# COMMUNICATION AND MUSIC

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It would be presumptuous of me to hand out communication theory in any great detail or of musicology among you, but I only wish to say a little about general ideas and attitudes necessary for such synthesis. For attitudes are far more important to deeper musical understanding than actual knowledge of technical details.

The basic premise in Science is that there is order in this universe, and the patterns of order (however complex and interlinked) could be epitomised in what are termed Laws of Nature, demonstrable and reproduceable, with mathematics for the tool to elucidate and study patterns — of sounds and their organisation. Could not the methods and concepts of science be applied to music? But this presupposes that music contains entities that are mensurable and calculable. Is such an idea acceptable to the musicians?

One impediment is the glib talk of the so-called 'spirituality' of Indian Music. Devotion might of course channel music into the best use for it. When Tyagaraja sings *Rama, ninne nammi nanu* we may say he pours forth his soul into the melody. But when he sings *Vegalesi neeta munigi boodi poosi*, hitting out against some humbugs, it is grouse pure and simple, and where is 'spirituality' in it? Both pieces are great music, and they are great because they use musical techniques that convey exactly the messages meant to be conveyed, and to put one in certain frame of mind exactly as intended. We know of great divines who made no music or only very bad music; we also know men such as film musicians, whose 'spirituality' we have every reason to doubt, who make at times, grand music. But what is meant to be conveyed is a 'state of mind' which is much more general, and at the same time a far deeper psychological experience, than the vehement emotions or "*rasa*-s" of dramaturgy and literature, —

although even these could be conveyed for short durations by techniques which have come to be called "mickey-mouseing".

Forgetting those who use the 'spirituality' to kill all inconvenient questions, we have however to take seriously the genuine doubters, the conscientious objectors to the application of scientific methods to music, hesitating before the metaphysical difficulties. The question could be asked: "In what domain of existence are such entities like thought, reason and decision to be allocated? Are they physical in nature, in the sense they have the same domain of co-existence as mass, charge, velocity, energy and so on, which are associated with material objects?" My answer is that they do not belong to this category of entities, but only that they are somehow related to the latter. Saint Ramanuja said there is a physical basis for every perceptual process, and put it succinctly by an analogy: There is no serpent coil without a coiled serpent. The serpent coil is an abstract concept while the coiled serpent is material whether physically present or not.

Science deals with measurable entities. But there are a few which are by their very nature indeterminate. For example, velocity being defined as rate of change of position, position and velocity cannot be measured simultaneously. This is of course the basis for the now famous Hiesenberg principle and indeterminancy. In such cases the way out would be to assign to them statistical qualities that are enumerable. For that matter, vigourously speaking, no measurement can ever be true except by accident, and computable by inference only, because all measurements are limited by: (1) the amount by which the experiment "loads" the entity, and alters its value; (2) by the accuracy with which the measuring instrument can approach the value in reproduction; (3) the accuracy with which the measured value is indicated, and (4) the closeness with which it can be cognised. Therefore, only by a theoretical construct we derive the "true" value out of such indeterminate and/or inaccurate measurements. This is certainly so in the case of all pitch, loudness and phonetic measurements. *Todi*'s *gandhara* may be different from *Bhairavi*'s and quite variable from *raga* to *raga*, and each *svara* may be an indefinite region, but, even so, the area must have limits, boundaries, lattitudes and longtitudes, and a capital, so to speak. Science would deal with both the physical basis for derivation of such reference points, their inter-relationships, and the basis for the variations in them when used in specific patterns which we call *raga*-s. The derivation of such reference points is simple arithmetic, but the delineation of their relationships in actual practical music is as complex as number theory. Very often arithmetic which is an insult to the art and science of music, passes for musicology. There are several instances on record in the history of science that simple experiments and measurements have disproved theories, and at the same time there are many cases of experiments which had however to be explained away for other reasons and sustaining the original theory. So in scientific studies theoretical-constructs are as important as experimental investigations.

One difficulty comes to our mind, exemplified in the analogous query: "There is a heap of grain. How many grains must be taken away so that it no longer is a heap?" The question is unanswerable unless we give an operational definition to 'Heap' and assign measurable limits to it. Communication theory abounds in such definitions — information content, noise, correlation, redundancy, entropy, etc. Therefore, if communication theory is to be applied to musical concepts we have to give these also operational qualities that are mensureable, taking care these do not conflict with acoustical, physiological or psychological phenomenon that are part and parcel of musical production, reproduction and appreciation. Above all, while Science in general pre-supposes order, communication theory, particularly, assumes the existence of a prior system or 'code' by which all messages are adjudged and processed. In music such 'codes' would be built of such basic psycho-acoustic facts as: (1) concordant sequence of notes are pleasant, (2) certain inflexions are forced by and paired with specific pitch relationships; (3) leaving off the music on concordant notes is pacifying; (4) certain inflexions of the voice are paired with certain attitudes or states of mind (5) and similarly certain tempo and dynamics; (6) even harmonic distortion is unpleasant and odd harmonic distortion is not, relatively speaking, unpleasant, and we can have 'curves of equal annoyance' by which power and distortion can be traded against intelligibility and pleasure; (7) certain relationships of upper partials content are paired to such impressions as 'presence' or 'distant music', stereo-sense; (8) there can be even unvoiced and unpronounced inter-pitch sounds in our music etc. The *ragas* are specific code-combinations out of these building blocks.

The simplest technique in statistical theory, that part of the mathematical tool of science seeking patterns in apparently random data, is content analysis. As every *raga* has by definition a specific shape, a graph of, say, percentage of time each *svara* is used among a large number of musical pieces of different composers or musicians plotted against pitch-level or *svara* is bound to have a definite shape. The general shape can be Poisson or Raleigh distribution rather than 'normal' or Gaussian. But if we draw a family of curves of percentage of time in use for any particular *svara* by the same composer or musician in different pieces of the same *raga*, the curves are most likely to be a family of Gaussian curves. But these are bound to be of limited utility in our understanding of the shape of the *raga*, particularly so due to the effect of weightages as in the stipulation, for example, as: in *Madyamavati* the *gandhara* cannot be used.

Of course, such weightages are required in practical music. No one can teach or sing all the possible combinations and permutations of the *svara-s*, nor is it necessary. If the cards of a pack are shuffled thoroughly the top one can be any one of the 52, the second any one of the remaining 51 and so on....; the possible number of combinations is 52 x 51 x 50.... a colossal figure. But if we stipulate that in the array alternate cards must be black and red, the number of possible combinations topples down; having chosen the first card, the next in this case can only be from half of the remainder, and so on....; the combinations reduces to 52 x 25 x 25 x 24 x 24 x .... If we specify still further that the numbers must be in sequence, ascending odd values, descending even values etc., the combinations reduce even more drastically in number. The point is, a single restraint alters the probabilities disproportionately. For the three letters A, B, C, there are 33 or 27 combinations AAA, AAB, AAC, ABA, ABB, .... Here each symbol is used 81 times. The probability of any one group of tri-gram occurring is of course 1 in 27. Suppose we exclude the group ABC. Then the probability of included item increases from 1 in 27 to 1 in 26, at the expense of the probability of the excluded item, which is zero. Simultaneously, the probabilities for the two-letter groups (or di-grams) AB, BC are also reduced and those for other di-grams such as BA, AA, CB, CA ... are slightly increased. Alternatively if the tri-gram AAA is excluded, the probabilities for A is reduced and those for B and C are increased; probability for the di-gram AA is reduced and those for other di-grams are considerably increased. Therefore, even if we have seen only one or two symbols we have far better chance of guessing what the next symbol is. That is, with the knowledge of the restrictions of the *aroha* and *avaroha* of *Madyamavati*, the enjoyment becomes specific. Now, if AAA is excluded, the A will be followed by B or C. In such restricted combinations — technically, 'reduced language' — some words may no longer require all symbols to be noticed for the word to be identified. For example, if AAB and AAC are both excluded, AA — must be completed with a third A. But then the third A is wholly redundant and gives no information not already given by the other two. In common English, if all possible 'words' were used, such as XAC, SULH, JIJK, etc., there is no such thing as mis-spelling; it is because language is redundant that we can correct a mispelt message. These redundancies, in fact, give a scope for imagination and variations. The study of content and redundancies in groups of such South Indian *raga*-s like *Madyamavati* (*Sa Ri Ma Pa ni Sa — Sa ni Pa Ma Ri Sa*); *Manirang* (*Sa Ri Ma Pa ni Sa — Sa ni Pa Ma ga Ri Sa*) and *Sri* (*Sa Ri Ma Pa ni Sa — Sa ni Pa Ma Ri ga Ri Sa*) could show what effect exactly the absence of *gandhara* produces in a *raga.*

In other words, content-analysis is more suitable in finding the special characteristics of a *raga* rather than the pattern among *raga*-s. Correlation function and auto-correlation function studies are most useful in this respect. Let us have signal represented by the series:

| | |
|---|---|
| Signal | $b_0 \ b_1 \ b_2 \ldots\ldots\ldots$ |
| time or step of measurement | $t_0 \ t_1 \ t_2 \ldots\ldots\ldots$ |

Any signal correlates perfectly with itself of course, but when correlation is attempted with a replica of the signal by a time or measurement-step T, we may expect the correlation to be less. The auto-correlation can be symbolically written All

$$\phi(T) = f_1\left(\sum_{-\infty}^{\infty} b_t\, b_{t+T}\right)$$
$$= f_2\left(\sum_{-\infty}^{\infty} b_s\, b_{s-T}\right)$$

musical signals satisfy the definition of "wavelet" in statistical communication theory in that it has a definite arrival time or origin (in the sense that all values before $t = 0$ is zero i.e., $b_t = 0$ for $t < 0$) and that it has stability. The *b*'s can therefore represent the flow of pitches in a *raga* musical intervals from *Sa*, or from the previous notes, from the scale or *aroha-avaroha* representing the *raga*, for different sets of investigations, to show up the patterns in our music.

But, for these investigations, measurements of the flow of *svara*-s in *raga*-s have to be made, including the microtonal variations in *gamaka*-s, and tabulate them against time and rhythm flows. The microtonal variations may last only a quarter of a second or even less, but which the trained voice definitely produces and the acute ear definitely follows. As an example, the *gamaka nokku* (marked *w*) occurs in the following.

*Bha ma ma ta la — tel pu....//*
m n w w
*ga,, Ma, da,, ri Sa' — dani Sa'ri'//*
(Tyagaraja *Kriti — Chesinadella — Todi*)
Che tu — la .............. ra — )
w
Sa' Sa', — Sa' ni da Pa Ma — )
(Tyagaraja *Kriti — Chetulara — Bhairavi*)
na ta jana —/ pari — pa .... la ka na // nannu —
D w w w
ga Ri, Sa Sa, —/ Sa Sa — Sa Nida, Sa Ni Sa, // Ri Ni Sa, —bro......
va......//
w
Riga ma Pa da Ni // (Tyagaraja *Kriti—Natajana—Simhendra madhyamam*)
nee...... va...... da ne ga na
w Da w
Da Ni Sa', Sa' Ni Ni Da Pa Pama Ga ma Pa Pa //
(Tyagaraja *Kriti — Neevadane — Saranga*)

Here the flat or sharp *Nishada* comes in association with several varieties of *rishabha*, *gandhara*, *madyama* and *dhaivata*. Is there a pattern in them, a common characteristic of *Ni* to be learnt from this? To answer this, we must measure the *gamakas*. Such studies have been started by a few, particularly Dr. Deva, but alas! not continued.

Are such studies necessary, both in the laboratory and with paper and pencil? Do not musicians teach their pupils the *Ri* of *Sriraga* differently from that of *Madyamavati*? To this I put the retaliatory question: why should the two be different at all? Great musicians may instinctively understand it, and correctly intone the *gamaka*-s, even when, in flashes, trying out new combinations. But if they cannot explain what they are doing, then they are merely passing on musical mannerisms, which the pupils imitate with no musical understanding on their part either. If the questions 'how?' and 'why?' are not asked intellectual life stops; the result would be dead music — only a museum piece. Our classical music is fast deteriorating to this stage. The causal factors in music cannot be explained except in terms of the acoustics of musical intervals and sequences — the *aroha* and *avaroha* or the scale in its general sense — and of tonal shifts. The concepts of scale and shifts are inherent in correlation studies. Even as velocity is more basic and widely understood than Space or Time, the flow of *svaras* and tonal shifts are easier concepts than *sruti* or *raga*. Those who quote our ancient texts *ad nauseum* should remember that tonal shifts are basic to the concepts of *moorcchana*, *grama* and *raga* also, and latterly of *mela*. That a special form of tonal shift, called the key-shift, is the foundation for Western music need not blind us to the fact that other forms of tonal shifts are present in our music. Science is analytic in its approach, but genuine scientific studies, ever seeking patterns and order, reaches through analysis a synthesized view of the universe. It is like the paradoxical situation in political economy, where savings are necessary for more economic activity, which includes more spending. To realise that *raga*-s are distinct and different from one another is only the first step. To understand the unities of all *raga*-s and the fundamental psycho-acoustical laws of all music, is an important step ahead. To want to know these, is thirst for knowledge of a higher order. Music is not an esoteric cult or black-magic, and its use and pleasures must be made available to every one. Scientific studies of music are therefore our crying need.