

Vocal Mechanism Knowledge and Voice Care Among Freshman and Senior University Voice Students

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Abstract

We surveyed university voice students ($N = 67$) majoring in voice performance, choral music education, or music therapy to assess potential differences between students beginning their degree programs ($n = 38$ freshmen) and students nearing the end of their programs ($n = 29$ seniors) relative to their knowledge and perceptions of laryngeal anatomy and physiology, voice disorders, proper voice care, and the roles of singing voice instructors and speech-language pathologists. Seniors scored significantly higher than freshmen on overall knowledge of the vocal mechanism and specific matters of anatomy and physiology. Seniors who had taken a vocal pedagogy course scored significantly higher on these items than seniors who had not completed such a course. Correct responses to items about voice disorders and laryngeal pathologies were fairly high among all participants, with no significant mean differences between seniors and freshmen, or between seniors who had completed a course in vocal pedagogy and seniors who had not taken that course. Among other findings: (a) Although seniors reported a significantly higher frequency of “positive” vocal behaviors than freshmen, seniors did not differ significantly from freshmen in reported frequencies of engagement in perceived “negative” vocal behaviors; (b) There were significant differences between respondents' ratings of the qualifications of voice instructors and speech-language pathologists to perform 5 of 7 presented tasks; (c) We observed low, but significant, positive correlations between overall knowledge scores and self-ratings of perceived knowledge, and between overall knowledge scores and total years of private voice instruction; and (d) We found significant, moderate relationships between years of university voice instruction and overall knowledge scores, and between years of university voice instruction and scores on vocal anatomy and physiology items. Students most frequently reported private voice instructors (88.1%) and/or choir directors (82.1%) as sources of education or information about the function and care of the voice.

Keywords

undergraduate voice students, vocal mechanism knowledge, singing voice care, voice instruction

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Few studies to date assess what university voice students know about the laryngeal mechanism, its care, and potential vocal pathologies. This matter may interest private voice teachers, choir directors, and therapists for two, primary reasons. First, an appropriate vocal hygiene program at the university level might help prevent some functional voice disorders in singers. Secondly, university students who pursue careers in vocal performance, choral music education, or music therapy, will one day teach singing to others in various contexts. Thus, the accuracy or inaccuracy of their current understandings could potentially affect other people as well as themselves.

Numerous authors (Braun-Janzen & Zeine, 2009; Broaddus-Lawrence, Treole, McCable, Allen, & Toppin, 2000; Brodnitz, 1953; Kovacic & Budjanovac, 2003; Timmermans, Vanderwegen & De Bodt, 2005b) have suggested that inexperienced singing students may be unaware when they engage in behaviors harmful vocal behaviors. Thurman and Lawrence (1980) suggested that voice misuse during the college years could result in serious consequences for a singer's future career because laryngeal maturation, which is not complete until the late 20s or early 30s, is still ongoing with most college-aged voices. In a review of research related to occupational risks for voice problems, Verdolini and Ramig (2001) suggested that professional singers might have a high risk factor for voice disorders relative to the number of professional singers in the general population.

Galloway and Berry (1981) hypothesized that voice majors would be more aware, cautious, and careful with the vocal mechanism because it represented their future career and professional opportunities (e.g., as performers, music educators, choir directors). They also expected that voice majors would present few voice issues and/or disorders. However, 23 (57%) of the 40 voice majors in their study evidenced some type of voice disorder.

Broaddus-Lawrence, et al., (2000) studied the effects of a vocal education program with 11 untrained, adult singers. The program consisted of four 60 min classes, and included the following elements: (a) anatomy and physiology of the phonatory mechanism, (b) vocal abuses, (c) laryngeal pathologies associated with vocal abuses, and (d) instruction on "proper" vocal technique. Results indicated that, following completion of the program, all participants valued the knowledge gained, stated that they would recommend a similar class to a fellow singer, and felt that they had a better understanding of their vocal mechanisms. However, the researchers found no significant reduction in participants' vocally abusive behaviors following their participation in these classes.

Timmermans, DeBodt, Wuyts, and Van de Heyning (2005a) evaluated the effectiveness of a voice training program with 23 future professional voice users. Participants received voice training (lectures, workshops, coaching) for two years and vocal hygiene education for one year. Dependent measures included the Dysphonia Severity Index (DSI) and the Voice Handicap Index (VHI) administered at two intervals (before and after nine months, before and after 18 months), and a questionnaire about daily voice habits administered at the study's onset and after 18 months' participation. Results indicated significant improvement in DSI scores after nine months, but no significant improvement after 18 months. The VHI scores remained unchanged after nine months, but showed significant improvement after 18 months. Questionnaire results, however, indicated that the reported high prevalence of vocal abuse, smoking, stress, and late meals among participants remained unchanged despite participation in the program. The researchers concluded that due to its low effectiveness the vocal hygiene program required revision. The voice training component, however, appeared

sufficiently well organized to yield improvement in DSI scores after nine months.

Many voice professionals have recommended application of proper vocal technique to speaking as well as singing. Sapir, Mathers-Schmidt and Larson (1996) analyzed questionnaires completed by female university students ($N = 159$), both singers ($n = 70$) and non-singers ($n = 89$). They reported that many of the young singers did not apply “good singing technique” to speaking, and suggested that vocally abusive speaking behaviors combined with hours of strenuous singing may put singers at high risk for vocal attrition.

In 2006, three organizations [the American Speech Language and Hearing Association (ASHA), the National Association of Teachers of Singing (NATS), and the Voice and Speech Trainers Association (VASTA)] published a joint statement in which they agreed that healthy laryngeal function is essential in both speaking and singing because the central mechanism for healthy phonation is fundamentally the same for both singing and speaking. As a result, possible etiologies of a voice disorder may be either improper singing or speaking techniques, or both.

Some studies (Braun-Janzen & Zeine, 2009; Kovacic & Budjanovac, 2003) have indicated that singers reported limited or no knowledge of the role of the speech-language pathologist (SLP) in working with singers. Lukkomen (2009) and Badgett (2013) explored the preparation and training of SLPs relative to their qualifications and abilities to work with singers.

Griffin, Woo, Colton, Casper and Brewer (1995) suggested that research should examine singers’ knowledge levels both at the beginning of their training and at the end of their training. According to Galloway and Berry (1981), voice students must be made aware of the intricacies and limitations of the vocal mechanism through knowledge of the anatomical structures of the larynx. Braun-Janzen and Zeine (2009) suggested that although it seems logical that

singing students would become knowledgeable about the anatomy, physiology, and care of the vocal mechanism during the course of their education and training, that outcome may not always occur.

A small number of previous studies has surveyed voice knowledge among various populations. Zeine and Walter (2002) surveyed 345 professional, amateur, and student actors. Kovacic and Budjanovac (2003) surveyed 147 amateur, semi-professional, and professional choral singers about voice care and voice protection. They found that the amateur and semi-professional singers were less well informed than the professional choir singers.

Braun-Janzen and Zeine (2009) examined the levels of interest in and knowledge of vocal function and dysfunction among 129 singers, including voice teachers, choir directors, professional singers, and amateur singers. Professionals, including singing teachers, answered significantly more knowledge-based questions correctly than amateurs in all areas (vocal anatomy and physiology, vocal hygiene, functional voice pathologies) except the role of the speech-language pathologist in voice treatment and care. Singing teachers significantly outperformed the other professional participants. Scores of participating choir directors were not significantly different from the amateur singers except with respect to knowledge of functional voice pathologies.

Daugherty, Bowers, and Okerlund (2009) presented a 21 item questionnaire about vocal anatomy, physiology, and acoustics to 348 students enrolled in selected choral ensembles and an array of undergraduate and graduate courses in vocal performance, choral music education, vocal pedagogy, music therapy, and choral conducting at two major U.S. universities and an associated community college. The researchers also invited participants to apply their vocal knowledge to a posed, hypothetical teaching situation. Among the primary findings: (a) music majors scored significantly higher

than non-music majors, (b) vocal performance and choral music education majors scored significantly higher than other music majors, (c) students who had completed a course in science-based vocal pedagogy scored significantly higher than other participants, (d) non-music majors who participated in choirs without also having had private voice lessons or a vocal pedagogy course scored significantly lower than other participants; and (d) most participants did not coordinate and apply successfully the discrete items of knowledge assessed by the questionnaire to comments about the holistic voice teaching situation.

Kwak, Stasney, Hathway, Minard, and Ongkasuwan (2013) administered an 80 item questionnaire to 110 singers, including undergraduate, master's degree, and doctoral/young artist singers. They found no significant differences in vocal knowledge across the three levels of training. Mean scores of all participants were just above 50% (ranging from 26% - 84% correctly answered items). There were no significant differences by level of training with respect to anxiety about vocal pathology, scope examinations, or visits to a speech-language pathologist.

To date, no study has explored the voice knowledge (including vocal anatomy and physiology), voice care practices, and perceptions of the entire population of freshman and senior class undergraduate voice students pursuing degrees in vocal performance, music education, and music therapy at the same university. No study, moreover, has attended specifically to potential voice knowledge differences between these two groups of singers, who are near the beginning and near the end of their university studies.

The present investigation surveyed university voice students ($N = 67$) on their knowledge and perceptions of the vocal mechanism, vocal behaviors, voice pathologies, and proper voice care. We hypothesized that singers at the end of their university training

(seniors) would demonstrate more knowledge than singers at the beginning of their training (freshmen). We also hypothesized that singers with previous academic coursework in vocal pedagogy or related topics would demonstrate more knowledge than their peers who did not have such academic exposure.

Method

Participants

Students enrolled in a required Voice Area Recital Seminar course at a university in the Northeastern United States served as participants for this study. The Seminar gathered all students with an applied emphasis in voice, regardless of their specific music major. Students present were invited to complete a nine-part questionnaire to measure their knowledge, awareness and interest levels regarding the structure, function, and care of the vocal mechanism.

Participation in the study was completely voluntary and confidential. Music faculty members were not present, nor did they have any knowledge of which students did and did not choose to participate. Prior to initiation of the study, the investigators obtained approval from the university Institutional Review Board (IRB).

To conceal the purpose of the study, a total of 129 voice students of all class ranks and concentrations (e.g., music performance, music education, music therapy) completed and returned the questionnaire. However, we analyzed only 67 questionnaires in order to compare responses from singers at the beginning of their academic training (freshmen) and near the end of their academic training (seniors). Among these 67 students were 38 freshmen (56.7%) and 29 seniors (43.3%). Thirty-two participants (47.8%) were male and 35 (52.2%) were female. The participants' ages ranged from 17-31 years ($M = 19.5$ years). Two

participants reported being diagnosed with a voice disorder or a laryngeal pathology, and three mentioned participating in previous speech or voice therapy.

Participants reported an average of 5.2 years of individual voice instruction: 0 -3 years ($n = 18$, 26.9%), 4 - 6 years ($n = 27$, 40.3%), 7-9 years ($n = 15$, 22.4%), and 10+ years ($n = 7$, 10.4%). Fourteen of the 30 (46.6%) senior participants reported completing a vocal pedagogy course. No freshmen had completed a vocal pedagogy course. The School of Music described its vocal pedagogy course as an introductory study of the art of singing. Upon completion of the course, the School expected students to demonstrate a working knowledge of the anatomy and physiology of the vocal mechanism as it relates to singing, and competency in working with voices of all ages in a studio setting. Additionally, vocal development, voice disorders and vocal hygiene were listed as course objectives.

Among listed professionals who may have provided them with education and/or information regarding the function and care of the voice, 88.1% ($n = 59$) of participants reported a private voice instructor, 82.1% ($n = 55$) listed a choir director, 56.7% ($n = 38$) mentioned a classroom teacher, 3.0% ($n = 2$). 13.4% ($n = 9$) reported "other," and 13.4% ($n = 9$) reported a speech-language pathologist. From a list of selected sources from which they may have obtained information/knowledge about the vocal mechanism and its care, over three-fourths (76.1%, $n = 51$) of the participants reported high school vocal instruction, 46.3% ($n = 31$) checked college voice instruction, 46.3% ($n = 31$) reported personal research/writing, 41.0% ($n = 27$) included the university's School of Music as a source of knowledge, 4.5% ($n = 3$) reported "other," and 1.5% ($n = 1$) included the university's Department of Communication Disorders and Sciences.

Survey Instrument

The researcher-designed questionnaire (see Appendix A) employed in this investigation was modified from an instrument developed by Braun-Janzen and Zeine (2009) to evaluate voice students' knowledge and awareness of the structure and function of the vocal mechanism, as well as vocal hygiene and behaviors. Braun-Janzen and Zeine recommended refining and modifying items so that technical and confusing questions would be presented clearly. They further stated that future research conducted with a "more refined questionnaire" might elucidate some of the "ambiguities and the overly technical" questions used (p. 477).

To avoid the ambiguities described by Braun-Jazen and Zeine (2009), we utilized only true/false knowledge based questions, fill-in demographic information, and Likert-type rating scales as applicable. Additional modifications included the addition of several knowledge based questions regarding anatomy and physiology, and a comparison of perceived qualifications of the voice instructor (VI) and the speech-language pathologist (SLP). The present study differed from Braun-Jazen (2009) in that it investigated singers only, specifically singers in training, and did not focus on differences between singers and non-singers. Prior to its administration, the second author met with the Director of the School of Music, who attested to the face validity of the questionnaire.

Section A of the instrument consisted of true-false questions designed to assess general knowledge of the anatomy and physiology of the vocal mechanism, as well as awareness of common voice disorders and pathologies. Of the 20 true-false items, 15 were modified from a questionnaire used in previous research (Braun-Janzen & Zeine, 2009), and 5 items were developed by the present authors based on

general knowledge of the area of voice (e.g., Colton, Casper & Leonard, 2006). We used all 20 true/false items to compute composite total knowledge (TK) scores, with items 1-8 contributing to the anatomy and physiology (AP) sub-scores and items 9-20 contributing to the pathology (PATH) sub-scores. For purposes of comparison, we converted the raw AP and PATH sub-scores to 100-point scales.

In Section B of the questionnaire, participants rated both their perceived knowledge (1 = *unknowledgeable*, 5 = *very knowledgeable*) and their interest in pursuing further knowledge (1 = *no interest*, 5 = *very interested*) relative to five areas: (a) vocal anatomy, (b) voice physiology, (c) vocal care, (d) detrimental vocal behaviors, and (e) disorders related to voice abuse or misuse.

Questionnaire Sections C and D included lists of 16 vocal behaviors. Six were considered “positive” behaviors (i.e., having a positive impact on the voice) and ten were considered “negative” behaviors (i.e., having a negative impact on the voice). Participants first rated (Section C) how frequently they engage in each behavior using a 5-point scale (i.e., 1 = *never*, 5 = *always*). Participants then rated (Section D) how positively or negatively (in their opinion) each of the same behaviors affects the voice and/or vocal quality using 5-point scales (1 = *most negative*, 5 = *most positive*).

Sections E, F, and G solicited information regarding voice instruction and related academic coursework. Section H consisted of various tasks performed by a speech-language pathologist (SLP) and/or a singing voice

instructor (VI). Participants rated how qualified they felt each professional would be to perform seven listed tasks (in their opinion) using a 5-point scale (1 = *not qualified*, 5 = *very qualified*). Section I solicited other demographic information such as sex, age, class rank, major/minor, and approximate number of hours per week spent singing and talking. Participants also answered questions regarding any prior voice disorders, laryngeal pathologies, as well as speech or voice therapy services they may have received.

Results

We report results according to tabulated questionnaire responses disaggregated by major topics: (a) vocal mechanism knowledge, (b) perceived knowledge levels, (c) effect and frequency of vocal behaviors, and (d) perceived speech-language pathologist and voice instructor qualifications. All statistical tests were two-tailed. A pre-determined alpha level of .05 indicated significance.

Vocal Mechanism Knowledge

Section A of the questionnaire assessed the participants’ current knowledge of the vocal mechanism. See Table 1 for mean, standard deviation and standard error values of total knowledge (TK) scores (questions 1-20), anatomy and physiology knowledge (AP) scores (questions 1-8), and pathology knowledge (PATH) scores (questions 9-20).

Table 1. Means, Standard Deviations, and Standard Errors for Respondents' ($N = 67$) Composite Scores and Sub-Scores on Questionnaire Items 1 - 20, Disaggregated by Year in School

	Freshmen ($n = 38$)			Seniors ($n = 29$)		
	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>M</i>	<i>SD</i>	<i>SE</i>
TK	66.45	14.28	2.32	78.10	9.49	1.76
AP	60.45	20.31	3.29	79.17	15.26	2.83
PATH	70.79	16.24	2.64	77.90	11.89	2.21

Note. TK = Total Knowledge Composite Scores, AP = Anatomy & Physiology Sub-Scores, PATH = Vocal Pathology Sub-Scores. All scores based on a 100-point scale.

Results of an independent samples *t*-test revealed a significant difference in the mean TK scores between freshmen and seniors, $t(65) = -3.799$, $p < .001$. Freshmen TK scores exhibited a wider range (40 - 95 points) than senior TK scores (55-100 points), indicating increased variability of scores among freshmen. Results also yielded a significant difference in the mean AP scores between the freshmen and seniors, $t(65) = -4.148$, $p < .001$. However, we found no significance between the freshmen and seniors in mean PATH scores, $t(65) = -1.984$, $p = .051$, although this group difference did approach significance.

Additionally, a paired *t*-test revealed that both freshmen and seniors demonstrated significantly higher mean PATH scores than mean AP scores, $t(66) = 2.004$, $p = .049$. An independent samples *t*-test revealed a significant difference between the mean TK scores of seniors who reported taking a course in vocal pedagogy and those seniors who did not, $t(27) = -2.659$, $p = .013$. There was also a significant difference between the mean AP scores of "vocal pedagogy seniors" and "no vocal pedagogy seniors," $t(27) = -3.467$, $p = .002$. However, there was no significant difference in mean PATH scores between vocal pedagogy seniors and no vocal pedagogy seniors, $t(27) = -.822$, $p = .418$. It should be noted that the

School of Music required voice students majoring in music performance to complete a vocal pedagogy course. However, voice students with other degree concentrations (e.g., music education, music therapy) could choose to take this course as an elective.

Lastly, a correlational analysis revealed a significant (albeit low), positive correlation between the mean TK scores and the mean total years of individual voice instruction reported by students ($r(65) = .243$, $p = .048$). However, there was neither a significant correlation between total years of individual voice instruction and mean PATH scores, $r(65) = .236$, $p = .055$, nor between total years of individual voice instruction and mean AP scores, $r(65) = .148$, $p = .232$. Results also revealed moderate, positive correlations between the number of years of college-level instruction and the mean TK scores, $r(65) = .362$, $p = .003$, as well as the mean AP scores, $r(65) = .405$, $p = .001$, both of which were significant. A low correlation between years of college-level instruction and the mean PATH scores was not significant, $r(65) = .190$, $p = .124$.

Perceived Knowledge Levels

In Section B, participants rated their perceived current level of knowledge on a five-

point scale (1 = *unknowledgeable*, 5 = *very knowledgeable*). An independent samples *t*-test revealed that seniors rated their knowledge levels significantly higher than freshmen did, $t(65) = -7.262, p < .001$. A Pearson product-moment correlation revealed a low, positive correlation between the mean TK scores and the mean perceived knowledge scores, $r(65) = .33, p = .007$.

Effect and Frequency of Vocal Behaviors

In Section C, participants reported how frequently they engaged in 16 vocal behaviors

using five-point scales (1 = *never*, 5 = *always*). In Section D, participants rated how positively or negatively they believed that each behavior affects the voice on five-point scales (1 = *most negative*, 5 = *most positive*). Table 2 combines data from questionnaire Sections C and D by presenting mean, standard deviation and standard error values for respondents' ratings of the perceived effects (positive or negative) of the listed behaviors and respondents' reported frequencies of engagement in those vocal behaviors.

Table 2. Means, Standard Deviations, and Standard Errors for Respondents' (N = 67) Reported Frequencies of Perceived Positive or Negative Effects of Specified Vocal Behaviors (Questionnaire Section D) and Reported Frequencies of Engagement in These Behaviors (Questionnaire Section C), Disaggregated by Year in School

	Freshmen (n = 38)			Seniors (n = 29)		
	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>M</i>	<i>SD</i>	<i>SE</i>
Positive Effect	4.38	.38	.03	4.30	.71	.13
Positive Frequency	3.16	.58	.09	3.46	.59	.11
Negative Effect	1.86	.67	.11	1.97	.90	.17
Negative Frequency	2.24	.44	.07	2.26	.46	.09

Note: Positive Frequency denotes students' reported frequencies of perceived positive vocal behaviors. Negative Frequency denotes students' reported frequencies of perceived negative vocal behaviors.

An independent samples *t*-test revealed a significant difference between freshmen and seniors' reported frequencies of behaviors positively affecting the voice, $t(65) = -2.079, p = .042$. However, there was no significant difference between frequency of negative behaviors reported by freshmen and seniors, $t(65) = -1.49, p = .882$.

Responses overall yielded no significant correlation between mean rating of perceived effects and reported frequency of behaviors that may have a negative impact on the voice, $r(65) = .006, p = .485$. Likewise, we found no

significant correlation between the mean rating of perceived effects and reported frequency of behaviors that have positive effects on the voice, $r(65) = .065, p = .606$.

Perceived Speech-Language Pathologist and Voice Instructor Qualifications

Participants rated how qualified they felt a SLP and a VI were to perform the following tasks: (a) educating student/singer on care of voice, and increasing awareness, (b) introducing vocal warm-ups and exercises, (c) working

towards reducing tension in the larynx and neck area, (d) diagnosing pathologies affecting the larynx, (e) facilitating raising or lowering the

pitch of a person's speaking voice, (f) diagnosing voice disorders, and (g) providing voice therapy. See Table 3.

Table 3. Means, Standard Deviations, and Standard Errors for Respondents' ($N = 67$) Ratings by Task for Speech-Language Pathologists (SLP) and Singing Voice Instructors (VI)

	SLP			VI		
	<i>M</i>	<i>SD</i>	<i>SE</i>	<i>M</i>	<i>SD</i>	<i>SE</i>
EDU	3.94	1.12	.14	4.63	.66	.08
INTRO	2.97	1.22	.15	4.86	.40	.05
REDUCE	4.30	.91	.11	4.38	.87	.11
Dx PATH	4.54	.93	.12	3.11	.25	.16
PITCH	3.78	1.24	.16	3.97	1.03	.13
Dx VOICE	4.50	1.01	.13	3.13	1.33	.17
THERAPY	4.46	1.03	.13	3.25	1.23	.16

Note. EDU = educating on care of voice, INTRO = introducing vocal warm ups and cool downs, REDUCE = working toward reduction of tension in larynx and neck, Dx PATH = diagnosing laryngeal pathologies, PITCH = facilitating the raising or lowering of speaking voice fundamental frequency, Dx VOICE = diagnosing voice disorders, THERAPY = providing voice therapy.

Paired *t*-tests revealed a significant difference between ratings of the two types of professionals for Task 1 (EDU), $t(65) = -4.381$, $p < .001$; Task 2 (INTRO), $t(65) = -11.790$, $p < .001$; Task 4 (Dx PATH), $t(65) = 7.404$, $p < .001$; Task 6 (Dx VOICE), $t(65) = 6.418$, $p < .001$; and Task 7, $t(65) = 6.656$, $p < .001$. However, we found no significant group differences for tasks 3 (REDUCE), $t(65) = -.608$, $p = .546$; or 5 (PITCH), $t(65) = -.979$, $p = .331$.

Discussion

Results of this study, although limited to the questionnaire, procedures, and participants in the investigation, present several matters for discussion and future research. Notably, seniors participating in this study demonstrate a significantly more comprehensive knowledge base than freshmen in terms of mean total knowledge and mean anatomy and physiology

scores, as well as in the frequency of engagement in reported positive or proactive vocal behaviors. These seniors also report significantly more confidence in their knowledge of the voice than freshmen. These findings confirm the first hypothesis we posed, namely that students nearing the end of their undergraduate studies would be more informed than students near the beginning of their undergraduate careers, which is good news in terms of the voice education afforded by this School of Music.

Seniors who report having taken a vocal pedagogy course perform significantly better than seniors who do not report such a course. This finding tends to confirm with the whole population of senior voice students at one university what some previous studies that included selected undergraduate seniors (e.g., Broadus-Lawrence, et al., 2000; Timmermans, et al., 2005a) have found, namely that singers

who have experienced a course or program that addresses voice physiology and vocal hygiene perform better on various measures of voice knowledge than singers who have not experienced such courses or programs. If borne out by subsequent studies with other populations of university students, this finding may prompt universities to consider requiring a course in voice pedagogy for all students whose primary applied music focus is voice, regardless of degree program. More research is needed to assess what particular content in vocal pedagogy courses abets higher scores on voice knowledge inventories.

Interestingly, our results indicate no significant group differences between seniors and freshmen on mean voice pathology sub-scores. Both groups appear reasonably well informed on the matters addressed by the voice pathology items appearing on our questionnaire, and both groups score higher on these items than on matters pertaining to vocal anatomy and physiology. The mean vocal pathology sub-scores of seniors (78 points) and freshmen (71 points) suggest that these seniors may tend to demonstrate somewhat more knowledge regarding laryngeal pathologies than freshmen, a trend that future research with other populations might explore.

However, the fact that both groups answer correctly over 70% of the items dealing with voice pathologies naturally raises the question of where freshmen, who are just beginning their university vocal studies without opportunity as yet to take a course in vocal pedagogy, obtain their information. Over 80% of participants report a private voice instructor and/or a choir director as a primary source of education and information about the voice. Thus, it might be conjectured initially that these professionals, either during the first year of university studies or sometime during the high school years, address matters related to voice pathologies and vocal care. Yet, we find no significant correlation between total years of private voice

instruction and mean sub-scores on voice pathology items, and no significant correlation between total years of private voice instruction at the university level and voice pathology scores. This puzzle presents an interesting direction for future research.

The significant (albeit low) correlation between total voice knowledge scores and years of private voice instruction suggests that private voice instruction can contribute to some extent to students' overall vocal knowledge. Future studies might address specifically potential relationships between voice knowledge and years of private voice instruction during the high school years. Subsequent studies might explore as well the knowledge levels of high school voice instructors and choir directors. Interestingly, we did not find a significant correlation between total years of private voice study and mean anatomy and physiology sub-scores, although our findings evidence a significant, moderately strong correlation between total years of university voice lessons and mean anatomy and physiology sub-scores.

This moderate association between total years of university voice instruction and the mean total knowledge scores and the mean anatomy and physiology sub-scores may reflect a distinction between instructional content at the university and high school levels. Alternatively, this association may have been skewed by the seniors who had taken a vocal pedagogy course in addition to presenting more years of private voice lessons at the university level.

Our findings indicate no significant group differences between freshmen and seniors with respect to their ratings of the effects (positive or negative) of various behaviors on the voice. Both groups appropriately identify such behaviors as vocal rest, exercise, use of humidifier, vocal warm-ups, water intake) as having a relatively positive effect. Similarly, both groups appropriately identify such behaviors as loud, prolonged talking, excessive singing, coughing, throat clearing, and

consumption of alcohol and caffeine as having a relatively negative effect on efficient voicing. This finding in conjunction with the relatively high sub-scores of both freshmen and seniors on voice pathology items suggests that, these students are receiving some generally appropriate and accurate information about proactive voice care. Although heartening, future studies might explore the sources of this information particularly among freshmen.

As is the case with findings from some previous studies (e.g. Timmermans, et al., 2005a), participants in the present investigation may not always practice what they know. Freshmen, for instance, report engaging in positive vocal behaviors significantly less frequently than seniors. Yet, we find no significant difference between freshmen and seniors with respect to reported frequencies of engagement in negative vocal behaviors. Moreover, given the absence of significant correlations between student ratings of the perceived effects of particular vocal behaviors (both positive and negative) and the reported frequencies in which they engage in these particular behaviors, findings of this study appear to suggest a possible disconnection between perceived knowledge and reported practice. Singing teachers may wish to consider this possibility when deciding how much emphasis to place on monitoring potentially harmful vocal behaviors during weekly singing lessons.

Students participating in this study clearly understand the benefits of training with a qualified voice instructor. But they do not appear to be fully aware of the supplemental services that can be provided by an SLP or other professional, who may provide them with information, training and services relating to the voice. This finding accords with results reported by Braun-Janzen and Zeine (2009) and Kovacic and Budjanovac (2003). Mean ratings by participants in this study, moreover, incorrectly attributed to voice teachers an ability to

diagnose pathologies affecting the larynx. This finding may suggest that further exposure during university years to the increasingly transdisciplinary nature of singing voice habilitation and rehabilitation may be warranted, particularly with respect to the respective roles that singing teachers, speech-language pathologists, and medical professionals are qualified to assume as they work together to benefit young singing students. It is important to note that ASHA recommends a multidisciplinary approach wherein speech-language pathologists, singing teachers, and voice trainers are involved in an integrated approach to promote optimal voice care and production for recovery (ASHA, 2005).

Although we employed a questionnaire modified from an instrument used in previous research (Braun-Janzen and Zeite, 2009), future investigations should use instruments more thoroughly assessed for content validity and for reliability across various populations of university voice students and others. One avenue of further research is the development of such an instrument. Future studies might also consider a longitudinal approach to assessing voice knowledge. Re-administering a survey instrument to the same students during each year of their university training could provide useful data. • IJRCS

Acknowledgments

The authors extend gratitude to the voice students and faculty for their participation in this study. We also acknowledge Christina Territo for editorial revising and formatting, and for assisting with administering the survey; Dr. Kim Tillery for her critical review and editorial comments; and David Rehfeld for his assistance in editing the final manuscript.

Institutional Review Board Approval and Compliance

The authors obtained approval from an appropriate Institutional Review Board to conduct this research in a manner that assured the ethical treatment of participants and the confidentiality of participant information.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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Appendix A

Knowledge and Awareness of the Vocal Mechanism and Care among University Voice Majors

A. For each of the following items, please indicate if each statement is correct by circling True, or incorrect by circling False

1. The primary muscle of inhalation is the diaphragm.
True False
2. Yawning raises the larynx (voice box) and tenses the muscles that surround the throat.
True False
3. Falsetto singing requires stretching of the vocal folds (vocal cords).
True False
4. The vibratory rate of the vocal folds (vocal cords) is measured as fundamental frequency.
True False
5. Fundamental frequency is perceived (heard) by the listener as loudness.
True False
6. The basic mechanism for healthy phonation is essentially the same for singing and for speaking.
True False
7. The glottis is a cartilage in the larynx.
True False
8. The soft palate (velum) must be raised when singing nasal sounds (*n, m, ng*).
True False
9. Vocal nodules (nodes) are more common in females than males.
True False
10. Vocal nodules (nodes) most commonly occur on only one vocal fold/cord.
True False
11. Vocal nodules (nodes) are typically acquired gradually.
True False
12. Vocal nodules (nodes), if left untreated, may progress into laryngeal cancer.
True False
13. Common drugs (e.g., antidepressants, antihistamines, diuretics) have the potential to be detrimental to the voice.
True False
14. Polyps on the vocal folds (cords) may develop suddenly, after an isolated incident of vocal misuse/abuse.
True False
15. Those who experience chronic heartburn and/or gastroesophageal reflux may also experience irritation of the larynx.
True False

16. Contact ulcers are more common in females than males.

True False

17. Singers with early stage nodules (nodes) will often report difficulty in register transitions.

True False

18. Voice therapy to modify vocal behavior is not beneficial for early stage nodules (nodes).

True False

19. The preferred treatment for early stage laryngitis is complete vocal rest until the symptoms subside.

True False

20. Improper singing and/or speaking are both possible causes of a voice disorder.

True False

B. For each area listed below, please indicate your level of current knowledge using the following 1-5 scale (1=unknowledgeable & 5=knowledgeable)

For each area listed below, please indicate your level of interest in increasing your personal knowledge using the following 1-5 scale (1=no interest & 5=very interested)

1. Structure (anatomy) of the vocal mechanism	Current	1	2	3	4	5
2. Function (physiology) of the vocal mechanism	Current	1	2	3	4	5
3. Care of the vocal mechanism (voice)	Current	1	2	3	4	5
4. Vocal behaviors that may be detrimental to the voice	Current	1	2	3	4	5
5. Vocal disorders relating to abuse, misuse and/or overuse	Current	1	2	3	4	5

1. Structure (anatomy) of the vocal mechanism	Interest	1	2	3	4	5
2. Function (physiology) of the vocal mechanism	Interest	1	2	3	4	5
3. Care of the vocal mechanism (voice)	Interest	1	2	3	4	5
4. Vocal behaviors that may be detrimental	Interest	1	2	3	4	5
5. Vocal disorders relating to abuse, misuse and/or overuse	Interest	1	2	3	4	5

C. Using a scale of 1-5 (1 = never and 5 = always), please indicate how often YOU do each of the following behaviors:

1. Loud, prolonged talking/speaking	1	2	3	4	5
2. Excessive singing	1	2	3	4	5
3. Yelling and/or screaming	1	2	3	4	5
4. Excessive throat clearing	1	2	3	4	5
5. Vocal rest	1	2	3	4	5
6. Excessive coughing	1	2	3	4	5
7. Exercise/ Physical Activity	1	2	3	4	5
8. Smoking	1	2	3	4	5
9. Using a humidifier	1	2	3	4	5

10. Talking and/or singing over loud noises	1	2	3	4	5
11. Talking and/or singing in smoky environment	1	2	3	4	5
12. Vocal warm-ups and/or cool downs	1	2	3	4	5
13. Drinking alcohol	1	2	3	4	5
14. Drinking caffeinated beverages	1	2	3	4	5
15. Drinking water	1	2	3	4	5
16. Adequate sleep	1	2	3	4	5

D. Using a scale of 1 to 5 (1 = most *negative* and 5 =most *positive*) please rate how each of the following behaviors affect the voice and/or vocal quality, in YOUR opinion:

1. Loud, prolonged talking/speaking	1	2	3	4	5
2. Excessive singing	1	2	3	4	5
3. Yelling and/or screaming	1	2	3	4	5
4. Excessive throat clearing	1	2	3	4	5
5. Vocal rest	1	2	3	4	5
6. Excessive coughing	1	2	3	4	5
7. Exercise/ Physical Activity	1	2	3	4	5
8. Smoking	1	2	3	4	5
9. Using a humidifier	1	2	3	4	5
10. Talking and/or singing over loud noises	1	2	3	4	5
11. Talking and/or singing in smoky environment	1	2	3	4	5
12. Vocal warm-ups and/or cool downs	1	2	3	4	5
13. Drinking alcohol	1	2	3	4	5
14. Drinking caffeinated beverages	1	2	3	4	5
15. Drinking water	1	2	3	4	5
16. Adequate sleep	1	2	3	4	5

E. From the following list, please choose the professionals who have provided you with education and/or information regarding the function and care of your voice (check all that apply)

- | | |
|---|---|
| <input type="checkbox"/> Private voice instructor | <input type="checkbox"/> Speech-language pathologist |
| <input type="checkbox"/> Choir director | <input type="checkbox"/> Other, please specify: _____ |
| <input type="checkbox"/> Classroom teacher | <input type="checkbox"/> None |

F. From the following list, please check any/all sources from which YOU have received information or gained knowledge about the vocal mechanism and vocal care (hygiene) (check all that apply)

- Academic course(s) through SUNY Fredonia’s School of Music
- Academic course(s) through SUNY Fredonia’s Communication Disorders and Sciences department

- Private instruction/voice lessons (please check all that apply)
- During high school During college
- Individual and/or personal reading and research
- Other, please specify: _____

G. Please check any/all academic courses (or equivalent courses) you have taken (check all that apply):

- SPA 310: Speech and Hearing Mechanism Other, please specify: _____
- SPA 316: Speech Science Non
- MUS 344: Vocal Pedagogy

H. For each of the following items, and for each profession (i.e., speech-language pathologist = SLP and voice instructor = VI) please use a rating scale of 1 to 5 (1 = not qualified and 5 =very qualified) to rate how qualified YOU feel each professional is for the listed task

	1. Educating student/singer on care of voice, and increasing awareness										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	2. Introducing vocal warm-ups and vocal exercises										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	3. Working towards reducing tension in the larynx and neck area										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	4. Diagnosing pathologies affecting the larynx										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	5. Facilitating raising or lowering the pitch of a person's speaking voice										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	6. Diagnosing voice disorders										
SLP	1	2	3	4	5	VI	1	2	3	4	5
	7. Providing voice therapy										
SLP	1	2	3	4	5	VI	1	2	3	4	5

I. Demographic information:

Age: _____

Gender (please circle):
 Male Female
 Bass

Voice type (please circle):
 Soprano Alto Tenor

Major: _____

Minor: _____

Class rank:

- freshmen
- sophomore
- junior

- senior
- graduate student

How many years of COLLEGE voice instruction have you received? _____years HIGH SCHOOL instruction?
_____years

How many years (total) of individual voice instruction have you had (your entire life)? _____

How many years (total) have you participated in a choir, chorus, or other singing ensemble? _____

Please indicate how many hours per DAY, on average, you spend singing

- 1-3 hours
- 4-6 hours
- 7-10 hours
- 10+ hours

Please indicate how many hours per DAY, on average, you spend speaking /talking

- 1-3 hours
- 4-6 hours
- 7-10 hours
- 10+ hours

Please answer the following items: (optional)

Have you been ever been diagnosed with a vocal disorder and/or a laryngeal pathology?

- YES
- NO

If yes, what was the diagnosis? _____

Have you ever received speech and/or voice therapy, from a speech-language pathologist?

- YES
- NO

If yes, *at what age* _____

Diagnosis: _____

For *how long* were services provided? _____