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Changes to spacing preference in ensembles of varying size: a pilot study

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Abstract

The primary purpose of this study was to examine individual spacing preferences of singers with changes to ensemble size. The secondary purpose of this study was to evaluate whether singers and auditors perceived changes due to spacing in an auditioned university ensemble and if those perceptions matched. An auditioned university choir (*N* = 42) sang an excerpt in close (1-inch), moderate (12-inches), and spread (24-inches) spacing while a professional sound engineer recorded the trials. Singers indicated their perceptions of how the spacing changes impacted the choir's sound, their individual tone, their ability to hear the ensemble, and the level of tension they experienced. A randomly selected small group (*n* = 16) repeated the procedure. Most participants in the large ensemble preferred spread spacing (63.4%). The majority (56.3%) of singers who participated in both groups preferred the same or increased spacing when singing with the smaller ensemble. Auditors (*N* = 24) listened to matched pairs of the recordings and indicated their overall preference and their preferences in the singer-indicated categories of balance, blend, intonation, and tone. Auditors were generally unable to distinguish between large group recordings. Auditors expressed clearer preferences in the small group recordings, generally selecting the wider spacing option and noting differences in the singer-indicated categories of balance and blend. Results of this study lend credence to Daugherty's (2003) suggestions that singers and auditors generally prefer spread spacing. These singers' preferences did not align with Ternström's (1999) expectations regarding ensemble size

Key Words:
choir, spacing, configuration, formation

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Many choral music educators have strongly held beliefs regarding the impact of choral configuration on ensemble sound and individual vocal production. Choral pedagogues often emphasize the importance of selecting the best configuration for rehearsal or performance and suggest that changes to the formation alone will elicit different aural effects from the ensemble (Brinson, 1996; Decker & Herford, 1973). Some even propose that changes to configuration can fix issues with intonation and blend (Collins, 1999; Roe, 1983; Webb, 1993). Archibeque (2005) argued that different formations could alter the ensemble's balance, tone quality, and blend in both performances and rehearsals.

In spite of the wide dissemination of these beliefs to practicing choral music educators, little empirical evidence has been gathered to support the validity of these claims. Many researchers have examined elements of choral configuration including formation (Atkinson, 2006, 2010; Daugherty, 1999, 2003; Lambson, 1961), acoustical placement (Ekholm, 2000; Folger, 2002; Giardiniere, 1991; Killian & Basinger, 2007; Tocheff, 1990; Woodruff, 2002), and spacing (Atkinson, 2010; Daugherty, 1999, 2003; Daugherty, Manternach, & Brunkan, 2012; Ternström, 1999) in order to determine their level of influence on the choral sound. Although choral pedagogues tend to emphasize formation and acoustical placement, researchers tend to agree that spacing may be the configuration element that has the most impact on the perception of both singers and listeners (Daugherty, 1999, 2003; Ekholm, 2000).

Lambson (1961) conducted one of the earliest studies to determine whether formation noticeably impacted choral sound. In this study, a collegiate choir performed in four choral formations (section blocks, mixed quartets, acoustical placement with no regard for voice type, and random) and a panel of ten adjudicators ranked each performance. These adjudicators expressed a general preference for the mixed quartets, but the preference was not strong. Lambson suggested that changes to formation may have less of an effect on choral sound than had been previously thought. In an acoustical examination of blocked sectional, mixed, and sectional column formations, Aspaas, McCrea, Morris, and Fowler (2004) found no difference in sound due to choral formation. The findings of several other researchers (Atkinson, 2006, 2010; Daugherty, 1999, 2003; Morris, Mustafa, McCrea, Fowler, & Aspaas, 2007) similarly indicate that formation may not have a strong impact on choral sound.

Another element of configuration, acoustical placement, appears to have a more consistent effect than formation on both overall choral tone and individual vocal production. Also referred to as voice-matching, acoustical placement is the practice of placing singers by those with whom their voices naturally blend. There are multiple ways to accomplish acoustical placement, but most researchers have focused on the system popularized by Weston Noble. Several researchers have concluded that choral music educators (Giardiniere, 1991) as well as undergraduate instrumental music majors and nonmusic majors (Killian & Basinger, 2007) can perceive the effects of acoustical placement. Additionally, researchers have noted its effects on singers, impacting their individual vocal production (Ekholm, 2000) and vi-

brato rate (Folger, 2002) as well as its influence over choral blend, balance, intonation, and dynamic control (Tocheff, 1990). In spite of the myriad benefits of this type of placement, Ekholm (2000) noted that it did not address the issue of oversinging and suggested that proper spacing may be a solution. Daugherty (2003) also emphasized the importance of spacing and proposed that it may accomplish on its own what choral music educators have attempted to accomplish with changes to formation and use of acoustical placement.

In a series of studies on choral configuration, Daugherty (1996, 1999, 2003) suggested that spacing may be the most impactful configuration change choir directors can make to alter tone production of choristers and perception of auditors. His participants expressed overwhelming preference for lateral (24-inches between shoulders) or circumambient (lateral spacing with the addition of an empty riser row) over close (1-inch between shoulders) spacing in both high school and collegiate ensembles. Daugherty et al. (2012) examined spacing with the addition of changes to riser height and found that collegiate singers and auditors preferred lateral or circumambient spacing over close spacing. They also found statistically significant differences in the long-term average spectra analyses of performances in the three spacing conditions. These studies have mostly utilized non-auditioned high school and undergraduate choirs, with the exception of Daugherty's (2003) use of a select, or auditioned, choir.

The effect of spacing may be rooted in the alterations spacing causes in the way singers hear themselves and those around them. Ternström (1999) examined the way singers perceive the volume of the ensemble in relation to their own sound, or the self-to-other ratio (SOR). SOR impacts singers' ability to hear themselves and other members of the ensemble, and individual singers may have different preferred ratios which allow them to sing with the most comfort. If singers are unable to adequately hear themselves, issues of intonation, vowel shape, and oversinging can occur. These changes may occur on a subconscious level, a phenomenon known as the Lombard effect, making them difficult for singers to overcome of their own volition. This inability to hear oneself (i.e., low SOR) can be caused by the acoustics of the room or by a choral formation that is too tightly spaced. Ternström also found that all singers or voice types do not share identical preferences, but that the preferred ratio varies among individuals. Additionally, he stated that SOR is affected by the acoustics of the room and by the size of the ensemble, both of which impact the volume of sound the individual perceives from the ensemble.

Based on these conclusions, Ternström (1999) suggested that, in order to maintain a particular SOR, ensembles of smaller size should utilize less floor space per singer (or a closer spacing) than a larger ensemble. However, in two empirical studies involving chamber choirs with 20 or fewer members (Atkinson, 2010; Daugherty, 2003), participants expressed preference for spread spacing in spite of the smaller ensemble size. In order to support the idea that individual singers prefer a closer spacing as the size of the ensemble decreases, a measurement of preference from singers within the context of large and small ensemble must be taken.

Due to the empirical evidence highlighting the importance of spacing in individual vocal production, overall choral tone, and audience perception, it may be advantageous for choral music educators to understand how changes to spacing will impact their ensemble members and their audiences. Empirical studies to date have not examined changing preferences of singers or auditors with adjustments to ensemble size. The primary purpose of this study was to examine individual spacing preferences of singers with changes to ensemble size. The secondary purpose of this study was to evaluate whether singers and auditors perceived changes due to spacing in an auditioned university ensemble and if those perceptions matched. For these reasons, the following research questions were developed:

1. Does singer preference for spacing change when the size of the ensemble decreases?
2. Are there perceived changes to choral sound by singers and auditors with changes to spacing among singers in a highly auditioned university ensemble?
3. Do the perceived changes to choral sound by singers match the perception of auditors?

Method

Participants

Singers. After I received approval from the Institutional Review Board (IRB), I invited students in the top auditioned choral ensemble of a large Southwestern university to participate in this experimental study. The large ensemble represented a convenience sample, and the small ensemble consisted of four singers per voice part randomly selected from the larger group. Members of the large ensemble (N = 42) ranged in age from 19 to 35 (M = 22.5, SD = 10.6). Years of experience in a choral ensemble ranged from .5 to 25 (M = 9.7, SD = 5.6). Years of private voice lessons ranged from .5 to 11 (M = 5.9, SD = 2.8). The large ensemble was an intact, mixed choir with 20 female and 22 male members, majoring in music (music, n = 5; vocal performance, n = 19; graduate conducting, n = 6; education, n = 12), and currently enrolled in either undergraduate (n = 33) or graduate (n = 9; master's, n = 3; doctoral, n = 6) programs.

Auditors. I selected auditors from a convenience sample of graduate (n = 24) students participating in music education summer master's programs at a large Southwestern university and a medium Midwestern university. All participants were currently employed as music educators and taught choir (n = 17), band (n = 3), or general music (n = 4) either at the elementary (n = 3) or secondary (n = 21) level. Participants reported a wide range of experience both in teaching (Range = 3–25 years, M = 6.5, SD = 10.6) and in choral music participation (Range = 8–25 years, M = 16.1, SD = 5.7).

Preparation of Stimulus Recordings

In order to ensure consistency between trials, I utilized a pre-recorded conductor (protocols employed by Daugherty, 1999, 2003, and Daugherty et al., 2012). The assistant conductor for the ensemble conducted the excerpt in the recording. He wore all black and stood against a light, solid background. The video showed the conductor from about mid-thigh to just above his head. The conductor video was projected on the back wall at eye level. The accompanist gave the initial pitches on the piano prior to each trial.

To prepare for the auditor portion of the study, a professional recording engineer recorded each trial. Recording equipment included two identical Schoeps CMC6 microphones with MK-4 capsules placed in NOS stereo pattern. The microphones were placed 4.6 meters in front of the ensemble, 3.4 meters above the ground, and 7.9 meters from the wall. The engineer recorded the trials using a Grace Designs m802 pre-amp and LogicProX on a MacBook Pro. He recorded all performances at a sampling frequency of 44.1 kHz with 24-bit resolution and auditors listened to the recordings in uncompressed WAV form.

The choir performed all trials in the room where they normally rehearsed. The volume of the rehearsal room was 965 cubic meters. A professional recording engineer measured the reverberation time of the empty room using a dbx RTA-M reference microphone placed in the same location as the microphones used for the recordings. He introduced a sound source from the same location as the choir and found a reverberation time of 1.5 seconds at 400 Hz. I calculated the equivalent absorption area using the formula $A = 0.16 \times V/T_{60}$, which yielded a value of 102.9 m2. I additionally calculated the reverberation radius using the formula 0.056×Ö(*V*/*T*60), which yielded a value of 1.4 m.

Procedure

Both the large and small ensembles performed an excerpt of "Set Me as a Seal" by René Clausen (1989) scored for SATB a cappella chorus. I selected this piece because the ensemble had recently performed it and was able to sing it from memory. Additionally, the fact that the piece is a cappella and homophonic removed possible confounding variables for the auditors. The choir began at measure 27 and sang through measure 38, one complete musical idea, for each trial. Each sung excerpt was approximately 32 seconds in length.

The choir used their normal standing position in section block formation on risers. Sopranos and altos stood in the first two rows, and basses and tenors stood in the back two rows. In the small ensemble, sopranos and altos stood in the first row and basses and tenors stood in the second row. In both ensembles, singers on the first row were asked to keep the back of their legs in contact with the first riser in order to ensure equal distance from the microphone on each trial. For close spacing, singers stood with approximately 1-inch from shoulder to shoulder. For moderate spacing (12-inches) and spread spacing (24-inches), singers measured the spacing using a nylon rope (550 paracord) adapted from a pilot test. Singers were instructed to hold the cord against their leg where the outer seam of the pants would be. Adjacent singers each held one end of the rope and moved until it was

taut between them. I pilot tested this procedure with another university choir (n = 60) and adjusted for clarity, with another university conductor not affiliated with the study serving as a validity check.

After completing all three trials, participants filled out the Singer Preference Form (SPF). The instrument was an adaptation of Daugherty et al.'s (2012) survey. I edited it for clarity following a pilot test with members of another university choir (n = 4). Participants used a 4-point Likert-type scale to indicate the degree to which spacing impacted the overall sound of the choir and their personal sound and tone production, anchored with the phrases *no effect* and *significant effect*. They also indicated which of the three spacing options they preferred for their ability to monitor the sound (self and choir), their best tone production (self and choir), where they experienced the most and least tension, and their overall preference, in forced-choice formats. At the end of the response form, I asked participants to explain why they chose the option they did for their overall preference. In an endeavor to explore whether singers' experiences could be perceived similarly by auditors, I included these responses as items in the Auditor Preference Form.

Auditors listened to matched pairs of the recordings and selected recording one, recording two, or no preference for each pair. The recordings were embedded in the Auditor Preference Form (APF) which participants accessed via weblink. Participants used Beyerdynamic DT 770 M 80 Ohm over-ear-monitor headphones to listen to the matched pairs in a computer lab equipped with iMac computers. The APF was modelled after Daugherty et al.'s (2012) survey with the addition of elements most frequently noted by singers in the open-response question at the end of the SPF: blend, balance, tone quality, and intonation. In addition to these elements, auditors selected their overall preference and rated the degree of difference they detected between the two recordings. The form was modified for clarity and length following pilot tests with in-service music educators (n = 3). The APF contained two sections: one with the large ensemble recordings and one with the small ensemble recordings. Because the data collected was nominal, I analyzed singer and auditor preferences in both ensembles as well as singer preference from large to small ensemble for significance using a chi-square test.

Results

Singer Preference Form

Large ensemble. In order to examine whether there were perceived changes to choral sound by singers with changes to spacing, I first evaluated responses from all singers in both the large and small ensembles. In the large ensemble, all singers indicated that they believed spacing had an impact on the overall sound of the choir and the majority (83%) also indicated that spacing affected their personal sound. Preferences for spread spacing over close and moderate were significant in the categories of ability to monitor self, $\chi 2$ (2) = 34.9, $p <$ .001, personal best tone, $\chi 2$ (2) = 15.9, $p <$ .001, choir's best tone, $\chi 2$ (2) = 10.6, p = .005,

and overall preference, $\chi 2\ (2) = 20.6$, $p < .001$. Additionally, participants indicated that, out of all three spacing options, they experienced the most tension in close spacing. There was no statistically significant preference among participants for their ability to monitor the sound of the choir, although many participants preferred spread spacing (48%), followed by moderate spacing (31%) and close spacing (21%). See Table 1 for complete results.

In the open-ended responses, participants most frequently cited balance (40%), blend (26%), tone (23%), and intonation (11%) as the elements most affected by spacing. One singer who selected spread spacing for his overall preference identified balance and freedom of tone as the important elements impacted by changes to spacing. He stated that it "created the best balance…in regards to being able to hear myself, sing with less tension, and be able to hear the sound of the whole choir." Another participant who chose spread spacing wrote, "I believe this option was best because standing farther apart from others felt so much more free. Therefore, this really allowed me to sing so much more freely and with a much better tone."

Small ensemble. In the small ensemble, as in the large ensemble, all participants indicated that they believed spacing had an effect on their overall sound, and the majority (93%) stated that it had some influence on their individual sound as well. Almost half (47%) of participants indicated that they believed spacing had a greater impact on their personal sound in the small group than it did in the large group, and the remaining participants indicated that the degree of impact was the same (27%) or lesser (26%) in the smaller ensemble.

There was a statistically significant preference for spread spacing over close and moderate in the categories of ability to monitor self, $\chi 2\ (2) = 11.4$, $p < .05$, and personal best tone, $\chi 2\ (2) = 6.1$, $p < .05$. Responses were evenly split between moderate and spread spacing

Table 1. Large Ensemble Singer Preferences

	1-inch	12-inches	24-inches
Ability to monitor self	9.5%	14.3%	76.2%
Ability to monitor choir	21.4%	31%	47.6%
Personal best tone	7.1%	35.7%	57.2%
Choir best tone	12%	33.3%	53.4%
Most tension	95.2%	0%	4.8%
Least tension	4.8%	21.4%	73.8%
Overall preference	4.7%	33.3%	62%
Spacing affected: our overall sound (100%), my personal sound (83%)			

for the choir's best tone, $\chi 2\ (2) = 8.0$, $p = .02$, and overall preference, $\chi 2\ (2) = 8.0$, $p = .02$, and these comparisons were statistically significant because no participants selected close spacing in either of these categories. Additionally, participants indicated that they experienced the most tension in close spacing, $\chi 2\ (2) = 14.0$, $p < .001$, compared to moderate and spread. There was no statistically significant preference for which spacing allowed participants to best monitor the sound of the choir, although many participants preferred moderate spacing (50%) followed by spread spacing (38%) and close spacing (12%). See Table 2 for complete results.

In order to understand whether singer preference for spacing changed when the size of the ensemble decreased, I examined the responses of these participants from both the small and large group trials. In the small group, 44% of participants' spacing preferences stayed the same compared to their answers in the large group (e.g., they selected spread spacing in both ensemble sizes), 19% of responses increased (e.g., selected moderate spacing in large group and spread spacing in small group), and 37% decreased (e.g., selected spread spacing in large group and moderate spacing in small group). When asked about their ability to monitor their own sound, the majority (75%) of participants preferred the same spacing from the large group to the small group while a few singers (25%) preferred a closer spacing. Similarly, when asked about their ability to monitor the sound of the choir, the majority (69%) of participants expressed preference for the same or increased spacing in the small group compared to the large group and a few singers (31%) preferred a closer spacing. See Table 3 for complete results.

In the open-ended response, singers again indicated perceived changes to freedom of tone, balance, blend, and intonation with alterations to spacing. One participant, who selected moderate spacing as her overall preference in the large ensemble and spread spacing

Table 2. Small Ensemble Singer Preferences

	1-inch	12-inches	24-inches
Ability to monitor self	0%	31.2%	68.8%
Ability to monitor choir	12.5%	50%	37.5%
Personal best tone	6.2%	37.5%	56.3%
Choir best tone	0%	50%	50%
Most tension	76%	0%	24%
Least tension	0%	37.5%	62.5%
Overall preference	0%	50%	50%
Spacing affected: our overall sound (100%), my personal sound (93%)			

as her overall preference in the small ensemble, wrote, "Option 3 [spread spacing] in this smaller group seemed to better fit the choir. Not as many singers as the previous study made filling the space harder. Option 3 allowed me to monitor the sound of the choir as well as my own voice the best." Another singer, who selected spread spacing in both the large and small group, wrote, "The spacing allows for better hearing and also gives the singer a small sense of individuality in something that is such a group effort."

Auditor Preference Form

In order to determine whether auditors were able to detect differences due to spacing, I evaluated auditors' indication of preference for overall sound. Because a secondary research question focused on whether auditor and singer perceptions matched, I also examined auditor responses to the singer-indicated categories of balance, blend, intonation, and tone. Last, because ensemble size was the primary concern of this study, I examined auditors' responses for matched pairs of large ensemble recordings and for small ensemble recordings.

Auditors were generally unable to detect differences between spacing conditions in the large ensemble recordings. When comparing moderate to spread spacing, 58% indicated that they heard no difference at all between the recordings. In this comparison, auditors tended to indicate that they had no preference for one recording over the other in any category. The majority of auditors (80%) indicated that they could hear some difference when comparing either moderate or spread spacing to close spacing. However, auditors still did not express a significant preference for one recording over another in any category. This preference did not match the observations of singers; they indicated a strong predilection for spread spacing in the large ensemble.

Auditors expressed clearer preferences in the small ensemble recordings and generally selected the more spread option of any given pair. When comparing moderate to spread

Table 3. Occurrences of changes in singers' ratings when changing from Large to Small ensemble

Category	Same	Increase	Decrease
Hear/monitor Self	0%	31.2%	68.8%
Hear/monitor Choir	12.5%	50%	37.5%
Self Best Tone	6.2%	37.5%	56.3%
Choir Best Tone	0%	50%	50%
Overall preference	0%	50%	50%

spacing, 83% of auditors indicated that they could hear differences, but there was no significant preference expressed for either recording. When comparing moderate to close spacing, almost all (96%) auditors detected changes. In this comparison, auditors selected moderate spacing most often in the categories of blend, $\chi 2\ (2) = 9.8$, $p < 0.01$, balance, $\chi 2\ (2) = 12.0$, $p < 0.01$, and overall preference, $\chi 2\ (2) = 7.0$, $p = 0.03$. Similarly, 88% of auditors could hear differences between spread and close spacing and showed a significant preference for spread spacing in the categories of blend, $\chi 2\ (2) = 7.8$, $p = 0.02$, balance, $\chi 2\ (2) = 6.8$, $p = 0.03$, and overall preference, $\chi 2\ (2) = 7.8$, $p = 0.02$. Auditors and singers generally had similar opinions regarding spacing in the small ensemble with a general preference expressed by both groups for moderate or spread spacing. However, the auditors' responses did not align with singer views in the categories of intonation or tone.

Discussion

The primary purpose of this study was to examine how individual spacing preferences were affected by changes to ensemble size. Most singers preferred the same or increased spacing in the small ensemble compared to the large ensemble and most auditors preferred the wider spacing option of any given comparison pair in the small ensemble recordings. The general preference by both singers and auditors for spread spacing confirms previous findings (Daugherty, 1999, 2003; Daugherty et al., 2012). However, Ternström's (1999) conclusion that "a large choir is likely to require more floor area *per singer* [emphasis in original] than a small choir" (p. 3572) did not necessarily hold true for this particular ensemble.

A secondary purpose of this study was to evaluate whether singers and auditors could detect aural changes in an auditioned collegiate ensemble and if those perceptions matched. Overall, singers in both the large and small ensemble agreed that changes to spacing impacted their individual sound and the sound of the ensemble. However, auditors perceived less difference in overall sound among spacing conditions, especially in the large ensemble recordings. In both the large and small ensembles, singers cited intonation, tone, balance, and blend as the elements most affected by spacing. However, of those elements, auditors only observed differences in balance and blend. It appears that singers may perceive changes that greatly influence their comfort and perhaps their confidence in the quality of the sound they are producing, but these changes may not always translate to conductor or audience members' perceptions. It may be advantageous for choral music educators to prioritize spending some rehearsal time listening from within the ensemble rather than listening exclusively from the podium or audience position. Additionally, it may be helpful for students to have opportunities to hear the ensemble from the audience perspective on occasion. Choral music educators might consider inviting a small number of students to step outside the ensemble to listen or recording the ensemble and playing it back for students to hear and evaluate.

Interestingly, singers noted an increased importance of spacing in the smaller ensemble,

and auditors were better able to detect differences in the small ensemble recordings. For these singers and auditors, spacing had a more pronounced effect on overall sound and individual vocal production with the smaller ensemble. Although it may not be plausible to establish a standard guideline for how spacing should change based on ensemble size, it may be advantageous to place a greater emphasis on spacing with smaller ensembles.

Although results from the current and previous studies support general preference for wider spacing, it is important to note the individuality of participants' responses. Researchers have indicated placement on the risers, voice part, and other factors impact spacing choices. Because spacing seems to have an impact on the amount of tension singers experience and the level of confidence they have in their individual sound and overall choral sound, it is important for each singer in an ensemble to experience their optimal spacing. Previous findings may not be generalizable to individual singers, so decisions on spacing should be made for the specific individuals in an ensemble.

To further elucidate this issue, researchers have indicated that the upper voices in each gender tend to prefer a higher SOR than the lower voices (Ternström, 1999). Therefore, we might expect the upper voices to prefer a wider spacing. However, in this ensemble, all voice parts overwhelmingly preferred spread spacing with the exception of tenors, the majority of whom preferred moderate spacing. Although analysis by voice part was not a specific research question for the present study, this anecdotal information illustrates the difficulty with generalizing findings to other ensembles. Additionally, two singers indicated close spacing as their overall preference, even though they also indicated that it was the spacing which afforded them the most tension. These singers were vocal performance majors and both listed blend as their primary reason for selecting close spacing. Clearly, spacing discriminations can vary widely within an ensemble as can the reasoning behind those preferences.

Singers indicated that changes to spacing affected their confidence level, comfort, vocal health, tone production, and intonation, among other factors. One singer, who selected moderate spacing as her overall preference, wrote, "This was the best for producing the best tone quality. I felt the most confident here!" Another participant, who selected spread spacing as his overall preference, wrote, "I felt more free to sing and it was easier for me, in that freedom, to tune to my fellow singers." Many singers felt strongly about these individual changes even though most auditors were not able to hear such changes. These factors could have an influence on singers' experience in ensemble singing, which may in turn impact the overall performance of the group. However, because these changes may not be readily apparent to a listener, it may be advantageous for choral music educators to solicit regular feedback from singers regarding their experiences in various spacings. Educators may involve students in spacing decisions, allow students to experience a variety of spacing options, or ask for written or verbal feedback regarding which spacing option allows singers to feel the most comfortable and confident.

Important information was gleaned from this pilot study regarding the level of influence

ensemble size may have on singer and auditor spacing preferences as well as reinforcing the individuality of spacing preferences. Spacing changes in both the large and the small ensemble influenced singers' perceived vocal production and comfort. Future study in this field is warranted in order to assist choral music educators in making decisions that will yield the best results for their singers. Researchers may consider examining the effect of spacing on younger or unauditioned ensembles. This pilot study was limited to perceptual data and did not examine the influence of the acoustical properties of the room on spacing preferences, which is an important factor in spacing decisions (Ternström, 1991). Choirs most often perform in a space with different acoustical properties than the room in which they rehearse; therefore, it may be valuable to consider this factor in future studies. It may also be useful to develop a measurement tool which choral music educators could use to quickly and efficiently gather feedback from students regarding their spacing preferences in order to make decisions regarding spacing and configuration for rehearsal and performance. It may be advantageous for educators to seek ways to ensure student comfort and success in choral rehearsals and performances. Deeper understanding of choral spacing in general as well as the factors which influence spacing preferences can assist choral music educators in making the best decisions for their ensembles.

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