ACOUSTIC EFFECTS OF VOCAL WARM-UPS

Murray Schellenberg
Department of Linguistics, University of Victoria, P.O. Box 3045, Victoria, B.C. V8W 3P4

1. Introduction

Singers, like others who undergo heavy physical exertion, benefit from a warm-up or light exercise prior to full use of the muscles involved in the exertion. The mechanics of vocal warm-ups, however, are not thoroughly understood. People who use vocal warm-ups know that they work but their scientific study has been somewhat overlooked.

The physiological responses to sports warm-ups are well documented [1] and it may be assumed that vocal warm-ups trigger similar responses: an increase in tissue temperature; increased blood circulation, etc. The purpose of this study is to examine whether these physiological changes affect the acoustic output.

2. Singer's Formant

The singer's formant is a peak of energy near 3 kHz found in singers' voices (except soprani) which helps project the voice. This is clearly seen as a wide band in the spectrogram [2,3]. As the voice warms up and settles into the "ideal" mode of production, the singer's formant should become more focused and the bandwidth of the singer's formant is expected to become narrower.

3. F_0 Range

Singers use a wide range of fundamental frequencies and this is generally considered to increase with a warm-up. The scattergram allows measurements of the extreme range as well as the range of controlled production. The extreme range is measured by means of a glissando or slide to the outer limits of the singer's range. The range of controlled production (the frequencies which can be sustained by the singer with "good vocal technique") is measured -- also by scattergram -- within the context of ascending and descending scales.

4. Average Energy

In musical terms, this section looks at control over dynamics; in acoustic terms, we are looking at energy. To measure the acoustic side of this, measurements of the singer's performance at three amplitudes (relative to each other) will be taken at three different F_0s. Measurements taken after the warm-up are expected to show a greater dynamic range.

5. EGG

The electroglottogram produces a glottal waveform by means of electrical impedance. The velocity of the closing phase is expected to increase as a result of the vocal warm-up.

6. Discussion

The singer's warm-up is designed to increase the efficiency of voice production. That efficiency increase should lead to observable changes in the acoustic output -- the most readily accessible aspect of the singer's production. The singer's formant is expected to narrow in bandwidth; the frequency and energy ranges are both expected to increase; and the glottal waveform should become more regular and "efficient". All this will help the singer perform more safely and more comfortably.

References

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