On Some Adaptations of Western Concepts of Intonation to South Indian Music

Madhu Mohan Komaragiri

Introduction:

Cross cultural exchanges have always happened as a result of travel, migration and invasions. Instances can be cited in the past, where actual learning of an outside idiom has affected the native form. In current times, interflow of culture has widened through the concert and lecture-demonstration tours and even overseas settling of teachers and performing artists. Interaction increased severally. Not only musical instruments but musical concepts also have been adopted. This is healthy cross pollination. But, because of the ready availability of information globally, today one could easily learn *about* an alien culture theoretically without practical insight, which is possible by being part of it. As a result, some adaptations are systemically questionable. This paper examines forced adaptations of contemporary western concepts, particularly to the current theory of intonation in South Indian music.

This paper specifically talks about the parallel concepts such as octave v/s *saptaka*; intervals v/s *śruti*-s; scales v/s *mēla*-s; modal shift of tonic v/s *grahabhēdaṃ* and consonance v/s *saṃvāditva*. The discussion is limited to the comparison of these modern concepts in a cross-cultural context.

This paper is concerned with the *mēla* system, with specific focus on the modern South Indian system of *rāga* music. The word 'modern' applies to the post seventeenth century period in Indian music. The words 'South Indian' and 'Carnatic' are used synonymously. The correct diacritical spelling however is *Karṇāṭaka*. The word 'Indian' refers to the current Indian *rāga* music, unless specified differently. The word '*rāga*' specifically refers to *Karṇāṭaka rāga*, although it can encompass *Hindustāni rāga* as well. In this paper, the word 'west' or 'western' refers to the contemporary period in western music, unless stated otherwise. Although the discussion pertains to the current times, in order to present a proper perspective, ancient concepts and their evolution have also been discussed as they formed the basis. The focus however is contemporary Carnatic music.

1. Octave v/s *Saptaka*:

These two words practically mean the same in all evolved forms of music, because the eighth musical note is the same as the first note. But conceptually, there is a difference. In the west, right from the Pythagorean times, the intervallic relation of the octave was established acoustically as 2**:** 1. The notes in the octave were mathematically derived from this premise. That is, the seven notes of the western octave were derived by *dividing* the octave, or by some kind of

Edited version of the paper presented at the International Conference on "India and the World**:** Intercultural Performing Arts" Department of Musicology, Faculty of Humanities, University of Amsterdam, Nov 20–22, 2008.

intervallic progression with octave as the reference. In the ancient Indian music, on the other hand, the seven notes were *positioned* first and the resulting gap between the seventh note and the 'octave' existed as a residue. The octave as such became incidental. Within the 'circle of *svara*-s' (*svaramaṇḍala*), the intervallic relation of the octave was never explicitly mentioned. In fact, as pointed out by Rowell (1992) the circular pitch continuum rendered the octave insignificant in ancient Indian music. It is not that the ancient Indians did not realize the octave relationship, but the approach was *not acoustical*, up until the modern period. In Indian music, *svara*-s have been positioned along a linear schematic within the frame of the 22 *śruti*-s[1]. Further, pertaining to the ancient *ṣaḍja-grāma*, Abhinavagupta said that the three *svara*-s, *Pa*, *Dha* and *Ni* could be produced from the positions of *Sa*, *Ri* and *Ga* respectively on the same string because of their *saṃvāda* relationship. These two sets of three *svara*-s each also satisfied the *samānaśrutika*[2] principle (Ramanathan, 1983). That is, there were two tri-chords along with *Ma* in the middle, constituting the seven notes of the *saptaka* (Rowell, 1992). The note *Ma* was in fact called as 'madhyama' which literally means the middle. This fulcrum middle note could neither be dropped nor modified.

2. Intervals v/s *Śruti*-s:

Intervals between simultaneous notes are called Harmonic Intervals and intervals between sequential notes are called Melodic Intervals (Lloyd, 1963). *Rāga* music employs melodic intervals and is therefore characterized by *melodic intonation*. Precise mathematical relations do not apply to melodic intervals as there are no resulting beats (Levarie, 1980). But certain *basic* acoustical relations, such as 2/1, 3/2, 4/3 etc. hold, because of the accompaniment of the *tambūra*. Also because of the Pedal Effect (Winckel, 1967), which is the retention in memory of the previous note, certain basic harmonic intervallic relations hold for melodic intervals[3] (Burns, 1999). Further, the *tonotopic organization* in the primary auditory cortex also provides the reference and guides interval production and perception (Weinberger, 1999). But since the tonotopic organization is based on pitch rather than frequency, mathematical rigidities do not apply. In other words, melodic intervals are not precisely acoustical, even if the notes are formed from the natural harmonic series. But expressing intervals accurately in the form of m/n for non-zero positive integers is purely acoustical and applies to harmonic intervals. Intonation in Indian music did not have an acoustical perspective till about the seventeenth century[4]. Musical intervals in Indian music have been traditionally expressed in term of the number of *śruti*-s between them. That is, at least theoretically, Indian intervals were explained in the context of the theory of 22 *śruti*-s. Sathyanarayana and Deva said that the 4-stringed *tambūra* (*tānpura*) might have been

introduced around the fifteenth century. Even by this estimate, acoustics of the natural harmonic series was alien to the traditional Indian musical thought until that time. *Śruti* was only a conceptual measure; not an acoustical quantity and it was never expressed in the form of m/n until the modern times when scholars unsuccessfully tried to import the western concepts and freely adapt them to Indian music. It might be germane to note here that *śruti* has also been incorrectly equated to the western concept of the *Just Noticeable Difference*[5] (Komaragiri, 2005).

In the current practice of South Indian music, the idea of two note names occupying the same position, leading to a system of sixteen (16) notes, is neither reflected in the west nor even in the North Indian music. Ideas such as Veṅkaṭamakhī[6] treating the same *svara* differently depending on the preceding *svara*, in terms of the number of *śruti*-s, is also unique to the South Indian music.

3. Scales v/s *Mēla*-s:

A *mēla* is a class of musical notes; it is a theoretical construct. Although scale systems of the west compared with the Indian *mēla*-s, it is a recognized fact that scale is not a *rāga*. In fact, despite all the theoretical deliberations culminating in a scale-centric approach to *rāga*-s, even today, genuine Carnatic music is still taught with typical *rāga* nuances oftentimes transcending the *ārōhaṇa* and *avarōhaṇa*. Carnatic *rāga* music is essentially idiomatic in nature with characteristic phraseology.

Intonation in Carnatic music is ***not*** acoustically based. That is, it is ***not*** based on the natural harmonic series, expressed in the form of m/n for non-zero positive integers. The pitching of the musical notes submits to the exigencies of the *rāga* employing them; it does not follow Pythagorean, Just, Equal Temperament or any other western tuning. The *Pitch Profiles*[7] in typical South Indian *rāga*-s seldom comprise plain notes. But even in terms of plain notes, the actual pitch values are different in Indian and the western systems. That is why if one plays just the notes of say, the major scale in C, on a piano or a keyboard, the South Indian *rāga Śaṅkarābharaṇaṃ* does ***not*** result. Therefore, scale equivalencies between Indian and the western systems are only of academic importance.

Although the Church modes, originating from the Chant, guided intonation in the west, musical instruments played a significant role in its evolution. Since musical instruments naturally resonate at certain harmonic frequencies, western scales were constructed based on the natural harmonic series (Olson, 1967) and then tempered to suit specific requirements. But such mathematical

tuning was never done in traditional Indian music until the modern times. The scales in Indian music were developed mostly by changing the *svara* positions (on a 22-*śruti* linear schematic) and did not correspond to the actual acoustical values (Komaragiri, 2005).

Today however, the *svara*-s in Carnatic music are positioned on musical instruments such as the *vīṇā* in line with the natural consonance determined aurally. But the intonation in practice continues to transcend these *svara* positions. For example, multiple *svara*-s are played on the same fret of the *vīṇā* by deflecting the string thereby changing the tension in the string, in which case, acoustically precise *svara* values are not possible. This is done to bring about the *rāga* gestalt. *Svara*-s in Indian classical music are not bound by the acoustical parameters. But the view that scale arrangements in monophonic music can be arbitrary (Backus, 1969) does not hold for *Karṇāṭaka* music as *svara*-s and *rāga*-s have definite characteristic pitch profiles.

4. Modal Shift of Tonic v/s *Grahabhēdaṃ*:

In the ancient system of Indian music based on *mūrchanā* and *jāti*, different scales were obtained by shifting the tonic. But in the current fixed-tonic *mēla* system, different scales can be obtained by simply changing the intervals; not by changing the tonic, which is fixed. That is, for example, keeping the tonic fixed the scale changes by changing the interval from say, *śuddha ṛṣabha* to *catuḥ śruti ṛṣabha*. In such a fixed tonic system, the very idea of 'shift of tonic' does not apply, systemically speaking. And the word 'modal' of course had already lost currency as the *mēla* system is a scale system. Therefore the very usage of the phrase 'modal shift of tonic' is inapplicable to the contemporary Indian music. In the western scale system, the tonic key can be changed, referred to as key modulation. But such modulation does not result in a changed scale in equal temperament. That is, a major scale remains a major scale, even when the key is modulated. The entire scale is simply shifted along with the tonic. The tonic key may be modulated to related keys. The purpose of key modulation is to add colour and dimension to a composition and not to theoretically generate new scales. Further, while modulating the tonic key, the original key is not sounded in the context of the changed key. But, in Carnatic concerts today, when an artist does the so-called *grahabhēdaṃ*, the *tambūra* continues to sound the original pitch, while the accompanying violinist plays the changed key. A new scale is supposed to result because the original note positions are considered fixed while the tonic changes. But the artist requires to posses the sense of *absolute pitch*[8] to be able to continue to hold on to the same positions despite shifting the tonic. The system of Indian music training does not provide this ability. In a performance, the artist can do the *grahabhēdaṃ* because of prior knowledge and not

because of the training to hold on to the absolute pitches of the musical notes. It is essential to understand this fundamental difference while equating *grahabhēdaṃ* with the modal shift of tonic.

The concept of modal shift indeed has theoretical use. It should however be noted that even if the generation of a new scale is accepted in terms of the positions of the *svara*-s, to say that a new *rāga* has resulted, would be incorrect as the intonation of the *svara*-s and the structure of the *gamaka*-s would have changed with the new *rāga*. For instance, *Ma* of *Kharaharapriya* and *Ga* of *Tōḍi* occupy the same position when the tonic of *Kharaharapriya* is shifted to *Ri*. Whereas the former can be rendered plainly, the latter must be rendered with a *gamaka*. But then, such inconsistencies are inevitable with the current practice of theoretically defining *rāga*-s purely in terms of scales.

5. Consonance v/s *Saṃvāditva*:

Consonance or *saṃvāditva* applies only when there are at least two musical notes. Therefore, for any meaningful discussion on this issue, the following two distinctions must first be made:

a. whether the interval between two such notes is harmonic or melodic, and
b. whether consonance is physical or musical.

Consonance and *saṃvāditva* are said to be the same. The concepts are indeed parallel. But, the contemporary western concept of consonance deals mostly with harmonic intervals while the modern South Indian concept of *saṃvāditva* deals with melodic intervals. Further, in ancient Indian music, Bharata defined *saṃvādī* in terms of two *svara*-s having an interval of 9 *śruti*-s ***and*** 13 *śruti*-s[9]. He specified only four pairs of *saṃvādī*-s in the *ṣaḍja–grāma* as *Sa-Ma*, *Sa-Pa*, *Ri-Dha* and *Ga-Ni* (Abhinavagupta, 1964). The concept was originally based on the *samānaśrutika* principle (see note 2), which cannot be applied in the same manner to the current fixed-tonic *mēla* system with changing intervals. According to the *samānaśrutika* principle, *Ma*, being a 4-*śruti*-ed *svara*, cannot find *saṃvāditva* with *Ni*, which is a 2-*śruti*-ed *svara*. That's why the pair *Ma-Ni* was not listed as a *saṃvādī* pair in the *ṣaḍja–grāma*, albeit having a 9 *śruti* interval. So, the operating principle was not pure acoustics of simultaneous notes. Scholars like Sambamurthy spoke of *saṃvāditva* in the context of simultaneous notes also, which is alien to the traditional Indian musical thought. But the very concept of *śruti* as employed in the ancient *grāma* system is inapplicable to the current *rāga* system with *changing unequal intervals*. And therefore talking about *saṃvāditva* in terms of the number of *śruti*-s is untenable in the context of current music (Komaragiri, 2005). It may also be noted here that the function and the application of the four

types of *svara*-s mentioned in the context of the ancient *grāma* system; *vādī*, *saṃvādī*, *anuvādī* and *vivādī*, to the current *rāga* system have not resulted from a systematic historical development (Ramanathan, 1983).

The physical approach involves the concept of zero (or minimum) beats when two tones are sounded simultaneously and the musical approach involves the artistic acceptance based on the exigencies of the idiom. A physical match between the two notes is concordance as opposed to consonance; which is purely a musical term and depends on the hearing and musical context (Lloyd, 1963). Helmholtz (1954) also had recognized that consonance is different musically and physically. For example, a minor second interval has a certain indispensable musical character, which cannot be accounted for, by pure physical concordance. Principles of harmony do not apply to melodic music. Beats do not occur between successive notes on the basilar membrane (Moore, 2003). The rigidities in the western consonance are relevant to polyphonic music. The acceptance of consonance is not a result of biological evolution; it depends on learning and training (Roederer, 1995) and therefore depends on the particularities of a musical culture. Therefore the western concept of consonance and the Indian concept of *saṃvāditva* have different connotations and contexts.

Conclusion:

Certain basic concepts of intonation in the current South Indian *rāga* music and their parallel concepts in contemporary western classical music have been compared and some fundamental systemic discrepancies were highlighted. Equivalences in concepts help in cross-cultural communication as long as one understands the discrepancies, which this paper sought to explain. In the recent times, studies in Indian music have largely overlooked these issues, contributing to untenable theories of intonation. The concept of *rāga* is highly characteristic and indigenous to Indian musical thought. Intonational imperatives and variability are necessitated by the idiomatic exigencies in vogue and therefore it is essential to gain insight native to both the systems before venturing to compare and adapt concepts and practices within a multi-cultural context.

Acknowledgements:

I wish to thank Professor N. Ramanathan, retired HOD, Department of Indian Music, Madras University, Chennai, India for his valuable guidance. I would like to acknowledge the insightful comments of Professor Lewis Rowell, Indiana University, Bloomington, Indiana, USA. I am grateful to the suggestions given by Mr. M. Subramanian, a perceptive musicologist of the Rasika-Gayaka

software fame, Chennai, India. I also wish to thank Dr. Timothy Sullivan, a Toronto-based composer and teacher, for his review and pertinent inputs.

Explanatory Notes:

1. The theory of 22 *śruti*-s states that the ancient Indian *saptaka* comprised 22 steps called as 22 *śruti*-s. In his opus, the *Nāṭyaśāstra*, Bharata illustrated the relative proportions of the seven *svara*-s in terms of *śruti*-s by the conceptual 2-*vīṇā* experiment. According to him, the seven *svara*-s, *Sa-Ri-Ga-Ma-Pa-Dha-Ni* had, in order, 4, 3, 2, 4, 4, 3, 2 *śruti*-s, counted from the note below, totaling 22 *śruti*-s. This of course pertained to the ancient *ṣaḍja-grāma* mode.
2. *Samānaśrutika*: the original seven *svara*-s (musical notes) in the *ṣaḍja-grāma* (an ancient system of grouping / arranging *svara*-s) according to Bharata's *Nāṭyaśāstra*, were measured in terms of *śruti*-s, considered as the basic unit / interval of the *saptaka* (octave). *Svara*-s with equal number of *śruti*-s were said to be *samānaśrutika svara*-s. The word *samāna* means same or equal. For example, *Ri* (second) and *Dha* (sixth) are three-*śruti*-ed *svara*-s and are therefore said to be *samānaśrutika svara*-s. In addition to Mataṅga (9th century: *Bṛhaddeśī*), only Abhinavagupta (11th century), talks about this principle. Śārṅgadēva (1210 – 1247) ignores it in his *Saṅgītaratnākara*, while Mahārāṇā Kuṃbha (1433 – 1468) discusses and dismisses it in his *Saṅgītarājā*.
3. The so-called experiments on the monochord have always had the fundamental sounded as a reference to study the musical intervals. Therefore the musical notes formed from the natural harmonic series will always have certain *basic* intervallic relationships such as 2/1, 3/2, 4/3 etc., even if the notes are arranged sequentially.
4. The three seventeenth century musical treatises; *Saṅgītapārijāta* (of Ahōbala), *Rāgatattvavibōdha* (of Śrīnivāsa) and *Hṛdayaprakāśa* (of Hṛdaya Nārāyaṇa) were the earliest treatises to explain the positions of *śuddha* and *vikṛta svara*-s in terms of string lengths for the first time in Indian musicology.
5. *Just Noticeable Difference* is a psychophysical unit used to determine the minimum perceptible change in pitch. It depends on several factors and it varies from person to person (Komaragiri, 2005). This concept applies to *any* sound stimulus; it is not necessarily limited to musical pitches. The number of detectable pitches within a semitone far exceeds the number of *śruti*-s traditionally allowed between two *svara*-s.
6. Veṅkaṭamakhī treats the same *svara* differently depending on the preceding *svara*. For example, *sādhāraṇa gāndhāra* (tenth position) is a 3-*śruti*-ed *svara* when preceded by *śuddha ṛṣabha* (seventh position) but, it is a 1-*śruti*-ed *svara* when preceded by *pañca śruti ṛṣabha* (*śuddha gāndhāra* – ninth position) and it becomes *ṣaṭ śruti ṛṣabha* in its own place,

which is a 6-*śruti* interval. Veṅkaṭamakhī wrote his famous *Caturdaṇḍīprakāśikā* in the seventeenth century.

7. The characteristic movement of a *svara* over a range of pitches in a given *rāga* is called as the *Pitch Profile* (Komaragiri, 2005). The pitch profiles are guided by the idiomatic requirements of the *rāga* and the tonotopic organization in the primary auditory cortex. These characteristic pitch profiles are not acoustically based but have definite structures within a musical context.
8. Absolute Pitch (AP) is the rare ability to identify a musical note based on its actual frequency value without any reference to the tonic, scale or the octave. That is, people with AP have memory of actual pitches of musical notes and not just relative pitches.
9. Bharata, Dattila *et al* defined *saṃvādī* as two *svara*-s with an interval of 9 ***and*** 13 *śruti*-s, within a circular arrangement of *svara*-s, totaling 22 *śruti*-s. Post-twelfth century scholars treated *saṃvādī* as two *svara*-s with an interval of 9 ***or*** 13 *śruti*-s within a linear arrangement of *svara*-s.

Glossary:

Ārōhaṇa: is the ascending arrangement of *svara*-s (notes) in a scale.

Avarōhaṇa: is the descending arrangement of *svara*-s (notes) in a scale.

Basilar Membrane: is a tapering membrane inside the inner ear (cochlea) that vibrates in response to the incoming sound stimuli. It helps to discriminate and resolve complex sound signals; and it helps to generate nerve impulses that are conducted through to the primary auditory cortex in the brain to enable pitch perception. Also see tonotopic organization.

Equal Temperament (ET): is the division of the octave into 12 equal semitones, where each step is equal to $\sqrt[12]{2}$. That is, all the intervals are represented by irrational numbers and are considered mistuned, acoustically.

Gamaka: constitutes a variety of characteristic modulations of the *svara*-s, necessary to bring about the *rāga* gestalt.

Jāti: is like a mode where the interval is fixed but the tonic is variable. Also see *Mēla*.

Just Tuning: was developed from the octave (2**:** 1), the pure fifth (3**:** 2) and the pure major third (5**:** 4) (Barbour, 1953). It is acoustically based on the concept of *triad*, where three simultaneous notes are

in a harmonic relationship represented by simple ratios. For example, the three notes of a major triad have a ratio of 4**:** 5**:** 6.

Mēla: is like a scale where the tonic is fixed but the intervals vary. Also see *Jāti*.

Pythagorean Tuning: was derived from the octave (2**:** 1) and the cyclic progression of the perfect fifth (3**:** 2). *This does not have pure major third* (= 5/4) (Barbour, 1953).

Ṣaḍja-grāma: is an ancient fixed-interval Indian mode with the seven notes, *Sa-Ri-Ga-Ma-Pa-Dha-Ni*, of the *saptaka* arranged in terms of *śruti*-s in the proportion of 4-3-2-4-4-3-2.

Saptaka: is the collection of the seven musical notes, *Sa-Ri-Ga-Ma-Pa-Dha-Ni*.

Śruti: is a conceptual measure of the *svara*-s in terms of their positions on a circular (or, linear) arrangement of *svara*-s without having a physical parametric value.

Svara: is a musical note

Tambūra **(*tānpura*):** is a 4-stringed fretless instrument continuously strummed to provide the reference tonal pitch along with an aural envelope to enable and guide intonation in Indian music.

Tonotopic Organization: the *characteristic frequencies* of neurons are mapped onto the primary auditory cortex, called as the tonotopic organization. The tonotopic organization is based on pitch and not on frequency. It is a pitch map which is altered and firmed up in the brain upon deliberate learning and training. Also see basilar membrane.

Viṇā: is a lute-like fretted stringed musical instrument primarily used in South Indian music.

References:

Abhinavagupta on Nāṭyaśāstra (1964). *Nāṭyaśāstra of Bharatamuni with Commentary Abhinavabhārati by Abhinavaguptācārya*. Vol. IV. Ed. Ramakrishna Kavi, M and Pade, J.S. Oriental Institute, Baroda (Gaekwad's Oriental Series no. 145).

Backus, J. (1969). *The Acoustical Foundations of Music*. W.W. Norton & Co. Inc. New York.

Barbour, J. Murray (1953). *Tuning and Temperament*. Michigan State College Press.

Burns, E. M. (1999). "Intervals, Scales, and Tuning." In Deutsch, D. Ed. *The Psychology of Music*, 2nd ed. New York: Academic Press.

Edited version of the paper presented at the International Conference on "India and the World**:** Intercultural Performing Arts" Department of Musicology, Faculty of Humanities, University of Amsterdam, Nov 20–22, 2008.

Helmholtz, H.L.F. (1954). *On the Sensation of Tone as a Physiological Basis for the Theory of Music*. Translated in English by Ellis, A.J. Dover Publication Inc. New York.

Komaragiri, Madhu Mohan (2005). *Pitch Analysis in Karṇāṭaka* Music - *An Examination of Intonation and Modern Theories of 22 Śruti-s*. Doctoral Dissertation. Madras, India: Department of Indian Music, Madras University.

Levarie, S. & Levy, E. (1980). Tone – A Study in Musical Acoustics. 2nd Ed. Kent State University Press. U.S.A.

Lloyd, S. Ll. (1963). *Intervals, Scales and Temperaments*. Macdonald, London.

Moore, B.C.J. (2003). *An Introduction to the Psychology of Hearing*, 5th ed. London: Academic Press.

Olson, F. H. (1967). *Music, Physics and Engineering*. 2nd ed. Dover Pub, Inc. New York.

Ramanathan, **N**. (1983). "Vadi, Samvadi, Vivadi and Anuvadi Svara-s." Journal of the Music Academy, Vol. LIV, Pp. 60-82, Madras.

Roederer, G. Juan (1995). *The Physics and Psychophysics of Music – An Introduction*. 3rd ed. Springer-Verlag, New York.

Rowell, L. (1992). *Music and Musical Thought in Early India*. The University of Chicago Press, Chicago and London.

Weinberger, N. M. (1999). "Music and the Auditory System." In Deutsch, D. Ed. *The Psychology of Music*, 2nd ed. New York: Academic Press.

Winckel, F. (1967). *Music, Sound and Sensation: A Modern Exposition*. New York: Dover Publications, Inc.

Edited version of the paper presented at the International Conference on "India and the World: Intercultural Performing Arts" Department of Musicology, Faculty of Humanities, University of Amsterdam, Nov 20–22, 2008.