

Neurological Effects of Prenatal and Infant Stimulation and a Comparison of
Suzuki and Kindermusik Early Childhood Music Programs

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Introduction

At five months gestational age, fetuses' hearing systems are formed and they can hear outside sounds in the womb (Barnett 1998 pg. 42). Speech patterns and familiar voices can be recognized within the womb (Ludington-Hoe, 1985, pg. 28). After birth, the brain goes through rapid changes as neural pathways are wired (Saladin 2007). Kindermusik and Suzuki Early Childhood Education assert that early childhood music classes aid in brain development and acquisition of music skills. Until fairly recently, rationale behind prenatal and baby music classes came primarily from anecdotal evidence regarding the baby's responses to music and movement. Teachers and parents reported that babies would smile and kick their legs in delight during baby music classes.

In addition to classroom anecdotal evidence, Dr. Suzuki's story of Hiromi is often cited in defense of early music stimulation. In Dr. Suzuki's book, *Nurtured By Love*, (1983) Dr. Suzuki describes Hiromi, a five-month-old girl who had heard her older brother practice Vivaldi's Violin Concerto in A minor, RV 356, Opus 3, No. 6 every day. During a master class, Dr. Suzuki played a Bach minuet and watched Hiromi's expression. Her eyes lit up upon hearing the music and the sound of the violin. When he began to play Vivaldi Concerto in A Minor, she turned to her mom with a big smile, waving her arms and kicking her feet as if to say, "I know that music!" Years later at a large concert 150 kids performed the concerto, but Dr. Suzuki noticed one girl in particular; she was playing with perfect posture and swaying back and forth to the melody. Dr. Suzuki learned that this was the same Hiromi he had met when she was five months old; she had grown and developed fine ability on the violin. Although this is a

great story, it does not offer any empirical evidence proving that Hiromi's early experiences influenced her musical abilities.

Many early childhood music programs report that music stimulation can increase brain development, although empirical evidence was rarely cited. The Suzuki Early Childhood Education website, www.suzukiece.com, states, “Early childhood experiences lay the foundation for all later learning and determine whether or not children succeed in school and later life”. The Kindermusik website, www.kindermusik.com, reports that, “music helps children learn” and offers a page of current research from psychologists, including Don Campbell, author of *The Mozart Effect* (1997). Campbell reports, “The more music children are exposed to before they enter school, the more deeply this stage of neural coding will assist them throughout their lives”. Educators must insist that there is substantial research to back up such statements.

Early research into brain development and music showed an increase in spatial-temporal reasoning (the ability to transform and manipulate mental images without a physical model) in preschoolers after receiving weekly piano lessons for nine months (Rauscher, Shaw, Levine, Write, Dennis, Newcomb 1997). Other areas of brain development were not affected. The interpretation of this research lead to exaggerated claims regarding brain development by both media and educators.

Over the past few years much attention has been given to the educational possibilities during the first years of life. Scientists have made great discoveries and psychologists have formed new theories regarding learning and brain development during the prenatal and zero to three ages. Teachers, parents, and administrators are rethinking policies and teaching practices in response to the discoveries. Scientists’ understanding

of brain development and function is still very limited and in its early stages. The information known about the brain is very complex, and it is often presented to the public in a very simplified manner. Consequently, teachers, administrators, and education policy makers often have a very rudimentary level of understanding regarding the limited amount of research, and to develop practices, policies, and promises resulting from an over-simplified understanding can be inaccurate and possibly detrimental to children.

The purpose of this research is to explore music and the effect of early stimulation on brain development from a scientific point of view. This research will examine how prenatal and early childhood stimulation influences learning and development.

Philosophies, curriculum, and program goals of Suzuki Early Childhood Education (ECE) and Kindermusik are compared and critiqued to investigate whether one program has an advantage over the other. Kindermusik was chosen for comparison because it is the largest music education program for young children in the world. Suzuki ECE is smaller but specific to the Suzuki community. Teachers and parents will have a greater understanding of how the brain functions and responds to early experience. In addition, perhaps this research will inspire more music programs to incorporate baby and toddler classes into their curriculum.

Building Neurological Structures to Facilitate Learning

In order to explore music's effects on brain development, it is important to understand how the brain develops and functions. An embryo's brain begins to develop just three weeks after conception (Healy 1990 pg. 12). Between the fifth and twentieth week of gestation, brain cells multiply at an estimated 50,000 to 100,000 cells per second (Diamond & Hopson 1998 pg. 44). Embryonic neurological cells establish subsystems within the brain responsible for reflexes, voluntary and involuntary body movement, perception, language, emotion, and thought. During the first trimester, many of the brain's physical structures are formed (Healy 1990 pg. 12). As the fetus continues to develop in the second and third trimester, the structures become more specialized and organized.

The brain is comprised of neuron cells and supportive structures. Neurons are cells that send and receive electrochemical signals to and from the brain and nervous system. Neurons have hair-like dendrites branching from the cell body and an axon tail (figure 1). Dendrites receive input and relay the information down the axon to a neighboring cell or structure. Neuron signals can be produced by the body and travel to the brain where they are processed into knowledge, or sent from the brain to muscles to allow for motor actions. As an infant receives sensory input, neurons fire and produce an electrical signal. The signal travels down the axon of a neuron and crosses over a synapse cleft to the dendrites of a neighboring neuron (Healy 1990 pg. 12), creating a network between the brain and body. The strength and efficiency of synaptic connections determines the speed and efficiency of the brain function (Healy 1990 pg. 12). The

brain's ability to form connections between neuron cells by means of synapses is remarkably high (Healy 1990 pg. 12).

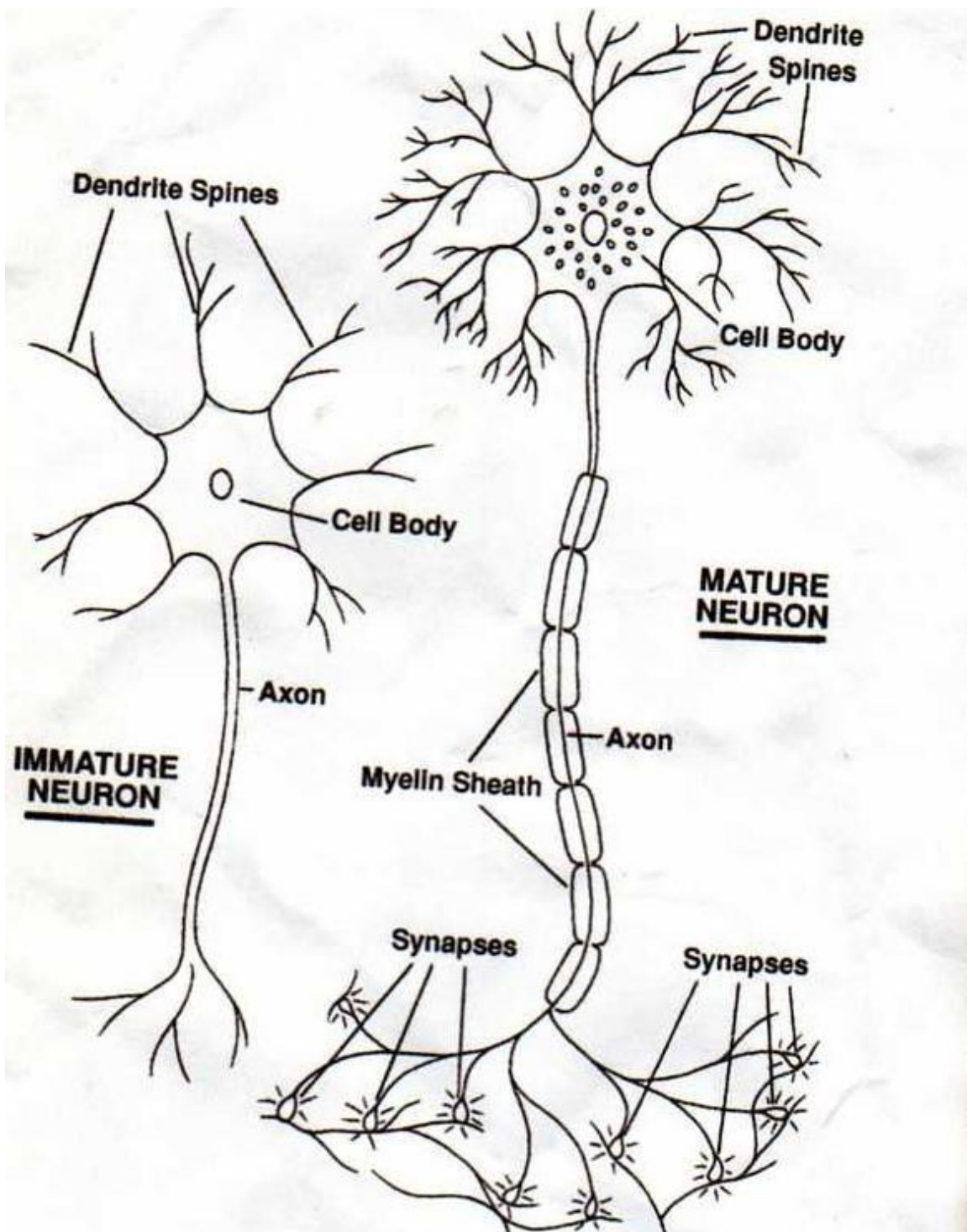


Figure 1: Immature and mature neuron cell depicting cell body, dendrites, and axon with myelin sheath (Healy 2004 pg. 12)

Stimulation Effects on Brain Structure and Function

Synaptic connections are essential for learning, and can be strengthened by repeated use (Healy 1990 pg. 12). Learning occurs when children are presented stimuli and there are changes in brain function as well as the structural composition of neurological wiring (Healy 1990 pg. 51). Structural changes do not refer to growing new neurons, but rather creating new synapse pathways between dendrites (Healy 1990 pg. 52). Synapses respond to life experiences; they can be added, deleted, or modified to make the connection more or less efficient (Saladin 2007 pg. 473). Synaptic plasticity describes the ability of synapses to change in order to accommodate the needs and demands of an individual's environment (Saladin 2007 pg. 473). Trails created by hikers are analogous to the process of how synapses are strengthened; pathways that are frequently traveled become easily accessed and eventually become walkways to allow hikers to move quickly and efficiently (Candiano-Marcus 2005 pg. 9). As neurons respond to stimuli and sensory information, they fire off messages that build new physical structures and synaptic sites to neighboring cells, enabling an efficient relay system to be established (Healy 1990 pg. 8). Conversely, synaptic connections that are not used are systematically pruned out and the neuron dies through a process of apoptosis or programmed cell death (Saladin 2007 pg. 450). Kindermusik and Suzuki ECE focus on synaptic plasticity in hopes that the music program and musical experiences during the prenatal and first years of life will strengthen neural systems related to music.

During the first years of life, the number of synaptic connections between neurons increases dramatically to nearly double the amount of synapses per neuron as compared to adults. (Gopnik, Kuhl, and Meltzoff, 1999 pg. 186). Scientists theorize that the initial

excess of neurons serves as an adaptive feature in the case of trauma or damage (Gardner 1983 pg. 42). If damage occurs when excess neurons are available, the chances of survival are greatly enhanced as the excess neurons serve as a reserve source (Gardner 1983 pg. 42).

After ages two to three, synaptic density starts to decline and remains relatively stable from ages sixteen to seventy-two (Gardner 1983 pg. 44). The purpose of synaptic pruning is to remove unnecessary neurological structures and improve upon the remaining wiring of synapses. Synaptic pruning is a means by which the brain is able to organize information and draw meaningful connections for learning (Saladin 2007 pg. 450). The pruning of neurons is essential for normal brain function and intelligence. Learning disabilities and mental retardation can result from the brain's failure to prune off excess neurons (Bruer 1999 pg. 85).

Repeated use of a particular nerve fiber will cause a myelin sheath to form around the axon (Saladin 2007 pg. 450). A myelin sheath is an insulating layer around the axon nerve fiber, much like rubber around a wire (Saladin 2007 pg. 450). Myelination of nerve fibers increases the efficiency of the task at hand by increasing the speed at which the particular impulse travels down the nerve tissue to the muscle. Scientists estimate that impulses travel along myelinated axons 100 times faster as compared to non-myelinated axons (Fields 2008). The myelination of the nervous system begins to develop fourteen weeks after conception and continues to develop into late adolescence (Saladin 2007 pg. 450). An infant is born with certain neurons well myelinated, such as those that control reflexes, breathing, digestion, and life-sustaining tasks. Skills such as walking and talking involve neurons that take longer to myelinate

(Saladin 2007 pg. 450). Fine, controlled movements, such as those necessary to play an instrument, require the myelin to form many layers around the nerve fiber (Coyle 2009 pg. 45). It is a slow process that requires the nerve to fire many times in order to stimulate the myelin to grow (Coyle 2009 pg. 45). Suzuki Talent Education and Suzuki ECE emphasize repetition because it aids neural tissue myelination for particular skills (Coyle 2009 pg. 45). Having many experiences and exposures is critical for myelin formation and increased synaptic efficiency (Coyle 2009 pg. 45).

Early childhood music programs such as Suzuki ECE and Kindermusik assert that the excess of neurons and synaptic plasticity present during the early years of life could potentially offer enhanced learning opportunities when children are presented the proper stimulus. It is during this period that the neurons can possibly wire themselves to be perceptive to music experiences. In an article titled, “What Suzuki Early Childhood Classes Can Do for the Instrumental Studio Teacher” (2007), Dorothy Jones, founder of Suzuki Early Childhood Education program, states that the first three years are the most important formative years because synaptic density is at its highest. The Kindermusik website quotes Don Campbell: “The more music children are exposed to before they enter school, the more deeply this stage of neural coding will assist them throughout their lives” (<http://www.kindermusik.com/News/News1.aspx> 2008).

Experience's Effects on Neurobiological Structures

Although scientists' understanding of brain function and myelin formation is still in early stages, several studies have given insight to how experiences affect neurological structures. A closer look at dendrites has provided scientists with further understanding. Along the dendrites are thousands of dendrite spines (McKinney 2005) (figure 2). Dendrite spines are small projecting structures that increase the surface area of the dendrite and allow for increased synapse sites and efficiency (Diamond & Hopson 1998, pg. 27). Dendrite spines are composed of a variety of shapes, although scientists have identified three main shape types (McKinney 2005). Type one spines are small bulbs of the dendrite branch that lack a clear head (figure 3). Type two spines consist of a short stalk and a large, mushroom-shaped head (figure 3). Type three spines have a thin, elongated stalk and a small head (figure 3). Studies with animals have shown the plasticity with which dendrites can grow, change shape, or shrink according to particular experiences (Diamond & Hopson 1998 pg. 12-29).

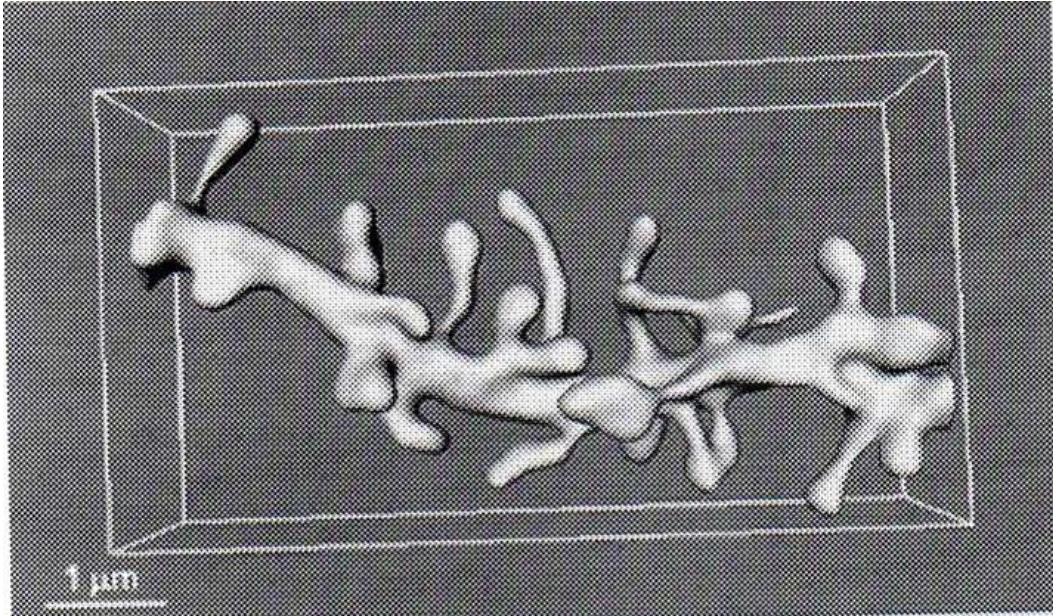
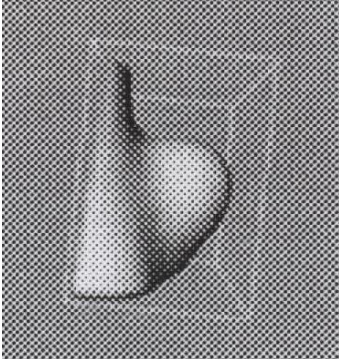
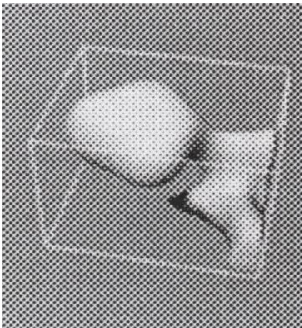


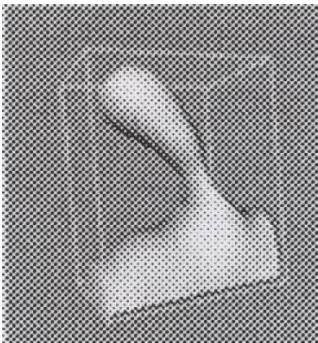
Figure 2: Dendrite depicting three types of spine projections (McKinney, R.A. (2005)).



Short Stubby Type 1



Mushroom Type 2



Thin Type 3

Figure 3: Dendrite spine shapes. The “short stubby” is type 1, “mushroom” type 2, and “thin” type 3 (McKinney, R.A. (2005)).

In a study at University of California Davis, scientist Richard Coss examined the brains of honeybees (Coss 1980). Dendrite spines were compared from several groups of bees; bees that had never left the hive, bees that took one single flight from the hive, bees that regularly leave the hive in search of pollen and nectar, and bees that stayed in the hive to nurse and tend to larva. According to Coss (1980), the total number of spines was dependent on the number of times the bee had left the hive. Bees that had never left the hive had type three spines with long stalks and small heads. The bees that made one single flight had long stalks and larger heads. Food forager bees that had extensive trips outside the hive had type two spines with very large heads and short stalked spines.

Similar research concerning human subjects is difficult due to ethics and the dissection of brain tissue, although several studies have shown similarities. Brain tissue samples of deceased mentally retarded children showed an abundance of long-stalked, small-headed type three spines and an absence of short, round type two spines (Purpura 1974). Another study discovered that before birth, the dendrite spines of a Down's syndrome fetus were identical to a normal fetus (Scott et-al 1983). Within four months after birth, the Down's syndrome child had fewer spines that consisted of mainly tall stalked, small headed type three spines (Scott et-al 1980). Although human samples are difficult to study, scientists do agree that type three spines represent virgin conditions in the cerebral cortex, where the neuron has not been stimulated properly to cause a structural change (Diamond & Hopson 1998 pg. 28).

Other studies have tested the influence environment has on brain structures. In a series of studies in 1964 at University of California Berkeley, scientists Diamond, Krech, and Rosenzweig divided rats into two test groups; half were placed in an enriched,

stimulating, and social environment, while the other half was placed in an empty, deprived environment. All the rats were descended from the same genealogy line, so the experiment design would control for environment influence versus inherent intellectual skill. The rats' brains from the enriched environment showed a higher concentration of neurological synapses and a heavier density in mass in the cerebral cortex. Pregnant females in the enriched, social environment had babies with increased cerebral cortex weight. The cerebral cortex is the brain's outermost layer consisting of gray matter (neuron bodies). It is the brain's most highly developed region and plays a key role in memory, thought, language, learning, consciousness, and attention.

New innovations in technology have allowed scientists to study effects of music on brain structure and function in human populations. The theory is that an environment rich in musical experiences could potentially increase the brain's efficiency. A study conducted by the Stockholm Brain Institute in Sweden compared brain structures of pianists as compared to non-pianists (Fields 2008). Fredrick Ullen was the professor conducting the study, and a piano virtuoso as well. Ullen used diffusion tensor imaging (DTI) technology to measure water diffusion signals throughout the brain (Fields 2008). In gray matter (dendrites, neurons), the diffusion signals are low whereas white matter, which consists of myelinated axons and glia cells (cells that surround the neurons to provide structural support and are a critical component for myelin formation), produce high diffusion signals (Fields 2008). Ullen discovered that in professional level pianists, the white matter is more developed in areas of the cerebral cortex used to coordinate finger movement and cognitive processes (Fields 2008). Ullen concluded that the more hours a day a musician had practiced over time, the stronger the DTI signals were in the

white matter (Fields 2008). This study suggests the importance of white matter structural components such as axons and glia cells as opposed to neural cell bodies and synapses in brain function (Fields 2008).

Early childhood music programs such as Kindermusik and Suzuki ECE are based on the idea that the stimulation experiences offered in the curriculum can potentially have an influence on how the brain shapes itself to adapt to the environment. By encouraging and providing stimulating experiences, the brain can potentially build structures that aid in musical abilities. Scientists do not yet have a complete understanding of the brain, although they do recognize a connection between experiences and brain structure and function. Perhaps in the future more investigative tools will be available and scientists can further understand the importance of early experiences and how they shape the brain.

Prenatal Stimulation

Providing an enriched environment may not only benefit babies, it may potentially benefit fetal brain development as well. Suzuki ECE offers a prenatal class founded on the theory that the stimulation can affect newborns' learning potential. Scientists have been investigating fetuses' responses to stimulus, and whether learning is possible within the womb. Ultrasounds, fetal heart monitors, fiber optic cameras, and other technologies have allowed scientists to research the environment inside the womb. At fourteen weeks gestation, the fetus displays many of the same movements as a full term newborn, including hiccupping, thumb sucking, bending, shifting, rotating its trunk, startle to loud sounds, breathing, and eye movement (Diamond & Hopson, 1998 pg. 87). At five months after conception, the hearing system has been formed and fetuses can hear outside sounds (Barnet 1998 pg. 42). Fetuses in the third trimester respond to a variety of sounds such as the rise and fall of the mother's voice, cadences, syllable stress, and length of phrases (Barnet 1998 pg. 42). Many studies have observed fetal reactions to stimulation, although scientists have yet to draw any definite conclusion basis for organized learning in the fetal brain (Bruer, 1999).

An article titled "Fetal Reactions to Recurrent Maternal Speech" (DeCasper, Lecanuet, Busnel, Granier-Deferre, & Maugeais 1994) describes an experiment in which pregnant women read a nursery rhyme out loud every day for four weeks during the third trimester. At the end of the four weeks, a tape recording of two rhymes read by a female experimenter was played. One rhyme was the one that the mother had read for the previous four weeks, the other was one that the mother had never read. Fetuses' responses were measured by their heart rate changes. When the daily rhyme was read,

the heart rate changed in a manner that did not occur when they heard the unfamiliar rhyme (DeCasper et al., 1994).

Obstetrician and father of seven children Dr. F Rene Van de Carr founded “Prenatal University” in Hayward, California in the early 1980’s. Today he has more than 3,000 patients enrolled in his classes. The program includes touching, talking to, and playing music for the fetus in order to produce changes that increase awareness and perceptive capabilities of the unborn baby (Diamond & Hopson 1998 pg. 86). Activities include talking to the newborn through a paper towel tube placed on the expectant mother’s abdomen, drinking hot or cold fluids and speaking aloud their qualities, playing music through headphones placed on the abdomen, shining flashlights on the stomach, and various types of touch (Diamond & Hopson 1998 pg. 86). Types of touching contact include patting, rubbing squeezing, shaking, stroking, and tapping while saying aloud the type of contact (Diamond & Hopson 1998 pg. 86). Parents of the program report a phenomenon known as the “kick game”, in which the fetus will kick where the hands are placed, and by moving the hands in various positions, the fetus will kick in circles and different patterns (Diamond & Hopson 1998 pg. 86).

Dr. Van de Carr describes the stimulated newborns as having increased muscle control, increased attention span, earlier verbalization, and teeth that emerge sooner (Diamond & Hopson 1998 pg. 87). One mother of the program reports that her son would become calm and happy each time she played “The Sound of Music” on the stereo, the same piece she had played for him every day while in the program (Diamond & Hopson 1998 pg. 91). The child’s first tooth emerged at two months, and by age two he had a vocabulary of 227 words (Diamond & Hopson 1998 pg. 91). At age three he was

identifying trees as either deciduous or evergreen (Diamond & Hopson 1998 pg. 91). A child psychologist at the school mistook his preschool drawing for that of a third grader (Diamond & Hopson 1998 pg. 91).

During the 1980's, Donald Shetler of the Eastman School of Music developed his own prenatal stimulation program (Shetler 1989). Shetler had been director of the Eastman Suzuki Talent Education Program for the past 14 years and had spent time with Dr. Suzuki in Japan. Shetler arranged for 30 pregnant women to play music starting at 5 months gestational age for no more than 5 minutes twice a day. The morning selection was to be an upbeat piece, such as Handel's "Music for the Royal Fireworks", or Beethoven's Seventh Symphony. The evening piece was to be calming, such as Bach's "Air on a G String", or other Baroque compositions with a tempo similar to the heartbeat, or 60 beats per minute.

The mothers-to-be, as well as a control group of mothers who did not present music to their fetuses, reported to Shetler every six weeks during pregnancy and brought their children in every 2-3 months for more than a decade after birth (Shetler 1989). Each check in would consist of an interview with the parent and child, and a videotaped performance of the child singing and playing toy instruments. Shetler found that the musically stimulated babies started talking three to six months earlier on average than the non-stimulated babies. Once in school, the stimulated babies excelled in cognitive development and several had skipped grades (Shetler 1989).

Shetler was most impressed by the stimulated babies' musical abilities. The children with musical stimulation could memorize pieces quickly and sing with ease (Shetler 1989). One of the stimulated children was able to sing a popular hymn in the

correct key with no melodic or rhythmic errors at age 21 months (Shetler 1989). The child could sing about 12 other songs from memory, could play piano with independent fingerings, and could sing while playing piano (Shetler 1989).

Not all scientists and child psychologists recommend stimulation in the early months. Burton White, author of *The New First Three Years of Life* (1995), cautions parents against stimulating very young newborns. White states that the young infant is a poor candidate for an enriched environment because they are rarely alert (White 1995 pg. 35). White does not believe enrichment has any benefit on a sleeping newborn because they are not alert or attentive. When they are alert, White believes newborns have limited sensory capacities and primitive intellect (White 1995 pg. 35).

Critical Periods and Learning

The Suzuki ECE website, www.suzukiece.com, states that, "Early childhood experiences lay the foundation for all later learning and determine whether or not children succeed in school and later life". Suzuki ECE asserts that the early years of life are a critical, defining period for learning development, and failure to properly stimulate children will have life-long implications. Suzuki ECE defends this position with research from psychologists Howard Gardner and Thomas Vemy. Writings and anecdotal evidence from Dr. Suzuki are also used in defense of a critical period for music and learning, although they lack empirical scientific merit.

In exploring the existence of critical periods and learning, it is important to understand the definition of a "critical period". Critical periods refer to time spans in development during which children acquire specific traits, behaviors, or skills (Bruer 1999 pg. 104). Learning takes place throughout an individual's lifetime, although there are periods when the brain is particularly open to new experiences (Barnet 1998 pg. 24). Rapid development occurs under the proper environmental conditions during a critical period (Gardner 1983 pg. 40). If during the critical period for a specific trait an animal has experiences that are normal for its species, the animal will develop that trait normally (Bruer 1999 pg. 104). If during the period, the animal has abnormal, species-atypical experiences, it will develop the trait abnormally (Bruer 1999 pg. 104). If the environment is highly abnormal, the animal may not acquire the trait at all (Bruer 1999 pg. 104). In their book, *The Youngest Minds* (1998), Drs. A. B. and R. Barnet state, "Special sensitivity to experience is the defining characteristic of early childhood. There are critical time periods when certain experiences must be available to the child so that

normal development of connections can take place” (pg. 24). The end of a critical period occurs when the process of synaptic elimination has progressed to the point where the remaining synapses are no longer subject to the competitive interactions of synaptic pruning (Gardner 1983 pg. 45).

Many well-known scientific studies prove the existence of critical periods. Ethnologist Konrad Lorenz discovered that newly hatched goslings will follow the first moving object they see after hatching, a behavior known as imprinting (Bruer 1999 pg. 104). The gosling will follow this object everywhere, and does not transfer its preference easily (Bruer 1999 pg. 104). If the gosling does not see an object after the first 24-48 hours, it will fail to imprint (Bruer 1999 pg. 104). Under normal circumstances, the first moving object a gosling would see after hatching would be its mother, making imprinting an important evolutionary survival benefit (Bruer 1999 pg. 104).

Songbirds have been cited frequently to prove the existence of critical periods. Male zebra finches sing to attract mates. Between days 25-80 after hatching, young male birds must hear the song sung by a mature male and be able to sing it correctly (Bruer 1999 pg. 105). If the male is not exposed to the song during this period, it will fail to learn it and thus fail to attract a mate (Bruer 1999 pg. 105).

Visual development appears to have a critical period. Scientists Huble and Wiese reported that newborn kittens whose eyes had been sewn shut for the first three months of life remained permanently blind (Bruer 1999 pg. 105). In another Huble and Wiese study, kittens had one eye covered with a patch for six weeks after birth. When the patch was removed, the kittens did not regain vision in the eye that had been occluded. The same visual deprivation had no effect on adult animals (Barnet 1998 pg. 24).

Another study reported that children born with congenital cataracts in their eyes fail to develop normal visual systems if the cataract is not removed promptly (Bruer 1999 pg. 105). Adults with cataracts do not develop the same abnormalities with their visual system (Bruer 1999 pg. 105).

Language development appears to have a critical period as well. The idea that the human brain is programmed to acquire language according to an innate maturation timetable is widely accepted among scientists and theorists (Barnet 1998 pg. 32). Linguist Noam Chomsky declares that learning one's mother tongue depends on an inborn language faculty that specifies and requires certain forms of word combinations in all languages and disallows others (Barnet 1998 pg. 33). According to Chomsky, "Universal grammar" consists of the biologically determined linguistic principles (Barnet 1998 pg. 33). All of the world's 4000-6000 languages share certain rules and principles governing sequences and combinations of words (Barnet 1998 pg. 33). Rules on word order, clauses and phrase structure have shared properties among all languages (Barnet 1998 pg. 33). Nearly all children, both normal and mentally challenged, acquire language skills without much instruction (Barnet 1998 pg. 33). Infants from all parts of the world will engage in babble speech not unique to their own native language (Gardner 1983 pg. 79). Deaf individuals engage in babble when they are infants (Gardner 1983 pg. 79).

According to scientist Richard Aslin, author of "Auditory Development and Speech Perception in Infancy" (1983), newborns have the ability to distinguish between various vowel sounds in different languages. By the time they are around one year old, children can only recognize sound combinations and contrasts in their own native language (Aslin 1983). Japanese newborns can distinguish between the sounds "ra" and

“la”, but this skill is lost around one year (Barnet 1998 pg. 47). Another study conducted by J. Werkler and C. Lalonde (1988) examined infants’ ability to discriminate between sounds within their native English language and Hindi. Prior to age six months, infants are able to discriminate sounds in both English and Hindi. After six months, infants can only discriminate sounds within their native English language (Werkler & Lalonde 1988).

Infants and young children with frequent ear infections and un-diagnosed hearing problems suffer in their language development. Susan Curtiss, a linguist at University of California, Los Angeles, describes a woman born with a severe hearing loss that went undiagnosed until she was 32 years old (Barnet 1998 pg. 32). When she was fitted with a hearing aid, she quickly learned to speak and understand many words, but her ability to combine words into appropriate and grammatically correct sentences was very poor (Barnet 1998 pg. 32).

Cases involving children that were severely deprived of auditory and language stimulation give scientists insight into critical periods. In a famous case, a girl named Genie was kept locked in a dark closet from ages 2-13 with no social or linguistic stimulation (Bruer 1999 pg. 105). When she was rescued, she was able to learn a few words, but failed to master English grammar (Gardner 1983 pg. 86). In another case, a child named Isabelle was first exposed to language at age 6. She was able to acquire several thousand words and construct complex grammatical sentences by age 8 (Bruer 1999 pg. 105). There appears to be a critical period for learning one’s native language that ends around puberty (Bruer 1999 pg. 105).

The previous studies all have implications for critical periods involving basic survival skills such as recognizing one's mother, vision, language, mating, and social development. Dr. Bruer, author of *The Myth of the First Three Years* (1999), states,

Critical periods make evolutionary sense because they rely on stimuli that is [sic] ubiquitous within normal human development....The stimulation children need to fine-tune their neural circuitry are [sic] everywhere around them...at home in the hills of New Guinea or on Manhattan's Upper West Side (pg. 110).

Sarah Spinks reports in "The First Year Fallacy" (2005) that researchers distinguish types of critical period development that are necessary to evolution as "experience-expectant". The brain "expects" certain experiences to occur to shape and wire basic neural systems. These experiences are universal to humans, regardless of geographical location or period in time. The brain's "expectancy" for these experiences has resulted from thousands of years of evolution. From an evolutionary perspective, a human that does not receive these experiences has a low chance to survive and procreate. "Experience-expectant" experiences ensure an individual's survival. Neural plasticity expert Dr. William Greenough believes that experience-expectant skills require the brain to prune the excess synapses.

"Experience-dependent" skills require the brain to grow new synapses and/or increase the efficiency of existing neural connections (Bruer 1999 pg. 109). "Experience-dependent" experiences are unique to specific individuals and cultures and not to the species as a whole. Evolution has created the brain to have "plasticity" and adapt to

different environments. The brain builds synapses and connections specific to an individual's environment. A child born into a South American indigenous tribe will learn to hunt animals and find edible plants, whereas a child born in an American suburban community will learn to play with blocks, use crayons, and read books (Bruer 1999 pg. 105). Greenough does not support the "use it or lose it" philosophy that synapses die off if a child is not presented the proper stimulation. Greenough did not argue a need for additional stimulation, but rather stated that there are no research studies to date suggesting that mobiles, flash cards, educational videos, or music lessons created more synapses in a baby's brain (Bruer 1999 pg. 109).

One neurological study that is often cited in early childhood literature as proof of critical periods with classical music is a study performed at University of Konstanz (Bruer 1999 pg. 115). Scientists used brain-wave recording technology to examine the effects that playing a string instrument had on the brain (Bruer 1999 pg. 115). The average age of the subject was 24. Half of the subjects had played a string instrument for an average of 11.5 years; the other half of the subjects had no experience playing a string instrument. Magnetoencephalography (MEG) technology measured the magnetic fields produced from the scalps of participants as they moved the fingers on their left hands (Bruer 1999 pg. 115). The magnetic field was generated by the electrical activity of tens of thousands of neurons used to control finger movement (Bruer 1999 pg. 115).

The measurements showed increased magnetic magnitude in the brain areas responsible for controlling finger movement among the string players (Bruer 1999 pg. 115). Furthermore, among the string players, the magnitude of the magnetic signal seemed to be dependent on how old the person was when he or she began playing the

instrument (Bruer 1999 pg. 115). Those that had been playing for more years appeared to have larger magnetic signals (Bruer 1999 pg. 115). Those that had started playing after age 12 also had increased magnetic signals compared to the non-players (Bruer 1999 pg. 115).

Many articles cited this research as being conclusive that parents must provide music lessons for their child before age twelve when this critical period ends, although Bruer believes that this is a faulty conclusion (Bruer 1999 pg. 115). The experiment measured the brain's response to a repetitive motor skill. Bruer states that scientists would have likely found the same evidence if they measured right hand magnetic fields with joy stick users of video game players to non-players (Bruer 1999 pg. 115). In addition, the experiment design used in this study cannot be used to determine the existence of a critical period. It is probable that the players who began lessons at a younger age had engaged in more hours playing; therefore the results could be from time spent playing rather than the age at which the players had started (Bruer 1999 pg. 116). The conclusion presented from this study is that the neural circuitry of the mature brain reorganizes itself in response to an individual's experiences (Bruer 1999 pg. 116). Even after synaptic pruning has been completed, changes in the brain structure conform to the needs and experiences of the individual (Bruer 1999 pg. 117).

When Dr. Bruer, contacted one of the experimenters in the study of MEG fields of string players, the scientist reported,

“I am definitely not happy with the interpretation and treatment of this article...

The interpretation and coverage missed the main point of the work entirely, which was not that you have a greater plasticity in the immature brain than in the mature

nervous system, but rather that [the] plasticity persists, at least in reduced form, into maturity. It is the latter that is contrary to the previously established view in neuroscience that gives the paper whatever importance it has” (Bruer 1999 pg. 116).

Scientists are not in agreement if acquisition of musical skills is experience-dependent or experience-expectant. David Sousa, author of *How the Brain Learns* (2005), argues that music and dance are basic to the human experience and necessary for survival (pg. 221). Music is present in all cultures around the world with some of the earliest manuscripts of western music dating to the 9th century B.C. (Sousa 2005 pg. 221). All members of a culture are able to participate in music through singing and simple clapping (Sousa 2005 pg. 221). Most cultures have highly complex music that requires training and practice (Sousa 2005 pg. 221). Music is thought to provide a means for preserving history, values, and tradition among people when written language is not available (Sousa 2005 pg. 221). If musical skills are experience-dependent, then there could possibly be a critical period for acquiring skills such as pitch and rhythm.

Several studies show interesting findings regarding pitch and melodic discrimination in infancy. Scientist L. Stewart reports in “Infant Learning, Music and the Baby Brain” (2005) that infants between six and twelve months can discriminate metric changes in both native and non-native music, compared with adults who can only spot the metric changes in their native style of music.

Stewart (2005) cites a study by Hannon and Trehub (2005) in which subjects ages six months, twelve months, and adults were presented native western music and Balkan

music to see if the subjects could detect meter changes (Hannon & Trehub 2005). Preferential looking was used to determine if meter change was recognized among the infants. Preferential looking is a method in which a stimulus is presented to an infant a number of times. The stimulus is then changed, and if the infant notices, they will turn and look towards the new stimulus. Western music meters are typically organized in 2, 3, or 4 note groupings whereas Balkan music has complex meters of 5 or 7 with irregular note groupings. Hannon and Trehub found that the subjects six months of age could differentiate between the changes of meter in both native and non-native music, whereas the twelve month old infants and adults could only recognize the meter change in their native Western meters (Hannon & Trehub 2005). After an exposure period of Balkan music for two hours per day for two weeks, the twelve-month-old infants were able to differentiate the meter changes with the same ability as the six-month-old infants (Hannon & Trehub 2005). The adults however failed to differentiate Balkan meter changes after two weeks of exposure (Hannon & Trehub 2005). This research suggests that a sensitive period exists in which the brain creates structures specific to what is presented in the environment. In response to this particular study Stewart remarks that perhaps the adults can learn to detect meter changes in non-native music although they do not have the same neural circuitry available and often have to overcome such limitations (Stewart 2005).

According to the research, it appears as if the first years of life do have important implications for learning, although the term “critical period” can be misleading. If music competency had a true “critical period”, there would be no occurrences of performers who began instruction past the defined critical period. The research suggests that there

may be benefits of starting early. A child who begins music instruction later in life can still reach high levels of competency, although very few children who start musical studies later in life reach competency levels necessary for a performing career.

Musical performance and comprehension involve many interrelated structures in the brain. Scientists' understanding of the brain and how the structures function together is still very limited. More research is needed before scientists will fully understand just how music ability is acquired and if there is indeed a critical or sensitive period. Music educators need to be informed and updated on the current research and share it with parents in an honest way. The Suzuki ECE statement, "Early childhood experiences lay the foundation for all later learning and determine whether or not children succeed in school and later life", may not be entirely true because the use of the word "all" is too generalized and there are many factors that determine whether a child succeeds in school and later life. The claim that the first years are the most important years, and if a parent fails to enroll in appropriate classes their child will suffer later on is not entirely true and should not be used as a factor for recruitment. Perhaps a more accurate statement would read, "Early childhood experiences shape and influence learning throughout childhood. These experiences can contribute to the success of a child in school and later life".

Part 2: Suzuki ECE and Kindermusik Program Comparisons

Suzuki ECE History

Dr. Suzuki expressed regret that he had not reached the youngest of minds, and stressed that that music education begins long before the studio lessons begin. Although the Suzuki Early Childhood Education program as we know it today had not been in place during Suzuki's lifetime, he clearly had expressed the importance of education in the earliest years in his writings. In Dr. Suzuki's book *Nurtured by Love*, he writes, "...a child is judged only from five or six years of age on. Nobody seems to care what happened before-what kind of education the child had from early infancy" (Suzuki, 1983, p.2). Suzuki continues,

It has been always thought that talent or superior qualities are inborn, or inherited. But can we test a suckling to find out whether or not such things are present? The problem is that children five or six years old (are) already trained (and) are judged from there on as to their ability...yet it is the earliest stages of infancy that are critical. We should be doing research on the potential talents of suckling babes (Suzuki, 1983, p.12).

During a visit to the Matsumoto School in Japan in 1985, Dr. Suzuki expressed his interest in educating the very young to Dorothy Jones. Jones had recently established an early childhood and elementary school that utilized Suzuki principles for general education. Dr. Suzuki was very pleased, but he said to her, "Don't forget the babies". Unfortunately, the school was not able to sustain itself due to inadequate funding, but Jones had not forgotten what Dr. Suzuki had said.

During the late 1980s Jones developed a pilot curriculum comprised of folk pieces from different countries. She presented these ideas to Dr. Suzuki for his approval and the

choice of pieces became finalized. In 1987 the first Suzuki ECE class began in London, Ontario with the help of Dorothy Jones' daughter, Sharon Jones. The class was on a 12 month continuous enrollment schedule and was of mixed ages. After the first year revisions were made to the curriculum to incorporate parent education and parent observation at each class in addition to the songs and activities. In 1993 the curriculum was approved by Dr. Suzuki and the International Suzuki Association. At this time the London, Ontario school became the first World Centre for Suzuki Early Childhood Education and Teacher Training. The Suzuki ECE program is currently active in America, Canada, Australia, and Finland, and continues to grow each year as more parents and teachers become aware of the benefits Suzuki ECE course can offer.

Suzuki ECE Philosophies

Suzuki ECE is based upon the same principles and philosophies as described in Dr. Suzuki's writings such as *Nurtured by Love* (1983) and *Talent Education from Age Zero* (1981/1969). Dr. Suzuki intuitively recognized and implemented many ideas and learning theories of famous child psychologists such as Jean Piaget and Lev Vygotsky. Suzuki ECE is the only early childhood music course that is recognized by the Suzuki Association of the Americas; however, the Suzuki Association of the Americas and Suzuki ECE are not accredited or endorsed by any third party organizations or individuals.

Every Child has Talent

Dr. Suzuki firmly believed that every child has great potential and talent. Prior to Dr. Suzuki, it was common belief that talent was a genetic gift that some people were born with and others not. The opening preface of Dr. Suzuki's book, *Nurtured by Love* (1983) states, "Talent is no accident of birth... We are born with the natural ability to learn." (Suzuki, 1983, p. iv preface).

Dr. Suzuki believed that every child had talent because all children could master their own language with ease to a very high degree by age three. Dr. Suzuki was amazed that children so young could master language complete with accents and nuances without any formal training. He theorized that the same process for learning one's native language could be used for learning music. *Mother Tongue Method* was the term he used to describe the learning process (Suzuki 1969/1981 pg. 5).

Dr. Suzuki accepted any child into his music studio, including a blind child and a child that had congenital cerebral palsy. This approach was radical during a time when

no special education existed for special-needs children, and talent was believed to be genetically based. Dr. Suzuki believed that all children had great potential; the only superior inborn talent was a child's ability to adapt with more speed and sensitivity to their environment (Suzuki 1983).

Talent Develops Early

In Dr. Suzuki's book, *Ability Development from Age Zero* (1981/1969), he writes about the importance of beginning early. Waiting until a child is in elementary school to begin education is compared to taking a withered sprout and flooding it with water and fertilizer, and expecting it blossom; it simply will not happen as naturally as a sprout that was carefully cultivated since germination. "All children skillfully reared reach a high educational level, but such rearing must start from the day of birth...here lies the key to the fuller development of man's potentials and abilities" (Suzuki, 1983, p.2).

Environment Encourages Growth

Dr. Suzuki discredited the idea that talent and ability were inborn qualities. He felt very strongly that it was the quality of the environment and training one received that produced talent and ability. Suzuki states in *Nurtured by Love* (1983), "Good environmental conditions and a fine education cannot help but contribute to the children's welfare and happiness, as well as promising light and hope for the future of mankind" (Suzuki, 1983, p.14).

Dr. Suzuki would often use the analogy of seedlings to illustrate his principles of Talent Education (Suzuki 1981). Just as a seed needs water, nourishment, and sunlight in order to grow, children need encouragement and love to develop their talent (Suzuki 1981). Seedlings are actively growing underground before any flower is noticeable on

the outside (Suzuki 1981). Children's minds and abilities are developing as well, even when the changes seem unnoticeable in the child's behavior (Suzuki 1981). Dr. Suzuki writes, "In the agricultural world, success depends upon the cultivation which the seed receives from the time it is planted. Human ability will not exist if it is ignored when it is in the seedling stage" (Suzuki, 1981, p.1).

One of the main goals of Suzuki ECE is to educate parents to nurture their child's talent while it is in the seedling stage. Suzuki ECE teachers remind parents that they are the child's most important teacher and they must prepare a home environment that is stimulating and encourages their child's growth. Suzuki ECE provides information for parents on how to create a home environment that is stimulating and encouraging. Parents are to provide a model for the child to imitate (Jones 1995). Parents should talk, hum, and sing to their babies while changing their diapers, feeding, bathing, and dressing them (Jones 1995).

Playing a selection of classical music every day is recommended for the home environment. Playing the same recording every day will soothe them and help develop their sensitivity to the music. The infant will take in the music and process it much the same way an infant takes in language (Suzuki 1981/1969 pg. 9). Dr. Suzuki theorized that the infant would have the piece completely memorized by age five months (Suzuki 1981). To test this, he asked parents to change the piece of music to something different than the infant is used to hearing. The infant would have a look of surprise and wonder on their face with the new piece, whereas the baby would smile and sway when the familiar piece was played. (Suzuki 1981/1969 pg. 9).

Language and literacy skills are important elements of Suzuki ECE. Suzuki ECE stresses that it is never too early in a child's life to read books (Jones 1995). Each class ends with a book read or sung out loud. Books with clear pictures and bright colors are enjoyable to babies (Jones 1995). Holding the baby in one's lap provides a bonding experience and allows the baby to view the pictures clearly (Jones 1995).

Parental Involvement:

Parental involvement is an integral aspect of Suzuki talent education. The degree of parental involvement is one aspect of Suzuki Talent Education that sets it apart from other traditional methods of instrument study. For preschoolers beginning instrumental lessons, often it is the parent who first learns how to hold the instrument and bow and play "Twinkle Twinkle Little Star" while the child observes. After the child has seen the parent and other children playing the instrument, they will naturally want a chance to play themselves. Playing an instrument becomes an activity that the child wants, rather than an activity the parent wants for the child. Educating the parent serves two purposes. The parent has a first-hand experience with the instrument so that they can understand and help the child learn more efficiently. Secondly, the parent serves as the teacher six days of the week when the child is not in lesson, guiding the child through practice. Therefore the more skilled the parents are in their role as teacher, the more success the child is likely to achieve.

Likewise, one goal of Suzuki ECE is to educate the parents on the importance of their commitment to their children's musical growth. Parents are expected to attend each class, read *Nurtured by Love*, and play recordings at home (Jones 1995). During each ECE class, teachers model and demonstrate the Suzuki philosophy in the manner in

which it should be repeated at home (Jones 1995). Parents are required to become actively involved in the classroom activities as well as at home practicing and listening.

Success Breeds Success: The Importance of Small Steps

Suzuki teachers strive to make children feel successful by praising each step in their development and encouraging them to enjoy the present moment. Each accomplishment is a building block for the next skill. When a child feels as if he has mastered a skill, he is motivated and excited to learn. Small accomplishments lay the foundation for higher skills. Suzuki methodology breaks down techniques to the smallest achievable skill so that the child is able to feel successful in every lesson or practice session. “Develop ability from what the child can already do and the ability will promote the happiness of doing things better and better” (Suzuki, 1981, p.21). The same theory has been noted by psychologist Lev Vygotsky, who used the term scaffolding to describe the process.

Ability Development from Age Zero (Suzuki 1981/1969 pg. 6) describes the principle of success breeding success. While learning language, the number of times a child must hear “ba-ba” is uncountable before the child is able to speak it for themselves. From that point, the ability (ease in pronouncing the new word) must grow before they can speak other words such as “mama” or “papa”. While practicing these three words, the ability must grow more before they can speak a fourth or fifth word.

Dr. Suzuki also illustrates the importance of small steps by describing the high jump training of Ninjutsu martial artists. Ninjutsus take a hemp seed and plant it. Each day they practice jumping over the plant, adding a small amount of height as the plant grows. Hemp grows at a fast rate, and after a month or two the plant is several feet in

height. If the Ninjutsu had not trained daily starting with a small plant, jumping over a full grown plant would prove impossible.

Suzuki ECE teachers will praise each child while teaching the parents the importance of recognizing and praising small accomplishments. The final five minutes of class are reserved for parents to write a small journal record of something positive that they noticed in their child's development for that class. This simple exercise helps parents to be observant and celebratory of their child's development.

Education of heart

An important aspect that sets Suzuki Talent Education apart from other music programs is Dr. Suzuki's desire to bring happiness to children's lives and teach them to have kindness in their hearts. Dr. Suzuki experienced first-hand the devastation of World War II on Japan. In his teaching he used music to cultivate happiness and sensitivity in children for hopes of a brighter tomorrow. Dr. Suzuki stressed the need for a pure heart and noble mind in his writings. In *Nurtured by Love* (1983), Suzuki writes, "If a musician wants to become a fine artist, he must first become a finer person" (Suzuki 1983, pg. 82). Suzuki makes it very clear that the purpose of Talent Education is not to create little prodigies or concert musicians; rather it is to teach children how to be aware and sensitive to the beauty around them. "I want Japanese children to grow up to be people who have this pleasure in their lives and be people of high intellect and sensitivity...the purpose of talent education is to train children, not to be professional musicians but to be fine musicians and to show high ability in any other field they may enter" (Suzuki 1983, pg. 78).

Suzuki ECE incorporates these same principles. Even at a young age, the children are expected to help out in the classroom and at home. Each class teaches the importance of sharing and waiting one's turn in the activities. Care and respect for the materials are practiced in each class. After using scarves for creative movement, the children carefully fold the scarves and put them away. At home, they are asked to help fold laundry in the same fashion, and many parents report that the children take pride in doing work. Suzuki ECE aids in increasing children's sensitivity to beauty. When the triangle is struck the children listen to the ringing vibrations and absorb the beauty. Teachers assist the children in creating beautiful sounds on the instruments instead of letting the children whack freely and create nothing but noise. Children listen to recordings of beautiful music as well. Dr. Suzuki states in *Nurtured by Love* (1983), "I just want to make good citizens. If a child hears music from the day of his birth, and learns to play it himself, he develops sensitivity, discipline, and endurance. He gets a beautiful heart" (pg. 104).

Suzuki ECE Curriculum

Choice of pieces

Suzuki ECE pieces are chosen from folk songs that have stood the test of time and most parents recognize from their own childhood. The songs were chosen among folk songs that incorporate elements of counting, rhythm, and simple diatonic melody.

Parents are more likely to participate if they feel knowledgeable and comfortable with the pieces. A CD with all the pieces as well as a lyric booklet is provided for each family.

Unfortunately, folk songs differ from country to country and Suzuki ECE cannot have a defined curriculum of pieces across all countries. Suzuki instrumental study uses the same standardized curriculum in all countries.

Age levels

The curriculum for Suzuki ECE is designed primarily for a classroom of twelve with children ranging in ages from 0 to 3 or 4. Although the children are at different developmental and skill levels, the teacher is able to challenge each child individually to reach a new level of mastery with each activity. By age three or four, most children demonstrate readiness for studio lessons. Jones presents a list of what a parent and teacher can expect from a child who has been in a Suzuki ECE program for three to four years (Jones 1995).

Suzuki ECE Skill Goals

Listening/Sequencing skills	<ol style="list-style-type: none"> 1. Follow simple directions 2. Listen Carefully 3. Recognize common sounds 4. Repeat a sequence of sounds
Understanding Size and Opposites	<ol style="list-style-type: none"> 1. Big Sound, small sound 2. Big movement, small movement
Pitch Skills	<ol style="list-style-type: none"> 1. High or low 2. Up and down 3. Fast and slow 4. Left or right (with pitch produced while playing xylophone) 5. Playing falling third interval on xylophone
Number Skills	<ol style="list-style-type: none"> 1. Counts orally 1-10 2. Counts fingers 3. Knows finger numbers
Motor Skills	<ol style="list-style-type: none"> 1. Walks to music 2. Jumps to Music 3. Hops to music 4. Runs to music 5. Marches to music 6. Claps to music 7. Passes ball to music

	8. Can do finger plays 9. Can cross the mid line with xylophone mallets
Social-emotional development skills	1. Approaches teacher without shyness 2. Can comfortably move away from parent 3. Maintains self-control 4. Shares with others 5. Develops independence
Vocabulary Skills	1. Acquires language 2. Communicates with parents and teacher 3. Memorizes pieces and movements
Total Growth	1. Creativity in movement 2. Sensitivity to sound 3. Works towards mastery of a skill

Children Learn From one Another

Suzuki ECE is not divided into age groups because of Dr. Suzuki's belief that children learn from one another. Suzuki music lessons incorporate group lessons with players of different ages and skill levels. The older children serve as mentors and role models for the younger ones. Dr. Suzuki stressed the importance of group lessons. "They play with children who are more advanced than they are; the influence is enormous and is marvelous for their training. This is real talent education" (Suzuki, 1983 pg. 95). Young children look up to the older children as an example and leader, whereas the older children serve the role as a model for the younger children.

Repetition and Review

Dr. Suzuki advocated strongly for children to perform many repetitions of a single skill in order to truly learn it and develop ability. In *Nurtured by Love* (1983), Dr. Suzuki describes the importance of repetition and mastery. He describes his own struggle for mastery while learning violin. "I did not know that it (talent) was just a matter of repeating a piece hundreds of times in order to play better, more nobly, and more beautifully" (Suzuki 1983, p.75). While doing repetitions, students are to repeat the passage with a specific goal or purpose in mind; this is not mindless repetition. Young children often enjoy doing repetitions if they are successful because it gives them a sense of accomplishment and competence, and allows growth of myelin around neurons (Coyle 2009, pg. 87). Many repetitions allow the parent able to give positive or corrective feedback after each repetition.

After a child has learned a piece of music, they do not simply go on to the next piece and disregard the previous one; they will take the piece of music and add a new skill to perform the piece of music at a higher level. Previously learned pieces are reviewed in order to produce finer tone, graceful movements, greater accuracy, and finer musicianship (Suzuki 1983). Review of previously learned pieces is necessary in order to develop ability to the highest level (Suzuki 1983).

Suzuki ECE incorporates repetition in each lesson by doing each piece at least three times. The young children enjoy the repetitive nature of the class, and parents are able to see their children master skills efficiently. Suzuki ECE uses what Jones describes as “layers” of complexity. In the early stages of the child’s musical development they are encouraged to simply keep a beat or hold a mallet and produce a tone. Each ECE activity has additional skills that the child can add on in order to perform the task to a higher level of mastery upon review of a piece. Dr. Suzuki said,

The mother does not say to the child, ‘You have said mama enough times. Next word.’ No. The child must repeat and repeat if he is to learn. Knowledge is not a skill. Knowledge plus 10,000 times is a skill” (Star 1983, p 13).

Dr. Suzuki was not the only teacher to advocate repetition for learning. Psychologist Michael Kubovy describes virtuosity as a human’s pleasure in doing things well and with mastery (Lillard 2007 pg. 178). The pleasure of performing a skill with mastery drives children to repeat the skill over and over (Lillard 2007 pg. 178). Early childhood educator and founder of the Montessori Education program Maria Montessori also noted in her writings the need for many repetitions to facilitate learning. Dr.

Montessori described repetition as leading children to carry out exercises correctly (Lillard 2007 pg. 178). If the environment provides feedback so that children do not keep repeating the same errors, the children are driven to repeat the exercises until they can perform them perfectly and with mastery (Lillard 2007 pg. 178).

Kindermusik

History

According to *The Kindermusik Classroom* (2005), Kindermusik was founded in former West Germany in 1968. The West German government commissioned the Director of the Association of German Music Schools, Diethard Wucher, as well a panel of leading musicians and early childhood specialists, to develop a music and movement program for kindergarten-aged children. The first Kindermusik curriculum was published in 1968 with over half a million Kindergarten children enrolled in the program. In 1974 teacher training programs were established in the United States. By 1984, the growing interest in Kindermusik programs led to the formation of Music Resources International (MRI) which held exclusive distribution rights for Kindermusik in North America. In 1993, MRI was renamed Kindermusik International and began to oversee programs located in the United States, Australia, Singapore, South Africa, and England. Currently, Kindermusik is taught by over 6,000 licensed educators around the world, making it the largest early childhood music program.

Kindermusik Core Philosophies

Total Growth of Whole Child

According to *The Kindermusik Classroom (2005)*, total growth of the whole child is a guiding principle when planning Kindermusik materials and activities. Kindermusik utilizes music and movement in order to foster physical, emotional, cognitive, language, and social growth. Each activity has “Foundations of Learning” statements on how the particular activity benefits one or more of the developmental domains. The Foundations of Learning statements also serve to educate parents on how each Kindermusik activity aids in the development of the whole child. The activities are designed to integrate learning in cognitive, physical, emotional and social developmental domains. The activities and materials are varied to increase in difficulty and complexity as children develop skills and understanding.

According to *The Kindermusik Classroom (2005)*, Kindermusik materials and curriculum follow the guidelines established by the National Association for the Education of the Young Child (NAEYC). Founded in 1926, the NAEYC is the world’s largest organization dedicated to quality and integrity in early childhood education. The NAEYC is a partner of the Global Alliance for the Education of Young Children as well as the World Organization for Early Childhood Education. The NAEYC has approximately 100,000 members, a national network of over 300 local, state, and regional affiliates, and a growing global alliance of like-minded organizations. The NAEYC serves as the accreditation organization for college programs committed to meeting national standards of quality in early childhood teacher training. Careful planning and

research have gone into each Kindermusik activity to ensure that it is developmentally appropriate.

The Kindermusik Classroom (2005), states that the Kindermusik program is not concerned with the accuracy or outcome of a performance, but rather places importance on the musical experience. The Kindermusik curriculum provides developmentally appropriate musical experiences with no expected level of accuracy or achievement.

The Kindermusik Classroom (2005) states, “Our goal is musical children rather than child musicians” (p.100).

Kindermusik is founded on the belief that the parent is the most important teacher in a child’s life and the home is the most important place for learning to take root and grow (*The Kindermusik Classroom* 2005). Kindermusik seeks to reach out and educate parents on how to support and continue musical experiences at home and provides a kit with a CD and small instruments to assist parents and their children in their home learning. Parents participate in the entire class for the youngest children, but when the children reach age three the parents are only present for the last fifteen minutes of the class.

Kindermusik segregates children according to age, and the curriculum is different for each class session. Programs range from ages newborn through seven. The pieces used are written and designed specifically for Kindermusik programs. The pieces are diatonic and incorporate singing, clapping, tapping, chant, dancing, and instrument play. Program units feature childhood themes such as the alphabet, animals, transportation, and daily routines.

Kindermusik is a licensed franchise, and in order to maintain consistency throughout the program, teachers are required to use only Kindermusik songs and curriculum. In addition, Kindermusik materials and curriculum cannot be used in a non-Kindermusik setting. Teachers are encouraged to personalize the curriculum to fit needs of their students, although they must adhere to the core curriculum and cannot add non-Kindermusik activities to the lessons.

Comparisons

Similarities

Kindermusik and Suzuki ECE both are founded on the belief that every child is unique and has a high potential for learning. All children are welcomed into the programs regardless of skill level. Both Kindermusik and Suzuki ECE acknowledge the importance of the early years for learning and seek to create a classroom and home environment that can support the child's growing mind. An at home CD or kit is provided for use at home to encourage families to practice each day and incorporate music into their daily routines. Both programs focus on the learning process and the small accomplishments for each child. Kindermusik and Suzuki ECE both offer a great opportunity for children to spend quality time with parents in a musical environment. Parents are involved in classroom and at home activities. Teachers in both programs are sensitive to the developmental stages of young children and the curriculum reflects the capabilities of the child's particular level of ability.

Differences

The Kindermusik program does not stress accuracy or mastery of musical skill, but rather emphasizes an enjoyment of music and celebration of learning. Suzuki ECE seeks to educate parents about the importance of skill mastery. Suzuki ECE asserts that mastery of skill is both possible and critical in the learning process, even at a young age. Suzuki ECE attests that mastery of skill is possible for all children by breaking the skill down to small, manageable steps that the child is capable of achieving.

Parental involvement is a crucial factor in both Kindermusik and Suzuki ECE. As children progress through the Kindermusik program, the amount of parent involvement is

reduced significantly. Suzuki ECE requires parent participation at all age levels both in the class and at home. Suzuki ECE educates parents on what their role will be in future Suzuki instrumental studio lessons.

Kindermusik has the advantage of being more accessible to students. Suzuki ECE has only been offered since 1993, and classes are offered in comparatively few locations. Currently there are only three Suzuki ECE teacher trainers in North America, whereas Kindermusik training has an accessible online training program. Suzuki ECE trainers and the Suzuki Association of Americas hope to offer more programs in the future as more teachers and parents recognize the potential benefits of early music education.

Advantages

The advantage to Suzuki ECE is that it provides an introduction for parents to the Suzuki philosophy. Suzuki ECE seeks to develop a sense of community among the families involved. Parents are an important aspect of Suzuki Talent Education, and Suzuki ECE teachers prepare parents how to best support their children's potential. Suzuki ECE strives to teach parents to cherish whatever stage of learning their child is in and builds a strong foundation of trust and respect between parent and child. Parents' knowledge of how to observe and encourage their children's learning will have a positive impact on how they guide their child throughout life. Regardless of whether or not Suzuki ECE has an effect of children's learning or brain development, the knowledge of how to observe and encourage their children can help parents support their child's learning throughout life. After completing Suzuki ECE, parents may decide to continue in private studio lessons. Suzuki ECE gives children a musical foundation and learning skills that will assist them in instrumental lessons. Kindermusik has classes and

curriculum up to age seven, which is late to start private instrumental lessons. Although Suzuki instrumental lessons are valuable and beneficial at any age, ideally instruction should begin at the three to five-year age.

Neither program has any specific curriculum advantages, although the Suzuki ECE program offers pieces that are well known American folk songs and rhymes. Familiarity of the pieces might make the parents feel more relaxed and comfortable participating both in class and at home. Because Suzuki ECE is not a franchise, teachers have more flexibility to adapt classes to fit the needs of the students, whereas Kindermusik teachers must follow the prescribed lesson plans. Suzuki ECE includes a story time portion to promote early literacy and love of reading. Activities include following objects left to right in preparation for reading. Teachers encourage parents to continue reading at home to their infant daily. Many Suzuki ECE teachers incorporate foreign languages in their classes, such as having the children count drums in Spanish or French. Families from other countries are encouraged to share a folk tune from their language for the class.

What sets Suzuki ECE apart from Kindermusik curriculum is the use of repetition. Myelin formation is a slow process that requires many exposures to a stimulus in order to grow (Coyle 2009 pg. 38). By having a curriculum that continuously changes, neurons may not have enough exposures to support myelin formation.

Outline of Program Comparisons

	Kindermusik	Suzuki ECE
Ages	Six months to seven years	Zero to age three or four
Mixed age or separate	Divided into groups depending on age	Mixed age classroom
Curriculum	Each weekly unit is provided to the teacher with specific learning domain targets and goals	Same curriculum pieces with increasing levels of complexity for children to master
Mastery of Skill	No accuracy or mastery is expected, the emphasis is on fun and enjoyment of music rather than end result	Great importance is placed on mastery of skills. The rate of mastery of each child is respected and no child is ever turned away from program
Parent involvement	Parents are an integral aspect of the class until age 5 Classes for ages 5-7 parents come for the final 15 minutes	Parents are expected to participate in each class and practice with their children at home
At home practice	An “At Home” kit with CD and small instrument is provided for each participant and families are encouraged (but not required) to practice at home	A CD is purchased and parents are educated on the importance of listening. No instruments are provided
Outside accreditation	National Association for the Education of the Young Child. (NAEYC)	Integrates ideas and theories from many child psychologists, although is not directly accredited or endorsed by third party person or organization
Program size	Worldwide, approximately 5,500 programs	Relatively small, Suzuki ECE is offered at studios in the USA, Canada, Australia, and Finland, New Zealand, Iceland, and Peru

Program's presentation of Current Biological Research

Suzuki ECE focuses on critical periods and enhanced brain development to encourage parents to join the program. It is important to remember that a critical period is defined by a specific window of development when, if particular criteria are not met, development of that skill will not occur. Critical period skills are experience-expectant and occur among all populations and time. Critical periods in developmental terminology describe an “all or nothing” approach to skill acquisition and therefore the term may not be appropriate for use with Suzuki ECE. “Sensitive period” might be a more correct label for the experience-dependent activities that occur during the 0-3 age period where perhaps musical development is enhanced due to the brain's particular plasticity in wiring systems. While the research clearly demonstrates the advantages of early instruction, children who begin lessons later in life are still able to attain high levels of musical skill, although skill may not develop with the same ease and fluency as it does in children who begin as preschoolers. It is theorized that children who begin musical training at a younger age build myelin at an accelerated rate compared to older individuals (Coyle 2009 pg. 45). Myelin formation around nerve fibers is a slow process and requires many repetitions of a skill (Coyle 2009 pg. 43). Children who begin earlier in life have more available oligodendrocytes (cells that produce myelin) and time to build repetitions and allow for myelin growth (Coyle 2009 pg. 45).

The Suzuki ECE website gives the impression that the excess of neurons present during the early years of life could potentially offer enhanced learning opportunities when children are presented the proper stimulus. It is during this period that the neurons can possibly wire themselves to be perceptive to music experiences. In an article titled,

“What Suzuki Early Childhood Classes Can Do for the Instrumental Studio Teacher”

(Jones 2007), Jones quotes psychologist Howard Gardner’s book *Frames of Mind*

(1983). H. Gardner writes,

In human beings the density of synapses increases sharply during the first months of life, reaches a maximum at the ages of one to two (roughly 50% above the adult mean density), declines between the ages of two and sixteen, and remains relatively constant until the age of seventy-two (Jones 2007).

Anatomically this statement is true, although the implications for learning are not entirely clear. It is possible that neurons do configure themselves in a way that is conducive to musical experiences. Scientists C. Nelson and F. Bloom (1997) state,

“The brain massively overproduces synapses early in life, only to be followed by selective elimination of these exuberant connections. Presumably, the purpose of overproducing synapses is to "prepare" the nervous system for experience by proliferation of connections If synapses are not confirmed or stabilized, they regress according to a developmental schedule or due to competition from confirmed synapses” (Nelson & Bloom, 1997).

If this is true, than the experiences offered through Suzuki ECE could potentially preserve and develop neurons that are associated with musical skills. It is important to note however, that synaptic pruning is an essential aspect of brain development and necessary for the brain to undergo. It is not clear yet if any early childhood programs do

indeed prevent certain neurons from being pruned or not. In order for any conclusive evidence to be proven, neural pruning patterns would have to be compared from children who attended ECE classes compared to children who have not, and that research is not available at the time. Scientists are only beginning to understand how learning and brain structures function, and learning appears to be the result of many physiological processes, not solely synapses.

The Suzuki Early Childhood Education website, www.suzukiece.com, states, “Early childhood experiences lay the foundation for all later learning and determine whether or not children succeed in school and later life”. While the research does indicate the importance of early childhood experiences, this statement is far too generalized and not entirely accurate. Whether or not a child succeeds in school and later life is not solely the result of early childhood experiences, nor does an enriched early childhood ensure success in life. Beethoven, Helen Keller, Oprah Winfrey, Christina Aguilera, and Louis Armstrong are all examples of people who have overcome childhood hardships to lead successful lives. Many successful people have come from homes where abuse and neglect were prevalent (www.biography.com). In addition, there are many children who had enriched early childhood experiences but struggle at school due to learning disorders, autism, and attention deficit hyper activity disorder. A more accurate statement regarding the possibilities of Suzuki ECE could read, “Early childhood experiences can affect brain development, and these experiences can influence learning throughout childhood”.

The Kindermusik webpage states, “You and your child will play, listen, and dance to musical activities specifically designed to stimulate early childhood development and

strengthen neural pathways in your child's mind". There is no explanation what exactly these activities are, or how they strengthen neural pathways. This type of statement is too vague and needs empirical evidence to back its credibility. In addition, the research available seems to support the theory that myelin formation is critical to strengthen neural pathways, and repetition is needed for formation to occur. Kindermusik's curriculum changes each session and is not based on repetition.

Don Campbell, author of *The Mozart Effect*, is often quoted on the Kindermusik website. Campbell is an accomplished musician who took interest in music and healing. He later studied psychology and brain development, specifically brain development throughout the childhood years. Campbell concludes that neural integration during the early childhood years occurs by physical movements and emotional associations. Movements such as dancing, skipping, jumping and marching develop a sense of physical rhythm and aid in neural integration. Campbell reports, "The more music children are exposed to before they enter school, the more deeply this stage [of brain development] of neural coding will assist them throughout their lives". He does not refer to critical periods, but rather that the early years offer a unique potential.

Conclusions

Learning processes and brain development are complex and are impacted by many conditions independent of music classes. Kindermusik and Suzuki ECE need to ensure that their terminology and presentation of facts are current, accurate, and in agreement with science. In addition, Kindermusik and Suzuki ECE need to present these ideas as potential theories and possibilities, and not as absolutes or cause-effect relationships. Scientists continuously employ skepticism to question new research findings. Skepticism requires scientists to present evidence, allow colleagues to criticize and test each other's ideas, and be willing to change theories with the discovery of new evidence. Teachers must utilize skepticism as well when research becomes available in regard to discoveries about brain development and learning.

Every day scientists are making new discoveries about the brain and how it works and how music can potentially influence brain development. With the current research discussed in this paper, there seems to be compelling evidence for the benefits that an infant music program can potentially offer. Dendrites, synapses, and myelin are shaped and influenced by experiences, and it appears that early childhood music experiences can enhance brain development and better prepare the brain for music intelligence. More studies are needed to prove this to be true. In addition, Suzuki ECE offers great benefits for students who will continue on to studio lessons. Children who complete Suzuki ECE programs enter studio lessons with knowledge of rhythmic accuracy, tonality, tempo, and dynamics. They know how to listen and follow directions, and seek mastery in their work. Parent education is a vital component to Suzuki ECE, and parents are taught how

to best encourage their child's development and learning. Parents are taught to be observant of their child's learning process and can witness Suzuki principles in action. Early childhood music programs offer a unique space for parents to bond with their children. Dr. Suzuki's primary dream was to bring more love into the world, and whether the classes enhance brain development or not, perhaps that is reason enough for studios to offer Suzuki ECE programs.

Bibliography

- Aslin, R. N., Pisoni, D. B. and Jusczyk, P. W. (1983). Auditory development and speech Perception in infancy. In M. M. Haith and J. J. Campos (Eds.), *Infancy and Developmental Psychobiology*. Volume 2 of the *Handbook of Child Psychology*, 4th Edition (P. H. Mussen, series editor). New York: Wiley and Sons, pp. 573-687.
- Barnet, A. B., & Barnet, R. (1998). *The Youngest Minds: Parenting and Genes in the Development of Intellect and Emotion*. New York NY: Simon and Schuster.
- Biography website. www.biography.com. Retrieved 18 August 2010.
- Bruer, J. T. (1999). *The Myth of the First Three Years: A New Understanding of Early Brain Development and Lifelong Learning*. New York NY: The Free Press.
- Campbell, D. (1997). *The Mozart Effect: Tapping the Power of Music to Heal the Body, Strengthen the Mind, and Unlock the Creative Spirit*. New York NY: Avon Books Inc.
- Candiano-Marcus, M. (2005). *Baby Prodigy, A Guide to Raising a Smarter Happier Baby*. New York NY: Ballantine Books.
- Coss, R. G., Brandon, J. G., & Globus, A. (1980, June). Changes in Morphology of Dendritic Spines on Honeybee Calycal Interneurons Associated with Cumulative Nursing and Forging Experiences. *Brain Research*, 192(1), 49-59. doi:10.1016/0006-8993(80)91007-0
- Coyle, D. (2009). *The Talent Code*. New York, NY: Bantam Dell.
- DeCasper, A. J., Lecanuet, J., Busnel, M., Granier-Deferre, C., & Maugeais, R. (1994). Fetal Reactions to Recurrent Maternal Speech. *Infant Behavior and Development*, 17(2), 159-164. doi:10.1016/0163-6383(94)90051-5
- DeCasper, A. J., & Spence, M. (1986). Prenatal Maternal Speech Influences Newborn's Perception of Speech Sounds. *Infant Behavior and Development*, 9(2), 135-150. doi:10.1016/0163-6383(86)90025-1
- Diamond, M.C., & Hopson, J. (1998). *Magic Trees of the Mind*. New York, NY: Penguin Group.
- Diamond, M.C., Krech, D. and Rozenwieg, M.R. (1964). The Effects of an Enriched Environment on the Histology of the Rat Cerebral Cortex. *Journal of Comparative Neurology*, 123, 111-120.
- Fields, D. R. (2008). White Matter. *Scientific American*, 298, 54-61.

- Garner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books.
- Gopnik, Alison, Kuhl, Patricia, and Meltzoff, Andrew N. (1999). *The Scientist in the Crib: Minds, Brains, and how Children Learn*. New York: William Marrow and Company Inc.
- Hannon, E.E. and Trehub, S.E. (2005). Tuning into Musical Rhythms; Infants Learn More Readily than Adults. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 12639-12643.
- Healy, J. M. (1990). *Endangered Minds*. New York: Touchstone.
- Howard, P.J. (2006). *The Owner's Manual for the Brain*. Texas: Bard Press.
- Jones, D. (2007). What Suzuki Early Childhood Classes Can Do For the Instrumental Studio Teacher. *American Suzuki Journal*, 36, 32-34.
- Kindermusik*. (n.d.). Retrieved from <http://kindermusik.com>
- Ludington-Hoe, S. & Golant, S. (1987). *How To Have a Smarter Baby: The Infant Stimulation Program for Enhancing your Baby's Natural Development*. New York: Bantam.
- McKinney, R.A. (2005). Physiological Roles of Spine Motility: Development, Plasticity, and Disorders. *Biochemical Society Transactions*, 33, 1299-1302.
- Nelson, C.A., & Bloom, F.E. (1997). Child development and neuroscience. *Child Development*, 68, 970-987.
- Purpura, D. P. (1974). Dendritic Spine Dysgenesis and Mental Retardation. *Science*, 186, 1126-1128.
- Rauscher, F.H., Shaw, G.L., Levine, L.J. Wright, E.L., Dennis, W.R., & Newcomb, R.L. (1997). Music training causes long-term enhancement of preschool children's spatial-temporal reasoning. *Neurological Research*, 19(1), 1-8.
- Saladin, Kenneth S. (2007). *Anatomy and Physiology; The Unity of Form and Function*. New York: McGraw Hill.
- Scott, B. S., Becker, L. E., & Petit, T. L. (1983). Neurobiology of Down's syndrome. *Progress in Neurobiology*, 199-237.

- Shetler, D. J. (1989). The inquiry into prenatal musical experience: A report of the Eastman project, 1980-1987. *Pre- & Perinatal Psychology Journal*, 3(3), 171-189.
- Spinks, S. (N.D.) The "First Years" Fallacy: Mozart, Mobile, and the Myth of Critical Windows. Retrieved June 4, 2007, from <http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/science/firstyears.html>.
- Stewart, L. and Walsh V. (2005). Infant Learning: Music and the Baby Brain. *Current Biology*, 15, R882-R884.
- Sousa, David A. (2006). *How the Brain Learns*. New York: Corwin Press.
- Suthers, L. (2004). "Music Experiences for Toddlers in Day Care Centers". *Australian Journal of Early Childhood*. 29 (4), 45-56.
- Suzuki, Shinichi. (1981). *Ability Development from Age Zero* (Mary Louise Nagata Translated) Miami: Warner Brothers Publications Inc. (Original work published 1969).
- Suzuki, Shinichi. (1983). *Nurtured by Love* (Waltraud Suzuki translated). Miami: Warner Brothers Publications Inc.
- Werker, J. F., & Lalonde C. E. (1988). Cross-language speech perception: Initial Capabilities and developmental change. *Developmental Psychology*, 24, 673-683
- White, Burton L. (1995). *The New First Three Years of Life*. New York: Fireside.