

Factors Associated With Singers' Perceptions of Choral Singing Well-Being



Q13 *[†]Elliana R. Kirsh, [†]Eva van Leer, [‡]Heidi J. Phero, [§]Changchun Xie, and [†]Sid Khosla, *[†]§||Cincinnati, Ohio

Summary: Objectives. Choral singing is a popular vocational pastime across cultures. The potential health benefits associated with choral singing, including positive effect on well-being, are a topic of interest in health research. However, anecdotal reports from voice professionals suggest that the unique demands of choral singing may enforce unhealthy singing habits. This study explores suboptimal vocal behaviors that are sometimes associated with choral singing, which include singing outside comfortable pitch range, singing too loudly, and singing too softly for blend.

Methods. The relationships between suboptimal choral singing habits, vocal warm-ups (WUs), vocal fatigue, and singing-related well-being were assessed via a 14-item Likert-based response format questionnaire. Participants consisted of 196 attendees of the international World Choir Games. The final study group consisted of 53 male and 143 female international amateur singers aged 10–70.

Results. Results indicated a positive correlation between vocal fatigue and suboptimal singing behaviors ($r = 0.34$, $P < 0.0001$). Participants who did not engage in suboptimal singing behavior experienced increased singing-related well-being ($r = -0.32$, $P < 0.0001$, $N = 141$). Vocal WUs were not related to vocal fatigue or singing well-being. Substantially, more participants from this demographic preferred choir over solo singing ($X^2[1, N = 196] = 22.93$, $P < 0.0001$).

Conclusion. Suboptimal choral singing behaviors may result in vocal fatigue and reduction of choral singing well-being and should therefore be considered when examining the effect of choral singing on singing-related well-being and health. Future research will compare the amateurs' perceptions of choral singing with perceptions from professional singers and will look at determinants of choral singing well-being.

Key Words: Choral singing—Vocal fatigue—Amateur choir.

Q4 INTRODUCTION



Prevalence of choral singing

Music plays a large role in the history and culture of many societies, often formally incorporated into various life events. In particular, group singing is an extremely prevalent form of music making in many cultures.¹ Ethnomusicologists have postulated that the origin of human polyphonic singing, or group singing with multiple pitches sounding simultaneously, may be intimately related to the evolution of human language, speech, and intelligence.² Perhaps because of this relationship, nearly every culture in the world has exhibited some tradition of group singing. In this article, group singing is defined as a polyphonic social activity, unassociated with any specific artistic level and distinct from monophonic solo singing.²

The social and musical factors of group singing contribute to its widespread prevalence. This popularity was recently recognized by the advent of the World Choir Games (WCG), a competitive choral singing event modeled after the Olympic ideals. In July 2012, 15 000 amateur singers, making up 362 choirs

from 64 countries, traveled to Cincinnati, Ohio, to participate in this event. This event served as the data collection site for the reported study.

Choral versus solo singing

Solo singing and choral singing are distinct styles of musical performance that differ acoustically because of varying spectral characteristics, sound levels, and phonation frequency. These acoustic differences translate to separate technical demands. Thus, when studying the demands related to singing technique, it is important to analyze solo and choral singing separately.

The choral singer must blend with an ensemble, whereas the solo singer must do the opposite.³ In learning Western classical vocal technique, solo singers develop strategies that enhance specific penetrating vocal qualities, so that the voice will be heard over powerful accompaniments.³ Most soloists also use vibrato, which aids in the perception of the voice as separate from the accompaniment.

To achieve optimal choral sound, the choral singer must continually match loudness, pitch, and voice timbre (ie, individual's characteristic tone color determined by harmonic partials⁴) with the group average.³ One of the greatest challenges in monitoring loudness is balancing the need to hear one's own voice with the need to blend with other voices. Additionally, choral singing requires pitch intonation or the individual production of a stable target frequency that matches the fundamental frequency of the choir. Choral singers are often asked to produce tones with as little frequency variation as possible, colloquially termed "straight tones," which require limited vibrato.⁵ Finally, optimal choral timbre requires uniformity of vowel pronunciation.³ This

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From the *Department of Voice, College-Conservatory of Music, University of Cincinnati, Cincinnati, Ohio; †Department of Otolaryngology, Head and Neck Surgery, University of Cincinnati, Cincinnati, Ohio; ‡Department of Communication Sciences and Disorders, College of Allied Health Sciences, University of Cincinnati, Cincinnati, Ohio; §Division of Epidemiology and Biostatistics, Department of Environmental Health, University of Cincinnati, Cincinnati, Ohio; and the ¶Center for Clinical and Translational Science and Training, University of Cincinnati, Cincinnati, Ohio.

Address correspondence and reprint requests to Eva van Leer, Department of Otolaryngology, Head and Neck Surgery, University of Cincinnati Academic Health Center, 231 Albert B. Sabin Way, MSB Room 6307B, Cincinnati, OH 45267-0528. E-mail: ellianarkirsh@gmail.com

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uniformity maximizes timbral contrasts between vowels and promotes consistency in loudness and pitch.

It is prudent to address anecdotal reports expressing concern for solo singers that alternate between the two styles of singing. Although the solo singer will retain many concepts, such as breath support, posture, range, typical aperture of the mouth and throat, and laryngeal flexibility,⁶ certain techniques, including diction, resonance, vibrato, vowel modification, and articulation, will be different in a choral context.⁷ In the choral setting, these techniques are carefully adjusted to achieve optimal blend; in the solo setting, these techniques are modified to enhance upper partials and maximize individuality of timbre.⁵ Thus, the goals of solo singing and choral singing may even be in conflict for a trained solo singer with developed upper partials.⁵

One of the goals of this study was to examine whether a preference for solo singing affects singing technique. Because choral singing frequently requires altering voice quality used for solo singing, it was hypothesized that solo singers would report altering singing technique in the choral setting. Considering the site of data collection, however, it was hypothesized that most singers in this demographic would prefer choral singing to solo singing and not report altering singing technique.

Suboptimal vocal behaviors in the choral setting

In the voice community, it is thought that the choral style places unique technical demands on singers that may cause suboptimal singing habits. Typical suboptimal singing habits associated with choir singing include singing too softly for blend, singing straight tone for blend, singing too loudly to carry a section, and singing outside one's comfortable pitch range. Anecdotal reports have hypothesized that these habits may cause vocal fatigue.^{5,8} In this study, vocal fatigue was defined as "a perception by the voice user, manifested primarily as a sense of increased vocal effort that increases over time with voice use, and subsides with voice rest."⁹ Singing too softly for blend, especially when combined with singing straight tone technique, may be harmful or vocally fatiguing for singers when induced via increased muscle tension and insufficient breath support.³ Excessive loudness is potentially damaging or fatiguing because aggressive treatment of the vocal folds can result in increased sensitivity and vocal injury.⁸ Singing outside the appropriate range is potentially damaging or fatiguing because it can promote laryngeal strain.¹⁰⁻¹²

Anecdotal and preliminary evidence from voice health professionals suggests that vocal warm-ups (WUs) may improve vocal function, whereas the absence of WUs may result in reduced vocal quality or fatigue.¹³⁻¹⁵ During a WU period, different aspects of singing technique, such as physical readiness of posture and breath, healthy vocal production, standards for vowel unification and harmonic/melodic intonation, and vocal development, are typically addressed in a variety of musical vocalizations.¹⁶ Suggested vocalizations differ depending on the age and skill of the singers in the choir,¹⁷ yet general WU recommendations include (1) glides, scales, or arpeggios with a partially occluded vocal tract, (2) two-octave pitch glides (up and down) using high vowels (eg,

/i/), (3) scales using forward tongue roll extensions (*/a/ to /i/*), and (4) staccato singing.¹⁸ This portion of the vocal WU allows singers to attend to voice production without the complications of ensemble singing and repertoire.¹⁷ A number of recent investigations have demonstrated evidence that vocal WUs are beneficial to objective vocal quality, phonation threshold pressure, static frequency production, formant amplitude, and general vocal performance.^{15,18} A recent study also indicated that vocal WUs might improve vibrato rate, which is linked to tone quality.¹⁹ However, the effects of vocal WUs remain largely undefined, as many other recent investigations on the benefits of vocal WUs have obtained inconclusive or statistically insignificant results.^{13,14}

In addition to possible vocal health benefits, vocal WUs in the choral setting serve to establish mental focus in the rehearsal and advance ongoing vocal/musical development.¹⁶ Specifically, choral vocal WU exercises are thought to enhance aural awareness and familiarize choral members with upcoming repertoire.¹⁷ Preparation to listen is achieved via the intentional inclusion of listening exercises and activities, which are essential to the development of aural cognizance and healthy singing techniques associated with ensemble balance and choral blend. Finally, WU exercises may serve to enrich singers' skills in music reading, conceptual learning, and musical expression.¹⁶

Although it is widely known that choral conductors and music educators acutely appreciate the benefits of WU groups, it is also generally recognized that WUs are not completed consistently for a variety of reasons, as indicated by the extensive literature that continually admonishes directors to initiate rehearsal with WU.¹⁶ In this study, vocal WU was examined to determine the prevalence of reported effective vocal WU among international amateur choirs and observe the relationship between reported effective WU and reported vocal fatigue. It is hypothesized that conditions in which vocal WUs are absent or reported ineffective could potentially lead to reported vocal fatigue among choir participants, whereas reports of effective vocal WU would be inversely correlated with reported vocal fatigue.

Although anecdotal reports of suboptimal vocal behavior in amateur choirs are prevalent, there is a lack of empirical evidence on this topic. The authors are not aware of any previous studies that have empirically addressed the relationship between suboptimal singing behavior and vocal fatigue in the choir setting. In this study, we examine the prevalence of these issues through self-report.

Improving general well-being

There is a long history of anecdotal evidence supporting the potential health benefits of singing, yet a dearth of empirical research.¹ Empirical investigation over the past few decades has addressed the possible psychophysiological effects of group singing, specifically its effect on general quality of life and wellness.^{1,20,21} Limitations of these studies include lack of common understanding of well-being and health as well as the absence of a theoretical model that links singing and well-being. However, many present studies have attempted to



231 overcome these issues via large cross-national surveys of choral
232 singers based on the World Health Organization definition of
233 health, or “a state of complete physical, mental and social
234 well-being and not merely an absence of illness or infir-
235 mity.”^{22,23} In this study, a sense of well-being from choral sing-
236 ing was defined as feeling generally relaxed after participation
237 in choir and believing that choir positively affects quality of
238 life.

239 Qualitative self-report studies on the benefits of group sing-
240 ing have tested diverse populations of singers, and each has
241 provided a range of subjective reports that indicate the potential
242 social, psychological, and health benefits. It is thought that
243 singing improves lung function and provides general social,
244 emotional, physical, and spiritual benefits.²³ A cross-national
245 survey of choral singers in England, Australia, and Germany,
246 reported six “generative mechanisms” by which singing affects
247 well-being and health: positive affect, focused attention, deep
248 breathing, social support, cognitive stimulation, and regular
249 commitment.²³ Another self-report study assessed the attitudes
250 of university college students via preliminary surveys and
251 found that students benefited from “meeting new people, feel-
252 ing more positive, increased control over breathing, feeling
253 more alert, and feeling spiritually uplifted.”²³ Other studies
254 have focused on improving the quality of life and general
255 wellness of older adults. Studies of singing in the geriatric pop-
256 ulation have shown that choral singing improves a sense of con-
257 trol or mastery and meaningful social engagement. These
258 improvements precipitate positive health outcomes, measured
259 empirically in one study via assessment questionnaires and
260 other self-report measures, such as improved ratings of physical
261 health, fewer doctor visits, less medication use, and fewer in-
262 stances of falls.²⁴

263 A few studies have delved beyond self-report methods to
264 demonstrate the psychoneuroimmunological benefits of group
265 singing. The quality of life and lung function of patients with
266 cancer was found to improve after participation in an amateur
267 choir.²⁵ In healthy individuals, participation in a choir has
268 been found to increase positive effect and secretory immuno-
269 globulin A, indicating that group singing may have positive ef-
270 fects on immune competence and emotional stress levels.²⁶
271 Although additional study is required, this research may inspire
272 new treatment methods for improving health and wellness
273 across a variety of populations.

274 Purpose

275 The purpose of this study was threefold: (1) to identify relation-
276 ships between common suboptimal vocal behaviors and vocal
277 fatigue, (2) to investigate the effect of suboptimal choral sing-
278 ing on singing-related well-being, and (3) to determine if a pref-
279 erence for solo singing has any impact on reported singing
280 technique. Hypotheses were the following: (1) typical subopti-
281 mal singing behaviors associated with choral singing will result
282 in vocal fatigue, (2) healthy singing is associated with good
283 singing-related well-being, and (3) most amateur singers will
284 prefer choral singing, whereas most solo-trained singers will
285 prefer solo singing, and most solo singers will alter singing
286 technique when changing tasks.
287

METHOD

288 The questionnaire and methods were determined not to be hu-
289 man research requiring University of Cincinnati Institutional
290 Review Board review on July 25, 2012.
291

Participants

292 Participants consisted of 196 attendees of the international
293 WCG in Cincinnati. Participants were asked to complete a short
294 questionnaire. For the purposes of this study, “amateur vocalist”
295 referred an individual cultivating the study of voice as a pastime,
296 with no significant intention of pursuing a career in singing.
297 Despite their international background, all WCG attendees
298 who participated in this study were proficient in English. Three
299 participants were excluded from the study because of incom-
300 plete data. The final study group consisted of 53 male and 143
301 female international amateur singers aged 10–70.
302

Questionnaire development

303 A questionnaire was developed to capture singers' perspectives
304 on choral singing through their self-report. A copy of the ques-
305 tionnaire can be found in [Appendix A](#). The questionnaire com-
306 prises 37 questions, which included nine yes/no questions, 14
307 open-ended questions, and 14 questions with a Likert-based re-
308 sponse format. The first section contained 23 questions that as-
309 sessed background information, including vocal background
310 (such as voice type and professional voice use), vocal health
311 history, and solo/choir singing preference. The second section
312 consisted of 14 questions that used a five-point Likert-based re-
313 sponse format. This response format was chosen because of its
314 balance and availability of a neutral center item. Questions in
315 this section addressed four topics: vocal fatigue, suboptimal
316 singing, well-being, and vocal WUs. Questions regarding vocal
317 fatigue, suboptimal singing, and WUs were developed to ad-
318 dress common concerns of the choral singing population.²⁷
319 Two questions, 10 and 12, concerned singers' perspectives on
320 the effect of choral singing on well-being. These questions
321 were adapted or copied in working and content from the Effects
322 of Singing questionnaire developed by Clift and Hancox.²³
323

324 In this study, information on suboptimal vocal behavior was
325 measured via questionnaire items describing singing outside
326 comfortable pitch range (questions 29 and 32), singing too
327 loudly (questions 31 and 34), and singing too softly for blend
328 (question 37). Thus, general suboptimal vocal behavior singing
329 was considered the combination of these related questionnaire
330 items (questions 29, 31, 32, 34, and 37). Information on vocal
331 fatigue was measured via questionnaire items that referred to
332 a vocally drained or vocally tired feeling after choir rehearsals
333 (question 28). Information on vocal WU was measured via
334 questionnaire items regarding the individuals' perceptions of
335 feeling warmed up (questions 27 and 28) as well as a free-
336 response question about what kind of WU exercises the choir
337 participants regularly perform (question 18). For the purposes
338 of this study, vocal WUs were considered “effective” when
339 the subject indicated feeling vocally warmed up for choir re-
340 hearsals and concerts. Finally, information on well-being was
341 measured via questionnaire items that referred to feeling gener-
342 ally relaxed after participation in choir, feeling a sense of
343
344

accomplishment and the satisfaction of team work after participation in choir, and believing that choir positively affects quality of life (questions 33, 35, and reverse score 30).

After 50 questionnaires were completed, the wording of question 33 was changed from “After choir rehearsals, I feel more rejuvenated than usual” to “Singing in choir is relaxing and helps me deal with stress” because several participants asked clarification regarding the meaning of the word “rejuvenated.” Responses to question 33 were then compared to determine if responses to the reworded question were similar. Mean responses for the “rejuvenated” wording were significantly higher (Kruskal-Wallis test $P = 0.0001$) at 2.7 (standard deviation [SD] = 0.76) than for the “relaxing” wording that yielded a mean score of 1.8 (SD = 1). Therefore, responses from the first 50 questionnaires were excluded from statistical analysis whenever question 33 was examined.

The readability of the resulting questionnaire was easy, as demonstrated by high values of the Flesch Reading Ease scores of 68.38 for the first section and 68.08 for the Likert section.²⁸

Procedure

Participants were recruited via personal invitation. Members of the research team approached WCG choir directors and requested permission to speak to choir members. After an explanation of the project, research team members administered printed questionnaires to choir members. Questionnaire data were entered into an Excel spreadsheet and statistically analyzed. In the event of missing data points, the following rule was followed: if the respondent did not answer a question, the question was given a “neutral” response; if the respondent answered a question twice and there were less than two spaces in between the answers, the mean value was recorded; if there were two or more spaces in between answers, the question was given a “neutral” response; if the respondent skipped more than two Likert scale questions, his or her responses were considered invalid and not used.

Statistical analysis

Questionnaire items were grouped by dimension (suboptimal vocal behavior, vocal fatigue, vocal WUs, solo singing, choral

singing, and well-being). For each construct, question scores were averaged to yield one resulting score per person. Thus, for well-being, participant scores on questions 33, 35, and reverse score 30 were averaged to yield a single well-being score. This well-being score was then used to calculate the correlation with other variables, such as vocal fatigue (question 30). Pearson correlation coefficients were calculated to identify significant relationships for each experimental hypothesis. Pearson correlation coefficients were also calculated between average dimension scores. Chi-square test was used when the two variables were binary variables. P value for significance was set at 0.05. Calculations were completed using SAS statistical software (version 9.2; SAS Institute, Inc., Cary, NC).

RESULTS

Table 1 provides a summary of related r and P values.

Suboptimal vocal behavior and vocal fatigue

Thirty-one percent of participants reported feeling vocally fatigued after choral singing. Within this group, reports of suboptimal vocal behaviors were moderately correlated with vocal fatigue ($r = 0.34$, $P < 0.0001$). Figure 1 shows a scatterplot of this finding.

Prevalence of each suboptimal vocal behavior was assessed by percentage and individual correlation with vocal fatigue. Thirty-five percent of participants reported singing outside their comfortable pitch range, and reports of this behavior were moderately correlated with vocal fatigue ($r = 0.34$, $P < 0.0001$). Fifty-one percent of participants reported singing too loudly, and reports of this behavior were weakly correlated with vocal fatigue ($r = 0.23$, $P = 0.0015$). Fifty-two percent of participants reported singing too softly for blending, yet the relationship between reports of this behavior and vocal fatigue was not significant ($r = 0.13$, $P = 0.0666$).

Most participants (81%) reported feeling vocally warmed up before choir rehearsals and concerts ($X^2[1, N = 196] = 75$, $P < 0.0001$). However, the relationship between singers who reported feeling warmed up and reported vocal fatigue was not significant ($r = -0.13$, $P = 0.0795$).

TABLE 1.
Pearson Correlations and Significance Levels of the Relationship Between Vocal Fatigue and Variables of Interest: Suboptimal Singing Behaviors, Healthy Singing, and Well-Being

Variable 1	Variable 2	Pearson Correlation Coefficient (r)	Significance (P)
Unhealthy singing (questions 29, 37, 31, 34, and 32)	Vocal fatigue (question 28)	0.34	<0.0001
Outside pitch range (questions 29 and 32)	Vocal fatigue (question 28)	0.34	<0.0001
Excessive loudness (questions 31 and 34)	Vocal fatigue (question 28)	0.23	0.0015
Extreme softness (question 37)	Vocal fatigue (question 28)	0.13	0.0666
Feeling warmed up (questions 26 and 27)	Vocal fatigue (question 28)	-0.13	0.0795
Healthy singing (inverse questions 29, 37, 31, 34, and 32)	Well-being (questions 33, 35, inverse 30)	0.32	<0.0001
Well-being (questions 33, 35, inverse 30)	Vocal fatigue (question 28)	-0.37	<0.0001

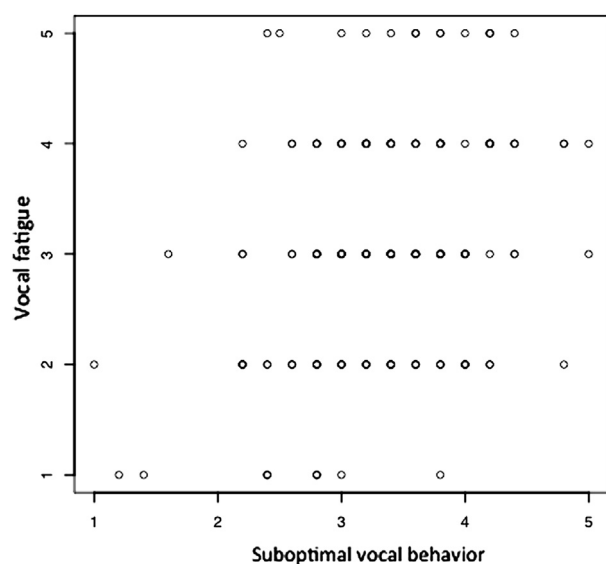


FIGURE 1. Pearson correlation between vocal fatigue and suboptimal behaviors.

Suboptimal singing and well-being

Reports of suboptimal singing were moderately negatively correlated with choral singing well-being ($r = -0.32$, $P < 0.0001$, $N = 141$). Figure 2 shows a scatterplot of this finding. Additionally, there was a moderate negative relationship between singers with a sense of well-being from choral singing and singers reporting vocal fatigue ($r = -0.37$, $P < 0.0001$, $N = 141$).

Choral singing and solo singing

Substantially, more participants from this demographic preferred choir to solo singing ($X^2[1, N = 196] = 22.93$, $P < 0.0001$). That is, 67.37% preferred choir singing, 19.47% preferred solo singing, and 13.16% enjoyed both styles.

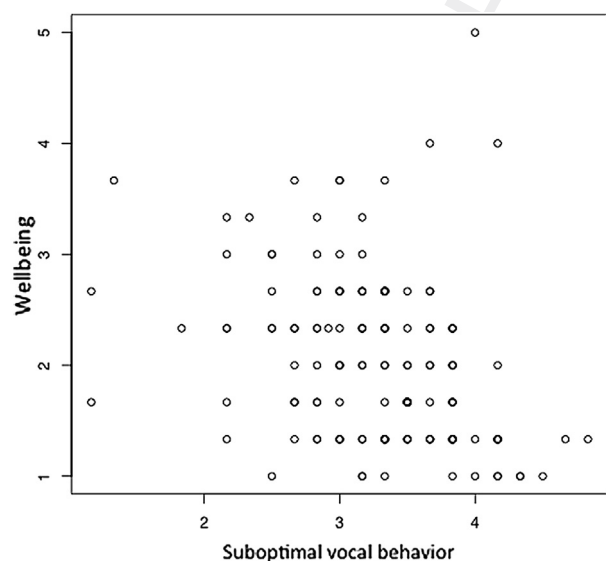


FIGURE 2. Pearson correlation between well-being and suboptimal vocal behavior.

Results indicated that 50% of participants actually sing both choral and solo styles. Seventy-two percent of these participants purposefully used different singing technique for each style. There was a relationship between singers who sing both solo and choral styles and singers who use different technique for each style ($X^2[1, N = 196] = 13.66$, $P = 0.0002$).

DISCUSSION

The purpose of this study was to identify relationships between typical suboptimal vocal behavior associated with choral singing, vocal fatigue, and choral singing well-being. We hypothesized that such behavior would be associated with vocal fatigue and a reduced sense of choral singing well-being. Our hypotheses were supported by the following main findings: (1) reports of suboptimal vocal behaviors were moderately correlated with reported vocal fatigue and (2) reports of suboptimal choral singing were moderately negatively correlated with a sense of singing-related well-being, whereas there was a moderate negative relationship between reports of vocal fatigue and well-being.

Suboptimal singing behavior and vocal fatigue

As hypothesized, suboptimal singing behaviors associated with choral singing were moderately correlated with perceptions of vocal fatigue when these behaviors were combined in statistical analysis. However, when analyzed individually, singing outside one's comfortable pitch range was most strongly associated with vocal fatigue, singing too loudly was only mildly associated with vocal fatigue, and the correlation with singing too quietly for blend was insignificant. Thus, although modest, the expected relationship between singing outside one's comfortable pitch and loudness range was confirmed. Associations between these behaviors and fatigue only explained 12% and 5% of the variance, respectively, suggesting that only a limited amount of variance was accounted for. The remaining variances could be explained by other unmeasured variables in the study, such as healthy singing technique, room acoustics in the rehearsal space, singer health, and vocal demands specific to the musical style.

The absence of a significant relationship between vocal fatigue and singing softly for blend is unexpected. Vocal complaints and concerns about blending may be specific or limited to the experience of trained classical soloists and are not necessarily representative of individuals with primarily choral experience throughout the life span.⁵ Thus, choral blending may be experienced as more fatiguing for trained classical soloists than for amateur choral singers because of the divergent acoustical characteristics and objectives inherent to each task. Moreover, certain cultural singing traditions may cultivate the development of healthy choral blend via unique vocal function, such as minimal vibrato and maximal nasality (eg, Bulgarian or Balkan singing). This factor would result in divergent definitions of blend across the subject pool and contribute to the inconclusive data. Further study could explore blending strategies by singing tradition and singer training.

Interestingly, subjects reported no correlation between feeling warmed up and reduced vocal fatigue. It is possible that the amateur singers involved in this study did not have enough familiarity with their vocal mechanism to accurately determine when they were vocally warmed up. Alternatively, it is possible that the main cause of vocal fatigue is not, in fact, related to vocal WU, but rather to overtly problematic vocal behavior during choral singing itself in spite of WU. Although warming up is known to have positive effects on singing effort,^{29,30} its relation to vocal fatigue may not be as strong as favorable vocal behavior (ie, singing within one's range with comfortable technique). It is interesting to note that these results are consistent with previous investigations, which reported that WU exercises did not systematically mitigate vocal fatigue in untrained singers with reported symptoms of vocal fatigue.¹⁴ Additional research is required before it is possible to draw definitive conclusions.

Singing and well-being

Reported suboptimal singing was moderately negatively correlated with singing-related well-being. That is, inversely, participants who did not engage in suboptimal singing behavior experienced increased singing-related well-being. These findings support previous research, which indicate that choral singing increases positive well-being and describe the potential health benefits of singing. Although a number of recent studies have investigated the therapeutic effects of music, many have been focused on a wide range of patients or concerned with only a few areas of impact. This study provides preliminary data on the attitudes of healthy singers.

As expected, reported vocal fatigue and suboptimal singing behaviors were negatively correlated with singing-related well-being. This implies that well-being effects related to choir singing may be restricted by vocal health. Thus, suboptimal singing behaviors and laryngeal status should be considered when investigating singing-related well-being.

As correlations between vocal behavior, fatigue, and singing-related well-being were modest (explaining 12% and 14% of the variance, respectively), well-being may also be influenced by variables not measured in this study such as affinity for the choral director, musical style preference, and the quality of the relationship with members of the choir.

Choral singing and solo singing

As stated, this population of amateur choral singers preferred choral singing to solo singing (67%). A small but significant proportion of participants who engaged in both choral and solo singing reported using different vocal techniques. This finding is consistent with extant pedagogical literature that promotes different technique for each task.³⁻⁵ The difference in technique can be explained by the differential acoustical demands of each task, with solo singing requiring unique voice quality and timbre to promote individuality and choral singing requiring the opposite.

Unfortunately, because of the small population of solo singers within the subject pool, it was not possible to use questionnaire data to analyze the relationship between solo singers

and sense of choral singing well-being. As choral singing frequently requires altering voice quality used for solo singing, there is reason to suggest that solo singers would experience a decreased sense of singing-related well-being in the choral setting. Further study is needed to examine solo singers' sense of well-being in the choral setting.

Limitations

This study is limited in several ways. First, psychometrics for the questionnaire are under development and could undergo further validity and reliability testing as well as improvement of wording. Examination of the relationship between one aspect of well-being (rejuvenation/relaxing) was limited by 50 data points because of these developmental issues. Although open-ended questions regarding topics such as specific vocal WU and choir style were included in the study (questions 7 and 18), responses were unspecific and proved impossible to analyze because of limited space on the questionnaire form.

Second, findings were reliant on participant awareness of their own voice production and therefore do not allow a complete objective view of the relationships examined in this study. For example, the presence of a relationship between vocal WUs and vocal fatigue may be obscured by possible limited participant awareness. It is unknown if the participants have experienced a comparable or definable feeling of warmed up and effortless voice production, thus it is unknown whether participants could accurately comment on the experience. The presence of suboptimal vocal behaviors or vocal health could not be verified as voice evaluation was not completed.

Third, the large heterogeneity of subjects included in this study, namely, an international population of amateur singers aged 10-70, presents some potential limitations. At either end of this age spectrum, there are myriad reasons why singers would prefer choral singing to solo singing. For instance, the youngest singers included in this study may have little opportunity for solo performance, whereas the older singers may no longer be vocally able to qualify for solo performance. Additionally, criteria for evaluation of potential suboptimal choral singing behaviors (extremes of range, dynamics, and voice quality) are based on the standards of ideal choral sound prevalent in the American choral tradition. However, the demographic of subjects encompasses amateur singers from as many as 64 countries. It is possible that the tradition of choral sound ideal in some countries may be very different from one deemed suitable in the American choral tradition. Furthermore, heterogeneity of participants may have increased noise and reduced strength of correlations in this study's significant findings.

Last, cool downs were not included in the scope of this study, although there is evidence to suggest their protective benefit on vocal health.

DIRECTIONS FOR FURTHER RESEARCH

This study reports the perceptions and experiences of primarily amateur choral singers. The findings provide preliminary evidence to suggest that individuals who prefer solo singing,

687 such as professional solo singers, may experience choral sing- 744
 688 ing differently. For example, professional singers might better 745
 689 be able to determine their perceptions on choral singing, such 746
 690 as effects of vocal WU. It is also likely that professional singers 747
 691 perform the unique vocal demands associated with choral sing- 748
 692 ing more frequently and with increased demands (ie, higher dy- 749
 693 namic levels, straight tone over longer periods). If suboptimal 750
 694 singing behavior affects singing-related well-being, further 751
 695 study is needed to examine the benefits of choral singing under 752
 696 the increased demands of a professional choir setting. 753

697 Recent investigations in the field of public health have 754
 698 worked to define a conceptual model of “well-being.”³¹ Sepa- 755
 699 rate studies have examined this construct in relation to choral 756
 700 singing.^{1,20,21,23–25} The present study identifies several factors 757
 701 that may affect such well-being. Future research may identify 758
 702 additional determinants of choral singing well-being, which 759
 703 could eventually result in a comprehensive model that could 760
 704 predict who may benefit from choral singing and describe the 761
 705 necessary conditions for this benefit to occur. Such work has 762
 706 the potential to further describe the therapeutic effects of choral 763
 707 singing. 764
 708
 709

710 CONCLUSION

711 This study represents a self-reported analysis of vocal health is- 765
 712 sues related to choral singing and reveals relationships between 766
 713 healthy choral singing and good well-being. Suboptimal choral 767
 714 singing behaviors may result in vocal fatigue that will nega- 768
 715 tively affect choral singing well-being and should therefore 769
 716 be considered when examining the effect of choral singing on 770
 717 singing-related well-being and health. Future research will 771
 718 compare the amateurs' perceptions of choral singing with per- 772
 719 ceptions from professional singers and will look at determi- 773
 720 nants of choral singing well-being. 774
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APPENDIX A

Questionnaire

1. Age:	3. Are you a participating singer in World Choir Games? Yes No	4. What is your nationality?
2. Gender (circle one): Male Female		
5. Do you sing professionally? Yes No	6. What is your voice type (e.g. soprano, tenor)?	7. What is your Choir's style (e.g. Classical, contemporary)?
8. How many hours do you sing in a normal week?	9. How many years (if any) have you had formal singing training?	10. How many years have you sung in choirs?
11. Do you have medical issues that affect your voice (e.g. allergies)? Yes No	13. Have you ever experienced a voice problem? Yes No	15. Have you ever seen an ear-nose-throat physician for your voice? Yes No
12. If yes, what?	14. If yes, how often per year?	16. If yes, what was the diagnosis?
17. Have you seen a speech-language pathologist for your voice? Yes No	18. What warm-ups (if any) do you do before rehearsals (scales, vocalizations, lip trills, glides, humming, etc.)?	19. Do you teach singing lessons? Yes No
20. Do you sing solo? Yes No	22. Is your technique in choir different from solo performance? Yes No	23. Which do you prefer? Choir Solo
21. If yes, how often?		

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
24. My choir director always leads warm-ups at the beginning of rehearsals.					
25. My choir director always leads warm-ups before performances.					
26. I am vocally warmed-up before choir rehearsals.					
27. I am vocally warmed-up before choir performances.					
28. My voice is often tired after singing with the choir.					
29. I am often asked to sing a part outside of what I would consider my voice type in choir.					
30. Choir rehearsals physically fatigue or drain me.					
31. I am often asked to sing louder than I normally would in choir.					
32. I am often asked to sing outside of my comfortable pitch range in choir.					
33. Singing in choir is relaxing and helps me deal with stress.					
34. I often feel that I need to carry my section in choir.					
35. Choir positively affects my quality of life.					
36. Singing a straight tone (instead of vibrato) in choir is vocally fatiguing.					
37. I often sing quieter than I normally would to blend in with the choir.					

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