuition is subsidized by the state. The assessments impose state standards for language development, creative expression, classroom environment and nutrition.

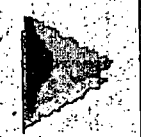
3. Parents should not be shy about visiting center, unannounced, to observe how the providers respond and interact with the babies and children placed in their care.

4. Seek a provider who responds warmly, and responsively, to the children's needs.

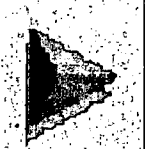
5. Look for an environment that is clean and safe.

6. Make sure there are enough adults so that your child gets individualized attention.

- Do children look happy, healthy and alert? **The face of a child doesn't lie.**
- Are indoor play areas safe? Are there any open windows, exposed electrical outlets, sharp objects or small items that could present a choking hazard?
- In the outdoor play area, is the fence secure? Are there soft surfaces beneath play structures? Are helmets provided for bike riding?
- Do staff members talk to the children and listen to their concerns?
- When discipline is needed, is the staff gentle but firm?



- In the classroom, do teachers praise accomplishments?
- Do activities stress creativity and new experiences? Are children encouraged to solve their own problems and think independently?
- Are activities balanced between vigorous outdoor play and quiet indoor play? Are children encouraged to work alone and in groups?
- Does the staff rely too much on TV to occupy the children?
- If children are of an appropriate age, are they encouraged to develop self-help skills such as dressing, washing, eating and resting?



- Are learning supplies: books, games, tape players, puzzles, in good condition?
- Are there items that foster imagination? Blocks, wheel toys, climbing equipment and dramatic props?
- Are meals and snacks nutritious, varied and served at appropriate times?
- Does the staff wash its hands before handling food and before and after changing diapers?
- How many staff members are trained in first aid?
- Are smoke detectors installed in proper locations?
- Do teacher-student ratios meet or exceed requirements?

Based on what is known about the brain, good mental nourishment in the earliest years of life can increase children's IQ by up to 20 points, reduce mental retardation by 50 percent and cut school failure rates by even more.

What the brain experiences as mental stimulation is not only recorded in the neurons, but actually shapes and reshapes the brain itself into a more effective and powerful learning organ.

Some learning activities to stimulate the brain can be incorporated within the routine care of your baby.

- Listening to language in stories, songs, nursery rhymes and everyday conversations is an important tool in your baby's learning process. Through repetition babies can learn to understand larger words before they can say them.

- Hold your baby's hand to your mouth while making sounds that you can see with your lips such as the "p" and "b" sounds. Not only will the baby see the sound come from your lips: s/he will feel how and where the sound is made.

- Practice the sounds using hand puppets. Move the puppet's mouth in sync with yours while articulating the sounds.
  **Repetition is the key.**

# Parents:

- Provide an enjoyable atmosphere that promotes exploration and teaches the joy of learning.
- Don't worry about spoiling your babies.
- Love, cuddle and respond to their needs.
- Play games such as Peekaboo and Five Little Piggies.
- **Remember :**
  In an environment of stimulating activities and personal attention, children's brains can develop to their unique potential.

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Back

- Do teacher-student ratios meet or exceed requirements?
- Does the staff talk to children and listen to their concerns? When discipline is needed, is the staff gentle but firm?
- In the classroom, do teachers praise accomplishments? Do activities stress creativity and new experiences? Are children encouraged to solve their own problems and think independently?
- Are activities balanced between vigorous outdoor play and quiet indoor play? Are children encouraged to work alone and in groups? Does the staff rely too much on TV to occupy the children?
- If a child is of an appropriate age, is he or she encouraged to develop self-help skills such as dressing, washing, eating and resting?
- Are learning supplies-books, games, tape players, puzzles-in good condition? What about items that foster imagination such as blocks, wheel toys, climbing equipment and dramatic props?
- Are meals and snacks nutritious, varied and served at appropriate times? Does the staff wash its hands before handling food and before changing diapers?
- How many staff members are trained in first aid? Are smoke detectors installed in proper locations?

## Programs Specializing in Early Intervention

**Even Start**
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**Healthy Beginnings**
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Stockton (209) 468-3983

**Head Start Child Development**
115 No. Walnut
Manteca (209) 239-6676

## Kindergarten

Many children enter kindergarten poorly prepared to undertake the beginning of their school journey. What are some of the skills a kindergarten student should possess in order to succeed? Research indicates there are twelve HOW TOs, the "Twelve Commandments for Pre-school Preparedness" which seem essential.

1. How to get along with others; how to share.
2. How to follow class rules.
3. How to recognize our name orally and in print.
4. How to use the bathroom independently.
5. How to recognize shapes and colors.
6. How to tell right from left.
7. How to walk in a straight line, jump, throw a ball.
8. How to let others know needs, wants and thoughts verbally.
9. How to tie our own shoes.
10. How to write our own name.
11. How to count and recognize the numbers from 1-20.
12. How to recognize the ABCs.



# Brainworks

## *Birth to Kindergarten*

**Maria Fisicaro, M.A.**
**Joyce Goss, M.A.**

# The Developing Brain

Recent infant brain research reveals there are "critical or window" periods for brain development, and the most important period is the first three years. It is during this period, that the foundation for thinking, language, vision, attitudes, aptitudes and other characteristics are laid down. Then the windows close and much of the fundamental architecture of the brain is completed.

The latest neurological research shows that your baby is born with trillions of neurons with an almost infinite potential for learning. If these neurons are used, they connect with other neurons and, if used repeatedly, make permanent connections. If not used, they do not develop.

It is the experience in the first three years that determine which neurons are used, and therefore which circuits are wired into the brain. The best way to unlock the learning potential in your child is to provide a stimulating environment full of the sounds and sights that will make those permanent connections in the brain. The information contained in this brochure can help you to give your baby a great start in life.



# The Enriched Environment

Based on what is known about the brain, good mental nourishment in the earliest years of life can increase children's IQ by up to 20 points, reduce mental retardation by 50 percent and cut school failure rates by even more. What the brain experiences as mental stimulation is not only recorded in the neurons, but actually shapes and reshapes the brain itself into a more effective and powerful learning organ.

Some learning activities to stimulate the brain can be incorporated within the routine care of your baby.

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- Practice the sounds using hand puppets. Move the puppet's mouth in sync with yours while articulating the sounds. Repetition is the key.
- Don't worry about spoiling your baby. Cuddle and respond to their needs.
- Play games such as peekaboo and Five Little Piggies.
- Provide an enjoyable atmosphere that promotes exploration and the fun of learning.

By providing an environment of stimulating activities and personal attention children's brains can develop to their unique potential.

# Quality Care/Preschool

## A parents' checklist for quality child care.

1. Centers must have a license. To get the license, operators must pass three inspections a year that show the center or home is safe. The license and any violations are supposed to be posted at the center. Check with the county office for information.
2. Many centers and family homes are subject to an additional review because they enroll low-income children whose tuition is subsidized by the state. The assessments impose state standards for things such as language development, creative expression, classroom and environment an nutrition.
3. Parents should not be shy about visiting a center unannounced to ask for a tour. That's a good way to check firsthand on safety, cleanliness and learning environments.

## Some important questions.

- Do children look happy, healthy and alert? The face of a child doesn't lie.
- Are indoor play areas safe? Any open windows, exposed electrical outlets, sharp objects or small items that could present a choking hazard?
- In the outdoor play yard, is the fence secure? Are soft surfaces beneath play structures? Helmets for bike riding?

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