

# The Singing Voice Before and After Vocal Warm-up by Students of Chinese National Singing

Yu Chen<sup>1\*</sup>, Weifeng Kong<sup>2</sup>, Yujie Chi<sup>3</sup>, Yanting Chen<sup>1</sup>, Jianguo Wei<sup>3</sup>, Jianwu Dang<sup>3</sup>

<sup>1</sup>Tianjin University of Technology, Tianjin, China

<sup>2</sup>Tianjin Conservatory of Music, Tianjin, China

<sup>3</sup>Tianjin University, Tianjin, China

chenyu@tjut.edu.cn



## Abstract

This paper compared the singing voices of four student singers of Chinese national singing before and after vocal warm-up. Statistics showed that the parameters such as deviation from the standard note, vibrato rate and jitter were undergoing significant changes after 30 minutes of warming up exercise, while the differences of vibrato extent demonstrated a controversy result. Overall, this paper indicated that, all of the participants benefited from vocal warm-up by increasing accuracy of singing tone heights, decreasing jitters and approximating their vibrato rates to the moderate range of western singing style.

## Introduction

Chinese national singing (or Nazionale cantanti) was developed in China from the twentieth century with the emergence of the New Music Movement (c.a. the 1930s), and matured in the 1990s. In the past few decades, a great number of papers had been published on different aspects of Nazionale cantanti such as history, artistic style and singing skills. Nevertheless, there are just a few acoustic analysis papers on it. Until now, there was no study discussing the vocal warm-up of Chinese national singing from the angle of acoustic analysis.

As an everyday routine for professional singers and singing students, vocal warm-up was acoustically demonstrated to be useful to improve voice quality, prepare their vocal folds for optimal performance and protect the vocal folds from injury for professionals of western singing. To retrospect, Moorcroft & Kenny had acoustically assessed vibrato rate and vibrato extent from 12 classically trained singers before and after 25 minutes of vocal warm-up exercise, and they found that the notable changes in vibrato rate indicating that the tone quality may undergo positive change after vocal warm-up.

Based on the above considerations, it would be meaningful to see if vocal warm-up could benefit singers of Chinese national singing as much as it does for singers of bel canto. Therefore, by comparing the changes of the parameters such as deviation from the standard tone (DV for short), vibrato rate (VR for short), vibrato range (VE for short) and jitter, this study will test whether students of Chinese national singing could achieve any significant improvement in voice performance after 30 minutes of vocal warm-up.

## Experiment

### Participants

Four female students of Chinese national singing, 19-25 years old, 8-10 years of professional training.

### Materials and Data Recording

1. The horizontal distance between the mouth of the singer and the microphone is 30 cm.
2. A Sound Level Meter was used to calibrate the actual sound pressure level.
3. Participants were forbidden to warm up for 24 hours before the data recording.
4. Participants were first recorded five basic singing vowels [a], [i], [u], [e], [o] in their most comfortable octave, starting pitch and tempo without accompaniment for three times.
5. Then the singers took a series of vocal warming up for 30 minutes accompanied by a piano under professional guidance.
6. Finally, under the same condition of Step one, the participants were recorded the same singing vowels again.
7. Overall, the experiments recorded 600 tokens (4 speakers \* 5 vowels \* 5 notes \* 3 times \* 2 experiments) of Chinese national singing notes.

### Acoustic Analysis

The Duration of each note, as well as the average, maximum and minimum value of F0 in Hertz of that note were automatically calculated by a Praat script. Then, pitch data was converted from Hertz to Semitone by function 1.

$$St = \frac{12(\lg(F0) - \lg 16.35)}{\lg 2} \quad (1)$$

DV means the deviation of a given singing note from its aiming standard tone, which indicates the accuracy of singing. In this experiment, the DVs in cent were calculated by function 2.

$$DV = 100 * |St_{mean} - St_{standard}| \quad (2)$$

VR means the modulation frequency which is defined by the rate of modulation about the fundamental frequency, and VE indicates how far (peak-to-trough) modulations vary relative to fundamental frequency.

Considering the conditions of vocal folds of the participants might be influenced by warming up exercise, in the present study, the value of jitter(relative) for each token was also calculated by function 3, where  $T_i$  is the duration of the  $i$ th interval and  $N$  is the number of intervals [?].

$$Jitter(relative) = \frac{\frac{1}{N-1} \sum_{i=1}^{N-1} |T_i - T_{i+1}|}{\frac{1}{N} \sum_{i=1}^N T_i} \quad (3)$$

After collecting the four parameters of the 600 tokens of singing notes, statistic analysis was applied to analyze the effects of vocal warm-up for students of Chinese national singing by SPSS 19.0.

## Results

### General Results

1. Overall, the changes of DVs indicated that those singing students with years of professional training still could benefit from accompaniments to maintain their pitch accuracy of singing.
2. The difference of the other three parameters among the five vowels are also noticeable.
3. After warming up, the VR was increased, as well as the DV, VE and Jitter were declined.

## Results of Paired-Samples T Test

1. Considering all data together, Paired-Samples T Test result of DV showed a significant difference before and after warm-up ( $t(299)=7.39, p<0.01$ , which meant that the participants were singing more accurately after vocal warm-up.
2. When checking the data of each participant individually, the results of subject 1 failed to report any evidence, while other participants showed clearly significant changes after vocal warm-up (see Figure 1).
3. Checking the results of Paired T Test of separated vowels, except for the cases of VEs, all the remaining data demonstrated significant changes following the vocal warm-up (See Figure 1).

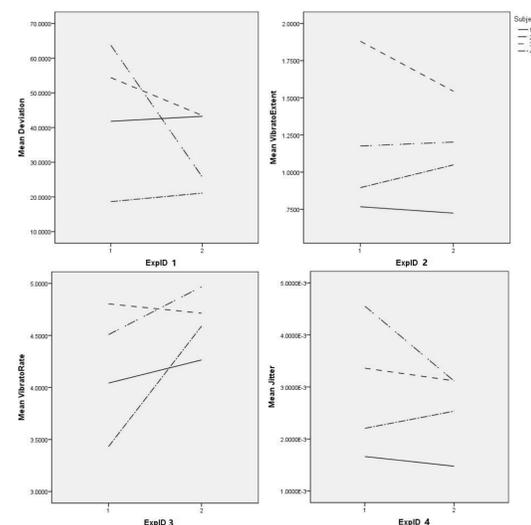


Figure 1: Mean value changes of four participants following the vocal warm-up

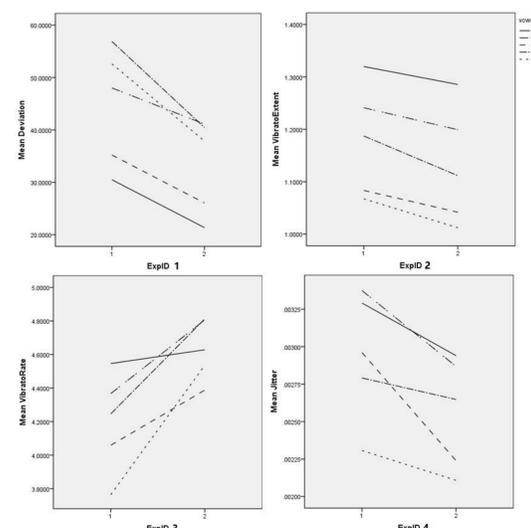


Figure 2: Mean value changes of five vowels following the vocal warm-up

## Discussions & Conclusions

- After a procedure of stretching and releasing their laryngeal and respiratory systems, together with the presence of piano accompaniment during warm-up, the singers' control of pitch became more reliable. At the same time, their auditory and somatosensory system might be more active by warming up exercise, which could help the singers to monitor their singing activities efficiently. Therefore, students of Chinese national singing could significantly improve their intonation accuracy in singing notes after a short period of vocal warm-up.
- Changes of jitter indicated that the participants' larynxes worked more smoothly and efficiently after warming up exercise, which could help the singers of Chinese national singing to optimize their singing performance, and protect their vocal folds from injures, as well as that for professionals of western singing. The results of the present paper also indicated that, as an index of singing voice's quality, jitter could be very valuable for singing teaching and research.
- Vibrato extent is not a reliable index as well as Vibrato rate for voice quality.

## Forthcoming Research

The vibrato rates of Chinese national singing might have different modality from that of western singing, which we will study in further studies.

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