



SUNADA
MUSIC, MUSIC THERAPY & MORE...

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From the Editor's Desk

In the past few months the Sunada team has been trying to dig into the past and see how the frequencies of the brain waves can be matched to the frequencies of various musical notes. The idea was to see how the brain waves which when recorded during an ailment can be brought back to their normal levels with music therapy, using suitable compositions to various patients. The reason being, what is melody for one can cause a malady for another. Music is completely subjective and enjoyed best at individual levels. We are trying to establish the relationship between musical frequencies and the brain wave frequencies. This issue deals with the Fibonacci numbers and how this ratio is present in the musical notes and their various frequencies. A lot of material had to be researched through the internet and put together in a relevant manner. Happy reading...

KS Vasantha Lakshmi,

Founder & Editor

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Fibonacci, the "greatest European mathematician of the middle ages

MUSIC AND FIBBONACCI

By

K.S. Vasantha Lakshmi & Dr. K.V. Narsasinga Rao

Knowingly or unknowingly, Dan Brown has introduced all lovers of casual reading to the great Fibonacci numbers, making ordinary people feel like intellectuals. Fibonacci was the "greatest European mathematician of the middle ages", his full name was Leonardo of Pisa, or Leonardo Pisano in Italian since he was born in [Pisa](#), Italy, the city with the famous Leaning Tower, about 1175 AD.

Pisa was an important commercial town in its day and had links with many Mediterranean ports. Leonardo's father, Guglielmo Bonacci, was a kind of customs officer in the present-day Algerian town of Béjaïa, formerly known as Bugia or Bougie, where wax candles were exported to France. They are still called "bougies" in French.

Leonardo grew up with a North African education under the Moors and later travelled extensively around the Mediterranean coast. He met with many merchants and learned of their systems of doing arithmetic. He soon realised the many advantages of the "Hindu-Arabic" system over all the others. He was one of the first people to introduce the Hindu-Arabic number system into Europe - the positional system we use today - based on ten digits with its decimal point and a symbol for zero:

1 2 3 4 5 6 7 8 9 0

His book on how to do arithmetic in the decimal system, called **Liber abbaci** (meaning *Book of the Abacus* or *Book of Calculating*) completed in 1202 persuaded many European mathematicians of his day to use this "new" system.

The book describes (in Latin) the rules we all now learn at elementary school for adding numbers, subtracting, multiplying and dividing, together with many problems to illustrate the methods.

Fibonacci is also very famous for his golden ratio. The Fibonacci sequence of numbers and the golden ratio are very clearly explained in music. These numbers are present in the octave, the foundational unit of melody and harmony. Stradivarius used the golden ratio to make the greatest string instruments ever created. Research on Debussy's works shows that the composer used the golden ratio and Fibonacci numbers to structure his music. The Fibonacci Composition reveals the inherent aesthetic appeal of this mathematical phenomenon. Fibonacci numbers harmonise naturally and the exponential growth which the Fibonacci sequence typically defines in nature is made present in music by using Fibonacci 77 notes. Perhaps it is present in other categories of things, such as tastes or smells. It has already been discovered in quantum mechanics and in time.

<https://www.youtube.com/watch?v=LunZFRteeJs&feature=share>

An Octave is the interval between a note and the next instance of that same note name on the piano or harmonium. An Octave interval is from C on the left to the C on the right of the keyboard. An Octave spans over a set of 13 notes. For example, an octave starting on C would include C, C#, D, D#, E, F, F#, G, G#, A, A#, B, C. This is known as a "Chromatic" scale. The interval between two consecutive notes in a

chromatic scale is a “Semitone” interval. The interval between F and G is a whole-tone. “Major and minor” scales span over 8 notes in one Octave with a mixture of semitones and whole-tones. For example an octave of major scales starting on C (the first white key) would include C, D, E, F, G, A, B, C. On a keyboard, there are 8 white keys and 5 black keys. The black keys are grouped into 2 and 3.

In the key of C, the notes C, E, G are the basic chords of the key. They are called the root triad. These are 1, 3, and 5 in the scale - Fibonacci numbers. In the Octave the foundational unit of melody, and harmony, one can see the Fibonacci numbers cropping up everywhere.

Musical frequencies are based on Fibonacci ratios

Notes in the scale of western music are based on natural harmonics that are created by ratios of frequencies. Ratios found in the first seven numbers of the Fibonacci series (0, 1, 1, 2, 3, 5, 8) are related to key frequencies of musical notes.

Fibonacci Ratio	Calculated Frequency	Tempered Frequency	Note in Scale	Musical Relationship	When A=432 *	Octave below	Octave above
1/1	440	440.00	A	Root	432	216	864

2/1	880	880.00	A	Octave	864	432	1728
2/3	293.33	293.66	D	Fourth	288	144	576
2/5	176	174.62	F	Aug Fifth	172.8	86.4	345.6
3/2	660	659.26	E	Fifth	648	324	1296
3/5	264	261.63	C	Minor Third	259.2	129.6	518.4
3/8	165	164.82	E	Fifth	162 (Phi)	81	324
5/2	1,100.00	1,108.72	C#	Third	1080	540	2160

5/3	733.33	740.00	F#	Sixth	720	360	1440
5/8	275	277.18	C#	Third	270	135	540
8/3	1,173.33	1,174.64	D	Fourth	1152	576	2304
8/5	704	698.46	F	Aug. Fifth	691.2	345.6	1382.4

The calculated frequency above starts with A440 and applies the Fibonacci relationships. In practice, pianos are tuned to a “tempered” frequency, a man-made adaptation devised to provide improved tonality when playing in various keys. Pluck a string on a guitar, however, and search for the harmonics by lightly touching the string without making it touch the frets and you will find pure Fibonacci relationships.

Musical compositions often reflect Fibonacci numbers and phi. Fibonacci and phi relationships are often found in the timing of musical compositions. As an example, the climax of songs is often found at roughly the phi point (61.8%) of the song, as opposed to the middle or end of the song. In a 32 bar song, this would occur in It is clear that the

Fibonacci sequence of numbers and the golden ratio are manifested in music. The numbers are present in the octave, the foundational unit of melody and harmony. Stradivarius used the golden ratio to make the greatest string instruments ever created. Fibonacci numbers harmonise naturally and the exponential growth which the Fibonacci sequence typically defines in nature is made present in music by using Fibonacci 77 notes. Perhaps it is present in other categories of things, such as tastes or smells. It has already been discovered in quantum mechanics and in time, the 20th bar.

<https://www.youtube.com/watch?v=pOwMDO0-zBw>



Face to face

MS. A. VIJAYA MURTHY,
Chinmaya Mission Vishakhapatnam



Q. You are actually a specialist in Library and Information Science, how did you get drawn towards spiritual, philanthropic and artistic pursuits?

Vijaya: I did my graduation and then pursued PG degree in Library and Information Science, both from Andhra University, Visakhapatnam. Worked in the university library for 3 years when I got married to Dr. ASN Murthy and shifted to BITS, Pilani, Rajasthan where my husband was teaching. While I was young I learnt Kuchipudi dance for couple of years but had to stop due to my father's frequent transfers. But since childhood I was interested in music and dance so in my later years my sister and I learnt Karnatic music on Veena for about four years. Though I stopped learning after marriage, I still retained interest, often

attending concerts and music programs and was always listening to some form of music on radio, tapes, cassettes and CDs.

From Pilani, we moved to Delhi where my husband worked as a professor in IIT. I was fortunate to get a job in the library at India International Center, Delhi, a cultural organization, which promoted international cultures. There were lot of dance and music programs from different countries, which I attended regularly and retained my interest in those art forms. After retirement, we moved to Visakhapatnam, where we living for the past 18 years.

Q. You also worked in helping the exchange of the cultures of various countries. How did this happen?

Vijaya: I was instrumental in starting an international library network for information exchange, called Delhi Library Network later re-named as Developing Library Network, where books on various subjects including arts were made available to interested people. I also acted as its Secretary for five years. I got to read a lot of books on various cultures during that period.

Q. How did you come to work for the Chinmaya Mission?

Vijaya: I was associated with Chinmaya Mission since my younger days and worked for the mission at various places, running Balavihars, youth programs, study classes etc. Ever since we came to Visakhapatnam after we both retired from active careers, I have become much involved with the mission activities and have been working for the mission in various capacities. Seeing my interest, I was asked by Swami Chinmayanandaji, my Guru and mentor to translate some of the mission publications into Telugu from English and I have

been doing that work for many years. The mission itself publishes and markets those books. I have translated some eight books so far. At the Chinmaya Mission, Visakhapatnam for the past 12 years we have been conducting Summer Camps at different levels for children from age groups 5 to 15. We teach them our culture, traditions, good conduct, spirituality (not limited to just Hinduism) and personality development through games, workshops, stories, skits, Shloka chanting competitions etc. We observed that these activities imparts a great amount of self confidence and allows them to face the challenges of life better. It has been a great success. I have been actively participating in these programs all these years and it gives me a lot of satisfaction. I consider myself fortunate to be of some use to the society at large in my own little way.

Q. It has been a great pleasure to talk to you Vijaya, and we, at Sunada, hope that that you continue your good work for many years to come.

WHAT YOU THINK



Dear Vasantha garu,

The article by Ms. Suryakumari is well written and sounded scholarly. Not to say that I am a pundit, I could still grasp the crux. I am appreciative of the interview given by the doctor who gained proficiency in music by sheer inspiration, self taught despite her busy schedule as a doctor. Composing through inspiration would make it look natural and free flowing as against composing by knitting words together.

Thanks and kind regards
E. Ramamohan, USA

I have read Dr Lakshimi's interview is very interesting. . She is doing a great service by donating to the small unknown temple.

B.Suryakumari,
Hyderabad

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Articles not exceeding 500 words can be sent to:
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