

# Meymandi at Large



## MUSIC, MEDICINE, HEALING, AND THE GENOME PROJECT

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This column is devoted to bridging the gap between basic sciences, medicine, the arts, and humanities.

Music existed way before there was a Neolithic man to discover, enjoy, and finally describe it in musical notes and terms. The winds blowing through the trees eons ago was music. The rhythmic undulation of grass and the mesmerizing sound of Brownian motion of cytoplasm and protoplasm

produced music billions of years ago. As for man-made music, archeologists and anthropologists have deciphered communications of Sumerians on the walls of their caves to have special sings (accents) similar to musical notes to introduce modification and modulation of sounds. Thus, in French, we have accent aigue, accent

grave, and accent circumflex—guides to phonetic enunciation of vowels that may be traced back to Sumerians.

The ancient man perceived the sound of the wind, rustling of leaves, and undulating tall grass as desirable, appealing sensations. Persuasive theories suggest that the early man's speech, like the natural occurring sounds, was sung. Children's conversation and communication is in rhythmic sing-song syllabic mode. Children are our best opera composers! We know that Moses, the author of *Pentateuch* (although some scholars argue he was not), knew of and enjoyed music, especially the singing of the shepherds on the outskirts of Mount Sinai, his regular hangout.

We literally have hundreds of references to music in the 39 books of the *Old Testament* and 27 books of the *New Testament*. The story of Orpheus, son of Apollo who gained access to Hades because of his beautiful and mesmerizing voice, has been dished out as folklore, musicals, and operas by numerous composers. The first Western opera, composed by Jacobo Peri and performed at 8:00pm, October 6, 1600, at Piti Palace in Florence, Italy, was *Orpheus and Eurydice*. Seven years later, in 1607, Monteverdi composed the first true opera by the same name. He introduced the formal architecture of opera, aria and recitative, in his version. We have enjoyed opera for more than 400 years.

### THERAPEUTIC EFFECT OF MUSIC

Since ancient times, music has been recognized for its therapeutic value. Greek physicians used flutes, lyres, and zitters to heal their patients. They used vibration to aid in digestion, treat mental disturbance, and induce sleep. Aristotle (323–373 BCE), in his famous book *De Anima*, wrote that flute music could arouse strong emotions and purify the soul. Ancient

Egyptians describe musical incantations for healing the sick.

We know of the protoplasmic movements of single cells, described by botanist Robert Brown (1773–1858), as Brownian movement/motion, and although random, the movements are rhythmic and produce music. In one of his romantic dissertations, Brown said the “motions are so musical...”

Researchers began to systemically study the application of music in medicine and healing near the end of the 19th century. Studies reporting the effects of music on physiological responses, such as cardiac output, respiratory rate, pulse rate, and blood pressure (BP), were originally reported by Diogel (late 1700s) of Salpetriere Hospital in Paris (the same hospital in which Princess Diana died 11 years ago). Diogel had soot-coated drums with a stylus to measure BP and

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pulse rate of his patients. Diogel would bring live musicians in his laboratory by his patients' bedsides to conduct his experiments and record his findings. (Remember! There was no recorded music at this time.) His first paper, a seminal scientific work, was published in 1880. Diogel showed that music lowers BP, increases cardiac output, decreases pulse rate and, in general, assists the work of the parasympathetic system. This work was replicated by Corning of America in 1880 and later by Tarchanoff (1846–1908) of Russia. Tarchanoff, a professor of medicine at the University of Moscow, often called on his colleague, Dr. Alexander Borodin (1833–1887), a professor of medicine and chemistry and also a musician and

composer, to play for Tarchanoff's patients while he recorded the effect of music on their vital functions. Tarchanoff published his paper in 1903 and dedicated it to Borodin.

### WHY DO WE LIKE MUSIC?

Music is a part of the cycle of natural life. Music is based on rhythm and harmony. Human life is based on rhythm. Day and night, seasonal changes, and all physiological and biological functions are rhythmic. We inhale and exhale, our hearts beat in systole (contraction) and diastole (expansion or relaxation.) Sleeping, eating, menstrual cycles, walking, talking, and other, if not all, functions of life are rhythmic.

We admire oratory eloquence because its rhythm and cadence, along with the words carefully chosen to awaken, inform, or appeal to our inner desires and thoughts, are harmonic

and orderly. One might conclude that man is really made of rhythm; so is nature, and so is music. Man, nature, and music are made of the same ingredients.

Bernstein in his 1973 Harvard lecture series on music forwards the theory of “monogenesis,” denoting that all languages spring from a single source. The prehistoric baby in the arms of his mother started to babble in rhythm and tone. The baby got hungry and exploded the word *MMMm* calling his mother's attention to his hunger. This word, or sound really, is the origin of the word *mom* or *mother*, and is shared by some 300 different languages, variations of which all start with letter “M.” This is a credible argument, for listening to tonal music

does rekindle the warmth of the mother-baby relationship. It stands to reason then that music makes us feel good because it reminds us of the warmth of our mothers' arms.

A UC Davis neuroscientist, Petr Janata, in a recent paper “The Neural Architecture of Music-Evoked Autobiographical Memories,” (published in 2009 in *Cerebral Cortex*) linked medial memory to music. He discovered that the region of the brain where memories of our past are supported and retrieved also serves as a hub that links familiar music, memories, and emotions.

### MUSIC: A MESSAGE AND A MESSENGER

The overworked cliché “music is the universal language of mankind” begins to take meaning by looking at the word *universal* itself. *Universal* is a big word and a dangerous word. At the same time that it implies likeness, it also implies diversity. Michelle de Montaigne (1533–1592) remarked that “the most universal quality of man's universality underlies his diversity.” Besides psychoanalysis, studying history, theater, music, and opera are powerful instruments of introspection and learning about one's self. For millennia, man has composed and enjoyed music without knowing the scientific reasons why he would do so. We have used music to enhance spirituality, to get closer to our maker, to unite us for a cause, to marshal us in wars, to swell us with pride, and to mourn and resolve sadness and grief. Additional data-driven discoveries in the past 60 years show us the promise of music in healing.

We have learned about the neuroanatomy of the limbic system. In the 1950s, when psychosurgery was legal in the US, experiments on the brain of death row inmates showed that stimulation of the ventral nucleus of hypothalamus by 70 millivolts of electricity would throw the subject into

rage. If one played soothing classical music while stimulating this region, the patient would not show anger. Clinical experiments at Columbia Hospital in the 1950s and early 1960s showed that patients with a propensity to religious orientation and enjoyment of classical music were a third faster to respond and heal postoperative retinal detachment than those who were not. Manfred Clynes (born 1925), a neurophysiologist whose family fled from Austria to Australia, published extensive data documenting the relationship between music, brain, and mind. His classical textbook *Music, Mind, and Brain*, published in 1982, is the benchmark of excellence in the field. The limbic system, consisting of thalamus, hypothalamus, amygdala, hippocampus, mammary bodies, and fornix, all subcortical structures in the brain, comprise the “anatomy of emotions.” They are responsible for the autonomic or the vegetative functions, such as breathing, appetite, body temperature, and moods (e.g., anger, sorrow, love, hatred, violence, compassion, sadness). Music brings about the excitation of the limbic system with corresponding changes in neurotransmitters, such as catecholamine, indolamine, dopamine, endorphin, and the latest, neuron growth hormone.

## GENOMES AND MUSIC

The most exciting discoveries of the effect of music on brain comes with the discovery of the Genome Project and the work of Venter et al published in 2001 in the journal *Science*. A Japanese geneticist and musician, Susumu Ohno (1929–2000), author of the seminal work *Evolution by Gene Duplication* (1970), was the first to propose the hypotheses of the Barr body and human paleopolyploidy and also contributed articles to the journal *Immunogenetics*. Ohno observed that music is like deoxyribonucleic acid (DNA) in repetition and development.

For example, each organism’s genes are composed of strands of DNA, which are made up of four nucleotides containing the four amino acids—adenine, guanine, cytosine, and thymine. The order of these bases of repeated four is far from random. Indeed, within a gene, certain oligomers, which are short chains of bases arranged in a set sequence, frequently occur in a predictable manner. Ohno stated that this is hardly surprising because recurrence is rampant in nature. According to Ohno in his classical paper *Genomes and Music*, “evolution relies on gene duplication; very much like music, it requires changes in variations on themes. All and all, truly new coding sequences generated by modern organisms recapitulate the first prehistoric coding sequence of eons ago...” When Ohno assigned notes to each of the four bases—cystine for *do*, adenine for *re* and *mi*, guanine for *fa* and *sol*, thymine for *la* and *ti*, and cytosine again for *do*, the genes made music. And that music wasn’t just melodies repeating endlessly, because in genes, wrote Ohno, “the monotony created by the endless recurrence of these decamers, hexamers, and their derivatives is broken by refreshing appearances of tandomly recurring base oligomers that are not directly related.” For example, a section of the ribonucleic acid mouse gene for polymerase II sounds like music from genes that encode cell adhesion molecules, which sound like a musical score Debussy would have written. And the sequence of human X-linked phosphoglycerate kinase (the enzyme for breakdown of glucose) played on violin is hauntingly melancholy, as though reflecting the Weltschmerz of the gene that persevered for hundreds of millions year ago.

## FINAL WORD

Music makes us feel like we are back in the arms of our mother, the

ultimate source of love and security. When all is said and done, it is Socratic elenchus of self examination and self acceptance (how we feel internally about ourselves) and external love; mom, music, warmth, fresh air, and support of the family bring us security and fulfillment of our maximum potential. I, for one, am grateful for the gift of music.

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