Effects of Focus of Attention on Tone Production in Trained Singers

Rebecca L. Atkins

Abstract
Motor performance in familiar tasks is often advantaged when performers focus on the effects of their movements rather than on the movements themselves. But, this phenomenon has yet to be studied systematically in the context of vocal production. I evaluated 20 trained singers’ vocal tone as they varied their focus of attention. Each participant performed a short vocalise, a phrase of “My Country ’Tis of Thee,” and a prepared solo piece under six different conditions in which they focused attention on either keeping the vibrato steady, the position of their soft palate, directing their sound to points in the room at three different distances from the singer, or imagining “filling the room” with sound. Each session began with singers performing with no focus instructions, which served as a baseline for comparison. Expert listeners rated all performances on seven variables. Multivariate analyses of variance (MANOVA) revealed significant effects for the evaluation variables of ring and overall tone quality in all singing tasks. Ratings were higher for ring and overall tone quality when the focus of attention moved farther from the singer.

Keywords
focus of attention, singing tone production, vocal pedagogy, motor skill learning

Producing resonant, ringing vocal tones is a challenge for aspiring singers at all levels of experience and expertise. Achieving a beautiful vocal tone is complicated by the fact that much of the ongoing muscular activity required for beautiful singing is not under conscious control. In fact, even many excellent singers are often quite unaware of precisely what physical behavior is involved in vocal production. Motor control in this regard is developed over time through repetition and attentive listening, during which singers begin to connect auditory and kinesthetic feedback in ways that gradually modify the neuromuscular control required to produce a beautiful tone (Nair, 1999).

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Focusing on the physical behavior of the learner is typical in many activities, including athletic skills, driving, table games, and a host of other human activities, in addition to singing. This seems entirely appropriate as learning to perform a new and perhaps unfamiliar task requires preliminary attention to the parts of the body that affect task performance. But it has become clear that skilled movement is often guided not by attention to movements themselves but by attention directed to the effects that the body’s movements are intended to create (for a review see Wulf, 2013).

The results from numerous studies across a variety of tasks illustrate that in novice and experienced performers alike, performance is negatively affected by an internal focus of attention (i.e., attention to movements of the body) and that an external focus of attention (i.e., attention to the effects that movements produce) often results in superior performance (Wu, Porter, & Brown, 2012; Wulf, Höß, & Prinz, 1998; Wulf, Lauterbach, & Toole, 1999; Wulf, McNevin, & Shea, 2001; Wulf & Prinz, 2001). Similar results were found for the effects of attentional focus in music learning (Atkins & Duke, 2013; Duke, Cash, & Allen, 2011).

Studies of motor behavior in a wide range of tasks have shown that the performance of physical skills often improves as the distance between the source of movement and the performers’ point of focus increases. McNevin, Shea, and Wulf (2003), for example, found that participants attempting to balance on an unstable, moveable platform improved their balance more quickly when they focused their attention on points distal to the position of their feet than when they focused on points that were closer to their feet or when they focused on their feet. Attentional focus refers not to visual focus but focus of cognitive attention. Participants’ visual gaze was directed to a point directly in front of them in all conditions.

Similarly, Duke et al. (2011) found that novice pianists performed a keyboard sequence with more even timing as the assigned focus of attention moved from their fingers (internal) to the ends of the piano keys (near) to the hammers (mid) and finally to the sound (distal). These results are consistent with those found in numerous other tasks, including golf putting (Bell & Hardy, 2009; Castaneda & Gray, 2007), long jumping (Porter, Anton, & Wu, 2012), and free-throw shooting in basketball (Shojaei & Daneghian, 2010).

Studies of muscle activations using electromyography (EMG) provide evidence that directing attentional focus away from the body and toward movements’ effects results in more efficient use of musculature, especially with regard to highly automatized movements. In general, the movements of muscles under implicit control tend to be smaller in amplitude and higher in frequency (indicative of skilled behavior) than are the same movements when the performer directs conscious attention to the body. This effect has been demonstrated in dart throwing (Lohse, Sherwood, & Healy, 2010; Marchant, Clough, Crawshaw, & Levy, 2009), weightlifting (Lohse et al., 2011; Vance, Wulf, Töllner, McNevin, & Mercer, 2004), balance and posture (McNevin & Wulf, 2002; Wulf, Mercer, McNevin, & Guadagnoli, 2004), jumping (Wulf, Dufek, Lozano, & Pettigrew, 2010), and basketball free-throw shooting (Zachry, Wulf, Mercer, & Bezodis, 2005). Seemingly small differences in the language of task instructions, shifting focus away from the body and toward movement goals, affect learning and performance across a wide range of tasks.
In a study examining the effects of focus of attention on vocal performance in untrained singers, Atkins and Duke (2013) found that performances were ranked higher by expert listeners when participants focused on external targets than when participants focused on internal targets. Specifically, participants’ overall vocal quality was better when they focused on directing their sound to their fingertips placed on the mask of the face, to a microphone positioned 18 inches in front of them, and to a point on the wall across the room; overall vocal quality was worse in a baseline condition (no focus instructions) and when they focused on feeling the vibration in their throat with their hand. Tones produced in the more distal conditions from the vocal source were rated higher than were tones produced when singers focused attention closest to the vocal source.

In a second experiment (Atkins, 2013), I was interested in determining what specific vocal characteristics were affected by different focus of attention instructions. I also wanted to find reliable ways to identify and measure these changes in tone quality. I recorded 11 trained singers performing two singing tasks under six different focus of attention instructions. I then invited expert listeners to speak freely about what they heard for each WAV file (N = 132). These descriptions were used to develop an evaluation instrument for assessing vocal tone quality (Figure S1 available online at http://jrme.sagepub.com supplemental). A panel of three expert listeners subsequently used that instrument to rate 20% of the recordings from the 11 participants’ singing two singing tasks under six different conditions (reliability = .77 for all evaluation variables combined). I also visually inspected the expert listeners’ initial descriptions of tone to their ratings using the new evaluation tool and found that the descriptions of each category reflected the ratings on the evaluation tool.

Using the acoustical software Praat (Boersma & Weenink, 2011), I determined the mean harmonic-to-noise ratio (H-N), intensity (dB), and formant frequencies (F1–F5) from the long-term average spectrum (LTAS) of each sound file. I found no reliably significant differences between conditions on H-N ratio, dB level, or any formant frequency measurements (the difference between F4 and F3, the difference between F5 and F3, and Singing Power Ratio [SPR]).

Results from the ratings and listener descriptions in this experiment revealed that trained singers produced better resonance/ring when they focused their attention on distal points in the room than when they focused on the position of the soft palate, keeping their vibrato steady, directing the sound to a microphone directly in front of them, and had no focus instructions. Significant effects of focus condition on the ratings of ring were revealed in recorded performances of a single [α] vowel and in recorded performances of excerpts of solo repertoire. These experiments were the first to systematically examine vocal pedagogical strategies and the effects of focus of attention on tone production in singers.

Although voice teachers for generations have employed various strategies to help focus singers’ attention away from the actual movements of the body and vocal mechanism and toward external outcomes, there has been little systematic research devoted to this aspect of vocal pedagogy. The current study was an extension of the previous study (with additional singing tasks and focus of attention instructions) designed to answer the following question: In what ways and to what extent is the tone quality of trained singers affected by their focus of attention while singing?
Method

Participants were 22 trained singers (8 sopranos, 5 alto/mezzos, 3 tenors, 4 baritones, and 2 basses) enrolled in various degree programs at the University of Texas at Austin. Participants’ ages ranged from 18 to 25 years old ($M = 21$ years, median = 21 years). Due to technical difficulties (incomplete recordings), 1 mezzo and 1 baritone were not included in the analyses.

The experimental procedure met all of the requirements for human subjects participation concerning confidentiality and informed consent. All participants volunteered to take part in the study, and they received no compensation for their participation.

Participants were recorded individually in 30-minute sessions over the course of a week in mid-November prior to December juries. Prior to singing, participants answered questions pertaining to age, voice classification, the degree they were pursuing, the number of years’ experience performing with a choir, the number of years of private voice lessons, other instruments played, and the number of years of private lessons on those instruments. Of the 20 participants, 18 were undergraduate students studying vocal performance (6), music education (9), music business (2), and biomedical engineering (1). One soprano was pursuing a doctor of musical arts degree, and another soprano was pursuing a master’s degree in opera performance. All participants reported taking private voice lessons and singing with choirs. Average duration of choir participation was 9 years (median = 6 years) and ranged from 4 to 17 years. The average duration reported for private voice instruction was 6 years (median = 4 years), ranging from 1 to 8 years. Fourteen participants also reported playing other instruments, including double bass, clarinet, French horn, guitar, mandolin, piano, trumpet, and ukulele. Of those 14, seven had enrolled in private piano instruction ($M = 6.7$ years, median = 7 years) ranging from 2 to 11 years.

The experimental sessions were held in a 175-seat recital hall and recorded with a Sony PCM-D50 digital audio recorder (96kHz/24 bit) and its on-board microphone. The empty recital hall was an acoustically somewhat live performance space. I checked recording levels prior to the start of each participant’s recording session using Bose QuietComfort2 Acoustic Noise Cancelling Headphones. I set all record levels on the recorder between 3.5 or 4.0 to accommodate for the individual singers’ loudness levels and avoid undesired reverberation or feedback. Recording was continuous throughout each participant’s session; for each participant, the gain (recording level) remained constant across all conditions. A separate video recording was also made to document the procedures.

I oriented the singers to four singing tasks as I set the microphone levels. In each focus of attention condition, participants first sang two three-note patterns on an [α] vowel, each pattern starting on a different pitch. Sopranos and tenors (an octave lower) sang a low-pitch [α] vowel pattern beginning on G4, ascending to A4, and then returning to G4, immediately followed by a high-pitch [α] vowel pattern beginning on D5, ascending to E5, and returning to D5. Altos and basses (an octave lower) sang a low-pitch [α] vowel pattern beginning on C4, ascending to D4, and returning to C4, immediately followed by a high-pitch [α] vowel pattern beginning on G4, ascending to A4, and returning to G4. Participants were given the starting pitch and performed these three-note patterns a cappella at a tempo of approximately 120 beats per minute, sustaining the final note for 6 to 8 seconds.
Participants then performed a cappella the first full phrase of “My Country ’Tis of Thee,” through the words of thee I sing. Sopranos and tenors performed in the key of G. Altos, baritones, and basses performed in the key of Eb. After the performances of “My Country ’Tis of Thee,” I asked participants to choose a well-known solo piece and to sing the first one or two phrases from memory (enough of the piece to generate a minimum of 7–8 seconds of singing). I provided the starting pitch for this performance in the key in which the piece had been learned.

These four tasks (low-pitch [α] vowel, high-pitch [α] vowel, “My Country ’Tis of Thee,” and solo piece) were performed one after the other under seven different conditions. Following a baseline condition, participants performed the six directed focus of attention conditions, which were arranged in a different random order for each participant. In other words, participants performed all four singing tasks in each condition before moving on to the next condition.

Each condition directed singers to focus their attention on a different target: focusing their attention to the position of their soft palate (soft palate); focusing their attention on keeping their vibrato steady and consistent (vibrato); directing their sound to the top of a tripod placed 18 inches in front of them at mouth height (tripod-near); directing their sound to a chair in the center of the performance hall, approximately 24 feet directly in front of the singer and marked with a piece of paper (chair-middle); directing their sound to a piece of paper on the back wall of the performance hall approximately 40 feet from the singer and approximately 8 feet above the level of the microphone (point-far); and thinking about filling the room with their sound (fill).

All participants started with the baseline condition (no focus of attention instructions). After singers performed the two three-note [α] vowel patterns, I asked them to describe what they had focused their attention on while singing. They next performed the first full phrase of “My Country ’Tis of Thee,” and following their performance described again what they had focused their attention on while singing. The final task was the performance of the first one or two phrases of a well-known solo piece. After completing the solo piece performance, they described their focus of attention.

Each participant then performed the same tasks in the remaining six conditions. The six focus of attention conditions were arranged in a separate random order for each subject. After participants sang the three-note [α] vowel pattern on two different pitches in the first condition, I asked them if their focus had remained on the target that I had directed them to focus on. Participants then performed the first phrase of “My Country ’Tis of Thee” under the same condition and again reported whether they had focused their attention as directed. This was followed by the performance of the excerpt of the solo piece, after which participants again reported whether they had focused their attention as directed.

In the few instances when the response to the focus of attention question was no, I asked the participants to identify what they had focused attention on during the performance.

**Preparation of Recordings for Analyses**

Using the acoustical software Praat (Boersma & Weenink, 2011), I isolated and extracted a 2-second excerpt from the last note of both three-note [α] vowel patterns in
each condition and saved each pitch in a separate WAV file (2 pitch levels in 7 conditions for each of 20 participants = 280 WAV files). I extracted the middle portion of the phrase from “My Country ’Tis of Thee” (the words sweet land of liberty) for each participant in each condition and saved each as a separate WAV file. One participant did not sing “My Country ’Tis of Thee” in one condition (experimenter error) and was not included in the analysis for that singing task (7 conditions for each of 19 participants = 133 WAV files). I also extracted the recording of the solo piece performed under each condition and saved each as a WAV file (7 conditions for each of 20 participants = 140 WAV files). I used 553 WAV files in the analyses reported in the following. All files were coded in a way that did not identify the focus condition in the file names.

Rating/Listening Procedures

Using a rating instrument (see Figure S1 available online at http://jrme.sagepub.com/supplemental) developed in a previous experiment (Atkins, 2013), I rated and described all examples while listening to the recordings in a quiet, distraction-free room through Bose QuietComfort2 Acoustic Noise Cancelling Headphones connected to the headphone jack of an Apple MacBook Pro computer (OS X version 10.7.5, 2.2 Ghz Intel Core i7 processor). To reduce fatigue, I listened in 1½-hour sessions (with a 5-minute break at 45 minutes) every other day until all 553 WAV files were rated (approximately six sessions). As I completed the rating scales, I made brief notes for every condition of the most obvious differences I heard between conditions.

I was blind to the focus condition associated with each WAV file except for the baseline condition. I rated the recordings of the solo pieces sung by all 20 participants first, followed by all participants’ recordings of “My Country ’Tis of Thee.” Because the recordings of the individual vowels were so brief, I then rated all participants’ recordings of the low-pitch [α] vowel and high-pitch [α] vowel, evaluating both vowel recordings for each participant before moving on to the next participant.

To rate the recordings, I opened the seven WAV files (seven conditions) for one task sung by one participant (either solo piece, “My Country ’Tis of Thee,” or vowels) using QuickTime software on a MacBook Pro. I first listened to the seven recordings one after the other, without making any ratings or notes. I then replayed the recordings as many times as needed to rate and briefly take notes about differences among the performances. I rated the recordings of the solo pieces and the recordings of “My Country ’Tis of Thee” in terms of ring, evenness, freedom of tone, color, intonation, vibrato, and overall vocal quality. I rated the recordings of the [α] vowels in terms of ring, freedom, color, vibrato, and overall vocal quality.

In two previous studies (Atkins, 2013; Atkins & Duke, 2013), no reliably measurable effects of focus condition in terms of acoustic variables (H-N ratio, F4–F3, F5–F3, and SPR) were found, even when listener descriptions and ratings reflected differences in the evaluation variables between conditions. Other vocal studies comparing similar vocal tasks also produced no significant effects in terms of acoustic measurements (SPR, energy ratio [ER]), though expert listeners reported effects through ratings and rankings (Callinan-Robertson, Mitchell, & Kenny, 2006; Kenny & Mitchell, 2006). Therefore, I did not evaluate the WAV files using acoustic measurements.
Reliability

An independent expert listener (a voice professor with more than 20 years’ experience) rated and described approximately 23% of the WAV files. I randomly selected the following WAV files to be evaluated by the listener: five participants’ solo piece recordings in each of the seven conditions, five participants’ recordings of “My Country ’Tis of Thee” from each condition, four participants’ low-pitch [α] vowel recordings from each condition, and four participants’ high-pitch [α] vowel recordings from each condition. Thus, the expert listener rated 126 of the 553 WAV files, following the same procedure that I had used.

I assessed the extent of agreement between my ratings and those of the independent expert listener. I defined reliability as the percentage of ratings that were within ±1 point of my ratings on each scale. The mean reliability between my ratings and the ratings by the other expert listener was .89 for all categories in ratings of “My Country ’Tis of Thee” and the solo pieces. The lowest reliability score was .72 for freedom, and the highest scores were 1.00 for color and .96 for ring.

In the combined low- and high-pitch [α] vowel recordings, the reliability between my ratings and the ratings by the expert listener was .77 for all categories combined. The lowest reliability score of .63 was for freedom, and the highest score was .88 for overall. The lower reliability scores for the analyses of single tones on the [α] vowel recordings are perhaps understandable given the brevity of the samples. I discuss the reliability questions further in the Discussion.

Results

One-way multivariate analyses of variance (MANOVAs) were performed to examine the effect of condition on the evaluation variables in each of the four singing tasks. Where sphericity assumptions were not satisfied, I applied the Greenhouse-Geisser adjusted degrees of freedom procedure. I found a significant effect of condition on the combined evaluation variables in the low-pitch [α] vowel performances, Pillai’s Trace = .663, $F(30, 570) = 2.91, p < .001$; the high-pitch [α] vowel performances, Pillai’s Trace = .651, $F(30, 570) = 2.84, p < .001$; the solo piece, Pillai’s Trace = .57, $F(42, 678) = 1.70, p = .004$; and in “My Country ’Tis of Thee,” Pillai’s Trace = .78, $F(42, 642) = 2.48, p < .001$.

Post hoc univariate analyses of variance (ANOVAs) revealed a significant effect of condition on the evaluation variables ring and overall in all four singing tasks. Table 1 shows the $F$ values and $p$ values for all evaluation variables (ring, overall, evenness, vibrato, freedom, intonation, and color) in all four singing tasks (low and high [α], “My Country ’Tis of Thee,” and the solo piece performance). A significant effect of condition was also found for the evaluation variable vibrato for “My Country ’Tis of Thee” and the solo piece performances. A significant effect of condition was found for intonation and color in the “My Country ’Tis of Thee” performance and for evenness in the solo piece performance. Because ring and overall were the only two evaluation variables to be significantly affected by condition in all four tasks, I focus on these two variables in the remainder of the report.
Univariate tests revealed significant effects of condition on ratings of ring in both the low-pitch and high-pitch [α] vowel performances, $F(6, 114) = 17.30$, $p < .001$, $\eta_p^2 = .48$. In both the low-pitch and high-pitch [α] vowel performances, pairwise comparisons ($p$ values reported with Bonferroni correction) revealed differences in the means for ring between the fill condition and all other conditions: baseline, $p < .001$; vibrato, $p < .001$; soft palate, $p < .001$; tripod, $p < .001$; chair, $p = .002$; and point, $p = .001$. Differences were also revealed between the point condition and the baseline, $p < .001$, vibrato, $p = .003$, and tripod conditions, $p = .028$. Ring was rated highest when singers focused on directing their sound to a point on the wall and when they focused on filling the room with their sound.

Univariate ANOVA revealed a significant effect of condition on the evaluation variable ring, $F(6, 108) = 9.38$, $p < .001$, $\eta_p^2 = .34$ for “My Country ‘Tis of Thee.” Pairwise comparisons ($p$ values reported with Bonferroni correction) revealed differences for ring between the fill condition and baseline, $p < .001$, vibrato, $p = .001$, soft palate, $p < .001$; tripod, $p < .001$; chair, $p = .002$; and point, $p = .001$. Differences were also revealed between the point condition and the baseline, $p < .001$, vibrato, $p = .003$, and tripod conditions, $p = .028$. Ring was rated highest when singers focused on directing their sound to a point on the wall and when they focused on filling the room with their sound.

Univariate ANOVA revealed a significant effect of condition on ratings of ring, $F(6, 114) = 9.32$, $p < .001$, $\eta_p^2 = .33$ for the solo piece performances. Pairwise comparisons ($p$ values reported with Bonferroni correction) revealed significant differences for ring in the solo piece performance between fill and all other focus of attention conditions: baseline, $p < .001$; soft palate, $p < .001$; vibrato, $p = .005$; tripod, $p < .001$; chair, $p < .001$; and point, $p = .018$. There was also a significant difference between the means for the baseline and point conditions, $p = .02$. Song performances in the fill condition were rated highest among the seven conditions in terms of ring.
Pairwise Comparisons for Overall

Univariate tests revealed significant effects of condition on ratings of overall vocal quality for both the low-pitch [α] vowel performances, $F(6, 114) = 4.33, p = .001, \eta^2_p = .19$, and the high-pitch [α] vowel performances, $F(6, 114) = 4.63, p < .001, \eta^2_p = .20$. Pairwise comparisons ($p$ values reported with Bonferroni correction) revealed significant differences for the evaluation variable overall between the fill and the baseline conditions in the low-pitch [α] vowel performances, $p = .018$, and in the high-pitch [α] vowel performances, $p = .014$. Ratings of the fill and tripod conditions were significantly different in both sets of recordings, $p = .004$. Ratings of overall vocal quality were highest when singers focused on filling the room with their sound.

Univariate ANOVA revealed a significant effect of condition on ratings of overall vocal quality, $F(6, 108) = 4.14, p = .001, \eta^2_p = .12$ for “My Country 'Tis of Thee.” Pairwise comparisons ($p$ values reported with Bonferroni correction) revealed differences between the baseline and point conditions, $p = .04$; between the baseline and fill conditions, $p = .001$; and between the chair and point conditions, $p = .04$. Performances in the fill and point conditions were rated highest in terms of overall vocal quality. See Figure 2 for the ratings for overall vocal quality on all singing tasks.

In the solo piece, univariate ANOVA revealed a significant effect of condition on ratings of overall vocal quality, $F(6, 114) = 2.39, p = .033, \eta^2_p = .11$. Only a difference among the means between the soft palate and fill conditions approached significance, $p = .08$.

Self-Report of Attentional Focus

Recall that I asked each participant after each singing task whether she or he maintained the attentional focus that I had directed. I asked the question 18 times per participant (6 times following the two [α] vowel performances [$N=20$], 6 times following...
the “My Country ’Tis of Thee” performances \([N = 19]\), and 6 times following the solo piece performances \([N = 20]\) for a total of 354 responses). In only seven instances (five different participants) did a participant respond that he or she had not followed the focus instructions. Responses most often related to breath management, resonance, musicality, diction, and text.

**Self-Report of the Relationship Between Voice Lesson and Experimental Directives**

Following the final singing task, I asked each participant to answer questions related to voice lessons, and I examined whether the responses to these questions were related to the quality of participants’ performances in the various conditions. I did not find any discernible relationships. Twelve participants reported that it was easy to sing in the fill condition, 9 participants reported that it was easy to sing in the point condition, and 6 participants reported that it was comfortable to sing in the soft palate condition. Few participants reported that it was comfortable to sing in the vibrato condition (2), the tripod condition (2), or the chair condition (3). Nine participants reported that the vibrato condition affected their sound negatively. Eight participants reported that the soft palate, point, and fill conditions affected their sound positively.

I compared the aforementioned responses to the actual performance outcomes. Only one participant who reported that the fill condition affected her tone positively actually performed best in the fill condition in all four singing tasks; only two participants performed best in this condition in three of the four tasks. I found in the remaining five participants no relationship between their report of a positive effect on tone and their actual performance.

No participants who identified the other conditions as having a positive effect on their singing actually performed best in those conditions. It appears that the singers in this study were unable to assess accurately the effect of condition on their tone quality.

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**Figure 2.** Mean Ratings for Overall in All Singing Tasks.
Discussion

My purpose in this study was to determine the extent to which trained singers’ tone quality is affected by their focus of attention. Consistent with other research in motor skill learning (Atkins & Duke, 2013; Bell & Hardy, 2009; Castaneda & Gray, 2007; Duke et al., 2011; McNevin et al., 2003; Porter et al., 2012), I found that performance improved the farther the singers’ focus of attention was from the source of movement.

Ratings for overall vocal performance and ring were higher when performers focused on directing their sound to a point on the back wall and filling the room with their sound rather than when they focused on internal targets and directed their sound to points at shorter distances. Focusing on filling the room with sound resulted in the highest mean ratings for all evaluation variables. This condition often resulted in a beautiful tone, and a majority of participants reported that this was used as a focus target commonly in their voice lessons. This raises a question of whether the superior singing in this condition was a result of the distal focus or the fact that singers were familiar with this instruction. This question should be explored further in future research.

Ratings for ring and overall were not as high when singers focused on the position of the soft palate, focused on keeping the vibrato steady, focused on directing their sound to a tripod (near) and chair (middle), and when singing with no focus instructions. For ring, I found differences between the fill condition and all conditions except point and between the point condition and the vibrato and baseline conditions.

Although not all conditions affected individual singers in the same ways, the majority of singers produced better ring and overall quality when they directed their sound to more distal targets. Although varied interpretations and differences in individual abilities affected tone quality, directives asking performers to focus on internal targets tended to interfere with excellent singing for most singers in the study. Yet, some performers who focused on keeping their vibrato steady, for example, performed with an inconsistent vibrato, whereas others performed with consistent vibrato. Some performers when focused on the position of their soft palate performed with a swallowed, tense, and over-dark tone quality, whereas others performed with a beautiful, relaxed, resonant tone. Similar results were obtained in all four singing tasks and indicate that focusing on distal targets elicited advantageous respiratory and articulatory movements.

One of the challenges in this study was determining a reliable measure for evaluating vocal tone. Voice teachers and researchers have struggled for decades to agree on clear definitions of terminology used to describe tone quality (Vennard, 1967). Even today, professionals interpret many terms that are related to vocal production differently from one another. Not only do judges often describe tone quality differently; individual singers interpret instructions differently as well. The directive “direct your voice to the back wall” may lead some singers to produce a thin, narrow sound and another student to produce a full, resonant sound.
The rating instrument used in this investigation performed reasonably well, though it should be noted that in calculating reliability I used a somewhat liberal definition of agreement (±1 point). Assessing vocal tone is an ongoing challenge that is complicated not only by the multiple dimensions of sound production and perception but also by differences in personal tastes and preferences. In light of previous unsuccessful attempts to assess vocal tone based on acoustic measurements (Atkins, 2013; Atkins & Duke, 2013; Callinan-Robertson et al., 2006; Kenny & Mitchell, 2006, 2007), the judgments of expert listeners are in many ways preferable for research of this type. The reliability estimates for the ratings in the current study were lower than I had hoped they would be, but even taking into account the arguably subjective element of vocal performance assessment, the results presented here demonstrate notable consistency.

Verbal directives influence vocal tone in solo singing and in choral rehearsals. Future investigations should continue to explore this aspect of vocal pedagogy in relation to attentional focus. The results of the current study demonstrate that focus of attention affects singers in ways that are similar to effects that are observed in other domains of human experience. Focusing on distal targets (e.g., directing sound to a point on the wall and filling the room with sound), directives used by voice teachers for many years, do in fact produce measurable positive effects.

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**Author Biography**

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