

Pitch Range Comparison between Trained Singers, Amateur Singers and Non-Singers

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Abstract

The study aims to compare the pitch range of trained singers, non-singers and amateur singers in young adults within the age range of 15 to 25 years. 90 participants with equal group and gender divisions were included in the study. Voice samples from each participant were collected and analysed using Praat software. Pitch ranges were analysed and compared statistically and results revealed that trained singers were having higher pitch range followed by amateur singers and lowest range were obtained for non-singers indicative of the effect of singing training and practice in improving the phonatory capabilities.

Keywords: pitch range, singers, professional voice users

Introduction

The human voice is a magical tool which allows people to communicate verbally. Every individual's voice is unique; almost like a fingerprint and can act as an identifier. The human voice is composed of a multitude of different components, making each voice different; explicitly, pitch, loudness and quality. Pitch, in speech, is the relative highness or lowness of a tone as perceived by the ear, which depends on the number of vibrations per second produced by the vocal cords. Pitch is the main acoustic correlate of tone and intonation. The loudness of a wave depends on its energy i.e. greater the energy, louder the sound. Voice quality is that component of speech which gives the primary distinction to a given speaker's voice when pitch and loudness are excluded.

The perception of fundamental frequency and corresponding harmonics is commonly known as voice pitch. The sound of the voice changes as the rate of vibrations varies. Faster rates equate higher pitches.

The vibrations and the speed, at which they vibrate, are dependent on the length and thickness of the vocal cords, as well as the tightening and relaxation of the muscles surrounding them. This explains why women generally have higher voices than men; women tend to have higher voices because they have shorter vocal cords. The length and thickness of the vocal cords, however, are not the only factors that affect one's pitch. The pitch of someone's voice can also be affected by emotions, moods and inflection. Pitch is not only an objective component of voice; research has shown that pitch is associated with attractiveness amongst men and women. A typical adult male will have a fundamental frequency from 85 to 180 Hz, and that of a typical adult female from 165 to 255 Hz. That is, the frequency ranges (of the fundamental frequency) are about an octave apart, for males and females.

Loudness is a perceptual quantity which can only be assessed by an auditory system, including the brain. Perceived 'loudness' varies according to pitch, because the human ear is not uniformly sensitive to all frequencies.

Loudness is the characteristic of a sound that is primarily a psychological correlate of physical strength (amplitude). That attribute of auditory sensation in terms of which sounds can be ordered on a scale extending from quiet to loud.

Voice quality is defined as a production characteristic of voice, and the produced sound as its consequence. Voice quality is often considered from the laryngeal point of view, the radiated sound at the singer's lips does not relate directly to the sound produced by the laryngeal vibration, but results from its filtering through the vocal tract shaped by the action of articulators. Therefore, voice quality is not only influenced by the glottal-source characteristics, but also by the structures of vocal-tract.

Vocal range refers to the full spectrum of notes that a singer's voice is able to produce, starting from the bottommost note and reaching to the uppermost note. In other words, range refers to the distance between the highest and lowest pitches that a singer is able to produce. An untrained singer typically has a more limited range than a well-trained singer, who has learned how to gain access to more notes through correct technique and through regularly exercising and using the vocal instrument for singing tasks. Every individual has their own unique range capabilities, as well, with some individuals being able to develop more extensive ranges than others. In contemporary styles of singing, singers typically

employ amplification (i.e. microphones, speakers, etc.) when performing, which makes more of their range audible and thus usable.

Singers are endowed with an ability which is innate in nature. The quality of ability to sing can be improved with training. Usually, the singers who have underwent training are practised with the pitch control, breath control as well as the loudness control which makes the singing effort more efficient. The parameters of voice are much into consideration while singing, as a minute variation can affect the quality of singing. Especially for professional singers, there cannot be a compromise in the quality of singing as their livelihood depends on it.

An insight into the effect of training in improving the voice characteristics will open more opportunities for a speech pathologist in the area of voice. Research on pitch range as well as the comparison between pitch ranges in different population will clarify the effect of training in improving pitch range. There is a need of comparing the pitch ranges of singers, amateur singers, and non singers, as the research works are limited in this field.

Review of Literature

For singing, especially in the case of trained singers, full appreciation requires pretty much the high quality standard. For the singing voice, a cut-off above 3000 Hz will make it sound numb and impoverished. Estis and Rowell (2011) concluded that trained singers were consistently more accurate than untrained individuals. Howard (2009) proposed that the acoustics of trained singers' voice has different from untrained singers, the difference is more lies in the breathing technique, larynx position or vocal tract.

The sound of each individual's singing voice is entirely unique not only because of the actual shape and size of an individual's vocal cords but also due to the size and shape of the rest of that person's body. Humans have vocal folds which can loosen, tighten, or change their thickness, and over which breath can be transferred at varying pressures. According to Crea and Watts (2007) conducted a study in relations of singing talent of trained versus untrained female singers and conclude that the onset time for singing talent is different for male and females.

The primary method for singers to accomplish this is through the use of the Singer's Formant, which has been shown to be a resonance added to the normal resonances of the vocal tract above the frequency range of most instruments and so enables the singer's voice to carry better over musical accompaniment.^{[11][12]} Hunter and Titze (2010) his findings reveals that the occupational teachers has more difference in variation of intensity, fundamental frequency and voicing that non occupational.

According to Hiroya Fujisaki (1984), for speech and singing, the voice fundamental frequency is vital for the quantitative analysis and linguistic interpretation of fundamental contour characterises. Chatterjee and Kumar (2012) they trained and untrained rabindra sangeet singers and they found that fundamental frequency is to be louder in trained group. Acoustic analysis acts as an extension of our ears in identifying changes in voice, and also in assessing amount of change and pattern of change in a more objective way.

Ramakrishnan and Prasanna (2015) conduct a study in voice source characterization using pitch synchronous discrete cosine transform for speakers identification and there results reveals that the characterization has good promise as a feature for speaker identification studies.

Balasubramaniam and Bhat (2015) done a study in cepstral characteristics of voice in Indian female classical carnatic singers and they conclude that there was a higher cepstral parameter among the singers than non singers.

The study carried out by Gunjawade and Bellur (2015) concluded that acoustic analysis showed a statistically significant difference for fundamental measures. The larynx is capable of producing a wide range of fundamental frequency and the vocal folds can be set into vibration at different frequency. This is termed as 'Pitch range'. Pitch range is defined as the difference between the highest F0 and the lowest F0 that an individual can produce. It is a measure of phonatory capabilities of an individual. Though way of measuring differed, many have attempted to study this parameter in singers (Sheela, 74) in dysphonics (Jayaram, 75) and in old age (Suresh, 91).

According to Bhuyan (2015) the vibrato and mordent (styles of singing) in Indian popular singers and found the novel methods of analysis for mordent has proposed.

Voice is one of the most sensitive indicators of human physiological and psychological states (Muller, 1991). With increasing age, 'The human voice undergoes age-related changes affecting Pitch, loudness and quality (Muller, 1991, P.2). Arunachalum and Mahalingam (2014) proposed that singers should need a regular assessment and vocal hygiene education.

Kishore and Bellur (2015) done a study on attitudes of Indian classical singers and he conclude that the SLPs has to gives more attention to promote their role in vocal health awareness management.

Maruthy and Ravibabu (2015) carried out an study in comparison of dyshonia severity index between younger and older Carnatic classical singers and non singers and concluded that DSI vary between singers and non singers.

Methodology

Aim

The aim of the present study is to compare the pitch range between trained, amateur singers and non singers.

Subjects

90 subjects within the age range of 20-30 years were grouped into singers, non singers and amateur singers were selected for the present study. Equal number and gender divisions were assigned in each group. Trained singers with minimum of 5 years experience, Amateur singers who have quality singing but not trained or not professionally voice users and Non Singers were included in the study. Trained singers who have below 5 years of experience and Amateur singers who is not professionally voice users were excluded from the study.

Instrumentation

The following instruments were used in this study

- Praat

- HP B4B09PA Headset with Mic
- Lenovo 100s laptop

Data Recording

The subject was seated comfortably on a chair in a sound treated room and was instructed to be relaxed, take a deep breath and to phonate /a/, /i/ and /u/ in three pitches i.e. the lowest pitch, habitual pitch as well as highest pitch that can be produced. The samples were recorded using a microphone attached to a laptop which was placed at a distance of 4-5 inches from the mouth. All the three samples were analysed using praat software.

Result and Discussion

The present study aimed at comparing the pitch range of non singers, amateur singers as well as trained singers. Figure 1 depicts the habitual pitch, low pitch and high pitch obtained from the voice samples collected from non singers, amateur singers as well as trained singers. The habitual pitch obtained was $222.10 \text{ Hz} \pm 5 \text{ SD}$ for females and $151.52 \text{ Hz} \pm 3 \text{ SD}$ for males. Pitch range obtained for each group are summarized in Figure 2, showed that the highest pitch range was observed for trained female singers followed by trained male singers with the pitch range of 349.6Hz and 332.4Hz. Amateur singers showed higher pitch range than non singers. In all the groups females showed higher pitch range than male. The lowest pitch range among the participants was observed for non-singers.

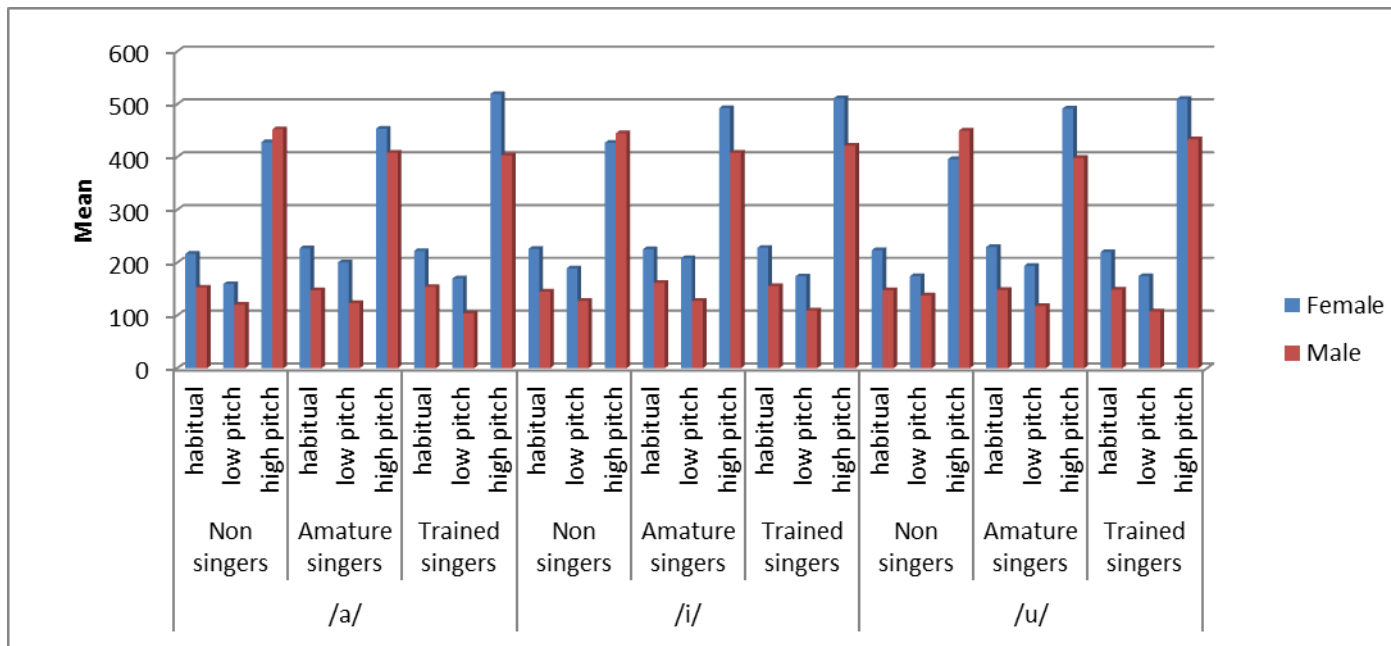


Figure 1. Habitual pitch, low pitch and high pitch of non singers, trained singers, amateur singers.

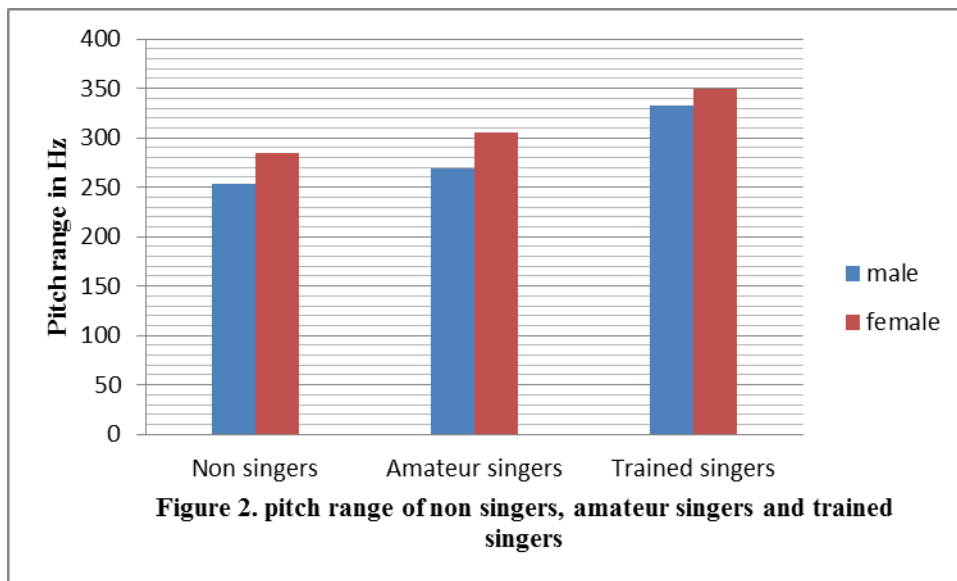


Figure 2. pitch range of non singers, amateur singers and trained singers

Summary And Conclusion

Pitch range is the difference between the highest F0 and the lowest F0 that can be produced by an individual, which is one of the measure of phonatory capabilities of an individual.

The present study aimed at comparing the pitch range of trained singers, non singers and amateur singers in of 15 to 25 years old young adults. The results revealed that trained

Language in India www.languageinindia.com ISSN 1930-2940 16:4 April 2016

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singers obtained higher pitch range followed by amateur singers and lowest by non singers. The above study gives an idea that training can improve the pitch range of an individual. This study opens new insight for voice pathologist to coach singers as well as other professional voice users to improve their phonatory capabilities, and also provide Speech language pathologists to refer traditional singing training techniques and to incorporate into voice therapy for professional vice users.

Limitations

- Sample size were limited
- Age range was limited
- Only a particular group of singers (carnatic singers) were included in the study.
- There were no specific criteria for the selection of amateur singers.

Further Recommendations

- Include more number of samples
- Incorporate different types of singers
- Include different age range.

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Language in India www.languageinindia.com ISSN 1930-2940 **16:4 April 2016**

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