

Music, Mathematics and Mozart

by Manjil Saikia - Wednesday, December 07, 2011

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We find in human history instances of various geniuses who live for a very short span of life but who leave a lasting impression in the field of his/her interest. In the field of music, Wolfgang Amadeus Mozart was such a genius. Mozart was born on January 27, 1756, in Salzburg, Austria, and he lived a short and turbulent life of only 35 years and died in 1791. But during his short life he produced more than six hundred compositions that are widely acknowledged as pinnacles of classical era, and he became one of the most influential composers in the Western music.

Although most people agree that Mozart's music sparkles brilliantly, no one knows for sure how Mozart created those majestic glimmering sounds. Today, scholars are investigating Mozart's life and work, not only to assess and admire how great a composer he was, but also to find why his music is so outstanding and classic on one hand and so appealing to all including the common man at the same time. Perhaps he relied on musical genius or inspiration from daily events. On the other hand, many wonder if mathematics played a role in the success of his works or that is to say if he might have composed music with mathematical equations. Author Mario Livio who studied the relationship between art and mathematics in fact thinks so, and tells us that in art most of us are attracted to symmetry spiced by some elements of surprise, and that combination is the essence of Mozart's music. It may indeed be noted that this symmetry and harmony is the very essence of mathematics.

The relationship between music and mathematics has fascinated generations, and it is generally believed that there is a mystic connection between the two, and that there is some kind of intrinsic affinity between music and mathematics. It is well known how much the Greeks were obsessed with numbers. The Greeks believed that the numbers have some divine values and that there are some numbers which are more perfect than others, and that the universe is governed by numbers. Even the astronomer Galileo observed in 1623 that the entire universe "is written in the language of mathematics" It is indeed remarkable the extent to which science and society are governed by mathematical ideas. From ancient Greek times, music has been seen as a mathematical art. Music, with all its passion and emotion, is also based upon mathematical relationships, and such musical notions as octaves, chords, scales, and keys can all be demystified and understood logically using simple mathematics. There is even a theory which is attributed to Pythagoras that musical notes having simple relative frequencies are necessarily aesthetically preferable to those having complex ones. This theory in fact explains the relationship between mathematics and music, and states that the notes of the musical scale have to be determined by the ratio of a perfect fifth, i.e. 3:2. for most aesthetic value.

While the exact relationship between music and mathematics is still under debate, the present investigation sets out to describe Mozart's music mathematically. This structural analysis of the music and its effects on the listener includes examples of the application of mathematics to music, the measurement of the effects of Mozart's music, the application of the golden ratio to Mozart's musical structure, and an analysis of the application of mathematics to the musical structure of Mozart concerts. These analyses strongly suggest the close correlation between music and mathematics. Various biographical writings

show that Mozart the musician was also a lover of mathematics, at least of Numerology and especially Gematria (Hebrew Numerology). Considerable evidence also suggests that Mozart dabbled in other kinds of mathematics too in his life. According to his sister, during his school days, Mozart "talked of nothing, thought of nothing but figures". Mozart is also said to have jotted mathematical equations in the margins of some of his compositions. Although these equations might not relate to his music directly, they do suggest his attraction to mathematics. Thus the connection between music and mathematics has always found fertile ground in the works of Mozart. Many scholars have analyzed the mathematical nature of his music, for example investigating if he used formulae like the golden ratio to decide how to section his movements. One author shows how the golden ratio occurs in music of Mozart especially in his Symphony in G Minor. There is also some evidence that Mozart used gematria in his music. In fact it has even been suggested that there is a "Mozart effect" - that listening to pieces by this composer can help students concentrate or even improve their test scores! This effect has been a subject of much debate in the scientific community, and there are still ongoing experiments. In one experiment, the pupils from a Grade six which listened to the composer performed 10% better than those taught without. "We have found that Mozart symphonies which have complicated note patterns stimulate mathematical thinking," the head teacher Doulla Simon said. "The music reaches certain parts of the brain which other composers do not."

It is not that Mozart's music is the only one which has this positive affect. There are many experiments that explore the number symbolism in the works of Beethoven, Bach and others. However it is Mozart that seems to be particularly suitable for accompanying maths lessons. In general it is proved that piano and singing instruction are superior to computer instruction in enhancing children's abstract reasoning skills.

Mozart's life brings to us some unique characteristics of geniuses in the field of music and mathematics. While the best works of a poet are often later in life, the best works of a musician or a mathematician seems to be generally when they are young. It's often mentioned, in this context, that, statistically speaking, performing musicians and mathematicians tend to mature young, and music and mathematics both tend to exhibit child genius more so than other disciplines.

The mystic connection between music and mathematics brings to us the question: does one need to have a good mathematical brain to develop excellence in music, and the vice versa? Or do the musical and mathematical brains or minds have the same roots. In fact it can be argued that the roots of mathematics are closely connected with those of music. The rational structure of mathematics is implicitly aesthetic, given its properties of order and harmony, and in this sense it is musical, even though there is no transmission of sound. By the same token, music-even though there are no explicit digits or other mathematical signs in it-is implicitly mathematical through its amplitude, frequency, quality, rhythm, melody, form and style.

As a matter of fact, we don't have to go too far deep into any mathematical analysis to believe that music has some affinity with mathematics. We know that many mathematicians are also good musicians. The life and works of the scientist, Albert Einstein throws much light in this direction. The picture of Einstein conjures in us an image of a genius who discovered the formula $E=MC^2$ on one hand and who plays the violin with the other. In his real life, Einstein was fascinated by Mozart and sensed an affinity between their creative processes, as well as their histories. Einstein once said that while Beethoven created his music, Mozart's "was so pure that it seemed to have been ever-present in the universe, waiting

to be discovered by the master." Einstein believed much the same of physics, that beyond observations and theory lay the music of the spheres — which, he wrote, revealed a "pre-established harmony" exhibiting stunning symmetries. The laws of nature, such as those of relativity theory, were waiting to be plucked out of the cosmos by someone with a sympathetic ear. Thus it was mainly to "pure thought" and less to laborious calculation, which Einstein attributed his theories.

For 250 years now, artists, writers and musicians have been tinkering with Mozart's music and legend, yet Mozart remains as untouched by it all as the day he strolled into Vienna. From operas to musical ditties whistled by first-graders, Mozart's music remains a touchstone for humanity and a gateway to the realm of angels. Musicologists may mull over the reasons for that, but the public has already voted: Mozart remains a genius who wrote music that thrilled the head and the heart. Like the great classical novels of the past, his music is both popular and immortal. As the critics would say, it is music that seems to "lie beyond making." This reminds us of the famous saying by Rabindranath Tagore who said, "The music stuff is of the haven (Songit jinista gogoner)."

"Music," Mozart once wrote, "even in situations of the greatest horror, should never be painful to the ear but should flatter and charm it, and thereby always remains music." Such a creed would eventually prompted Goethe to declare "Mozart should have written 'Faust.' "

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