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Observational study of differences in head position for high notes in famous classical and non-classical male singers

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Abstract

Introduction. Differences in classical and non-classical singing are due primarily to aesthetic style requirements. The head position can affect the sound quality. This study aimed at comparing the head position for famous classical and non-classical male singers performing high notes.

Method. Images of 39 Western classical and 34 non-classical male singers during live performances were obtained from YouTube. Ten raters evaluated the frontal rotational head position (depression versus elevation) and transverse head position (retraction versus protraction) visually using a visual analogue scale.

Results. The results showed a significant difference for frontal rotational head position.

Discussion and conclusion. Most non-classical singers in the sample elevated their heads for high notes while the classical singers were observed to keep it around the neutral position. This difference may be attributed to different singing techniques and phonatory system adjustments utilized by each group.

Key words: Classical, head depression, head elevation, head position, head protraction, head retraction, non-classical posture, singing, singing technique

Introduction

Since the initial understanding of singing voice, body posture has attracted a great deal of attention from singers, vocal pedagogues, coaches, and teachers alike. Regardless of their origin (Italian, German, French, or contemporary schools) different approaches to posture based on anecdotal experiences have vastly influenced generations of pupils (1). As knowledge of vocal physiology advances, there is an effort to gradually replace these anecdotal pieces of information with objective evidence.

Good posture is considered essential for various human activities. Voice production is not an exception to this as it allows for improved phonation (2) and better blood circulation (3). For professional classical singers, good posture is also related to an improved response from audiences (4). Throughout the years, many studies have been developed to understand better the relationship between body posture and voice. Some studies were aimed at identifying the function of extrinsic muscles of the neck as well as the thoracic muscles involved in vocalization (5–13). An X-ray study of cervical spines of professional singers, for example, showed that professional singers modified their postures while singing and carried these changes through into non-singing vocalization (14). Electromyographic investigations of neck muscles (sternocleidomastoid, scalenus, and trapezius) showed their influence on the upper thoracic movements affecting the subglottal pressure (5). The same group of muscles suffers increased tension due to inappropriate posture of the cervical spine. This is because they are recruited to improve stability rather than maintaining their primary function related to motion (15,16).

In addition to influencing thoracic movement, the extrinsic muscles of the neck also control head position in relation to the thorax. The position of the head can be altered in many ways: frontal rotation (depression versus elevation), transverse movement (retraction versus protraction), and lateral rotations.
Many studies have shown the effects of head position on voice parameters such as: fundamental frequency ($F_0$), sound pressure level (SPL), and resonance, also called timbre (14,17,18). Studies have shown that head protraction raises $F_0$ with an indirect influence on SPL (14,18) due to $F_0$ and SPL being positively correlated (19). Further positive correlation between these two parameters can be found when head protraction is combined with head elevation (9). Head protraction was also found to be associated with larynx elevation (8). In turn, larynx elevation was shown to raise $F_0$ (6,20–23). In addition, the vertical larynx displacement was found to be affected by the inhalatory abdominal wall movement (26), which is related to muscular adjustments required for different singing techniques.

Another aspect of voice production that is affected by head movement is voice timbre. Perceptual analysis studies on how head movement influences timbre in classical singing show that lowering the head for high notes yields a more pleasing sound than raising it (10,27). Hence head posture is addressed in singing pedagogy as a major feature in determining voice timbre.

In addition to singing-related issues, voice therapists and pedagogues have endeavoured to improve therapeutic approaches to deal with postural problems related to voice complaints (28). A major feature concerning postural problems related to voice pathologies is the protraction of the head. Such head position is reported to raise the larynx, which leads to hyperfunction of the neck muscles and possibly muscle tension dysphonia (MTD) (8,16,29–31). MTD is a highly prevalent voice diagnosis (32–34) often associated with a high-held larynx (35–38). Rubin et al. (37) stated that vocal performers are especially at risk of developing MTD due to postural issues. Hence, good postural alignment is considered indispensable for optimizing voice production by professionals involved in voice rehabilitation (12,39).

The current knowledge of the effects of posture on voice can be further developed by examining the differences between singing techniques. One factor that seems important to investigate is the head position of famous professional singers, who often serve as an example to young pupils wanting to achieve similar voices. Professional singing is primarily divided into classical and non-classical singing, which differs due to vocal aesthetic demands. Classical singing requires homogeneity of sound quality, while non-classical singing has no such constraints and often welcomes unusual voice qualities and unconventional types of phonation (40). Homogeneity of sound, as desired within classical singing, can be achieved by a constantly lowered larynx position (41). Studies show that professional singers producing high notes exhibited significantly lower larynx positions for a classical singing style when compared to their non-classical counterparts (42). Furthermore, larynx position was shown to be influenced by changes in head posture (22). Therefore, major differences between classical and non-classical singing may be expected to be associated with head postures. However, to the best of the authors’ knowledge, such differences have not yet been properly documented.

The aim of this observational study was to investigate the differences in head positions when famous classical and non-classical male singers are singing high notes. We hypothesize a more protracted and elevated head position for famous non-classical singers whilst performing high notes when compared to famous classical singers. Support for this hypothesis is found in reports in the literature where researchers suggest that high notes correlate with changes in head position (14,18).

**Method**

Pictures were captured from ‘YouTube’ videos of 73 well known male singers in live performance situations. The sample ($n=73$) comprised 39 singers of Western classical style and 34 singers of non-classical styles. The still images were analysed with regard to head posture (see Supplementary Appendix to be found online at http://informahealthcare.com/doi/abs/10.3109/14015439.2014.988290). In famous classical singers, the images were obtained from the moment they reached an A#4 (466.16 Hz) in the phrase ‘e di pensier’ from ‘La Donna e Mobile’. The sole reason for choosing this specific aria was that, due to its popularity, there was a greater availability of it on YouTube. To obtain the pictures, the YouTube videos were paused whilst the A#4 was being sustained by the singers. A still shot was then captured from the screen monitor. The videos were paused at the central part of the sustained A#4 to avoid capturing the head whilst moving. For famous non-classical singers, the same procedure was implemented for various songs. An attempt was made to find YouTube videos of non-classical singers producing the same note (A#4) as classical singers. However, since non-classical singers’ repertoire is not matched to voice type, and musical scores were not easily available, it turned out to be difficult and highly time-consuming to find a sufficient number of adequate images for the note A#4 in famous non-classical singers. We therefore allowed the pitches of these singers to vary slightly around the note A#4. Nevertheless, the notes did not vary more than three semitones, i.e. one semitone below A#4 (note A4, 440 Hz) and one or two semitones higher, i.e. notes B4
(493.883 Hz) and C5 (523 Hz). For the including criteria, the A4 note was set as lower boundary for high notes as it is highly demanding for singers and often only found in solo work (43).

A 10 cm visual analogue scale (VAS) was implemented for two postural parameters: frontal rotation and transverse positioning (Figure 1). For frontal rotation, the 0 cm mark labelled ‘depression’ referred to the head facing down with the chin closest to the chest. The 10 cm was labelled ‘elevation’ at the opposite head extreme. The transverse positioning labelled ‘retraction’ for 0 cm was defined as the maximum level of backward head displacement. The 10 cm mark labelled ‘protraction’ referred to maximal forward head displacement (Figure 2). Both scales presented the neutral head position at the 5 cm mark.

The data were analysed by 10 voice professionals (evaluators). Eight evaluators were completely blinded with respect to the purpose of the study. The other two evaluators were the authors of the study. A short training session was carried out before the assessments. The evaluators were asked to mark the appropriate position within the visual analogue scale after each picture was presented. Some pictures showed the singers from different angles making the visual perception more complex. Hence, the evaluators were advised on this issue and asked to take it into consideration while scoring. No time restrictions were implemented for this task.

After the data were gathered, an assessment for head position differences between both singing techniques was done. A series of Spearman correlation tests was employed to assess inter-evaluator consistency for the VAS scoring. Afterwards, the two-sample Kolmogorov–Smirnov test was implemented to assess the differences in head position between singing techniques. The statistical analysis was performed using R GNU software (44).

**Results**

**Frontal rotational head positions**

The results of the inter-evaluator consistency analysis for frontal rotational head positions are given in Table I. A significant consistency was found here between evaluators’ VAS scores with high significance levels ($P < 0.001$) and strong Spearman’s correlation scores ($Rho > 0.81$). This result indicates that the different evaluators judged the frontal rotational head positions similarly. A two-sample Kolmogorov–Smirnov test showed highly significant differences ($D = 0.78, P$ value $< 0.01$) between the famous classical and non-classical singers for frontal rotational head positions. The VAS mean value and standard deviation was $4.53 \pm 0.69$ for the famous classical singers and $6.65 \pm 1.46$ for the famous non-classical singers (see also Figure 3).

**Transversal head positions**

The inter-evaluator consistency analysis for transversal head positions is given in Table II. The VAS scores show non-significant results between some evaluators ($P > 0.05$); additionally, no strong correlation was found between their evaluations for transversal head positions. This suggests that the evaluators did not evaluate the transversal head positions consistently. Hence, due to lack of inter-evaluator consistency, no statistical tests were performed for transverse head position analysis between famous classical and non-classical singers.

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**Analysis of transversal and rotational head position**

| Frontal Rotation |
|------------------|
| depression | neutral | elevation |

| Transverse |
|------------|
| retraction | neutral | protraction |

Figure 2. Visual analogue scale (VAS) for frontal rotation and transverse head movements.
Table I. Inter-evaluator consistency analysis for frontal rotational head position.

| Frontal rotational position | SG   | MS   | GW   | AM   | HL   | AL   | HS   | PA   | JS   | VH   |
|----------------------------|------|------|------|------|------|------|------|------|------|------|
| Spearman’s test (Rho)      |      |      |      |      |      |      |      |      |      |      |
| SG                         |      |      |      |      |      |      |      |      |      |      |
| MS                         | 0.83 |      |      | 0.00 |      |      |      |      |      |      |
| GW                         | 0.89 | 0.87 |      | 0.00 |      |      |      |      |      |      |
| AM                         | 0.85 | 0.82 | 0.82 | 0.00 |      |      |      |      |      |      |
| HL                         | 0.84 | 0.84 | 0.88 | 0.86 | 0.00 |      |      |      |      |      |
| AL                         | 0.83 | 0.85 | 0.88 | 0.83 | 0.00 |      |      |      |      |      |
| HS                         | 0.83 | 0.87 | 0.85 | 0.86 | 0.00 |      |      |      |      |      |
| PA                         | 0.84 | 0.83 | 0.85 | 0.88 | 0.84 | 0.90 |      |      |      |      |
| JS                         | 0.89 | 0.87 | 0.89 | 0.85 | 0.84 | 0.86 | 0.89 |      |      |      |
| VH                         | 0.87 | 0.81 | 0.85 | 0.84 | 0.84 | 0.83 | 0.89 | 0.89 |      |      |

P values are presented in the top right part (*0.05, **0.01, ***0.001), and Rho values are presented in the bottom left part.

Discussion

The frontal rotational head positions assessment showed significant inter-evaluator reliability; thus the evaluators agreed among each other in their assessment. Figure 3 shows the frontal rotational head positions scatter and box plots for the VAS observations for famous classical and non-classical singers. The line at 5 cm on the scatter plots represents neutral head position (Figure 3a and b). The scatter plots show that famous classical singers tend to keep their heads below or close to the neutral position for high notes (Figure 3a). In contrast, famous non-classical singers tend to raise their heads above the neutral position for high notes (Figure 3b). Additionally, the scatter plot for non-classical singers shows the corresponding note evaluated for each singer. Although the notes ranged from one semitone lower (A4) to two semitones higher (B4, C5) than classical singers, there are no distinctive differences visible in the scatter plot in the distributions of the head positions among these notes sung by the non-classical singers. Notice that both the most elevated and most
depressed head position was found for the note B4. Furthermore, the scores for all the notes sung by the non-classical singers tend to be located mostly above the neutral head position. Hence, for simplicity, all the notes are evaluated here as one set of data.

The box plot (Figure 3c) shows more variability for famous non-classical singers (ranging from 3.78 cm to 9.35 cm) in comparison to famous classical singers (ranging from 2.56 cm to 5.64 cm). This wider distribution indicates a variety of possible head positions employed by famous non-classical singers for high notes. In contrast, the narrower distribution for famous classical singers suggests a limited use of head positions for high notes. This finding supports our hypothesis that famous non-classical singers produce high notes with the head in an elevated position while famous classical singers produce the high notes with their head close to the neutral position.

While a majority of the famous non-classical singers (21 singers) produced notes between A4 and C5 with an elevated head position, 11 non-classical singers produced notes between A4 and C5 with the head in the neutral position (i.e., VAS scores within the range of 4 to 6 cm). Interestingly, three famous non-classical singers produced the notes A4, A#4, and B4 with their heads below the neutral position (Figure 3b). On the other hand, all the famous classical singers were found to produce the A#4 note around the neutral head position (never more than 1 VAS point above it).

Previous studies showed that the head position correlates with the vertical laryngeal position (21, 22). Hence, the neutral head position found for famous classical singers during high notes (Figure 3a) is likely associated with a neutral larynx position. The use of neutral or lowered position of the larynx for high notes is well documented for famous classical singers (45–50). It is usually associated with the so-called ‘voice covering’ and vowel modification during transitions to higher notes (51). This constant relative lower larynx position helps in keeping a homogeneous sound quality throughout the singing range by maintaining the resonance cavities constant (40).

Conversely, the raised head positions that are seen here adopted by most of the famous non-classical singers at high notes have not yet been properly documented. Head elevation or protraction was shown to be associated with high vertical laryngeal position (22), and it is a common feature in rock singing (most non-classical singers in this study are rock singers) together with pharyngeal compression and laryngeal supraglottic compression (52). In contrast to classical singers, it suggests an implementation of supralaryngeal tissue structures and extrinsic laryngeal muscles associated with head elevation to raise \( F_0 \) (22).

Traditionally, head elevation or protraction has mostly been associated with hyperfunctional voices that could lead to voice problems (8, 27–31). Considering the fact that the non-classical singers analysed in this study were all very successful artists, their use of elevated head position as documented here challenges this traditional view. It has been previously shown that singers can produce normal phonation while presenting abnormal laryngeal findings (53, 54). Some studies also indicate that non-classical singers can have long-sustained successful careers even with pathological laryngeal findings (53). Furthermore, in some non-classical singers, unusual voice quality may be the key for their originality and success. From the therapeutic view, this brings new challenges and changes of ideals (55).

The VAS inter-evaluator analysis showed inconsistency between evaluators for the transversal head positions. While the results indicated a more protracted head in non-classical singers than in classical ones (average VAS scores of 5.28 ± 0.63 and 4.34 ± 0.57, respectively), the low correlation
between the different evaluators (Table II) prohibited making any firm statements on the transversal head positions. A possible explanation for this discrepancy of scores for transverse head positions is the different camera angles from which the singers were filmed during their performances. Some of the pictures were taken with the singers facing forward towards the camera, making it difficult correctly to evaluate the transverse displacement of the head. Hence, further investigations using more objective examination methods are needed to elucidate the transversal head positions in singers.

Another possible hindering factor for this study stems from the uncontrolled environmental conditions, for example, the use of microphones or musical instruments, which are often required by famous singers. Bartlett (56), surveying the professional environment of non-classical singers, found that the majority of singers use a personal microphone and play musical instruments in live performances. The position of the microphone in relation to the mouth may influence the singer's natural body posture affecting the head position. Classical singers are less affected by microphone position as microphones are generally positioned at some distance directly in front of singers. The use of musical instruments in non-classical singers while performing can also have an effect on body and head positions. These factors, however, represent normal conditions in which famous singers perform and should also be considered when evaluating various aspects of their singing techniques. These aspects should therefore be taken into consideration when analysing head position during live performances.

The major limitation of this study is related to the use of subjective observations rather than objective measures. This limitation stemmed from the nature of the famous singers investigated – it was unrealistic to perform objective measurements of all those famous singers in well-controlled conditions. This study therefore relied on a subjective visual assessment instead of objective measurements of the head position. Therefore, some limitations with regard to the accuracy of the head position quantification are expected. This inaccuracy is, however, not expected to have a major impact on the overall finding of the study: the famous classical singers use a different frontal rotational head position than the famous non-classical singers.

Although some pedagogical literature refers to head position in singing, few systematic studies address the differences in head positions between singing techniques. This study therefore aimed to assess head position differences in famous classical and non-classical singers; the results of this pilot study may provide the basis for future research involving a more robust assessment of head movement based on objective measurements.

Conclusion

Famous classical and non-classical singers produce high notes with different head positions. Whereas classical singers tend to maintain a neutral head position, non-classical singers tend to raise their heads. This difference may be attributed to the different singing techniques and phonatory system adjustments utilized by each group.

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Supplementary material available online

Supplementary Appendix