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Endocrinology and Psychology of Voice: Scientific and Musical Perspective

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Abstract

Man has been gifted with a voice, which makes him different from other animals. Indeed, vocal tools like speech and singing enable him to articulate and convey his thoughts and emotions, fostering communication and ecstasy. To control the process of voice and singing, large-scale studies have been made on the morphology and physiology of the vocal cord in general and endocrinology and psychology in particular. Hormones play a major role in voice-making in both males and females. In ancient times, boys who were good at singing were castigated to rule out changes in voice after puberty. Sex hormones and thyroid hormones play an important role in shaping the voice of a growing individual. Keeping such changes of voice in mind, an individual can make suitable improvements in singing throughout his life. In ancient literature, the mind was known as a precursor to voice making. The voice actually reflects inner feelings. Psychologists also believe that the feeling of delight during singing is due to the release of hormones like endorphin and oxytocin. So maintenance of good hormonal health also plays an important role in voice-making and overall singing.

Keywords : Morphology, Physiology, Endocrinology, Psychologists, Voice, Singing

Research Paper

Introduction

Every organism is equipped with a network to communicate within its body and outside world, according to its specific needs. Even Amoeba, a microscopic animal respond to environmental changes. The process of control and coordination through communication become more complicated in higher-order animals. And sound has further influenced animals due to its varied applications. The roar of a lion serves to intimidate and instill fear in the animals of jungle.

Human voice stands apart from that of other animals, showing its inherent superiority. Among the human beings, voice has the power to influence others, whether through authoritative speaking or melodic singing. Controlling it for specific applications continues to be an enigma across generations. From Vedic period onwards, children's throat were trained in Vedic recitation so that the voice quality improved for singing. Similarly in the later period of history, many Musical treaties like **Natyashastra, Naradiya Shikha, Manasollasa, Sangeet Ratnakar** etc. enumerated various measures to develop good voice culture.

In western countries, efforts were made to understand the science of voice. A new term was coined as **Vocal Science. "Manual Garcia (1805-1906)** may justly be regarded as the founder of Vocal Science."[1] He was so enthusiastic to learn the process of voice that "he invented the laryngoscope only in 1855"[2] Laryngoscope helps to see the larynx and its adjoining structures understanding the process of voice production. Of course, larynx has two other functions also that are to prevent fluid or food entering the trachea and lungs and to allow passage of air while breathing.

In structure, the larynx is a triangular shaped box consisting of nine cartilages, both big and small. "The thyroid cartilage is typically larger and more prominent in males than females because of the effect of male hormones on the development of larynx during puberty."[3] Two strong pairs of connective bands which are connected at the opening of larynx from anterior to posterior are known as true vocal cords and false vocal cords. True vocal cords vibrate to produce sound whereas the false vocal cords merely provide support without vibrating. Two pairs of laryngeal muscles, known as extrinsic and intrinsic, are important to change

length, tension and position of vocal cords. "Mature males generally have thicker and longer vocal cords than females, therefore, the vocal cords of male vibrate more slowly and produce lower pitches. The loudness of vocal sound is determined by the force of air passed over the vocal cords and the amount of vibration. The Vocal cords do not vibrate when whispering."[4] In vocalization besides the involvement of brain cortex "speech is composed of two mechanical functions Phonation which is achieved by the larynx.

Articulation which is achieved by the structure of the mouth."[5] In phonation, larynx acts as a vibrator and stretches the vocal folds. "Contracting and relaxing the muscles varies the tension in the vocal folds much like a loosening or tightening a guitar string."[6] Sound so originated from the vibration of the vocal folds need articulation for converting into recognizable voice. "The pharynx, mouth, nasal cavity and paranasal sinuses all act as resonate chambers that give the voice it's human and individual quality. We produce the vowels sound by constructing and relaxing the muscles in the wall of the pharynx. Muscles of the face, tongue and lips helps us enunciate words."[7] Besides involving the above parts of our body our abdomen, diaphragm and chest play important role in speech and singing. "The body's physiology significantly influences sound quality, encompassing characteristics such as voice (audible sound waves), pitch (vocal fold vibration rate), resonance (voice quality and depth), intonation (pitch variation without word distinction), tone (pitch variation with word distinction), intensity (sound pressure), timbre (characteristic tone or quality), and articulation (production of vowels and consonant sounds)" [8]

Previously overlooked, the study of hormones (Endocrinology) has shed light on this aspect of voice change. Hormones, secreted by ductless glands throughout the body, flow through the bloodstream impacting gender distinctions, voice, singing, and personal traits and psychological development. "From the late 16th century, castration was carried out in Italy to preserve the unbroken male voice into adult life, but the high pitch was accompanied by fully grown resonating chambers and a large thoracic capacity, giving rise to the unique voice of the castrato."[9] However, the role of sex and other hormones in voice production was only established in the early twentieth century. During puberty, testosterone secreted in males is more powerful than estrogen and progesterone secreted in females, resulting in significant vocal differences. Thyroid hormone influences metabolism and growth, and its disorders adversely affect the voice.

In the life of a female Pre-Menstruation, Menstruation, Pregnancy, and Menopause affect the size and functioning of vocal cords resulting in the quality of voice. Pancreas disorder causing Diabetes impact overall body physiology and voice production. Vocal health depends upon the general well-being of an individual, where anxiety, stress and performance phobia can be overcome through knowledge of voice science and psychological principles of self-control. Perfect singing induces delight and ecstasy due to the release of positive hormones. Ultimately, understanding the intricacies of vocal science is paramount in appreciating the profound impact of various aspects on the quality of one's voice.

Methodology

Aim: To investigate the awareness of individuals in the music field, with a specific focus on vocal music,

(a) regarding the impact of hormones on vocal cord structure and overall body physiology.
(b) Additionally, explore the correlation between hormonal effects on a singer's physiology and its influence on their psychological well-being.
(c) Finally, examine the relationship between hygiene practices and vocal health in singers.

Procedure: To study aspects (A) and (B), as mentioned above in the Aim, two distinct groups of Music Teachers and Students were formed.

Study 1

1. In the first group, twenty-three undergraduate students from UG classes, of both vocal and instrumental music, were selected.
2. Administered a questionnaire through "Google form[10], consisting of five multiple choice questions related to:

a. How to achieve melodious vocals
b. Organs involved in singing.
c. Reasons for the difference in male and female voices
d. Coping mechanisms for stage fear
e. Factors influencing voice changes in eunuchs.

3. Questions were presented in Hindi, the participants' preferred language. 4) The result of the responses collected from both male and female students in the vocal and instrumental music classes are as follows–

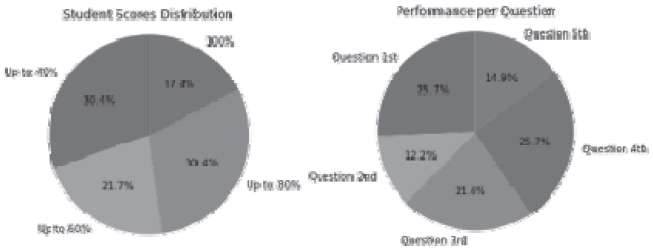
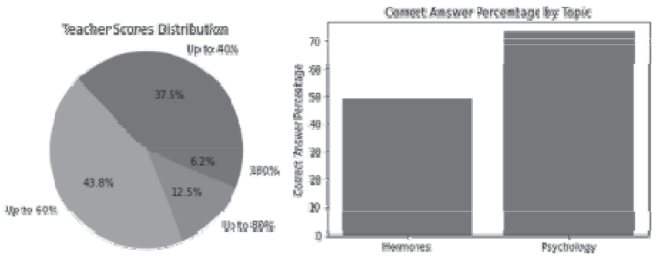


Chart 1 Pie Chart 2

Adding up the scores of these twenty-three students, who took part in the study, collectively achieved an average score of 3.22 out of 5. Performance per Question and Student score distribution are shown in Pie Charts 1 and 2, respectively. Notably, around 60% of students lack knowledge about the organ responsible for voice production, and more than 50% lack information about eunuchs and knowledge regarding contribution of sex hormones in voice culture. However, topics such as chemical secretions like hormones, and control and coordination are covered in the 8th and 10th grade science syllabus prescribed under the National Council of Scientific and Industrial Research (NCERT).

Study 2

1. In the second group, sixteen music teachers from various colleges who volunteered for the study were selected.
2. Administered questionnaire of Google Form[11], consisting of 12 multiple-choice questions and 3 yes/no questions.
3. Questions were presented in English language.
4. The result of the responses collected from both male and female teachers of vocal and instrumental music are as follows:



Pie Chart 3 *Histogram 1* The histogram displays the percentage of correct answers for questions on hormones (49.21%) and psychology (73.21%).

Pie Chart 3

Histogram 1: The histogram displays the percentage of correct answers for questions on hormones (49.21%) and psychology (73.21%).

Adding up the scores of these sixteen music teachers, who took part in the study, collectively achieved an average score of 7.75 out of 15. Teachers' Score Distribution and Performance break down on Hormones and Psychology study are illustrated in Pie Chart 3 and Histogram 1, respectively. Of these 15 questions, the music teachers were asked 3 questions in yes/no format to inquire whether they seek help of specialist to teach voice production, sound, and voice culture.

Pie Chart 3

Histogram 2: This histogram displays the percentage utilization of specialists in Human Biology, Physics, and Psychology, with both Physics and Psychology having the highest utilization at 31.3%.

Due to the absence of specific textbooks prescribed by the University for completing the Bachelor Music syllabus, teachers rely on their own resources and understanding to educate students.

The assessment regarding the third Aim of the study emphasizing the Hygiene practices and Vocal health of singers has not been conducted as no specific ENT doctor was found to share data regarding the singer's vocal ailments. But it is imperative for the novice singer to visit an ENT specialist to address any vocal or other health issues. "Unlike other musical instruments, the voice is "human", growing, maturing and varying between sexes."[12] Regular visits by singers to ENT doctor are always beneficial.

Results

Findings from the research paper indicate that both teachers and students adhere to traditional techniques of practice, yet they tend to overlook its scientific perspective. Overall performance of twenty-three students, scoring 64.4 percent, falls below a promising

level. Students lack sufficient knowledge about the effects of hormonal changes during adolescence, particularly in males, on voice and overall health. It is evident from the question number 5 pertaining to hormones where score is 47.8 percent.

Notably, students lack awareness regarding the location of the "Sarira-Veena" or "Gatra Veena"[13], also known as the bodily lute, as only nine students responded correctly which is 39.1 percent of the participants. When students are not aware about the vocal organ and its protection, other means of improving voice culture will not be wholly fruitful. Our vocal cords act as a string and a wind instrument.

Moreover, the research reveals that over 50 percent of teachers are not familiar with the hormonal role in maintaining a good voice. Additionally, a significant proportion, 75 percent of teachers, do not arrange for a Human Biology specialist, while 68 percent lack a Physics specialist and 68 percent lack a Psychology specialist to enhance a comprehensive understanding of music as illustrated in Histogram 2. Overall performance of the teachers in solving the questionnaire is 51.66 percent, that is also disappointing. The psychological aspect of music will fully be understood by attaining the knowledge of physiology of our vocal organ and influence of hormones in our body.

While no data were specifically gathered to assess the hygiene practices and vocal health of singers, the absence of a scientific approach in music education in India suggests a potential reluctance to seek medical assistance for enhancing voice production.. These insights underscore potential areas for improvement in integrating scientific knowledge and interdisciplinary approaches in music education.

Discussion

Music, regarded as an enduring art and humanity subject, has evolved over centuries, with distinct voices shaped by cultural traditions such as the Gharana tradition. Despite maintaining unique styles of the respective traditions, beginner singers may inadvertently employ faulty techniques, potentially causing harm to their vocal cords. Our research uncovered a lack of scientific perspective among both college teachers and students regarding singing techniques. Bridging this gap is crucial not only for preserving the authenticity of various musical styles but also for ensuring the long-term well-being of vocal artists within the ever-evolving landscape of musical expression.

Beyond the physical aspects of vocal cord structure, the control and coordination of various body parts prove crucial for effective voice production. Hormones, with both positive and negative effects, play a significant role in this process. Positive hormones like endorphins and dopamine, released during singing, counteract stress and strain, although their in-depth analysis exceeds the scope of this paper. When a vocalist is knowledgeable about the vocal organ disorders, such as thyroid gland imbalance, sex hormones, diabetes etc., he will promptly consult a qualified doctor rather than relying on simple home remedies to preserve their voice.

Addressing the challenges in music education and promoting proper singing, the integration of tradition and science is required. So, a music student gaining musical skill and knowledge should also be well-informed about the structure and functions of vocal organs, how physiology is influenced by hormones, vocal ailments, hygiene and protection of vocal cords, and how sound generation, its control mechanism, and acoustics help in the improvement of voice culture. Psychological aspects, aligned with principles from psychologists like Carl E. Seashore and contemporary experts, are crucial for knowing the relationship between mind and music.

Therefore, a comprehensive music curriculum should be framed to encompass the study of anatomy of vocal organs, the principles of sound of physics applicable to singing, and the intricate harmony between the brain and body for psychological well-being. Such interdisciplinary studies align with the principles endorsed by the new education policy, fostering a holistic approach to musical education. Teachers should also broaden the scope of music education by inviting concerned teachers/ specialists in fields such as biology, physics, psychology etc., ensuring a more efficient and comprehensive approach to teaching the subject.

Conclusion

In conclusion, our research underscores the vital need for a paradigm shift in music education. The findings reveal a prevailing lack of scientific awareness among both college teachers and students regarding singing techniques, highlighting potential risks associated with faulty practices. To address these challenges, it is imperative to integrate tradition and science seamlessly.

A comprehensive music curriculum should transcend its traditional boundaries encompassing art, culture, tradition, history, and religion, expanding to incorporate the scientific dimensions inherent in the discipline

Ultimately, our findings propose a foundation for reform in music pedagogy, aiming to enhance the understanding and practice of singing while nurturing the well-being of both teachers and students.

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