SHORT TERM EFFECT OF 'SEMIOCCLUDED VOCAL TRACT EXERCISES' ON HEALTHY ACTORS' VOICES

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Abstract: **The aim of this study was to investigate the effect of a 10-minutes warm-up protocol with semi-occluded vocal tract exercises (SOVTE) on actors without voice complaints. A short dramatic passage was audio-recorded at 4 time points. Between the second and the third recording the actors performed the exercises, while between the third and the fourth they performed in a show. The voice quality was acoustically and auditory-perceptually analysed at each time point by blinded raters. Self-assessment parameters anonymously collected pre and post exercising were also evaluated. No statistically significant differences on perceptual ratings and acoustic parameters were found between pre/post exercise session and males/females. Statistically significant improvement was found in the self-assessment parameters concerning comfort in production (males), sonorousness, vocal clarity and power (both males and females). The proposed vocal warm-up with the SOVTE protocol created may thus be effective in determining a self-perceived improvement in comfort, voice quality and power.**

Keywords: **theater actors, vocal warm-up, SOVTE**

I. INTRODUCTION

Theater actors are voice professional with high vocal demands. These lead to laryngeal hyperfunction and perceived vocal fatigue [1,2]. In a study of Rangarathnam et al. [3], auditory-perceptual and aerodynamic measures of theater actors' voices significantly deteriorated after six weeks of stage performances and rehearsals, indicating a voice quality worsening.

In this population voice problems have shown to lead to both poor psychological and occupational issues [1,4].

Previous studies on the effects of semi-occluded vocal tract exercises (SOVTE) showed that phonating while reducing the diameter of the vocal tract at the level of the tongue and the lips can result in a more effective and efficient vocal production on healthy, disordered and singers' voices [5–8].

According to Titze [9] and Guzman et al. [10], this effect is due to an increased oral pressure.

SOVTE can be divided into groups according to the resistance created by the semi-occlusion, which directly relates to the amount of oral pressure which is generated [9, 10].

Moreover, Amarante Andrade et al. [11] reported that SOVTE can also be classified according to the presence or absence of a vibratory component at the semi-occlusion level. In line with this model, exercises performed with a second source of vibration in addition to the vocal folds (named fluctuating) are characterized by a predominant massage effect of the vocal tract. Exercises performed with only the vibration of the vocal folds (steady) promote, instead, an easy phonation.

To the best of our knowledge, only one existing study has determined the effects of SOVTE on the actor's voice, while most of the literature focused on singers' and disordered voices. Leino et al. [12] found an increase of the speaker's formant (a peak around 3.5 kHz in the Long Term Average Spectrum-LTAS of trained speaking voice) as well as a better perceived voice quality on a single actor after 30 minutes of SOVTE training. LTAS provides a visual display of the average frequency distribution of the energy of a continuous speech sample. It thus yields some information about the quality of the voice signal.

The aim of the present study was to determine the acoustical, auditory and self-perceived short-term effects of a vocal warm-up based on a protocol of different SOVTE in a population of actors with healthy voices.

II. METHODS

The study was performed on professional theater's actors on stage with a play, without voice complaints and with at least three years of working experience.

Difficulties in performing the exercises would have led to participants' exclusion.

All participants agreed to participate in the study by signing a written consent form.

4 audio-recordings (R1, R2, R3, R4) were made for each actor while interpreting and reading aloud with acting voice a selected short passage of "Hamlet" as translated in Italian and imagining an audience of 400 people.

The recording tool consisted of a SM58 dynamic microphone (Shure, Niles, Illinois, US) coupled with an US-322/366 external sound card (Tascam, Santa Fe Springs, California, US) and a VivoBook A551LB laptop (Asus, Taipei, Taiwan), Audacity® (Audacity Team, 2017) set at a 44.1 kHz sampling rate and 16 bit resolution. A constant mouth-to-microphone distance of 15 cm was kept with the use of a metal spacer.

A timeline of the data collection procedures is displayed in Fig. 1.

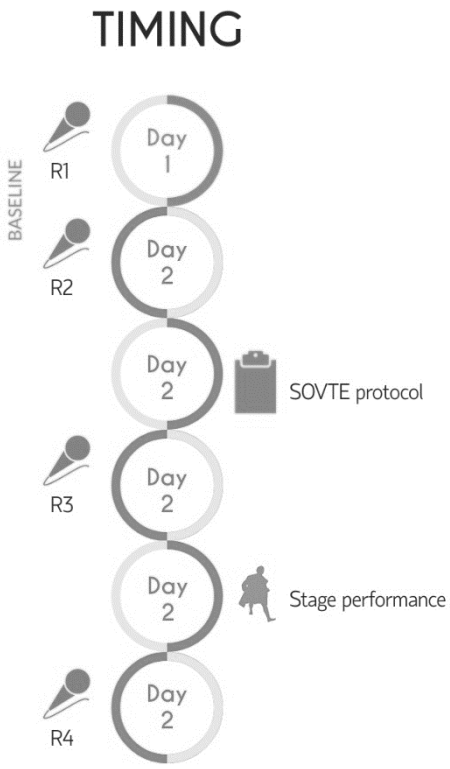

Figure 1. Timeline of the data collection procedures.

The exercise session consisted of a series of 10 minutes of SOVTE progressing from high to low resistance and including both steady and fluctuating tasks (Lax Vox with tube immersion of 3 cm in water, 20 vocalisations on /u/; straw phonation, 20 x sustained /u/; 10 lip trills, 10 tongue trills and 10 hummings).

R1, R2, R3 and R4 were analysed perceptually for voice quality by 5 blinded experts in voice analysis through a 100 mm Visual Analogue Scale.

Moreover, the recordings were acoustically evaluated with BioVoice [13] for duration, voiced/unvoiced selection, %voiced, %unvoiced, dynamic range, LTAS, jitter, quality ratio and mean, max, min, standard deviation of F0 (fundamental frequency) and of F1-F5 (formants). Praat [14] was used to analyse shimmer and noise-to-harmonic ratio.

Anonymously collected self-assessment parameters (comfort in production, sonorousness, expressiveness, pleasantness, vocal clarity and power) were also evaluated. For this analysis, participants were asked to fill in a questionnaire indicating, for each parameter, if their voice was worse, the same or better after the vocal warm-up as compared to its quality before SOVTE.

Data analysis was performed both together and separately for males and females with SPSS version 25 (IBM, Armonk), the significance level was set to 0.05.

The auditory-perceptual evaluations of the 5 raters were averaged as well as all the data of R1 and R2, which made the baseline.

Student t test and Cohen's d effect size were used to statistically and clinically analyse pre-post session changes in the perceptual and acoustic outcomes as well as the differences between males and females.

Binomial distribution and Fisher exact test were applied to analyse the self-assessment ratings.

Bonferroni correction was applied to statistically significant results.

III. RESULTS

The data analysis showed no statistically significant differences both for the perceptual ratings and for the acoustic parameters between pre/post exercise session and males/females. Due to space limitations, the results of acoustical analysis are not detailed here. Fig. 2 displays the perceptual rating for all actors. Similar results were found separately analyzing male and female data.

This analysis showed a high inter-individual variability. For instance, the two examples of LTAS reported in fig. 3 and 4 show an opposite result, as in the former we can notice a decrease in the energy level around 3.5 kHz, while in the latter an increased energy peak around the same frequencies after the exercises.

Statistically and clinically significant improvement was found in the parameters concerning comfort in production (males, $p<0.001$), sonorousness, vocal clarity and power (both males and females, $p<0.05$).

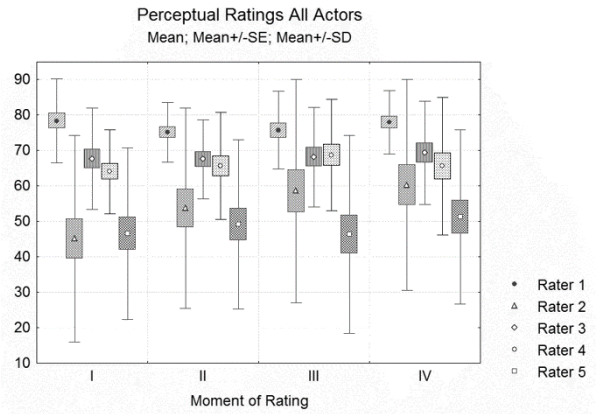

Figure 2. Mean, standard error (SE) and standard deviation (SD) of the actors' perceptual evaluation at each time point and for each rater.

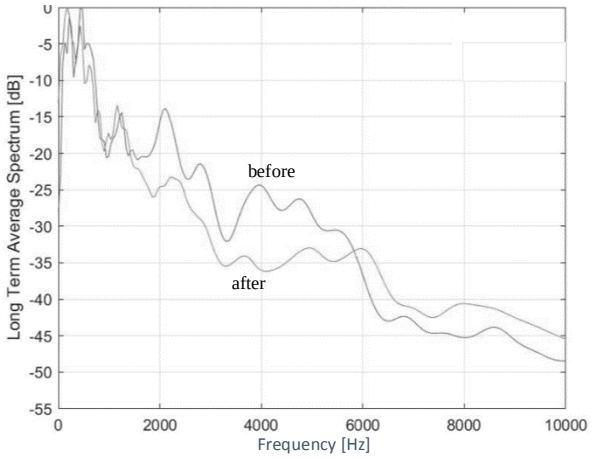

Figure 3. Energy level [dB] across Frequency [Hz] before and after the exercise session in a single actor.

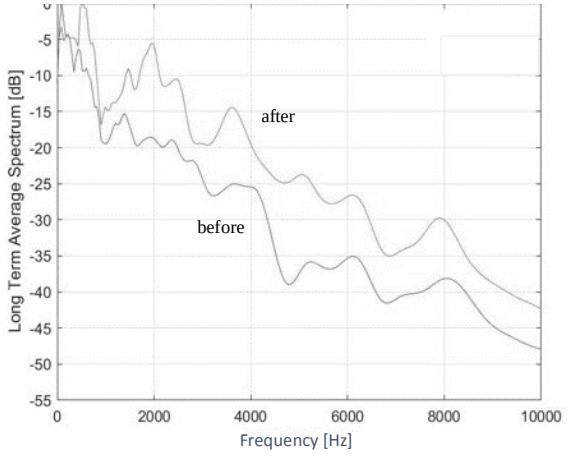

Figure 4. Energy level [dB] across Frequency [Hz] before and after the exercise session in a single actor.

IV. DISCUSSION

The present study aimed at finding the short-term effects of a SOVTE warm-up protocol on the actor's voice.

After 10-minutes of vocal warm-up, no statistically nor clinically significant differences were found on either the acoustic and auditory-perceived voice quality parameters. These findings differ from the ones obtained in the previous work of Leino et al. [12] on one single actor. As the exercises performed in this previous study were 30 minutes in length, it might be that 10 minutes of vocal warm-up is not enough to create an effect at the acoustic and auditory-perceptual levels. The present study was conducted in a real environment and during the stage performance period rather than in an artificial context (voice laboratory). A shorter protocol was preferred being more feasible before the stage performances and to avoid a tiring effect on the voice. The conditions in which the present data were collected, however, are more generalizable to the real context.

The findings of this study show that a 10-minutes vocal warm-up with SOVTE is enough to determine a self-perceived improvement in comfort for males and in sonorousness, voice clarity and power for both males and females. This result is in line with the previous literature on the effects of SOVTE on the singer's voice [7].

This result is anyway relevant being the human voice an extremely complex mechanism whose study requires a multidimensional approach. The primary goal of clinicians dealing with the voice is indeed to help patients and professional users to fully use their voice without efforts, but at the same time expressively and strongly, thanks to the use of comfortable and effective tools.

V. CONCLUSION

In actors, vocal warm-up with a 10-minutes SOVTE protocol is effective in determining a self-perceived improvement in comfort, voice quality and strength.

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