CHAPTER-1
INTRODUCTION

“Music like life is divine in essence, so nothing makes us feel the truth of this better than music’s ever welting spring, which has flowed through the centuries until has become an ocean”.

- Romain Rolland

Nature of Music: Philosophical Speculations

Music is the finest expression of what is perhaps the most sublime, noble and dynamic in man! No culture in this world has been without music. Making music appears to be one of the fundamental activities of mankind. Something, which gets the credit of giving meaning to life, or as Nietzsche (1982) expressed: “Something for the sake of which it is worthwhile to live on earth”.

Music surrounds us—and we wouldn't have it any other way. An exhilarating orchestral crescendo can bring tears to our eyes and send shivers down our spines. And our fondness has deep roots: we have been making music since the dawn of culture. Tramo (2001) believes that music and dancing preceded language. Archaeologists have discovered flutes made from animal bones by Neanderthals, more than 50,000 years ago! (Weinberger, 2002).

In ancient Greece, musicians and philosophers used to believe that music exists eternally in the ethereal space in the form of vibrations of the cosmic energy. The ancient musicians and philosophers of India similarly believed that real music exists in the subconscious mind in the form of divine energy “Kundalini” in an un manifested form, and when it is
manifested, it is transformed into tones and tunes, tinged with the colour of aesthetic sentiments and moods.

Persian mystics believed that music could raise human consciousness to the higher levels of cognition. Moulana Rumi, the great Persian mystic, poet and musician described music as “The pangs of separation from the ultimate truth”.

According to the Marxist theory of music, collective rhythmical work activities, the most important factor in development of mankind, are symbolized in music. Marxist artists think that music involving the intellect and the emotions can be regarded as both an end and a means. It is an end in itself so far as it moves the aesthetic senses, gives immediate pleasure and becomes a part of our being, it is a means in the sense that it can raise us to a higher level, make us capable of going further and joining others to accomplish more difficult, more productive acts of cognition, in short, of developing our own power and helping to develop those of the community (Aryaanpour, 1970).

Contemplating on the essential meaning and nature of music many philosophers have expressed their opinions, which reflect their differing cosmological orientations and reveal intrinsically complex nature of music as an art form. The art of music creates a special kind of sound that is not to be found in nature and outside music. Where do these sounds come from? Dubes (cited in Borev 1981) noted that just like a painter imitates the forms and colours of nature so the musician imitates the sounds, intonations, sighs, modulations of the voice, in short all the sounds with the help of which nature expresses feelings and passions. Herbert Spencer1, a famous philosopher asserted that music originates from passionate excited speech.

1 Cited in Borev 1981
The annotations of human speech that lie at the basis of musical image are always emotionally charged. The musical image is woven of human feelings. Music is the direct language of the soul. In a similar vein, Stravinsky (1947) wrote that music is inherently dynamic. It consists of not only special kinds of sounds but also the movement of these sounds, their flow in time expressing the whole gamut of human emotions. It is, as it were, poetry of sounds. Leibniz who was a rationalists and mathematician philosopher defined music as “a hidden arithmetical exercise of the mind”. Schopenhauer (1966) the famous German philosopher who wrote extensively on the nature of music considered music to be a metaphysical exercise of the soul, an immediate image of the blind, unconscious and ubiquitous will. While Schopenhauer underplayed the role of cognition in music, Spangler, another renowned philosopher, considered music to be the “supreme form of human cognition”. Many definitions of music implicitly hold that music is a communicative activity which conveys to the listener moods, emotions, thoughts, impressions or philosophy. Because of its ability to communicate, music is sometimes described as the “universal language”. Musical language may be used to mean style or genre, while music may be treated as language without being called such, as in Lerdahl or others’ analysis of musical grammar. Bryant defines music not as a language but as a marked-based, problem solving method such as mathematics (Ashby 2004).

It is indeed difficult to disentangle the role of emotional and cognitive forces as well as representational and intuitive elements in the creation of musical image. Emotional experience and the idea imbued with feeling expressed through a special kind of mind based on the intonations of human speech probably underlie the basic nature of music but this does not exhaust
the meaning and mystery of music. Hegel\textsuperscript{2} considers music to be superior to other forms of art and says, “What music claims as its own is the depth of a person’s inner life as such it is the art of the soul and is directly addressed to the soul”. Levi Strauss (1970) the famous French thinker has observed: “Since music is the only language with the contradictory attributes of being at once intelligible and untranslatable the musical creator is a being comparable to the Gods, and music itself the supreme mystery of the science of man”. He considers music to be the ultimate challenge for human science.

Glory of music as an art has been sung by many other thinkers, like Hardy, Susan Langer, Pandit Vishnu Digambar, Pandit Bhatkande, Ustad Alladia Khan etc. however, aesthetics and power of music remain quite elusive and beyond easy comprehension.

Systematically ordered rhythmic arrays of sounds, which we call music, its power, its mystery is too deep, its mechanisms and effects too subtle! (Langer, 1971; Deva, 1974; Storr, 1992; Ranade, 1993; Weinberger, 2004).

Perhaps as Anthony Storr remarks, “To describe music a new type of language is required”.

Psychology of Music

“Mathematics and music! The most glaring possible opposites of human thought! And yet connected, mutually sustained! It is as if they would demonstrate the hidden consensus of all the actions of our mind, which in the revelations of genius makes us forefeel unconscious utterances of a mysteriously active intelligence”.

\textit{Hermann von Helmholtz,}\textsuperscript{3}

\textsuperscript{2} Cited in Borev 1981
\textsuperscript{3} On The Physiological Causes of Harmony in Music,” 1857
Psychology of music is a scientific discipline, which using experimental and analytical methods endeavors to investigate different aspects of the phenomenon of music in a scientific or empirical manner (Krumhansi, 1991). Historically there have been two traditions in this area. One is due to great German physiologist Helmholtz (1954) who did pioneering work on the physical attributes of sounds which are perceived as musical pitch, the laws of the constitution of musical sound, and the second is due to Seashore (1967) who studied the individual differences in performance on musical tasks. He also did pioneering work in standardizing psychological tests for assessing aptitude for music. The contemporary discipline of psychology of music now draws upon contributions of psychologists working within the framework of psychoacoustics, Gestalt psychology, individual differences psychology and cognitive psychology. Influence of developmental, cross-cultural, neuroscience and computational approaches are also evident. Multifaceted phenomenon of music is divided into a number of areas for systematic examination. Acoustics of music, diverse manifestations of music, individual differences in musical sensitivity, nature and dynamics of musical creation, musical personality, cross-cultural perceptions of music etc. are some of the areas which have been discussed and to some extent empirically explored (Mezzano and Prueter, 1974; Perretti 1975, Smith, Moris and Larry 1977; Pearce 1981; Francis, 1983; Rider and Kibler, 1983; Bledso, 1984; Manzo, 1984).

One very important area of musical research, which is of great interest to students of psychology and which has engaged the attention of psychologists has been a study of diverse effects of different kinds of music on human psyche i.e. on human emotion, cognition and performance. Therapeutic effects of music on emotions like anxiety, depression and anger
as well as on stress related psychological disorders (e.g. hypertensions, asthma, insomnia etc.) and other clinical syndromes like neurotic disorders are being empirically demonstrated. Music therapy is now legitimately recognized as one specific type of psychotherapy and is being very fruitfully used and researched in clinical settings (Meyer, 1980; Hanser, 1985; Bunt, 1988; Wigram, 1993; Mohammadi, 1999).

In India, Music Research Centers situated at Chennai, Bangalore and Gujarat are engaged in very intensive researches on therapeutic effects of Indian Classical Music (Times of India 21.2.2003).

**Neuropsychological Considerations in Music and Cognition**

“If I had my life to live over again, I would have made a rule to ... listen to some music at least once every week; for perhaps the parts of my brain now atrophied would thus have been kept active through use”.

*Charles Darwin Autobiography*

The way in which the brain works is one of the greatest mysteries and wonders of science. In about 400 B.C. Hippocrates first wrote on the possibility of the duality of the brain and in 1684 Sir Thomas Browne suggested that the two halves of the brain might have a preference or “prevalency” for the behaviors they control. In 1874 John Hughlings Jackson introduced the idea of the brain having “leading hemisphere”. Initially, the left hemisphere was regarded as the knowledgeable vital side of the brain, eclipsing the right hemisphere in importance. Research since 1942 has however, definitely shown that the right hemisphere has many specialized functions as the left hemisphere. The method of information processing in each hemisphere seems to be different, but inter-related
(Weinberger, 2004). The right hemisphere or mind does not use the conventional mechanism for thought analysis as does the left hemisphere; instead it is specialized for holistic processing.

Language is considered to be predominantly processed in the left hemisphere, whereas music seems to have more to do with the right hemisphere; even though language and music cannot be considered single entities and they need to be decomposed into different component operations or levels of processing. Brain imaging findings suggest that a region in the frontal lobe enables proper construction of the syntax of both music and language, whereas other parts of the brain handle related aspects of language and music processing (Patel, 2004).  

Similarities and differences between language and music processing are examined from an evolutionary and a cognitive perspective. The division of function is not so much between words and music as between logic and emotion. When words are directly linked with emotions, as they are in poetry and song, the right hemisphere is more predominant; but it is the left hemisphere which deals with the language of conceptual thought.

According to a neuropsychological research, Brain imaging scans have shown that different regions of the brain respond to pleasant, harmonious musical sounds and to musical sounds that clash. As music increases in unpleasantness, an area on the right side of the brain important to emotion -- the parahippocampal gyrus -- becomes active. On the other hand, as the music increases in pleasantness, other areas on the left and right side that control emotions are activated (Blood, 2004).

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4 Neuroscientist in Institute in San Diego, U.S.A
5 A researcher in neuropsychology at the Montreal Neurological Institute and McGill University in Canada
The difference between the hemispheres can be demonstrated in a variety of ways. It is possible to sedate one hemisphere of the brain whilst leaving the other in a normal state of alertness. If the left hemisphere is sedated ability to speak will be lost but ability to sing will remain. The right hemisphere processes the perception of melody more efficiently than the left hemisphere does. Vissarion Shebalin, a Russian composer, suffered a stroke in 1953 and could no longer talk or understand speech, yet he retained the ability to write music until his death 10 years later. This experience suggested that music and speech were processed independently. Whereas some researchers like Chan (2003) believe that: it’s too simplistic to divide brain functions (such as music) strictly into left or right, because “brain works like a network system, it is interconnected, very co-operative and amazing”.

Although the traditional concept of hemispheric lateralization of music has been challenged by recent neuroimaging studies; but the research to investigate hemispheric specialization is still going on.

Sparing, Meister, Wienemann, Buelte, Staedtgen & Boroojerdi conducted a research published in: European Journal of Neuroscience, (2007), entitled: “Task-dependent modulation of functional connectivity between hand motor cortices and neuronal networks underlying language and music: a transcranial magnetic stimulation study in humans”. As the researchers mention although language functions are, in general, attributed to the left hemisphere, it is still a matter of debate to what extent the cognitive functions underlying the processing of music are lateralized in the human brain. To investigate hemispheric specialization, they evaluated the effect of different overt musical and linguistic tasks on the excitability of both left and right hand motor cortices using transcranial magnetic
stimulation (TMS). The findings of the study, demonstrate that right-hemisphere preponderance of music is nevertheless present.

The neurophysiologic insights on human brain reveal that hearing and sense of balance and orientation are closely allied. Anything which increases our feeling of being securely balanced and in control of our movements enhances our sense of wellbeing. Music can order our muscular system, it also can order our mental contents. A perceptual system originally designed to inform us of special relationships by means of imposing symmetry can be incorporated and transformed into means of structuring our inner world.

There are evidences to support the argument that music has a strong neuro-physiological basis. The research conducted by Schlaug, Winner and Morton (2001) found that there are striking structural differences in the brains of professional musicians and non-musicians. For instance the corpus collasum (a fiber bundle connecting the left and right hemisphere of the brain) is larger than average in musicians which may enhance communication between the two halves of the brain. "Finding evidence like this is sort of remarkable. The structure seems to adapt" to early years of training and practice, “Musicians are not just born with these differences” Schlaug (2001).

Further more, brain regions responsible for movement planning and movement execution as well as brain regions responsible for hearing were found to be larger in musicians compared with non-musician controls.

As was mentioned music and visuo-spatial functioning chiefly scanned and appreciated in the right hemisphere (e.g. Kumara 1964, Chase 1966, Shank Weller 1966, Bower 1994; Holden 1994, Sparing et al 2007). There are evidences indicating that if there is some kind of training in the exercise of skills belonging to on hemisphere, there will be a positive
transfer in the exercise of another set of skills belonging to the same hemisphere. Training in calligraphy, for instance can have positive effect on the acquisition of drawing skills since both the skills have many common elements and have their basis in the same processing regions. Music and other abstract, non-verbal cognitive functions like visuo-spatial skills seem to have the same processing regions (Rudd, Wayne 2000).

A relationship between music and abstract cognitive operations (such as spatial reasoning) exists in the works of composers such as Bach and Mozart. This view is exemplified through compositional techniques such as retrograde, inversion and aleatory music. The relationship between music and mathematical and visuo-spatial skills has inspired several studies on the area of mathematics, music and the human brain. The data collected by such research suggests that there is a relationship between the way music and mathematics is processed by the brain. This relationship observed when comparing the neural firing patterns of the subjects involved with either music or mathematics (Rudd and Stephen Wayne 2000).

Wagner and Menzel (1997) also demonstrated that listening to music stimulates both alpha and beta brain wave activity in humans. This is considered an evidence manifesting the importance of music for abstract cognitive operations.

In the neuropsychological framework it has been further pointed out that when two or more tasks are processes simultaneously in the same hemisphere, performance on at least one of the tasks maybe impaired (Kee Bathurst and Hellige 1983, Kinsbourne and Hiscock 1983 Bathurst and Hellige 1984, Ikeda 1987). This might be one basic limitation of the researches that have not got positive effect of music on abstract cognitive operations or have got unfavorable effect of it. If music is played
simultaneously while some abstract cognitive tasks are being performed it can decrease the efficiency of performance. The same hemisphere which mediates the two related neural activities remains unable to process them efficiently (Mc Farland and Kennison 1988). Selection of type of music and mode of musical presentation can influence learning (Keenison and Mc Farland 1989).

Different form of music also can influence different dimensions of human cognition. Human brain can make a connection between the messages it receives, can create order for better learning and better understanding. Music promotes order within the mind the way it brings order to muscular movement. Therefore its role in facilitation connected learning is clear (Mackline 1998, Stormer & Stenklev 1999, Hetland 2001, Marlene, Hanson 2003).

As was mentioned one of the greatest mysteries and wonders of science is to find out how brain works, how information is acquired, stored and retrieved in the brain. The mystery of how cognitive processes like visuo-spatial ability, memory or creativity could be enhanced, through music, is the favorite subject of many researchers. The latest findings on the effect of music on brain and mind can be summarized as follows:

“Making Music "exercises" the whole brain and mind”.
“Making Music can strengthen synapses in all brain systems.”
Meaning and Rationale

“If music becomes a permanent part of our mental furniture, it must exert an influence on our lives”.

- Anthony Storr

Speculations regarding the association between music and abstract cognitive operations are traced back to Pythagoras (600 B.C.). Cognitive sciences regard music as a category of perception. This view argues that music is not merely sound, or the perception of sound, but a means by which perception, action and memory are organized. Thus, it can be said that music encompasses many processes that are common and perhaps essential precursors to all cognitive tasks, be it mathematics, verbal reasoning, creativity, memory or visuo-spatial reasoning. Music is known to provide a unique integration of the body and mind which is a crucial factor, in learning readiness.

Besides therapeutic effects of music and its aesthetic value, music has some biological effects on the brain as well. Plasticity involves the brain’s ability to change its circuitry early in life, and if one is exposed to music education before age 6 or 7, their neural connections become more strengthened than without (Steinkraus, 2005). A 2001 MRI study indicated that classical music, Mozart in particular, increased the blood flow in areas of the brain responsible for spatial reasoning (Steinkraus, 2005). Blood flow towards one part of the brain indicated whether subjects were listening to a burst of noise or the steady flow of classical music. Cells found in the auditory complex of the brain have shown to be processors of harmonic

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relationships. The processing of melody and rhythm are separated by specific brain lesions (Weinberger, 1994).

In 1973, Dr. Gordon Shaw used a computer to model the brain with a graduate student, Xiaodan Leung. While using musical notes to represent areas of brain activity, they discovered that their results sounded like classical music. Dr. Shaw revolutionized Cognitive Psychology with his theory that he coined the “Mozart Effect”, which was to unite music and the functions of the brain. Most of the correlations tied spatial-temporal reasoning and mathematical ability along with music. Dr. Shaw went on to form the M.I.N.D. Institute (Music Intelligence Neural Development). In a 1993 study, he initially tested three year olds but then was later known for his testing on college students. He wanted to know if there was any affect of classical music on the brain. After the college students listened to Mozart’s “Sonata for Two Pianos in D Major”, he tested their IQs and was astounded to discover an increase of as much as nine points (Burack, 2005). He then tested 84 undergraduate students on visual puzzles. Those who listened to the same Mozart piece beforehand scored relatively higher than those who sat in silence for 10 minutes immediately before the test (Knox, 1994). Shaw discovered that the students had a temporary enhancement of spatial-temporal reasoning as a result of this experiment. This could be because the Mozart piece was selected for its symmetry, patterns and form (Shaw, 2004).

In a 1997 study, Shaw and his colleague, Frances Rauscher, tested the spatial-temporal reasoning skills of preschoolers who had weekly piano lessons and those without. The ones who had the lessons scored 34 percent higher on spatial reasoning tests than those without. Spatial-temporal reasoning is required for such later skills as science, mathematics and engineering, and music enhances these functions. According to Ted Smith,
Chairman of the M.I.N.D. Institute, “Dr. Shaw’s unwavering belief that each child has the ability to do complex math should be given the opportunity to reach their full potential…” (Burack, 2005). Dr. Shaw’s theory challenges Piaget’s notion that children are not ready for the formal operational stage until much later. Spatial reasoning tasks are processed in the right hemisphere of the brain, in which objects are mentally rotated and manipulated, clearly an indication of higher-level thinking (Knox, 1994). It is similar to Mozart’s music because their effects involve abstract cognitive operations (Brown & Wilson, 1997). A 2001 study published in Psychological Science found that those who listened to a fast-paced Mozart piece did much better on spatial abilities tests than those who listened to slow, sad music. Those who listened to the sad music ironically did worse than those who did not listen to any music (Steinkraus, 2005). Mathematics is strongly affected by music. Even young children of 2 or 3 years of age who use bells or count rhythm are learning subdividing and fractions (Steinkraus, 2005). A subdivision of M.I.N.D. was formed focusing strictly on music’s affect on mathematics, the Math & Music (M+M) program, designed for second through fourth grade children. (Shaw, 2004) Children learn confidence as their natural abilities to solve complex mathematical programs are enhanced through the use of music.

An early music education also has a significant impact on a child’s ability to read. According to a 1975 study published by Hurwitz, Wolff, Bortnick and Kalas, children learned folk songs in order to enhance their melodic and rhythmic knowledge. In comparison to a control group which received no formal training, the experimental group exhibited much higher reading scores than the control group, scoring in the 88th percentile as opposed to the 72nd percentile (Hurwitz, Wolff, Bortnick & Kokas, 1975).
After another year of music training, the experimental group scored significantly higher than the control group, indicating that the ability to read is strongly facilitated by music education.

According to Norman M. Weinberger of the University of California, “music promotes cognitive development and abstract thought” (Weinberger, 1994). Draper and Gayle obtained a list of the benefits a music education can have on a child: “Self-expression and creative pleasure; development of an aesthetic sense; motor and rhythmic development; promotes cultural heritage; promotes vocal and language development; promotes cognitive development and abstract thought; teaches social and group skills” (Draper & Gayle, 1987).

In a study by Mohanty and Hejmadi, the effects of a music education on learning and creativity were investigated. Four and five year olds were instructed on learning the names of various body parts, with four different groups using different methods of learning: non-training control, verbal instruction on learning the names by rote, verbal instructions accompanied with an acting out of the movements and music and dance. Their creativity was assessed with the Torrance Test of Creative Thinking. The experimental groups all performed much better on test scores than the controlled group, but the music and dance group had the greatest improvement on learning the body parts and overall creativity (Mohanty & Hejmadi, 1992).

Mathematics and dance hold a strong correlation. Obviously, most music that one would dance to (other than the waltz) is held in 4/4 time (otherwise known as common time), where there are four beats in one measure with the quarter note receiving the beat. This explains why many dances are performed in an 8-count. According to Anne Watson of the University of Oxford, “there are a least four aspects of mathematics that can
be related to dance: spatial exploration, rhythm, structure and symbolization” (Watson, 2005). Dance can be used as a mnemonic for memory retrieval. If abstract concepts are acted out in a dance, the mind is more likely to form connections from prior experience to it and help develop it further into long term memory (Watson, 2005). Their spatial reasoning is further enhanced, which leads to Piaget’s level of formal operations. Knowledge of rhythm and toe tapping lead to an early understanding of fractions and multiplication. Structure can be learned by performing square dances, which correlates to abstract concepts in algebra, such as symbolism (Watson, 2005). The concept of symbolization is recognized when children can invent ways to encode dance movements and use those codes in order to convey their ideas to others (Watson, 2005).

A study conducted by the Music School in Providence, Rhode Island, attempted to prove the validity that music greatly improves a child’s performance in mathematics and reading (Gardner, 1996). The subjects of the study were ninety-six students enrolled in eight first-grade classrooms. Four of the classrooms had an extensive music and visual art curriculum, which included one hour each of music and visual art training per week. The other four classrooms, the control groups, only received one hour of visual arts training and forty-five minutes of music over alternating weeks (Gardner, 1996). The results indicated that 77% of those who were in the experimental group were ahead of the control group in both reading and mathematics (Gardner, 1996).

Further research has been done on the role that music plays on other areas of academic growth. Joyce Eastlund Gromko and her colleagues studied the affects music has on mathematical and spatial reasoning. Using sight-reading proficiency tests on high school wind instrument players, they
wanted to see if there was any real correlation. They tested students from four Midwest high schools (one rural, one suburban, one east urban and one west urban) on their musical abilities, both rhythmic and tonal, and immediately after tested their spatial ability using rotations and cube comparisons. The results indicated that music and spatial reasoning exercise the same area of the brain that is stimulated by mathematics (Grokmo, 2004).

In an even more complex study involving young adults with Williams Syndrome, researchers attempted to pinpoint why these otherwise disabled people had exceptional musical ability. However, their vocabulary and mathematical skills were below average for the chronological age level (Milne, Reis, Schader & Stephens, 2003). Their method was to test young adults with WS and compare them to the control group of other people their age without WS. The results indicated that those with WS were frustrated that their being in special education programs prevented them from participating in more advanced music classes, even though it has been shown that music appreciation and knowledge increases a person’s understanding of math.

Research has also been done with verbal memory’s connection to musical training. According to a study done by the Chinese University of Hong Kong, young adults who had at least six years of music training performed better on the Honk Kong List Learning Test than those without. This measured verbal memory, but not visual memory, and could be due to an enlarged left planum temporale present in those with musical training compared to those without (Chan, Cheung & Ho, 2003). It would be important for the education system to not disregard music as merely an extracurricular activity. The biological evidence, along with the
improvements in reading, mathematics and other academic areas suggest that Piaget's theory of the formal operational stage might be achieved much earlier than previously thought, as long as music is added into the curriculum.

The term "Mozart Effect" refers to the finding that 36 college students who listened to 10 minutes of a Mozart sonata scored higher on a subsequent spatial-temporal task than after they listened to relaxation instructions or silence. The effect lasted approximately 10 minutes (Rauscher, Shaw, & Ky, 1993). Although the effect was replicated by several researchers, other researchers were unable to reproduce it (Hetland, 2000a). Research on the causes and limitations of the effect in adults is ongoing (Husain et al., 2002).

The above mentioned studies and evidences thus provide the present study with a sound empirical justification. However, in spite of a relatively large and recent number of researches in this area, the inconsistent and sometimes controversial observations have provided impetus to the present study. One limitation of the previous studies which failed to find the positive effect of music, was the simultaneous use of background music along with the task performance. According to the neurophysiological insights simultaneous use of music interferes with the performance on some cognitive tasks. (Kee Bathurst and Hellige 1983, Kinsbourne and Hiscock 1983 Bathurst and Hellige 1984, Ikeda 1987.) The present study endeavors to remove this pitfall by presenting music immediately before the task performance. Other special features of the present research are that it incorporates different forms of music and a number of important components of human cognition.