

# CHAPTER 14

## NEUROLOGICAL BASIS FOR MUSIC IN EARLY CHILDHOOD EDUCATION IN NIGERIA

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### Abstract

The question of if music education has any effect on the cognitive development of children has been very contextual from the research point of view. Some researchers claim to have found effects on cognitive growth, such as the increase in the ability to concentrate and academic achievement. Also, effects in the social and emotional domains have been reported. Understandably, musicians and music educators point to studies like these to underpin the importance of music education in childhood development, hence, this study aims to review the importance of music education in the cognitive development of children between the ages of 1-5 years. To achieve the set objective, a systematic literature review was carried out which aims to extensively research the literature and critically evaluate the quality of the research findings. The study was anchored on the neurological basis of active music involvement. Evaluation of the study cases showed that musical activities and early music education have positive effects on children's social, affective and psychomotor development. Based on the literature reviews and two meta-analyses discussed above we may conclude that music education, music therapy and exposure to music can have a positive effect on child functioning.

**Keywords:** Neurology, Cognitive Development, Music Education, Early Childhood

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### Introduction

The fields of neuroscience and music have been intertwined over the past two decades to unlock some of the secrets of how the human brain develops and functions. Eminent neuroscience researcher. Zatorre (2005) wrote that "music involves a tantalizing mix of practically every human cognitive function" (p. 312) and because of this music provides unique insights into how

the brain develops and processes information. Early studies involved participants listening to music while positron emission tomography and functional magnetic resonance imaging technology were used to observe how the brain made sense of the sounds. Comparative studies that observed responses to different melodies or rhythmic samples were undertaken. Brain imaging technology rapidly advanced so that neuroscientists could observe musicians in the act of making or imaging to make music. Theories of how musical and nonmusical information is stored and processed began to emerge.

Neuroscientists began to see identifiable differences between participants they classified as musicians and nonmusicians. These differences are divided into two areas: brain structures (the areas in the brain, such as the corpus callosum and auditory cortex) and brain functions (the mechanisms the brain uses to form message pathways and process information). These differences covered a variety of attributes. Participants classified as musicians were found to have heightened capacities in multiple areas of the brain, including memory (Degéet al., 2011; Jonides, 2008), language acquisition and syntax (Dammann, 2009; Patel, 2009), executive function (Hanna-Pladdy & MacKay, 2011; Posner, Rothbart, Sheese, & Kieras, 2008), and brain plasticity (Hannon & Trainor, 2007; Hyde et al., 2009). These differences sparked several studies that attempted to identify how and why participants classed as musicians displayed significant differences in their brain function and structure to nonmusicians.

Music can be found in every culture all around the world. In the face of difficulties, music education is achieving its objectives of educating individuals. Brown (2002:77) said it can help to organize the needs of individuals in the area of finding a wide variety of wisdom and knowledge in enhancing intelligence quotient. Societal influence-the society has not given music education a chance to grow because of the negative image placed on those who study music. To date, parents do not encourage their wards or children to choose a music career. Government can encourage the study of music through its effort to establish a formidable music programme that will promote the acceptability of the subject in schools. This is because music education is futuristic and can help to develop children for future learning abilities.

The value of music education can be seen in the 3 domains of education; affective (emotional expression), cognitive (intelligence, reasoning or intuition) and psychomotor (physical and mental activity, skills acquisition). Participation in music (dance) will penetrate the senses of the children, liberate the mind and propel feelings towards acquiring knowledge. Stanley and Madsen (2001) observed that this can convey ideas of enjoyment and recreation which is an outlet for social interactions and celebration. The dance involved in music education will enhance children's emotional upbringing, expression, reasoning and skill development that will propel quick decisions during play and learning activities.

The objective of this study was to examine the neurological basis of music in the development of children. The study critically examines the neurological basis of active music involvement in preschool children, the effect of listening to music on a child's development and how musical training enhance cognitive development in children.

Even though the ancient cultures were widely aware of the comprehensive benefits of music, it was only with the emergence of contemporary neuroscience, that those benefits were ultimately recognized by larger audiences. In the last two decades music has become a window for studying higher cognitive functions' processing and, on the other hand, a means of enhancing optimal brain functioning. This neuroscientific trend that points out the importance of early brain stimulations also influenced the trend in music education. Music education started to emphasize the benefits of infants' active systematic musical involvement and therefore started to offer different musical programs for children from birth on. This trend though not consciously used but is seldom used by parents and caregivers. The issue of the role of music education in a child's development has been an interest-based controversy; many parents, teachers, scholars, and businesses are interested in learning more about the influence of music on the development of children. Children could potentially be influenced by music in several ways. Some researchers investigate whether and how children benefit from listening to music. Others focus on how formal music training impacts various aspects of cognitive development such as perception, memory, and language skills. Examination of the findings from each of these avenues of research can inform adults as they strive to support children's learning. Therefore, it is important to bring to the public light the importance of music education at the earliest stages of life. Hence, this seminar aims to educate and inform parents of the many ways that music can be a helpful tool to enrich their children's cognitive development.

### **Review of Related Literature**

Music has become such a big part of our lives that researchers can't help but want to study how music affects people, especially children. Many parents, teachers, scholars, and businesses are interested in learning more about the influence of music on the development of children. Others focus on how formal music training impacts various aspects of cognitive development such as perception, memory, and language skills. Researchers have believed for years that music can stimulate cognitive development. According to the Mozart Effect, "The idea is that infants and young children can benefit from early music exposure and training" (Caufield, 1999, p. 119). Understandably, musicians and music educators point to studies like these to underpin the importance of music education. The leading organization in the United States of America, The National Association for Music Education (NAfME, before MENC), goes even further by putting on its website under 'Facts and Figures' 'The Benefits of the Study of Music' "The study of music helps to achieve: success in society; success in school and learning; success in developing

intelligence; success in life." Claims like these are supported by statements of opinion leaders, among them President John F. Kennedy, who said in 1962: "The life of the arts, far from being an interruption, a distraction, in the life of the nation, is close to the centre of a nation's purpose – and is a test to the quality of a nation's civilization" (MENC, 2009). Some researchers are interested in documenting the effects that listening to music may have on children's development. When considering this topic, the notorious "Mozart Effect" likely comes to mind, referring to claims that listening to Mozart's music improves cognitive ability in young children. The initial study of Mozart's Effect done by Francis Raucher and Gordon Shaw along with colleagues was focused on college students, not infants, which they claimed to be the main reason for the study. The Mozart Effect is now generally considered to be invalid, but this does not mean that music does not affect cognitive development.

Norton, Winner, Cronin, Lee, and Schlaug (2005) wanted to know if there are pre-existing neural, cognitive, or motoric markers for musical ability. Their results showed no correlations between music perceptual skills and any brain or visual-spatial measures. They did find, however, correlations between music perceptual skills and both non-verbal reasoning and phonemic awareness. Other research showed that even a little bit of musical training can enhance reading skills as well as pitch discrimination abilities in speech (Moreno, Marques, Santos, Santos, Castro, & Besson 2009). Another study by Gromko (2005) showed that children who receive musical training will develop aural skills for spoken sounds and spoken words faster than children who did not receive musical instruction. Finally, Franklin, Moore, Yip, Jonides, Rattray, and Moher, (2008) found evidence for greater verbal working memory span in musicians than non-musicians.

Researchers believe that music can positively affect brain development in young learners (Strickland, 200 112002). Can research support this theory or does research suggest that it is a mere hypothesis with little support? If music does benefit learning, then how can we use it in the classroom to successfully teach children? This literature review will present research-based articles that provide evidence supporting music's benefits on children, the specific subjects influenced by music, and how music has been presented in the Classroom. In this review, the term "music" will be used, which has a broad understanding. For the sake of the reader, the term music education is defined as "any musical instruction given in school, choral, general, or instrumental" (Kelstrom, 1998:39).

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Many are aware of the broad claims made in the name of the preliminary research by Rauscher, Shaw, and Ky (1993) on the Mozart Effect (Campbell, 2001) and the capacity for music, but not music education, to raise intelligence levels. Campbell's interpretation of the Rauscher et al. study along with many other studies has been refuted by numerous researchers in the field and may have done music education a great disservice at the time. However, the field of neuroscience has continued to discover, and strengthen, the links between music education and positive brain development. The study in this article aims to give music educators more recent and credible findings about music education from the decade of research since the Mozart Effect. As mentioned in the introduction, the use of these findings to support and advocate for the importance and value of music education needs to be viewed in tandem with the specific criteria that researchers have used to define a musician. Musicians have been found to possess advanced skills in both long and short-term memory (Jonides, 2008) and memory storage and retrieval (Dunbar, 2008). It has been suggested that music rehearsal helps improve the memory pathways in the brain and that musicians use pictures and narrative to link memories. Furthermore, it has been suggested that musicians attach multiple "tags" to a single memory, such as a conceptual tag, emotional tag, and contextual tag, and this considerably enhances memory storage and retrieval. Enhanced verbal memory is linked to these skills and suggests that music education enhances the pathways for melodic memory and that the brain translates this into language. Most recently, Koelsch (2011) has suggested that "the human brain, particularly at an early age, does not treat language and music as strictly separate domains, but rather treats language as a special case of music" (p. 16).

Following this finding, musicians have been found to acquire language and understand the rules of language and its syntax more effectively than nonmusicians (Dammann, 2009; Peretz et al., 2009; Wandell, Dougherty, Ben-Shachar, Deutsch, & Tsang, 2009). This area has attracted attention from researchers on the basis that the study of music processing might provide insight into the development of language processing in the brain (Patel, 2008). Researchers suggest that music education assists in the understanding of musical syntax, which in turn assists in understanding language syntax. Music education may develop the mirror neuron system in the brain (Haslinger et al., 2005; Molnar-Szakacs & Overy, 2006; Overy & Molnar-Szakacs, 2009). This system enables the brain to complete two processes at once, making the brain work twice as effective in the same amount of time. In essence, a musician's brain can work twice as well in half the time. However, it should be noted that at the time of writing, significant debate remains over whether music education is solely responsible for this type of brain development, or if it simply capitalizes on preexisting differences in an individual's mirror neuron system (Zatorre, Chen, & Penhune, 2007).

The same mirror neuron system allows simultaneous processing of different types of information, for example, analyzing a sound for both its perceptual and hierarchical qualities. This area of brain development connects with a group of skills known collectively as Executive Function.

Musicians have been found to have higher levels of Executive Function (Geake, 2009; Hanna-Pladdy & MacKay, 2011), which refer to a group of interlinked tasks that include planning, strategizing, setting goals, and paying attention to detail. To perform these tasks at a high level, the brain needs to be able to analyze information simultaneously and consider both the cognitive and emotional aspects. High levels of Executive Function are evident in a person who can successfully resolve internal and external conflicts, or solve problems effectively. Again, research has suggested that musical rehearsal assists with the development of attention skills, which is a significant factor in Executive Function (Jonides, 2008)

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Musicians also appear to have higher levels of brain plasticity and this was one of the original areas that sparked an investigation of the benefits of music education to brain development (Munte, Altenmuller, & Jancke, 2002; Schlaug, 2001). Brain plasticity refers to the capacity of the brain to change, remain flexible, and continue to learn throughout one's life. This challenges earlier thinking that the human brain became “set” or unable to change or learn once we reached adulthood, summed up by the adage “you can't teach an old dog new tricks.” Music education has been found to encourage high levels of plasticity in the auditory cortex (where we process sound information) and frontal cortex (where we process many executive functions such as the ability to predict consequences, moderate emotional reactions, and determine similarities and differences). This plasticity allows for higher levels of creativity and divergent thinking (Gibson, Folley, & Park, 2009) as well as improved brain health in later life (Moser, 2005).

### **Theoretical Framework**

The learning theory by Jean Piaget (Morrison, 2016: 239; Santrock, 2007: 243) is related to cognitive development which explains how children think deeply and make a concept about their knowledge including problem-solving matters. Considering the opinion of another figure such as Vygotsky who states that the cognitive skill of children is supported and developed through social interaction, not only children as the developer of their intelligence kecerdasannya sendiri

(Morrison, 2016: 253). When children find the answer based on their questions, so the related cognitive structure is continuously developed (Ünal & Aral, 2014). The role of the teacher and parent is to direct their attention to explain and teach the problem-solving skill in the twentieth century (Kaya, Tadeu, SAHRANÇ, Arslan, & Demir, 2017).

### **Methodology**

Due to the broad scope of this study, we decided to do a systematic search and a "critical review," which aims to extensively research the literature and critically evaluate its quality. Several steps were taken to ensure the high scientific quality of the work. The search for relevant articles was conducted via three routes. First, PubMed, EMBASE (Ovid), PsycINFO, and EBESCO databases were systematically searched.

### **Analysis and Discussion**

#### **Neurological Bases of Active Music Involvement in Pre-school Children**

According to Daniel Levitin, "Musical activity involves nearly every region of the brain that we know about and nearly every neural subsystem" (Levitin, 2006, p.299). Schlaug and others (2010) additionally claim that engaging in musical activities not only shapes the organization of the developing brain but also produces long-lasting changes even after brain maturation is complete. A wealth of scientific research over the last decade is proving that music education is a powerful tool for attaining children's full intellectual, social and creative potential. It speeds the development of speech and reading skills, trains children to focus their attention for sustained periods and helps children gain a sense of empathy for others. From the neurological perspective, the benefits of early music education can be recognized in stronger neural connections, more grey matter and better information processing, higher IQ and better memory and attention and better motor coordination. Research shows that active musical involvement benefits both, brain structure and brain function (Peretz & Zatorre, 2003). We could say that music is the best brain fitness with many beneficial transferable functions, especially for preschool children, when neural development is booming.

Neurological studies about the benefits of preschool active music involvement show, that training before the age of seven, during a sensitive period in development, may have the largest effect on brain structure and behaviour, which results in changes in white-matter connectivity in the corpus callosum part and sensorimotor synchronization performance (Steele et al., 2013). Music lessons taken in early childhood could benefit a child's brain later in life, even if they do not continue taking lessons into adulthood. They discovered that brain responses to speech are faster among older adults who used to take music lessons even if they have not taken music lessons in a long time. The benefits seem to be stronger the longer a person took music lessons as a child (Kraus et al., 2014). Learning to play musical instruments accelerates brain development in young children, particularly in the areas that are responsible for processing sound, language development, speech perception and reading skills (Habibi et al., 2016). Learning an instrument also develops the

brain's executive functions which are coordinated in the brain's frontal lobe. It allows a child to manage time and attention, organize their thoughts and regulate their behaviour (Zuk et al., 2015).

### **Music Listening and Child's Development**

Some researchers are interested in documenting the effects that listening to music may have on children's development. One line of work in this area focuses on what children learn about the music itself by listening to music. Another line of work investigates how listening to particular forms of music may impact development outside of the musical domain. Explorations of the influence of experience on children's ability to match auditory and visual stimuli within the domain of music are an example of the first research direction. Pick, Gross, Heinrichs, and Love (1994) explored whether young children could recognize the source of different sounds from instruments in different families, as well as different instruments within an instrumental family. Pick et al. (1994) asked 107 3-7-year-old children to watch a video of two musicians playing different instruments while a soundtrack from one of the instruments was played. Results showed children between the ages of 5- and 7 years of age were able to differentiate between different types of instruments as well as instruments within an instrumental family that differentiated by size and pitch. Children between the ages of 3- and 4 years of age were able to differentiate different musical families, but not different instruments within the same family. In a second study group, Pick et al. (1994) showed that infants between 7- and 9 months of age looked longer at the musical instrument that corresponded with the soundtrack. These findings suggest that experiences with seeing and hearing musical performances over the first few years of life, likely influence what children know about the relationship between instruments and sounds. However, the finding that even young infants know something about the sounds particular instruments makes suggests that experience is not the only explanation.

While instrument identification does not have any implications outside of a musical domain, it leads to the question of whether listening to music affects other areas of development outside of music. When considering this topic, the notorious "Mozart Effect" likely comes to mind. The "Mozart Effect" refers to claims that listening to Mozart's music improves cognitive ability in young children. This claim is based on an original study by Rauscher, Shaw, and Ky (1993) which found that college students who listened to Mozart's sonata in D major before taking a standard test of abstract spatial reasoning scored higher on tests of spatial intelligence than college students who listened to either some relaxing music or no music at all. Thus, the researchers concluded that listening to Mozart could provide a short-term spatiotemporal performance enhancement. They recognized, however, that the effect was a short-lived benefit to those completing a spatial-temporal task when differences in mood and arousal were held constant. University students were tested in three standard tests for spatial reasoning. The mean standard age scores were converted into the Stanford-Binet Intelligence scale. Their IQ scores were 8 to 9 points higher after the participants had listened to Mozart than those who listened to some relaxation music and silence. Rauscher, Shaw, and Ky (1993) did not make any statement of increased IQ in general, but their results showed that spatial intelligence scores were higher. Despite these caveats, the publication of this finding led companies to begin to develop materials that offered young children the

opportunity to listen to Mozart, with promotional materials suggesting that doing so would foster intellectual growth.

Waterhouse (2006) wrote a critical review on multiple intelligence, the Mozart effect, and emotional intelligence. As to the Mozart effect, that is to say, the effect of music exposure on intelligence, the available evidence did not support the belief that the Mozart effect is a mechanism that can improve spatial skills without practice or emotional arousal. The evidence disconfirming the Mozart effect suggested that there is no effect at all. The evidence confirming the Mozart effect, however, suggested that certain compositions of Mozart may be a pleasant means of inducing emotional arousal and may thus provide a brief improvement in spatial-temporal skills precisely because it induces such arousal. Waterhouse (2006) also argued that it may be that cortical arousal stimulated by the music can prime cortical circuits for spatial processing where the circuits for music and spatial processing overlap. In sum she concluded: The evidence to date does not justify advocating music as means to improve spatial skills 'for free.' The Mozart effect theory should not be taught without consideration of the disconfirming evidence or without consideration of the possibilities of the mechanisms that may underpin the Mozart effect (Waterhouse, 2006, p. 216).

Eady and Wilson (2004) studied the effects of music education and concluded in their literature review of the influence of music appreciation and music performance on students' learning performance, that several studies and observations show a possible positive impact of music on both academic achievement and study skills. Eady and Wilson emphasized popular music and music technology. Various studies and observations indicated that music can influence learning in core subjects (such as language and mathematics) as well as contribute to the attainment of core goals of learning.

Hallam (2010) concluded in her review on the power of music education that the positive effects of active engagement with music on personal and social development only occur if it is an enjoyable and rewarding experience. According to this author, this would have implications for the quality and methodology of teaching music:

In early childhood there seem to be benefits for the development of perceptual skills which affect language learning and which subsequently impact literacy. Opportunities to be able to coordinate rhythmically also seem important for the acquisition of literacy skills. Fine motor coordination is also improved through learning to play an instrument. Music also seems to improve spatial reasoning, one aspect of general intelligence, which is related to some of the skills required in mathematics. While general attainment is affected by literacy and numeracy skills, motivation, which depends on self-

esteem, self-efficacy and aspirations, is also important in the amount of effort given to studying. Engagement with music can enhance self-perceptions, but only if it provides positive learning experiences which are rewarding (Hallam, 2010, p. 281/282).

In many studies on exposure to music, music therapy and music education, cognitive development is operationalized in terms of school academic achievement (Slijper, 1998; Waller, 2007). Research has been done on the effects of music therapy in residential settings and special education. In a meta-analysis in which 12 studies had been used to investigate the influence of music therapy interventions on academic achievement Slijper (1998) reported about 1606 subjects in total with a mean age of around 11 years old. A total of 794 subjects attended a form of music therapy, while the control group consisted of 812 subjects. The main research question was: "Can music help to increase one's academic performance, and if so, is there a dose-response relationship?" The analysis of this study shows that music therapy had a small but significant effect on academic achievement. The interventions in the reviewed studies were similar to the ones that are used in regular educational settings (Kodály, Houlahan & Tacka, 2008), arts-enriched programs, using background music, et cetera), while the control groups got no treatment at all, or were offered a non-music program. Because of the nature of these interventions, it is likely to assume that the positive outcome of this study would be similar in regular educational settings.

Gold, Voracek & Wigram (2004) performed a meta-analysis on the side effects of music therapy for children and adolescents with a wide range of psychopathology (developmental delay, disorders in psychological development, emotional disturbance, et cetera). They examined how the size of the effect of music therapy had been influenced by the type of pathology, client's age, music therapy approach, and type of outcome. In this meta-analysis, 11 studies were incorporated with a total of 188 subjects. The effect sizes were combined with weighting for sample size, and their distribution was studied. After the exclusion of an extremely positive outlying value, the analysis revealed that music therapy had a medium to large positive effect (ES .61) on clinically relevant outcomes, that was statistically highly significant ( $p < .001$ ) and statistically homogeneous. The authors found no evidence of publication bias. Effects tended to be greater for behavioural and developmental disorders than for emotional disorders; greater for eclectic, psychodynamic, and humanistic approaches than for behavioural models; and greater for behavioural and developmental outcomes than for social skills and self-concept. However, considering the specific pathological conditions in these studies, it is questionable if these highly positive effects of music therapy interventions for children with psychopathology may be translated to regular educational situations.

## **Musical Training and Cognitive Development**

In contrast to the disputed nature of the Mozart Effect, research reveals that music training has an influence on a variety of aspects of development in early childhood. There are many different types of musical skills a person learns when he/she is involved in musical training. For example, a musician needs to know how to physically play and work his/her instrument, or how to make vocal sounds the correct way. A musician also needs to know how to read music.

To read music, a musician needs to know how to read different intervals between different notes on a staff and translate them to his/her instrument. The faster a person can read and interpret notes on a staff, the faster he/she can play his/her instrument. Sightreading is a skill that has to be practised repeatedly to do it successfully. Sight-reading requires planning in a very short amount of time for the musician to be successful (Drake & Palmer, 2000). Sight-reading requires instrumentalists to look at least two measures ahead to plan for the upcoming notes. This is a very specific skill that, once learned, can make a musician more aware of the music. Once a musician has learned his/her instrument and has not only learned to read music but has also learned to sight read, she/he can put together a performance that is pleasing to not only the musician but also to an audience. Reading music and sight-reading allows the musician to produce musical notes in order and the notes after, at the right timing.

The cognitive processes of reading music also manufacture rhythm and structure. To read music successfully, a musician needs to read the correct rhythms if the music is to be performed correctly. A musician also needs to pay attention to the meter, the tempo, the bar lines, and the phrases, which point to the overall structure of the music. Developing expertise in each of these areas enables a musician to put together a performance that is pleasing to not only the musician but also to an audience. Music instruction is critical in helping musicians to develop these skills. An interesting question in the psychological literature is whether and how this type of training also impacts development more generally, such as within the areas of brain development perception, language, and memory.

Considering psychomotor development in preschool children and active music involvement studies show, that most fundamental motor patterns emerge before the age of five (Gilbert, 1980, 1981) and that stimulating music settings can largely influence body movement and vocal performance (Gruhn, 2002). Integrated physical education/music instruction leads to improvement in the motor, auditory, and language aspects of perceptual-motor performance. Kodaly's method, which combines singing with movement, was supposed to enhance particularly dynamic coordination, abstract conceptual thinking, and play improvisation and originality. Zachopouloua, et al. (2004) found that music and movement programs resulted in significantly improved results in jumping and dynamic balance tasks. The authors concluded that music and movement education facilitates the development of rhythmic ability in motor skills execution.

Considering cognitive development in preschool children with active music involvement the revolution was made by the mysterious Mozart effect (ME), scientifically introduced by Rauscher and Shaw (1993) and popularized by Don Campell and his two books: *The Mozart effect* (1997) and *Mozart effect for children* (2000), not to mention all the cd's released with Mozart's music under the title Mozart effect. Even though there have been many contradictory research findings about the ME (Schellenberg in MacDonald, Kreutz & Mitchell, 2012) we can conclude that Mozart's music, because of his high frequencies and symmetrical structure, is one of the most beneficial music for our brain (Habe in Kenedy & Gadpaille, 2016) and that especially piano playing at a young age positively affects neural bindings (Rauscher et al. 1997). Besides the Mozart effect, where benefits of music were established in spatiotemporal reasoning, one important aspect of general intelligence which is related to some skills required in mathematics, there is increasing evidence that active engagement with music can increase phonological skills (Anvari et al., 2002; Gromko, 2005; Schlaug et al. 2005), literacy (see Butzlaff, 2000), numeracy (see Hallam, 2010) and creativity (Kalmar, 1982; Koutsoupidou & Hargreaves, 2009).

### **Brain Development**

Norton, Winner, Cronin, Lee, and Schlaug (2005) investigated how musical training influences brain development in 5-7-year-olds. Two groups of children participated in this study. One group was comprised of children who were provided with music lessons. The other group of children, a control group, received no musical training. Norton et al. (2005) looked for differences in brain structure, as revealed by MRI scans, of children in both groups. In addition to investigating overall group differences, Norton et al. (2005) explored individual differences by assessing whether children who excelled in musical ability after instrumental training differed in visual-spatial, verbal, and/or motor skills before training from children in the training group who did not end up excelling in music, and to children in the non-music group. By looking retrospectively at the brains of those children who stick with their music training over time and emerge showing exceptional talent and achievement, they aimed to test whether the brains of musicians look different before training, and/or respond differently to training compared to those of children taking music lessons but showing only average talent or interest in music. This strategy was also designed to reveal whether the positive effects of music training on nonmusical outcomes as shown in past studies are due partly to pre-existing correlations between musical and non-musical skills or just the outcome of training. Results showed no correlations between music perceptual skills and any brain or visual-spatial measures. They did find, however, correlations between music perceptual skills and both non-verbal reasoning and phonemic awareness.

More definitive results regarding the influence of music training on brain development are offered by Hyde, Lerch, Norton, Forgeard, Winner, Evans and Schlaug (2009). They examined the auditory brain structures of children with varied musical training experiences. In this study, two groups of 5-7-year-old children were engaged in different musical experiences. Fifteen children were part of the "instrumental" group getting private keyboard lessons for 15 months. In contrast, the "control" group did not receive instrumental music instruction but did participate in a

weekly 40-minute group music class in school that consisted of singing and playing with drums and bells. Children who played and practised a musical instrument showed numerous benefits, such as greater improvements in motor-finger dexterity and auditory melodic and rhythmic discrimination skills. In addition, findings from MRI brain scans showed that "structural brain changes in motor and auditory areas (of critical importance for instrumental music training) were correlated with behavioural improvements on motor and auditory-musical tests" (Hyde et al., 2009, p. 3021-3022). According to Hyde et al. (2009), musical training and practice is the cause of differential development in certain regions of the brain. Before the musical training, there were no structural brain differences found between groups, disproving preexisting biological predictors of musicality, which supports the Norton, Winner, Cronin, Lee, and Schlaug (2005) study.

### **Language and Linguistic Development**

Musical abilities are as universal as language abilities; they are inborn musical capacities that can be developed with the right social stimulation. Edwin Gordon (2011) calls this "musical aptitude"; basic musical skills or musical potential. He recognizes the importance of positive environmental influences from birth on, especially in a preschool period, and emphasizes the role of music exposure from a young age as a foundation for developing a child's full musical potential. Music and musical activities ignite infants' cognitive, psychomotor, affective and social development (Campbell, 2004, Denac, 2002, 2011). Music represents the first bridge between a child's inner and outer worlds.

Anvari, Trainor, Woodside, and Levy (2002) support claims of a relationship between musical training and linguistic development. They examined phonological awareness, early reading skills, and music perception skills in 100 children between the ages of 4-5 years. The children were given experiences with a set of musical tasks that focused on rhythm, melody, and chord progression. They were then tested on phonological awareness and reading skills. Anvari et al. (2002) found that music skills were correlated with phonological awareness and early reading skills. The basic auditory skills for music perception were similar to early reading skills which shared some of the same auditory mechanisms that predicted reading ability. Thus, although this study was not based on an experimental methodology, the authors suggest that skill in music perception gives children an auditory awareness that helps when it came to reading. Another group of researchers pursued a similar question more experimentally and found that training in music helps build skills important to reading. Enhanced listening skills help develop the linguistic organization. In a study Milovanov, Tervaniemi, and Gustafsson suggest that there is a connection between music and language skill (Milovanov, Tervaniemi, Takio, & Hämäläinen, 2007).

As children get older, they begin to expand their vocabulary and they start to make connections with words and their meanings. Another way that children can enhance language development can be found through music and ear training. Forgeard (2008) found that instrumental music training may enhance auditory discrimination, vocabulary, and non-verbal reasoning skills.

## Conclusion

With all musical activities, evaluation of the study cases showed positive effects on children's social, affective and psychomotor development. Educational musical games which involved instrument playing or playing accompaniments to singing had bigger impacts on the affective domain and the tendencies of the development of social skills in terms of understanding and following the instructions and game rules, sharing musical instruments with peers, and developing empathy. Singing, rhythmic texts and listening to music, on the other hand, stimulated the development of basic skills, such as listening, establishing eye contact with the mentor/parent and following instructions.

Based on the literature reviews and two meta-analyses discussed above we may conclude that music education, music therapy and exposure to music can have a positive effect on child functioning. However, the studies analyzed in this review still seem limited in their scope and subjects and were undetermined as to the content of the musical interventions. Although the reviews above may be taken as suggesting a possible relationship between music and performance, it is still unclear whether this relationship can be maintained for regular education in families and schools in general. Moreover, several reviews also report negative results concerning the influence of music on human functioning (Jones & Zigler, 2002; Waterhouse, 2006).

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