A Comparative Study of Trained and Untrained Rabindrasangeet Singers

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Abstract This scientific paper proposes an analytic framework specifically for Rabindrasangeet singing that models the time-varying physical and expressive characteristics unique to an individual voice through a phonetogram analysis. The present study incorporates the most popular Rabindrasangeet into account for analysis to get an idea about the specific numerical data regarding the fundamental frequency, semitones, SPL range, and area as well as to give a precise guideline to those clients. While comparing the trained and untrained singers both males and females the F0 parameter is found to be louder in trained group. The mean semitone is always higher in females than in males and the trained male subjects have significantly higher SPL range than trained female subjects and trained females have higher SPL range than untrained female subjects. The enclosed area is larger in trained singers and more in females than males. Results of this study indicate differences between untrained and trained phonetograms. These differences can be attributed to greater natural capacities in trained subjects or a superior learned control over the voice mechanism.

Keywords Phonetogram · Rabindrasangeet · SPL range

Introduction

Rabindranath or the songs of Rabindranath added a new dimension to the world of Bengali music. The development

of acoustic measures to differentiate trained singers and non-singers like phonetography is a practicable and readily accessible method to investigate and map the quantitative potentialities of vocal output. The maximally loud and soft phonations throughout the entire frequency range are indicated in a plot of frequency against sound pressure level (SPL). The phonetogram analyses we have taken into vocal capabilities vary among persons, depending on individual laryngeal anatomy, as well as physical and physiological conditions. In order to place a given voice along this continuum some quantitative measures of vocal function have to be used. Two conveniently measurable quantities, substantially characterizing the acoustic output of the voice, are SPL and fundamental frequency (F0). The voice range profile (phonetogram) is one of the most variable of musical analysis which can be determined by plotting minimum and maximum SPL along a person's frequency range.

Need of the Study

One of the most popular Rabindrasangeet has been taken into account for analysis to get an idea about the specific numerical data regarding the fundamental frequency, semitones, SPL range, and area as well as to give a precise guideline to those clients.

Objective

1. To compare acoustic parametric variations of trained and untrained Rabindrasangeet singers.
2. To give an ideal range of the parameters to the professional Rabindrasangeet singers came with voice pathology.

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- To establish a baseline measure in which singers can be categorized in terms of vocal pathology as an effective estimates of clinical pedagogy.

Method

Subjects

All phonetograms were registered by two investigators, both familiar with the equipment and phonetographic procedure, and having had adequate musical training and experience. In a few test sessions they were trained to use a standard set of instructions for the subjects. Subjects from the four groups were randomly assigned to the two investigators. A total of 60 individuals took part in the investigation voluntarily of them 30 were trained singers and 30 untrained singers each group having 15 male and 15 female singers. The trained singers had been performing the Rabindrasangeet for a period of 4–10 years, with an average of 7 years. Their ages ranged from 18 to 30 years with an average of 20.9 years. None of the untrained subjects had formally studied singing before participating in this investigation. During the time of participation in the study, all singers reported to be in good vocal and physical condition.

Stimulus

1 min live sample of popular Rabindrasangeet has been taken.

Data Collection

Phonetography recommendations by the UEP were followed [5]. The direction and distance (30 cm) of the subject's mouth to the microphone was carefully controlled during the procedure. The recordings were performed in an anechoic studio-chamber of the Speech Science Laboratory of The Ali Yavar Jung National Institute for the Hearing Handicapped, Kolkata. The background noise level measured inside the chamber was 35 dB (A) as measured by an integrating sound level meter (RadioShack sound level meter 332055).

The subjects were recorded one by one. Each was asked to perform one traditional Rabindrasangeet. The data was analyzed by using a standard statistical program called "SPSS-10" which includes percentile method, and parametric *t* test.

Result

- Trained male singers and untrained male singers: There is significant difference in all the 4 parameters of the

Fig. 1 Trained and untrained male singers

Fig. 2 Trained and untrained female singers

present study and the most significance is seen in fundamental frequency and semitones. All male trained singers' semitones were marked as 'g' tone in upper limit and 70% of the lower limit were marked as 'G' tone, 20% were 'g#', and rest is 'A'. In untrained singers 90% of the upper limits were 'g' and 10% 'f#'. In lower limit 50% were 'c' tone, 10% were 'A#' and 20% each were 'A', 'B'. There is a noticeable difference in the mean of semitones Fig. 1.

- Trained female singers and untrained female singers: There is significant difference in fundamental frequency and semitones. All the female trained singers' semitones were marked as 'g1' tone in upper limit and the entire lower limit were marked as 'g' tone Fig. 2.
- Trained male singers and trained female singers: The most significance is seen in fundamental frequency and semitones along with other parameters also Fig. 3.
- Untrained male singers and untrained female singers: No significant difference is seen in the 4 parameters Fig 4.

Discussion

While comparing the trained and untrained singers both males and females the F0 parameter is found to be louder in trained group. The possible explanation is that the non-singers demonstrate limited loud phonation capacities, where the singers' superior abilities to produce sound in the

Fig. 3 Trained male and trained female singers

Fig. 4 Untrained male and untrained female singers

false alto register are reflected in the intensity levels at higher frequencies [1]. The higher intensities of trained singers might be related to their superior training. The louder sound intensities in male singers could well be related to a laryngeal disposition enabling flow phonation in these persons. Also, a better control of tuning the spatial dimensions of the vocal tract enhances the resonance effect, thereby increasing the sound intensity [7].

The mean semitone is always higher in females than in males and also higher in trained than untrained singers. The trained females are practiced enharmonically with ornamentation and modulation of pause and musical interval which caused more number of semitones in the same duration of the sample song [6].

The trained male subjects have significantly higher SPL range than trained female subjects and trained females have higher SPL range than untrained female subjects. The greater natural capacities in trained subjects or a superior learned control over the voice mechanism is due to the anatomical constitution of the larynx, which provides varying vocal capacities among persons. In exploring the physiologic boundaries of these capacities, the ability to control the voice source is directly related to the measured dynamic and frequency ranges. The singing experience is associated with improved neuromyogenic control over the voice source [3].

Singers, especially the male group, demonstrate their ability to produce vocal sound at low frequencies, resulting in a phonetogram with larger dynamic capacities at these

frequencies. Both female and male singers have larger dynamic ranges, especially in soft voice [4]. The enhanced possibilities with the soft voice suggest a better breath control during voicing and the ability to oscillate vocal folds at lower subglottal pressures. At the ends of the frequency range untrained subjects produced louder intensities. However, these differences are a result of the rescaling procedure, which makes comparisons at relative frequency levels. Had the comparisons been made at absolute frequencies, the untrained subjects would have shown no such louder intensities. Another common feature of trained phonetograms is the relative absence of a local minimum at the frequency range where the register transition takes place.

The enclosed area is larger in trained singers and more in females than males. The trained groups have larger enclosed areas. Of all groups, the female trained subjects have the largest value, which means that their combined capacities in the frequencies and dynamic range are unsurpassed [2].

Conclusion

Results of this study indicate differences between untrained and trained phonetograms. These differences can be attributed to greater natural capacities in trained subjects or a superior learned control over the voice mechanism [2]. The enhanced possibilities with the trained voice suggests a better breath control during voicing and the ability to oscillate vocal folds at lower subglottal pressures. The fact that specific differences in mean intensity levels between male and female subjects have been ascertained is an indication that male and female results might preferably be discussed separately in future studies.

The description of phonetograms with explicit parameters offers the possibility of determining deviations, from normal values, for pathological entities. If these deviations show specific disease-related characteristics, each type of disease with effects upon phonation and phonatory potentialities could be represented by a set of parameter statistics. Knowledge about a special combination of parameter statistics can be used to build an expert system. In an expert system specific knowledge on observed behavioral patterns is formalized in a computer program, giving the users a stronger basis for making decisions. A suggested expert system based on knowledge of constellations of parameter values of phonetograms, specific for groups of subjects or patients could be a very useful tool for speech pathologists, therapists and ENT physicians to help in diagnosing diseases or in supporting a diagnosis. Before this can be realized, a large number of phonetograms per pathologic entity have to be analyzed in order to build the knowledge

base. A computerized phonetometer with analysis techniques can make a major contribution toward an optimal clinical employment of phonetograms. In future we can study using more sophisticated software like Multi Dimensional Voice Profiles, Speech Science Laboratory, and Computerized Speech Laboratory and also study the spectral loci, null shift and spectrum relating them with phonetographic data. As Rabindrasangeet has a wide range covering many ragas and varied moods, tunes, singing patterns, so these all types should be taken into account for deriving a conclusion regarding acoustic analysis of Rabindrasangeet.

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