The Impact of Vocal Cool-down Exercises: A Subjective Study of Singers' and Listeners' Perceptions

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Summary: Objective. Using subjective measures, this study investigated singers' and listeners' perceptions of changes in voice condition after vocal cool-down exercises.

Study Design. A single-subject crossover was designed to evaluate whether there were discernible differences in either singer or listener perceptions from pre (no vocal cool downs) to post (with cool downs) test. Subjective questionnaires were completed throughout the study.

Methods. Twenty classically trained female singers documented self-ratings and perceptual judgments through the Evaluation of the Ability to Sing Easily survey, the Singing Voice Handicap Index, and Self-Perceptual Questionnaires after a 60-minute voice load. Recordings were made and assessed by four expert listeners.

Results. The assessed data from the Singing Voice Handicap Index, the Evaluation of the Ability to Sing Easily, and Daily Perceptual Questionnaires show 68%, 67%, and 74% of singers reported improvement, respectively. However, because of significant variability in the underlying scores, the amount of improvement was not deemed to be statistically significant. Expert listeners correctly identified the cool-down week 46% of the time.

Conclusions. Singers strongly perceived positive impact from the cool-down exercises on both their speaking and singing voices. Even though the objective data were statistically insignificant, the singers' subjective data clearly indicates a perceived sense of vocal well-being after utilizing the vocal cool-down protocol. The variability in the daily life of a singer (eg, stress, menses, reflux, vocal load, and vocal hygiene) makes it difficult to objectively quantify the impact of vocal cool downs.

Key Words: vocal cool-down exercises–vocal fatigue–semi-occlusions–singing–subjective singing study.

INTRODUCTION

Warming up the voice is an accepted tradition among singers and is often considered essential for healthy singing technique. Centuries of experience-based practice and publications have created the belief that warm-up is a necessary aspect in vocal training. However, vocal cool downs at the end of a lesson, rehearsal, or performance are less the norm. Although the lay person believes that cooling down the body after exercise is a necessity, research in exercise science has yielded studies to both support and contradict the importance of cooling down. Certainly, many vocal athletes neglect this activity after singing. In recent years, singers have more frequently been encouraged to cool down the voice. Yet to this date, empirical and scientific data remain in their infancy with regard to evidence-based information. For this to change, there is a need for scientific research to substantiate cool-down exercises as a necessary aspect of a singer's conditioning. Until that time, it is reasonable to guide singers to continue cooling down their voices based on anecdotal experience of voice pedagogues.[1] The subjective study presented here will provide some continued guidance to the ongoing conversation.

Singing has traditionally been categorized by its artistic nature. However, the past few decades of research have provided more knowledge of anatomy, physiology, and acoustics of the voice. This has led to a new appreciation of the singer as a vocal athlete. Much has been drawn from the sports science community to inform research within the voice community. Because there is a historical precedence for vocal warm-ups, studies have focused on that aspect of the singing voice. Numerous studies have evaluated the convention of vocalises and their impact on training and warming up the voice.[2–5] One recent study of 188 musical theater singers found that approximately 90% of incoming freshmen used vocal warm-ups. However, only 15% of those singers used vocal cool downs.[6] Yet another study of 117 participants reported that 54% always use vocal warm-ups before singing and 22% use vocal cool downs.[7]

A recent dissertation focused solely on the efficacy of vocal cool-down exercises in nine graduate students at Cincinnati Conservatory of Music.[8] The results show that, based on the objective acoustic and aerodynamic measures, the impact of cool-down exercises on the voice remains unclear. The study found that there may be perceived benefits 12–24 hours after cooling down the voice, rather than immediately following.

The fact remains that studies exploring the method of cool downs and their effectiveness are in the early stages. At The Voice Foundation Symposium in 2013, the author of this article presented a study on the efficacy of cool-down exercises with colleagues Marty Nevdahl, Tanya Meyer, and Albert Merati.[9] Data were collected *via* videostroboscopic examination, and *via* acoustic and aerodynamic measures, and yielded inconclusive results because of various circumstances. The group postulated that this could have been due to the choice and/or the timing of measures taken. However, the small subjective survey from this original pilot study provided evidence that further research was warranted. The singers' perceptual feedback was promising enough to significantly expand the subjective measures from the

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TABLE 1.
Cool-down Protocol for Female Classical Singers

1. Straw phonation:
   a. Slide slowly from bottom to top of scale.
   b. Ascending/descending slides working up the scale in increments of about a fifth during ascent and about a third during descent starting at A3 (220 Hz) and ascending to A5 (880 Hz).
2. Sing scale degrees 1 through 3 while humming. Starting pitch is G4 (392 Hz) and top pitch should be G5 (784 Hz) at a soft to medium soft dynamic level.
3. Sing hm-[i], hm-[e], hm-[ɑ], hm-[ɔ], hm-[u] on single note, each syllable getting sung for a 1-second beat, starting at C5 (523 Hz) descending by half steps to C4 (262 Hz).
4. Sing wh[ɔ] on sustained pitch F4 (349 Hz) to C5 (523 Hz) for a 2-second duration.
5. Gentle vocal fry for 5-second durations a total of five times.
6. Sing a three-note scale on v[æ] (vowel sound like cat) in chest register G3 (196 Hz) to F4 (349 Hz) on a medium loud dynamic level.
7. Sing scale degrees 1-5-1 on v[æ] in chest register Ab3 (104 Hz) to D4 (294 Hz). The pitch A4 (440 Hz) should be the top note. This should be sung on a medium loud dynamic.
8. Sing a five-note descending scale on soft, floaty [u] starting at C5 (523 Hz). Continue ascending to G5 (784 Hz) (C chord) then continue descending until E4 (330 Hz) is the top note of the A3 (220 Hz) scale. This should be done at the softest dynamic level. Note: A floaty [u] vowel is a very round vowel sound, such as in the word "who." The intent is for it to be sung with a great deal of ease and resonance felt in the mask, even at a soft dynamic level. No tension should be experienced.

original study and to include an expert listener evaluation in this study.

The research presented in this paper sought to gather information on singers' and listeners' perceptions of cool-down exercises following the typical voice load of an emerging classical singer. Subjective data were collected immediately following a singing rehearsal and included observations across a 24-hour time period. The cumulative impact for a 5-day week was also ascertained. Randomized paired recordings (created both with and without the cool-down protocol) of the two study weeks were then assessed by four expert listeners. Perceptual judgments were made regarding singers' vocal condition through a series of questions. The intent of this research was to determine (1) whether singers perceived any differences in their vocal function, vocal health, or tone quality when using vocal cool downs, and (2) whether expert listeners perceived any differences in tone quality before or after the singers used vocal cool downs.

METHOD AND DESIGN

This study used a single-subject crossover design for subjective measures followed by an expert listener assessment posttest. Twenty singers participated in the study over a 3-week period, which included 1 week between the two assessed weeks. During each of the two assessment weeks, singers participated in a 60-minute voice load that represented a typical emerging classical singer's practice session. This included 20 minutes of vocal warm-ups and 40 minutes of repertoire. The vocalises were familiar and part of their normal practice regimen. The selected art songs and arias were from each singer's current repertoire and approved by their applied voice teacher.

The 20 singers were divided into two groups and labeled "cohort A" and "cohort B." Each cohort completed five consecutive days of the 60-minute practice sessions described above. At the end of each session during week 1, cohort A completed the cool-down protocol (Table 1), whereas cohort B did not. For the 1 week between the two assessed weeks, singers continued with their normal singing activities. Following the second assessed week, each cohort switched so that cohort B sang the cool-down protocol following the 60-minute voice load for five consecutive days and cohort A did not. After every daily practice session, each cohort completed the Evaluation of the Ability to Sing Easily (EASE) survey[10,11] (Table A1) and a Daily Self-Perceptual Questionnaire. The Singing Voice Handicap Index (SVHI)[12] was completed twice during the study: pre- and posttest. At the conclusion of the entire study, singers filled out a 10-question end-of-study Self-Perceptual Questionnaire (Table 2) and provided their additional feedback from the entirety of the study. (See Table A2 for Study Design Matrix.)

Participants

Singers were recruited from the School of Music vocal performance degree program following approval of the study by the University of Washington's Institutional Review Board. Additional participants were recruited from the principal investigator's private voice studio. Twenty classically trained female singers across a broad range of *fachs* volunteered to participate in the study. Their mean age was 22.85, standard deviation (SD) = 3.54, and their mean years of vocal study was 7.85, SD = 3.44. Singers had studied on average with 3.55 voice teachers, SD = 1.50. All of the participants were currently earning either Bachelor or Master of Music degrees in vocal performance or were recent graduates. All singers were classically trained singers currently studying with a university voice teacher. They self-reported good vocal health. Fifteen of the 20 singers had recently undergone videostroboscopy and vocal health assessments at the University of Washington Speech and Hearing Clinic. There were no significant issues noted. The data from the EASE survey, the SVHI, and numeric part of the Daily Self-Perceptual Questionnaire utilized for this paper include 17 of the 20 singers who completed all aspects of the study. Three were eliminated because