

Effects of Vocal Demands on Voice Performance of Student Singers

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Summary: Purpose. The objective of this study was to investigate the effect of cumulative vocal demands on the voices of music students majoring in voice throughout an academic semester.

Method. Acoustic and aerodynamic voice parameters captured across an academic semester were analyzed. This study was designed as a time-course investigation, in which all participants were tested individually at three separate times distributed equally over an academic semester. General effects were verified with the application of one-way within-participants analysis of variances with repeated measures. The equipment used for monitoring vocal behavior consisted of the Computerized Speech Lab, the Phonatory Aerodynamic System, and the Ambulatory Phonation Monitor, computer-based systems for the assessment of voice. Self-reported data regarding voice usage were also collected.

Results. In this study, comparisons of voice parameters of student singers repeatedly measured throughout an extended period of time did not lead to statistically significant differences. Self-reported information suggested a reasonable level of knowledge and awareness regarding voice concerns in this population.

Conclusions. The results of this study indicated consistent stability of voice acoustic and aerodynamic parameters in this group throughout an academic semester.

Key Words: Singing voice—Voice acoustics and aerodynamics—Voice monitoring.

INTRODUCTION

Singing is among the functions that most critically rely on the voice. Continuous vocal production is an activity that involves a synchronized interaction of multiple physical processes such as respiration, phonation, and resonance.¹ Refined singing is then a multivariate task that requires extensive education and training of these functions.^{2,3} Singers are expected to attain and maintain an optimal level of vocal performance to execute complex phonatory maneuvers.⁴ Vocal performing competence includes having a functional, healthy, and aesthetically acceptable voice; consequently, the training demands are high.⁵ In addition, the performing voice is frequently affected by extra loading environmental factors.^{6,7} Hence, singers are considered at risk of developing voice disorders,^{6,7} which can be quite debilitating for them, physically and psychologically.^{8–10} For this reason, elite voice performers are expected to acquire knowledge about caring for the vocal mechanism when learning voice technique.^{11–13} Plans to obtain and maintain vocal health must include proper voice usage education, particularly for professional purposes.²

Cumulative effects of laryngeal overload

Professional voice users, a larger spectrum in which singers are included, have a tendency to expose their voices to elevated risk factors, not always preserving their vocal systems from the impact of excessive vocal usage.^{14,15} Major voice risk factors include using the voice without rest, voice usage in

nonfavorable organic or environmental conditions, using the voice in an effortful manner, and reserving a limited time to recover after illness that affects the voice.^{1,7} As a consequence, singers may be prone to develop vocal cumulative effects symptoms associated with vocal fatigue, a condition associated with excessive voice demands placed on speakers, in which loss of phonatory abilities develops as phonatory effort increases.¹⁰ Voice fatigue is typically described by an array of self-reported symptoms related to the overtaxing of the larynx, leading to a chronic subjective sensation of voicing tiredness that tends to increase with voicing activity, and in many cases progresses with time.^{5,11,16–18} These symptoms are perceived as irregularities and changes in quality of voice, including restricted frequency and intensity ranges.^{19–22} The literature reveals that vocal fatigue symptoms may have a detrimental impact on vocational and economic goals of professional and preprofessional voice users, and consequently in their quality of life and psychological well being.^{20–23} It has been suggested that there is a gap between acquiring voice care knowledge and implementing vocal hygiene methods among professional users.^{24–28} An investigation conducted with students majoring in voice, acting, and broadcasting revealed that some future elite professional voice users fail to take precautions to care of their voice systems.¹² This is compatible with results from an investigation, which demonstrated that radio students and professionals had a tendency to underestimate the consequences of overlooking vocal hygiene regimens among this population.¹

A study using a similar design to the present investigation, conducted with a population of student teachers, indicated deterioration of acoustic and aerodynamic voice parameters investigated through an academic semester.²⁹ Given these past findings suggesting that ongoing vocal demands can deteriorate vocal quality and stability in a population of student teachers, the same might be expected of singing students whose demands and load are comparable or potentially even more intense.

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Research questions and hypothesis

The research questions focused primarily on behavior of students majoring in voice through repeated observations of vocal acoustics and aerodynamics in student singers (a) using the Computerized Speech Lab (CSL; KayPENTAX, Montvale, NJ) and the Phonatory Aerodynamic System (PAS; KayPENTAX) in the voice laboratory, and (b) using the Ambulatory Phonation Monitor (APM; KayPENTAX) throughout a sustained period of time (ie, 7 hours) as a tentative identification of changes in vocal acoustics and behavior of student singers in natural settings. Complementary findings were related to vocal habits as well as subjective feelings and attitudes regarding voice usage surveyed with the voice profile of singers (VPS) created for this study (Appendix), and the Voice Handicap Index (VHI; Jacobson et al, 1997), a standardized method to examine psychosocial aspects of voice usage. It was initially hypothesized that cumulative vocal demands may have an adverse effect on the voice of student singers, as verified in association with other occupational voice categories.^{1,12,29}

Because of the high occupational demands, it may be difficult for professional and preprofessional voice users to carry out proper voice care.^{28,30,31} Their voice production should be supported by appropriate education and training, including identification and elimination of voice overloading aspects.^{14,25,26,32,33} As high level and high demand performers, student singers may be at risk for developing voice disorders; their vocal behavior when singing and when speaking should be supported by a proper technique.^{34–36} This study was designed to investigate the effects of vocal demands that typically unfold during an academic semester on voice quality of students majoring in voice. The research questions were guided by the inspection of voice parameters of student singers over an academic semester to understand the specific needs of singers and student singers. Cumulative academic-related voice demands that typically unfold during an academic semester including regular curricular activities such as singing classes and rehearsals may have a detrimental impact on voice performance, leading to a risk of developing voice disorders.

The effects of vocal demands on the voice have been described in the literature.^{10,16} A study conducted before this investigation using a population of student teachers revealed that cumulative vocal demands throughout an academic semester had a detrimental impact on voice performance of participants.²⁹ Although the literature hints that increased vocal demands impact vocal fold functioning, there is limited empirical data on the relationship between cumulative vocal demands faced by student singers over the progress of an academic semester. Additional considerations concern a possible attenuating influence of previous voice training on potential effects of cumulative vocal demands on voice performance.

METHOD

Participants

Eight university music students majoring in voice aged 22–34 years and reporting a healthy voice history participated in

this study. Two participants were respectively 30 and 34 years old at the time of data collection, whereas all others were aged between 22 and 27 years. Despite the slightly broad age range, participants reported a relatively narrow range of 4–6 years of formal voice training. Four participants were female and four were male, all of them were native English speakers. To minimize differences in voice training experience, students were selected from a group with similar educational background: all had an undergraduate degree in music and were attending college classes at the same level, pursuing a Master's degree in music with voice as their primary instrument.^{14,17} After appropriate approval by the institutional review board, students were invited to participate in the study.

Materials

Objective instrumentation. Objective voice assessment was conducted using the CSL, the PAS, and the APM, sophisticated computer-based systems used for acoustic and aerodynamic assessment of voice.^{37–39} The CSL and the PAS were located in the SIUC Voice Lab. The APM is a portable device, associated with the remaining voice laboratory components.

Acoustic voice samples were collected in a quiet room using a microphone (Shure dynamic model BG with frequency response of 85–14 000 Hz). Voice samples were collected and analyzed with the application of the Multi-Dimension Voice Program (MDVP) module of the CSL model 4500 (KayPENTAX) used to capture and analyze voice parameters.^{37,40}

Voice aerodynamic assessment was conducted using the PAS model 6600 (KayPENTAX). The PAS hardware external module consists of an ergonomic device with bilateral handles with integrated microphone, face mask, pneumotach, and pressure transducer.³⁹

The APM (KayPENTAX) provided objective data associated with voice use generating the acoustic measures of F0 and sound pressure level (SPL) obtained through an accelerometer adhered to the base of the participant's neck and connected by a cable to a hardware module worn in a waist pack. The data collected throughout periods of time were subsequently downloaded to a computer equipped with APM software for analysis.³⁸

Variables

The independent variable for each of the research questions in this study was the singing vocal demands (SVD) condition, defined as cumulative voice demands that develop throughout a typical academic semester (ie, 16 weeks), including group and individual singing lessons, rehearsals, and presentations. The dependent variables included objective acoustic and aerodynamic voice parameters, defined as noninvasive methods applied in observation and documentation of vocal function.⁴¹ The participants were individually assessed in the first, eighth, and 15th weeks of the academic semester, respectively.

Acoustic measures provide quantitative assessment of voice quality and vocal function associated with sound waves,^{42–45} whereas aerodynamic measures refer to the motion of air passing through the region of the vocal folds during phonation.³⁹

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